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Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region

U.S. Army Corps of Engineers

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Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region

U.S. Army Corps of Engineers

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Final report

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Abstract: This document is one of a series of Regional Supplements to the Corps of Engineers Wetland Delineation Manual, which provides technical guidance and procedures for identifying and delineating wetlands that may be subject to regulatory jurisdiction under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act. The development of Regional Supplements is part of a nationwide effort to address regional wetland characteristics and improve the accuracy and efficiency of wetland-delineation procedures. This supplement is applicable to the Atlantic and Gulf Coastal Plain Region, which consists of all or portions of the District of Columbia and 19 states: Alabama, Arkansas, Delaware, Florida, Georgia, Illinois, Kentucky, Louisiana, Maryland, Mississippi, Missouri, New Jersey, North Carolina, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, and Virginia.

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Preface

This document is one of a series of Regional Supplements to the Corps of Engineers Wetland Delineation Manual. It was developed by the U.S. Army Engineer Research and Development Center (ERDC) at the request of Headquarters, U.S. Army Corps of Engineers (USACE), with funding provided through the Wetlands Regulatory Assistance Program (WRAP).

This document was developed in cooperation with the Atlantic and Gulf Coastal Plain Regional Working Group. Working Group meetings were held in Atlanta, GA, on 5-7 December 2006; and Baltimore, MD, on 17-19 April 2007. Members of the Regional Working Group and contributors to this document were:

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Independent peer reviews were performed in accordance with Office of Management and Budget guidelines. The peer-review team consisted of Lee Davis, NRCS Central National Technology Support Center, Fort Worth, TX (chair); Raymond Dolezel, Nacogdoches, TX; John Galbraith, Virginia Tech, Blacksburg, VA; Laura Giese, Wetland Studies and Solutions, Inc., Gainesville, VA; James Gregory, North Carolina State University, Raleigh, NC; Nicholas Laskowski, Berg Oliver Associates, Inc., Houston, TX; Thomas Roberts, Tennessee Technological University, Cookeville, TN; and Ed Weinberg, EW Consultants, Inc., Stuart, FL.

Technical editors for this Regional Supplement were Dr. James S. Wakeley, Robert W. Lichvar, and Chris V. Noble, ERDC. Katherine Trott was the project proponent and coordinator at Headquarters, USACE. During the conduct of this work, Dr. Morris Mauney was Chief of the Wetlands and Coastal Ecology Branch; Dr. David Tazik was Chief, Ecosystem Evaluation and Engineering Division; Bob Lazor was Director of WRAP; and Dr. Elizabeth Fleming was Director, EL. COL Gary E. Johnston was Commander and Executive Director of ERDC. Dr. James R. Houston was Director.

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1 Introduction

Purpose and use of this regional supplement

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

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

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

Table 1. Sections of the Corps Manual replaced by this Regional Supplement for applications in the Atlantic and Gulf Coastal Plain Region.

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

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

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

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

Applicable region

This supplement is applicable to the Atlantic and Gulf Coastal Plain Region, which consists of all or portions of the District of Columbia and 19 states: Alabama, Arkansas, Delaware, Florida, Georgia, Illinois, Kentucky, Louisiana, Maryland, Mississippi, Missouri, New Jersey, North Carolina, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, and Virginia (Figure 1). East of the Mississippi River, the region is bounded by the Fall Line, the often distinct topographic break between the piedmont of the Appalachian Mountains and the marine sediments of the Coastal Plain. The region includes the Mississippi River Embayment, a vast area of primarily marine sediments and recent alluvium that extends northward beyond the present-day Illinois state line. To the west, the region is bounded by the Ouachita Mountains in Arkansas and the eastern edge of the semi-arid Great Plains in Texas. The region encompasses a variety of landforms and ecosystems but is differentiated from surrounding regions mainly by the combination of flat to hilly topography, a relatively warm and humid climate with abundant rainfall, mixed pine and hardwood natural vegetation, and current land cover dominated by forests or by a mosaic of forest, agriculture, and urban land uses. Hydrologic modifications (e.g., levees, ditches, subsurface drains) are common in agricultural and silvicultural areas, particularly in the Mississippi Alluvial Valley and on the outer Coastal Plain.

The approximate spatial extent of the Atlantic and Gulf Coastal Plain Region is shown in Figure 1. The region includes the following Land Resource Regions (LRR) and Major Land Resource Areas (MLRA) recognized by the U. S. Department of Agriculture (USDA Natural Resources Conservation Service 2006a):

- All of LRR O (called the Mississippi Alluvial Valley in this supplement)
- The following portions of LRR P (Inner Coastal Plain):
  - MLRAs 133A, 133B, 134, 135A, 135B, 137, and 138 (all except MLRA 136)
- MLRA 149A of LRR S (Northern Coastal Plain)
- All of LRR T (Outer Coastal Plain)
- All of LRR U (Florida Peninsula)

Most of the wetland indicators presented in this supplement are applicable throughout the entire Atlantic and Gulf Coastal Plain Region. However, some are applicable only to particular subregions (LRR) or smaller areas (MLRA).

Region and subregion boundaries are depicted in Figure 1 as sharp lines. However, climatic conditions and the physical and biological characteristics of landscapes do not change abruptly at the boundaries. In reality, regions and subregions often grade into one another in broad transition zones that may be tens or hundreds of miles wide. The lists of wetland indicators presented in these Regional Supplements may differ between adjoining regions or subregions. In transitional areas, the investigator must use experience and good judgment to select the supplement and indicators that are appropriate to the site based on its physical and biological characteristics. Wetland boundaries are not likely to differ between two supplements in transitional areas, but one supplement may provide more detailed treatment of certain problem situations encountered on the site. In transitional areas, users should

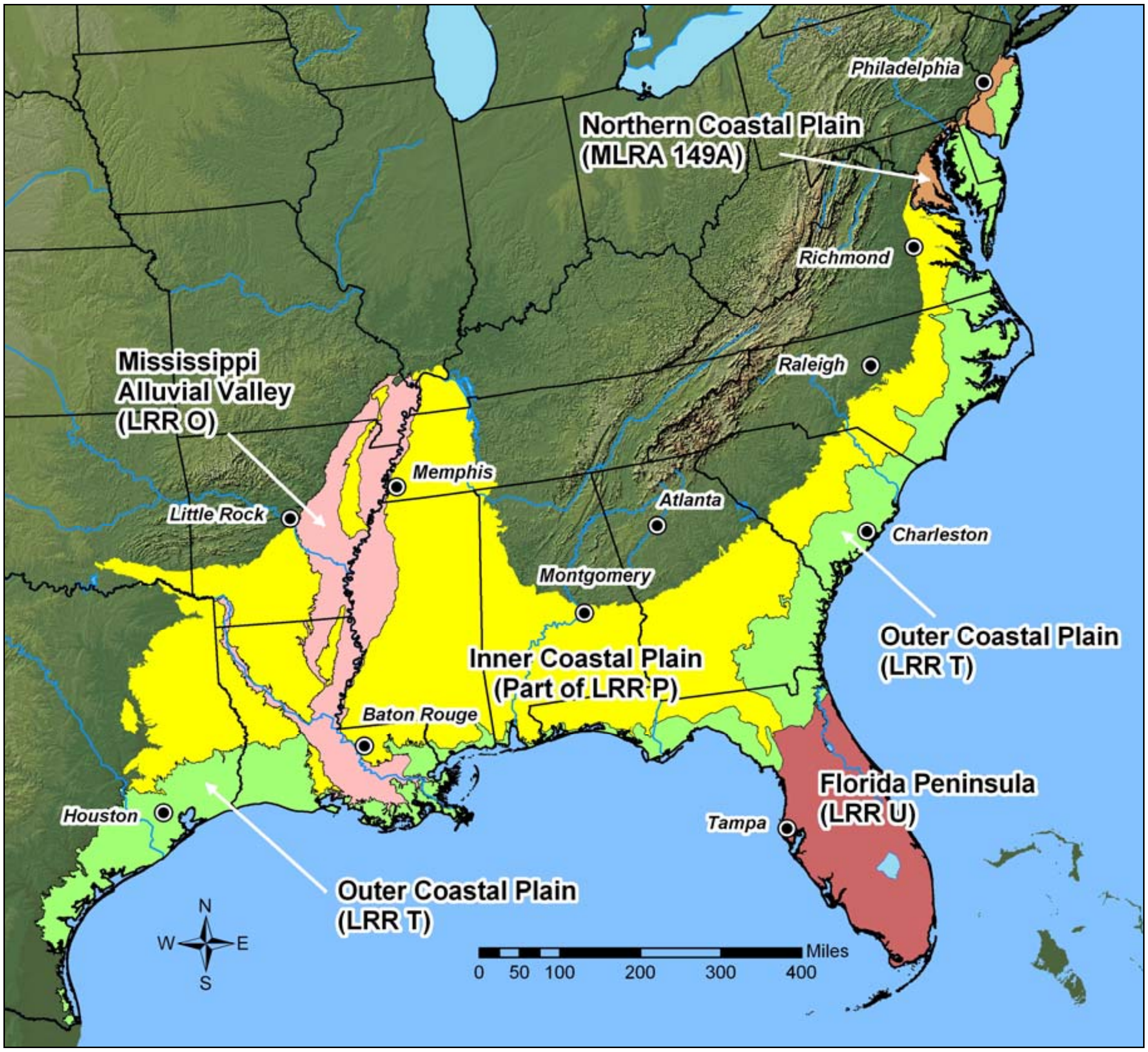

Figure 1. Approximate boundaries of the Atlantic and Gulf Coastal Plain Region. This supplement is applicable throughout the highlighted areas, although some wetland indicators may be restricted to specific subregions or smaller areas. See text for details.

document the rationale for using a particular regional supplement. If in doubt about which supplement to use in a transitional area, apply both supplements and compare the results. For additional guidance, contact the appropriate Corps of Engineers District Regulatory Office. Contact information for District regulatory offices is available at the Corps Headquarters web site (http://www.usace.army.mil/cw/cecwo/reg/district.htm).

Physical and biological characteristics of the region

The Atlantic and Gulf Coastal Plain is a region of nearly level to hilly topography. It is composed primarily of sedimentary rocks of marine origin up to 65 million years old and alluvial sediments of Pleistocene and more recent age, all sloping gently toward the sea (U.S. Geological Survey 2004). Most of the region is less than 500 ft (150 m) above sea level. Streams are generally slow-moving, and swamps and marshes are numerous (Bailey 1995).

The climate across the region is relatively warm and humid. Average annual temperature ranges mostly from 60 to 70 °F (16 to 21 °C) with cooler temperatures toward the north. Average annual precipitation ranges from 40 to 60 in. (1,020 to 1,530 mm) and, in most of the region, is well distributed throughout the year. There is an annual moisture surplus (i.e., annual precipitation exceeds evapotranspiration). However, evapotranspiration is greatest during the summer, resulting in a summer dry season that is generally mild along the coast and more pronounced inland (Bailey 1995). In peninsular Florida, rainfall is most abundant from June through October, with a typically dry spring.

Highly weathered, light-colored soils that developed primarily under deciduous forest vegetation (Ultisols) dominate the central and northern portions of the Atlantic and Gulf Coastal Plain Region. These co-dominate with less-weathered forest soils (Alfisols) in Mississippi, Louisiana, Arkansas, and Texas. Clay soils (Vertisols) are abundant in the Mississippi and Red River valleys, in river valleys along the Texas coast, and in the Blackland Prairie area of Mississippi and Alabama. Organic soils (Histosols) are common in current and former wetlands on the outer coastal plain from Texas to New Jersey and in scattered locations across the Florida peninsula. Organic soils dominate the Everglades region of south Florida and the Okefenokee Swamp region of northeastern Florida and southeastern Georgia. Spodosols are soils with distinctive, dark-colored, subsurface horizons (spodic horizons) of accumulated organic matter, iron, and aluminum, often overlain by a light-colored eluvial or leached layer. Spodosols form mainly in sandy soil materials under coniferous forest vegetation and are particularly common in Florida, southeastern Georgia, eastern South Carolina and North Carolina, and in the pine barrens of New Jersey (USDA Natural Resources Conservation Service 1999, 2006a).

Mixed pine/hardwood forest is the potential natural vegetation over most of the Atlantic and Gulf Coastal Plain Region, except for the Everglades area of south Florida, historic prairie areas of coastal Texas and Louisiana, and the vast bottomland hardwood tracts of the Mississippi Alluvial Valley (Küchler 1964). In the northern and more inland portions of the region, common tree species include hickories (*Carya* spp.), shortleaf pine (*Pinus echinata*), loblolly pine (*P. taeda*), white oak (*Quercus alba*), and post oak (*Q. stellata*). In the southern and outer portions of the coastal plain, common species include American beech (*Fagus grandifolia*), sweetgum (*Liquidambar styraciflua*), southern magnolia (*Magnolia grandiflora*), slash pine (*P. elliottii*) (especially in Florida), loblolly pine, and laurel oak (*Q. laurifolia*).

The Atlantic and Gulf Coastal Plain Region is divided into five subregions (Figure 1) that correspond to USDA Land Resource Regions. Important characteristics of each subregion are described briefly below; further details can be found in USDA Natural Resources Conservation Service (2006a).

Mississippi Alluvial Valley (LRR O)

This subregion was formed from alluvial deposits of the ancestral Mississippi River and its tributaries. The topography of the area is nearly level to gently sloping. Elevations rise gradually from near sea level in the south to about 330 ft (100 m) in the north, giving an average slope of approximately 8 in. (20 cm) per mile. Some local relief is provided by historic natural levees, point-bar deposits, terraces, and abandoned channels formed as the river shifted course many times in its history. Large areas of clay soils are common in backswamps and flats. Today the Mississippi River and many of its tributaries are constrained between man-made levees and the once extensive bottomland forests have largely been cleared for the production of crops, such as cotton, soybeans, corn, rice, and sugarcane (in the south), and the development of catfish-rearing ponds.

The species of trees that dominate on a site depend on its position on a gradient of moisture conditions from nearly permanently inundated to seasonally saturated. Important species in swamps and deep sloughs with nearly continuous flooding include baldcypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*). Poorly drained flats and backswamps are often dominated by water hickory (*Carya aquatica*) and overcup oak (*Quercus lyrata*), giving way to water oak (*Q. nigra*), Nuttall oak (*Q. nuttallii*), American elm (*Ulmus americana*), beech, and sweetgum on first bottoms and low terraces. Better-drained areas of low ridges and terraces support cherrybark oak (*Q. pagoda = Q. falcata* var. *pagodifolia*), Shumard oak (*Q. shumardii*), swamp chestnut oak (*Q. michauxii*), and other species (Smith and Klimas 2002, USDA Natural Resources Conservation Service 2006a, World Wildlife Fund 2006).

Inner Coastal Plain (part of LRR P)

The Inner Coastal Plain subregion is an area of level to hilly topography, dissected by numerous streams. Much of the area consists of material eroded from the ancestral Appalachian Mountains and deposited in the ocean. Wind-blown loess of Pleistocene age covers the older marine sediments along both sides of the Mississippi Alluvial Valley but more extensively in western Kentucky, Tennessee, and Mississippi. Clay, marl, limestone, and chalk deposits underlie the Blackland Prairie area of Mississippi and Alabama. A band of sand hills marks the boundary between the Piedmont and the Coastal Plain in Georgia, South Carolina, and North Carolina. These sands were deposited along the shoreline during Cretaceous times (USDA Natural Resources Conservation Service 2006a).

Potential natural vegetation in the subregion was classified as oak-hickory-pine forest by Küchler (1964). Today, pines tend to predominate in large areas that once were farmed or cleared but later abandoned or allowed to regenerate. Typical pine species include shortleaf, loblolly, and longleaf (*Pinus palustris*) pines. Sweetgum, yellow-poplar (*Liriodendron tulipifera*), white oak, and southern red oak (*Q. falcata*) are also common. Dogwoods (*Cornus* spp.) and American holly (*Ilex opaca*) are common understory species in the east. In the west, pines are commonly associated with bluejack oak (*Q. incana*) and post oak, with an understory of yaupon (*Ilex vomitoria*) and flowering dogwood (*C. florida*) (USDA Natural Resources Conservation Service 2006a, World Wildlife Fund 2006).

Northern Coastal Plain (Part of LRR S)

A small part of LRR S (MLRA 149A) lies within the Atlantic and Gulf Coastal Plain Region. It consists of nearly level to rolling terrain, dissected by many streams. The area supports pine/hardwood natural vegetation, including loblolly, Virginia (*Pinus virginiana*), and shortleaf pines, southern red oak, black oak (*Quercus velutina*), pin oak (*Q. palustris*), northern red oak (*Q. rubra*), black walnut (*Juglans nigra*), yellow-poplar, sweetgum, and red maple (*Acer rubrum*) (Natural Resources Conservation Service 2006a).

Outer Coastal Plain (LRR T)

This very diverse subregion includes coastal lowlands, tidal marshes and flats, estuaries, islands, and river deltas from New Jersey to southern Texas. The terrain throughout is mostly level to gently sloping with little local relief. The native vegetation is mainly pines and hardwoods, but grass dominates the southwestern end of the subregion (Natural Resources Conservation Service 2006a).

Along the Gulf coast, much of the coastal plain at the time of European exploration and settlement was dominated by open stands of longleaf pine with a wiregrass (*Aristida stricta*) understory maintained by frequent fires. With fire suppression, pine savannas in many areas have been replaced by hardwoods and by agricultural and urban development. Gulf coastal marshes support gulf cordgrass (*Spartina spartinae*), little bluestem (*Schizachyrium scoparium*), switchgrass (*Panicum virgatum*), rushes (*Juncus* spp.), and sedges (*Carex* spp.). The Gulf coastal plain in Texas was originally prairie laced with hardwood riparian zones. Little bluestem, Indiangrass (*Sorghastrum nutans*), switchgrass, and big bluestem (*Andropogon gerardii*) are common species (USDA Natural Resources Conservation Service 2006a, World Wildlife Fund 2006).

Atlantic coastal flatwood vegetation is dominated mainly by loblolly pine, sweetgum, red maple, blackgum (*Nyssa sylvatica*), and oaks on drier sites, and by water tupelo, swamp tupelo (*Nyssa sylvatica* var. *biflora*), baldcypress, sweetgum, and red maple on bottomland sites. The pine barrens of New Jersey are a unique community developed on sandy soils that are nutrient poor. Much of the area supports a stunted forest of pitch pine (*Pinus rigida*), blackjack oak (*Quercus marilandica*), post oak, and other species. Atlantic white cedar (*Chamaecyparis thyoides*) was once common in swamps along the entire length of the Atlantic coastal plain (Laderman 1989, World Wildlife Fund 2006).

Florida Peninsula (LRR U)

The Florida Peninsula has a hot and humid climate with more than half of the annual rainfall occurring from June to September. Fall and winter are drier. Topography is nearly level to gently rolling with many scattered lakes and wetlands. The northern portion of the peninsula supports primarily a flatwoods community dominated by slash pine, longleaf pine, cabbage palm (*Sabal palmetto*), live oak (*Quercus virginiana*), saw palmetto (*Serenoa repens*), gallberry (*Ilex glabra*), and grasses. Soils are mostly Entisols (i.e., soils with relatively little horizon development), Alfisols, and Spodosols. The Everglades and surrounding areas of south Florida are dominated by freshwater marsh and forested wetland. Organic soils (Histosols) are common. Marsh areas support mainly sawgrass (*Cladium jamaicense* = *C. mariscus*, and *C. mariscoides*), with glasswort (*Salicornia* spp.), willows (*Salix* spp.), buttonbush (*Cephalanthus occidentalis*), and maidencane (*Amphicarpum* spp.). Baldcypress is the dominant tree in forested wetlands. In addition, red (*Rhizophora mangle*), black (*Avicennia germinans*), and white (*Laguncularia racemosa*) mangroves grow in saltwater areas along the eastern, southern, and southwestern coasts (USDA Natural Resources Conservation Service 2006a).

Types and distribution of wetlands

Wetlands occupy a relatively high percentage of the Atlantic and Gulf Coastal Plain Region and may dominate the landscape in some areas. Although the region covers a broad geographic area, including several climatic and physiognomic zones, landscape characteristics are similar across the region (USDA Natural Resources Conservation Service 2006a). The region consists mainly of low-elevation, flat-to-rolling terrain, with numerous streams, abundant rainfall, a complex coastline, and many opportunities for the establishment and maintenance of wetlands. Coastal marshes, beach/dune systems, and wet flats are typical of the outer coastal plain on recent or Holocene sediments, while mixed evergreen/hardwood forests occur on rolling hills of the inner coastal plain on Pleistocene and older sediments. These landscapes are periodically interrupted by large river floodplains of recent origin containing bottomland hardwoods, swamps, and other riparian forests (NatureServe 2006). The lower Mississippi River floodplain is the largest of these areas, extending from southern Illinois to the Gulf of Mexico.

Coastal fringe wetlands can be found in estuaries, bays, and shorelines throughout the region. Typical species in coastal marshes depend upon salinity, tidal regime, and other factors (Odum et al. 1984, Wiegert and Freeman 1990). Smooth cordgrass (*Spartina alterniflora*), gulf cordgrass, and needlegrass rush (*Juncus roemerianus*) are common dominants in tidal salt and brackish marshes. Salt flats and pans, where tidal waters may become trapped and concentrated through evaporation, sometimes support succulent halophytes, such as saltwort (*Batis maritima*) and glasswort.

Tidal and non-tidal freshwater marshes tend to support a greater diversity of plants than in salt marshes, including arrowhead (*Sagittaria* spp.), pickerel weed (*Pontederia cordata*), arrow arum (*Peltandra virginica*), sweetflag (*Acorus calamus*), sawgrass, wild rice (*Zizania aquatica*), giant cutgrass (*Zizaniopsis miliacea*), cattails (*Typha* spp.), and bulrushes (*Scirpus* spp.) (Eleuterius 1980, Odum et al. 1984, Duncan and Duncan 1987, U.S. Army Corps of Engineers 1988). In the Everglades and the Okefenokee Swamp, freshwater marshes are extensive and spatially diverse. Variations in microtopography, water levels, and fire history affect the distribution and diversity of Everglades marsh types (U.S. Army Corps of Engineers 1988).

Primarily from central Florida southward, mangrove swamps are often found in association with coastal marshes in tidally influenced saltwater or brackish situations. The three common mangrove species are distributed according to their tolerances for salinity, wave energy, and competition with each other (Odum et al. 1982). Red mangroves predominate along the immediate coastline and in areas flooded regularly by tides. White mangroves and black mangroves are found on less frequently flooded sites, and black mangroves are common in tidal basins and areas of higher salinity (Odum et al. 1982, U.S. Army Corps of Engineers 1988). Black mangrove shrublands are also found along the Texas and Louisiana coasts (NatureServe 2006).

Beach/dune systems are typically associated with barrier beaches, both on the coastline and along the edges of barrier islands. Interdunal swales from the coastal plain of Texas to Virginia generally support pond or marsh-like vegetation. Many are permanently or semi-permanently inundated with fresh water but are affected by salt spray or overwash during periodic storm events (NatureServe 2006). Saltmeadow cordgrass (*Spartina patens*) and sea oxeye (*Borrichia frutescens*) are often found in these areas.

Wet flats are present throughout the coastal plain region, and may be dominated by herbaceous plants, hardwoods, pines, or a mixture of pines and hardwoods. Often the wetlands occur in shallow depressions or microtopographic lows in very flat landscapes. Wet flats and surrounding communities are known by various names across the region, including flatwoods, pine savannas, pine barrens, and coastal prairies. The hydrology of wet flats can be highly seasonal and is derived mainly from direct precipitation, high water tables, and shallow overland flow. Depending on the location and fire history, common tree species in wet wooded flats include slash pine, longleaf pine, loblolly pine, pond pine (*Pinus serotina*), swamp chestnut oak, willow oak (*Quercus phellos*), water oak, and laurel oak. In Gulf coast pine savannas, frequent fires, low soil nutrients, and abundant sunlight produce highly diverse understory assemblages of grasses, sedges, and other herbaceous plants. Pitcher plants (*Sarracenia* spp.), other carnivorous plants, and orchids are often present (McDaniel 1987). Along the western Gulf, flatlands support extensive, highly diverse grasslands.

Pocosins are freshwater shrub bogs found on inter-stream flats in the coastal plain from southern Virginia to northern Florida, with the greatest concentration in North Carolina (Sharitz and Gibbons 1982). They are seasonally saturated or inundated, contain organic or organic-rich mineral soils, and support mainly broadleaf evergreen shrubs and small trees. Typical species include hollies (*Ilex* spp.), leucothoe (*Leucothoe* spp.), zenobia (*Zenobia pulverulenta*), titi (*Cyrilla racemiflora*), and pond pine.

Depressional wetlands in the coastal plain region are known locally as Carolina bays, Delmarva bays, Grady ponds, and many other names. They range from seasonally saturated to semi-permanently inundated and often support shrubs and trees of various bay species (e.g., sweetbay (*Magnolia virginiana*), red bay (*Persea borbonia*), loblolly bay (*Gordonia lasianthus*)) and species also found in pocosins (Sharitz and Gibbons 1982). On the Louisiana and Texas coastal plain, depressional wetlands are part of the coastal prairie landscape and are known locally as platins, marias, and prairie potholes. They support assemblages of grass-like plants, including switchgrass, maidencane (*P. hemitomon*), eastern gama grass (*Tripsacum dactyloides*), and beaksedges (*Rhynchospora* spp.) (NatureServe 2006).

Slope wetlands occur in the headwaters of coastal plain streams and in seeps throughout the region. Headwater slope wetlands are often associated with low-order streams and their headwaters in flat coastal plain landscapes. Their hydrology is derived primarily from groundwater discharge that can be highly seasonal. Locally called bayheads or baygalls, headwater slope wetlands are often dominated by various species of bay trees (e.g., *Persea* spp., *Magnolia virginiana*) along with swamp tupelo, oaks, and slash pine. Shrub bogs can be found in uplands of the inner coastal plain. Shrub bogs have typical bog vegetation containing pitcher plants, grasses, sedges, orchids, and yellow-eyed grass (*Xyris* spp.), surrounded or broken by areas of shrubs or small trees. Many of the shrubs common to pocosins are also found in shrub bogs, including buckwheat tree (*Cliftonia monophylla*), titi, poison sumac (*Toxicodendron vernix*), and pond cypress (*Taxodium ascendens*). Other kinds of seep wetlands exist throughout the region and their characteristics can be highly variable.

Floodplain and riparian ecosystems occur along major rivers and streams throughout the coastal plain, including the James, Roanoke, Savannah, and St. Johns Rivers on the Atlantic coast and the Apalachicola, Pascagoula, Mississippi, and Brazos Rivers on the Gulf coast. Repeated alluvial landforms, including natural levees, backswamps, sloughs, and abandoned channels are often scattered throughout these floodplains as a result of natural river meandering over long periods of time. Bottomland hardwood forests occupy the floodplains of second-order and larger streams and rivers. Under natural conditions, these forests are often seasonally inundated by overbank or backwater flooding. Typical dominant trees include various species of oaks, sugarberry (*Celtis laevigata*), red maple, green ash (*Fraxinus pennsylvanica*), American elm, and sweetgum. Areas that are semi-permanently inundated, including the fringes of oxbow lakes, often support swamp forests dominated by baldcypress, swamp tupelo, water tupelo, oaks, and ashes (*Fraxinus* spp.). Near the mouths of major rivers, swamp forests may be tidally influenced (Wharton et al. 1982). On the inner coastal plain, riparian wetlands are associated with the floodplains of smaller rivers and streams. These relatively narrow floodplains or branch bottoms have species composition similar to the bottomland hardwood forests and swamps of larger rivers, but more upland species may invade second bottoms and higher terraces.

2 Hydrophytic Vegetation Indicators

Introduction

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

Many factors besides site wetness affect the composition of the plant community in an area, including regional climate, local weather patterns, topography, soils, past and present land use, and current and historical plant distributional patterns at various spatial scales. The sediments that comprise the Atlantic and Gulf Coastal Plain Region were laid down in the ocean and the region has been influenced by repeated fluctuations in sea levels and climatic conditions as a result of glaciation and deglaciation of northern regions during the Quaternary Period. Recent sea-level rise has drowned river mouths and produced numerous large bays, estuaries, and sounds along the Atlantic and Gulf coasts, and has facilitated the development of barrier islands. The diversity of environments in the coastal plain region has resulted in a flora that, although younger than that of the adjoining Appalachian area, is rich and contains many endemic species. Along the Atlantic coast, for example, nearly 1,400 plant species have been reported from southern New Jersey, over 2,000 from the Delmarva Peninsula, 1,750 from coastal Georgia, and nearly 2,200 from central Florida (Thorne 1993).

Before European settlement, fire was a regular and pervasive feature of the coastal plain landscape, particularly along the south Atlantic and Gulf coasts. Early explorers commented on the open and park-like qualities of coastal plain forests, grasslands, and savannas. Frequent fires were caused primarily by lightning strikes and secondarily by native Americans who used fire to drive game and produce more open habitats (Ware et al. 1993, Rheinhardt et al. 2002). Coastal plain forests are characterized by several species of pines, especially *Pinus rigida* in the north and *P. palustris* and *P. elliottii* in the south, in part due to repeated fires and the frequent occurrence of poorly drained soils. In contrast, headwater wetlands, floodplains, and swamps, where fires are less frequent, tend to be dominated by oaks, bays (e.g., *Magnolia virginiana, Persea borbonia*), gums (*Nyssa* spp.), and baldcypress. Areas where fires have been suppressed in recent times are often invaded by shrubs and hardwoods.

While the inner coastal plain is more hilly and dissected by numerous streams, the outer coastal plain is often very flat and is characterized by extensive flatwoods, savannas, and coastal marshes. Soils in these areas are often poorly drained although they typically dry out during summer when air temperatures and evapotranspiration rates are highest. Many species in the region develop morphological adaptations (e.g., adventitious roots, buttressed bases) that help them to survive in soils that are periodically inundated or saturated. Throughout the coastal plain region, the species composition of ground-layer vegetation in some wetlands may shift seasonally as FACU and UPL annual species become established and dominate during dry periods. These shifts can make some wetland plant communities difficult to identify during the dry season or in drought years.

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

Hydrophytic vegetation indicators and procedures presented in this chapter are designed to identify the majority of wetland plant communities in the coastal plain region. However, some wetland communities may lack any of these indicators, at least at certain times. These situations are considered in Chapter 5 (Difficult Wetland Situations in the Atlantic and Gulf Coastal Plain Region).

Guidance on vegetation sampling and analysis

General guidance on sampling of vegetation for wetland-delineation purposes is given in the Corps Manual for both the routine and comprehensive methods. Those procedures are intended to be flexible and may need to be modified for application in a given region or on a particular site. Vegetation sampling done as part of a wetland delineation is designed to characterize the site in question rapidly without the need for detailed scientific study or statistical methods. A balance must be established between the need to accomplish the work quickly and the need to characterize the site's heterogeneity accurately and at an appropriate scale. The following guidance on vegetation sampling is intended to supplement the Corps Manual for applications in the coastal plain region.

The first step is to stratify the site so that the major landscape units or vegetation communities can be evaluated separately. This may be done in advance using an aerial photograph or topographic map, or by walking over the site. In general, routine wetland determinations are based on visual estimates of percent cover of plant species that can be made either (1) within the vegetation community as a whole, or (2) within one or more sampling plots established in representative locations within each community. Percent cover estimates are more accurate and repeatable if taken within a defined plot or series of plots. This also facilitates field verification of another delineator's work. For wetland delineation purposes, an area is considered to be vegetated if it has 5 percent or more total plant cover during the peak of the growing season.

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

Plot and sample sizes

Hydrophytic vegetation determinations under the Corps Manual are based on samples taken in representative locations within each community. Random sampling of the vegetation is not required except in certain comprehensive determinations. For routine determinations in fairly uniform vegetation, one or more plots in each community are usually sufficient for an accurate determination. Sampling of a single- to multi-layered community can be accomplished using a 30-ft (9.1-m) radius plot for all strata.

In general, the appropriate size and shape for a sample plot depend on the type of vegetation (i.e., trees, shrubs, herbaceous plants, etc.) and the size or shape of the plant community or patch being sampled. The plot needs to be large enough to include adequate numbers of individuals in all strata, but small enough so that plant species or individuals can be separated and measured without duplication or omission, and the sampling can be done in a timely fashion (Cox 1990, Barbour et al. 1999). For hydrophytic vegetation determinations, the abundance of each species is usually determined by estimating areal cover. Plot sizes should make visual sampling both accurate and efficient. For most situations on the coastal plain, a 30-ft-radius plot is adequate for all strata. An alternative method for collecting abundance data for the tree stratum is to estimate basal area of each species using a forester's 10-factor prism. However, basal-area data cannot be used in the prevalence index described later in this chapter.

The sizes and shapes of sampling plots, if used, may be modified as appropriate to adapt to site conditions and should be recorded on the field data form if they deviate from those recommended in the Corps Manual or this Supplement. A sampling plot should not be allowed to extend beyond the edges of the plant community being sampled or to overlap an adjacent community having different vegetation, soil, or hydrologic conditions. This may happen if vegetation patches are small or occur as narrow bands or zones along a topographic or moisture gradient. In such cases, plot sizes and shapes should be adjusted to fit completely within the vegetation patch or zone of interest. For example, in linear riparian communities where the width of a standard plot may exceed the width of the plant community, an elongated rectangular plot or belt transect that follows the stream is recommended. If possible, the area sampled should be equivalent to the 30-ft-radius plot for all strata. An alternative approach involves sampling a series of small subplots (e.g., 5 by 5 ft (1.5 by 1.5 m), or

10 by 10 ft (3.1 by 3.1 m)) in the riparian community and averaging the data across subplots.

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

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

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

Reference	Comment
Kent, M., and P. Coker. 1992. *Vegetation Description and Analysis: A Practical Approach*. New York, NY: Wiley.	Simple and clear methods for setting up a study, and collecting and analyzing the data. Initial chapters are helpful for data collection and sampling approaches in wetland delineation.
Mueller-Dombois, D., and H. Ellenberg. 1974. *Aims and Methods of Vegetation Ecology.* New York, NY: Wiley.	A standard text in vegetation ecology, sampling, and analysis. This reference provides many sampling and analytical methods that are helpful in complex delineations.
Peet, R. K., T. R. Wentworth, and P. S. White. 1998. A flexible, multipurpose method for recording vegetation composition and structure. *Castanea* 63: 262-274.	Good background information on various aspects of vegetation and their influence on numerical outcomes. Useful for possible comprehensive sampling approaches.
Tiner, R. W. 1999. *Wetland Indicators: A Guide to Wetland Identification, Delineation, Classification, and Mapping.* Boca Raton, FL: Lewis Publishers.	Includes reviews of various sampling techniques and provides a list of vegetation references.

Definitions of strata

Vegetation strata within a plot are sampled separately when evaluating indicators of hydrophytic vegetation. The structure of vegetation varies greatly in wetlands across the region, from single-layered marsh communities to multi-layered forests. For sampling purposes, the following system, which divides the community into five strata, is recommended in this region. It combines herbaceous plants and small individuals of woody species into the herb stratum. Shrubs are woody species approximately 3 to 20 ft (1 to 6 m) tall. Trees and saplings are greater than 20 ft (6 m) tall but differentiated by diameter at breast height (DBH). Unless otherwise noted, a stratum for sampling purposes is defined as having 5 percent or more total plant cover. If a stratum has less than 5 percent cover during the peak of the growing season, then those species and their cover values can be combined into other similar woody or non-woody strata for sampling purposes. For example, a sparse tree stratum would be incorporated into the sapling stratum, and a sparse herb stratum would be combined with the shrub stratum.

1. *Tree stratum* – Consists of woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger DBH.

2. *Sapling stratum* – Consists of woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

3. *Shrub stratum* – Consists of woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

4. *Herb stratum* – Consists of all herbaceous (non-woody) plants, including herbaceous vines, regardless of size. Includes woody species, except woody vines, less than approximately 3 ft (1 m) in height.

5. *Woody vines* – Consists of all woody vines, regardless of height.

Although the five-stratum sampling design presented above is recommended in the Atlantic and Gulf Coastal Plain Region, investigators who prefer a four-stratum sampling design may use the one recommended in the nearest adjacent region, with the approval of the appropriate Corps of Engineers district.

Hydrophytic vegetation indicators

The following indicators should be applied in the sequence presented. The stepwise procedure is designed to reduce field effort by requiring that only one indicator, the dominance test, be evaluated in the majority of wetland determinations. Hydrophytic vegetation is present if any of the indicators is satisfied. These indicators are applicable throughout the entire coastal plain region.

Indicators of hydrophytic vegetation involve looking up the wetland indicator status of plant species on the wetland plant list (Reed 1988 or current list). For the purposes of this supplement, only the five basic levels of wetland indicator status (i.e., OBL, FACW, FAC, FACU, and UPL) are used in hydrophytic vegetation indicators. Plus (+) and minus (–) modifiers are not used (e.g., FAC–, FAC, and FAC+ plants are all considered to be FAC). For species listed as NI (reviewed but given no regional indicator) or NO (no known occurrence in the region at the time the list was compiled), apply the indicator status assigned to the species in the nearest adjacent region. If the species is listed as NI or NO but no adjacent regional indicator is assigned, do not use the species to calculate hydrophytic vegetation indicators. In general, species that are not listed on the wetland plant list are assumed to be upland (UPL) species. However, recent changes in plant nomenclature have resulted in a number of species that are not listed by Reed (1988) but are not necessarily UPL plants. Examples in the region include woolly croton (*Croton capitata*) and callery pear (*Pyrus calleryana*). Procedures described in Chapter 5, section on Problematic Hydrophytic Vegetation, can be used if it is believed that individual FACU, NI, NO, or unlisted plant species are functioning as hydrophytes on a particular site. For Clean Water Act purposes, wetland delineators should use the latest plant lists approved by Headquarters, U.S. Army Corps of Engineers (Figure 2) (http://www.usace.army.mil/inet/functions/cw/cecwo/reg/reg_supp.htm).

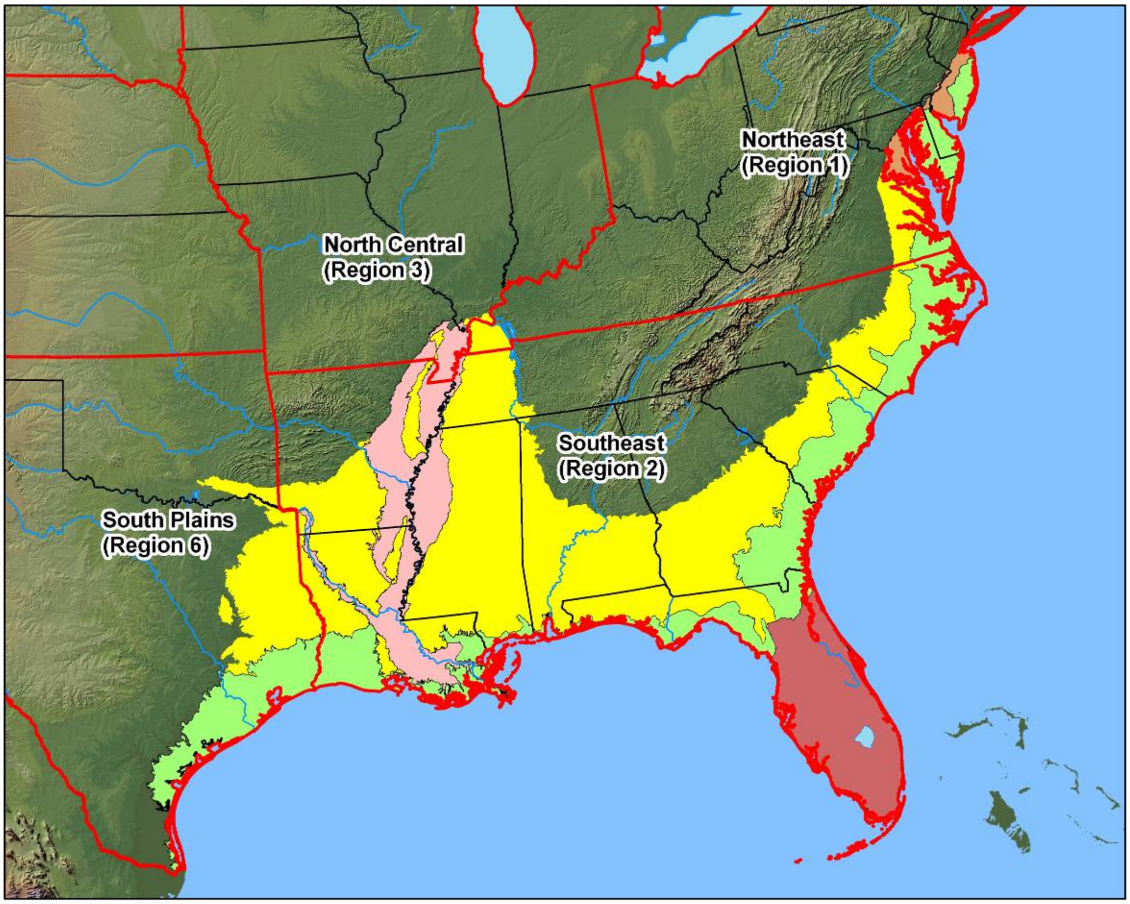

Figure 2. Plant list regional boundaries (red lines) currently used by the U.S. Fish and Wildlife Service, National Wetlands Inventory, in the Atlantic and Gulf Coastal Plain Region.

The dominance test (Indicator 1) is the basic hydrophytic vegetation indicator and should be applied in every wetland determination. Most wetlands in the coastal plain have plant communities that will pass the dominance test, and this is the only indicator that needs to be used in most situations. However, some wetland plant communities may fail a test based only on dominant species. Therefore, in those cases where indicators of hydric soil and wetland hydrology are present, the vegetation should be re-evaluated with the prevalence index (Indicator 2), which takes non-dominant plant species into consideration. Finally, certain problematic wetland situations may lack any of these indicators and are described in Chapter 5.

Procedure

The procedure for using hydrophytic vegetation indicators is as follows:

1. Apply Indicator 1 (Dominance Test).

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

2. Apply Indicator 2 (Prevalence Index). This step assumes that at least one indicator of hydric soil and one primary or two secondary indicators of wetland hydrology are present.

    a. If the plant community satisfies the prevalence index, then the vegetation is hydrophytic. No further vegetation analysis is required.
    b. If the plant community fails the prevalence index, then hydrophytic vegetation is absent unless indicators of hydric soil and wetland hydrology are present and the site meets the requirements for a problematic wetland situation (Chapter 5).

Indicator 1: Dominance test

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

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

Procedure for Selecting Dominant Species by the 50/20 Rule: Dominant plant species are the most abundant species in the community; they contribute more to the character of the community than do the other non-dominant species present. The 50/20 rule is the recommended method for selecting dominant species from a plant community when quantitative data are available.

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

1. Estimate the absolute percent cover of each species in the first stratum. Since the same data may be used later to calculate the prevalence index, the data should be recorded as absolute cover and not converted to relative cover.

2. Rank all species in the stratum from most to least abundant.

3. Calculate the total coverage of all species in the stratum (i.e., sum their individual percent cover values). Absolute cover estimates do not necessarily sum to 100 percent.

4. Select plant species from the ranked list, in decreasing order of coverage, until the cumulative coverage of selected species *exceeds* 50 percent of the total absolute coverage for the stratum. If two or more species are equal in coverage (i.e., they are tied in rank), they should all be selected. The selected plant species are all considered to be dominants. All dominants must be identified to species.

5. In addition, select any other species that, by itself, is at least 20 percent of the total absolute percent cover in the stratum. Any such species is also considered to be a dominant and must be accurately identified.

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

Stratum	Species Name	Wetland Indicator Status[1]	Absolute Percent Cover	Dominant?
Herb	*Impatiens capensis*	FACW	30	Yes
	Boehmeria cylindrica	FACW	18	Yes
	Pilea pumila	FACW	12	No
	Athyrium filix-femina	FAC	3	No
	Symplocarpus foetidus	OBL	3	No
		Total cover	66	
		50/20 Thresholds: 50% of total cover =33.0% 20% of total cover =13.2%		
Shrub	*Ilex opaca*	FACU	18	Yes
	Viburnum dentatum	FAC	6	Yes
	Clethra alnifolia	FAC	3	No
	Vaccinium corymbosum	FACW	3	No
		Total cover	30	
		50/20 Thresholds: 50% of total cover =15.0% 20% of total cover = 6.0%		
Sapling	*Acer rubrum*	FAC	9	Yes
	Liquidambar styraciflua	FAC	9	Yes
	Fraxinus pennsylvanica	FACW	2	No
		Total cover	20	
		50/20 Thresholds: 50% of total cover =10.0% 20% of total cover = 4.0%		
Tree	*Acer rubrum*	FAC	18	Yes
	Liquidambar styraciflua	FAC	18	Yes
	Platanus occidentalis	FACW	12	Yes
	Fraxinus pennsylvanica	FACW	6	No
	Liriodendron tulipifera	FACU	3	No
	Nyssa sylvatica	FAC	3	No
		Total cover	60	
		50/20 Thresholds: 50% of total cover = 30% 20% of total cover = 12%		
Woody Vine	*Toxicodendron radicans*	FAC	5	Yes
	Lonicera japonica	FAC	4	Yes
	Parthenocissus quinquefolia	FACU	1	No
		Total cover	10	
		50/20 Thresholds: 50% of total cover = 5.0% 20% of total cover = 2.0%		
Hydrophytic Vegetation Determination	Total number of dominant species across all strata = 11. Percent of dominant species that are OBL, FACW, or FAC = 10/11 = 90.9%. Therefore, this community is hydrophytic by Indicator 1 (Dominance Test).			

[1] Indicator statuses according to the Region 1 (Northeast) plant list (Reed 1988).

6. Repeat steps 1-5 for any other stratum present. Combine the lists of dominant species across all strata. Note that a species may be dominant in more than one stratum (e.g., a woody species may be dominant in both the tree and sapling strata).

Indicator 2: Prevalence index

Description: The prevalence index is 3.0 or less.

User Notes: The prevalence index ranges from 1 to 5. A prevalence index of 3.0 or less indicates that hydrophytic vegetation is present. To calculate the prevalence index, at least 80 percent of the total vegetation cover on the plot (summed across all strata) must be of species that have been correctly identified and have assigned wetland indicator statuses (Reed 1988 or current list) or are upland (UPL) species.

Procedure for Calculating a Plot-Based Prevalence Index: The prevalence index is a weighted-average wetland indicator status of all plant species in the sampling plot, where each indicator status category is given a numeric code (OBL = 1, FACW = 2, FAC = 3, FACU = 4, and UPL = 5) and weighting is by abundance (absolute percent cover). It is a more comprehensive analysis of the hydrophytic status of the community than one based on just a few dominant species. It is particularly useful in (1) communities with only one or two dominants, (2) highly diverse communities where many species may be present at roughly equal coverage, and (3) cases where strata differ greatly in total plant cover (e.g., total herb cover is 80 percent but sapling cover is only 10 percent). The prevalence index is used in this supplement to determine whether hydrophytic vegetation is present on sites where indicators of hydric soil and wetland hydrology are present but the vegetation initially fails the dominance test.

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

1. Identify and estimate the absolute percent cover of each species in each stratum of the community. Sum the cover estimates for any species that is present in more than one stratum.

2. Organize all species (across all strata) into groups according to their wetland indicator status (i.e., OBL, FACW, FAC, FACU, or UPL) and sum their cover values within groups. Do not include species that were not identified.

3. Calculate the prevalence index using the following formula:

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

   where:

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

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

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

Indicator Status Group	Species Name	Absolute Percent Cover by Species	Total Cover by Group	Multiply by:[1]	Product
OBL species	*Symplocarpus foetidus*	3	3	1	3
FACW species	*Boehmeria cylindrica* *Fraxinus pennsylvanica*[2] *Impatiens capensis* *Pilea pumila* *Platanus occidentalis* *Vaccinium corymbosum*	18 8 30 12 12 3	83	2	166
FAC species	*Acer rubrum*[2] *Athyrium filix-femina* *Clethra alnifolia* *Liquidambar styraciflua*[2] *Lonicera japonica* *Nyssa sylvatica* *Toxicodendron radicans* *Viburnum dentatum*	27 3 3 27 4 3 5 6	78	3	234
FACU species	*Ilex opaca* *Liriodendron tulipifera* *Parthenocissus quinquefolia*	18 3 1	22	4	88
UPL species	None	0	0	5	0
Sum			186 (A)		491 (B)
Hydrophytic Vegetation Determination		Prevalence Index = B/A = 491/186 = 2.64 Therefore, this community is hydrophytic by Indicator 2 (Prevalence Index).			

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

[2] These species were each recorded in two or more strata (see Table 3), so the cover estimates were summed across strata.

3 Hydric Soil Indicators

Introduction

The National Technical Committee for Hydric Soils (NTCHS) defines a hydric soil as a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (USDA Soil Conservation Service 1994). Most hydric soils exhibit characteristic morphologies that result from repeated periods of saturation or inundation that last more than a few days. Saturation or inundation, when combined with microbial activity in the soil, causes the depletion of oxygen. This anaerobiosis promotes certain biogeochemical processes, such as the accumulation of organic matter and the reduction, translocation, or accumulation of iron and other reducible elements. These processes result in distinctive characteristics that persist in the soil during both wet and dry periods, making them particularly useful for identifying hydric soils in the field (USDA Natural Resources Conservation Service 2006b).

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

This list of indicators is dynamic; changes and additions are anticipated with new research and field testing. The indicators presented in this supplement are a subset of the NTCHS *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service 2006b or current version) that are commonly found in the coastal plain region. Any change to the NTCHS *Field Indicators of Hydric Soils in the United States* represents a change to this subset of indicators for the coastal plain region. The current version of the indicators can be found on the NRCS hydric soils web site (http://soils.usda.gov/use/hydric). To use the indicators properly, a basic knowledge of soil/landscape relationships is necessary.

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

Concepts

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

Iron and manganese reduction, translocation, and accumulation

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

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

Sulfate reduction

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

Organic matter accumulation

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

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

Organic soil materials are classified as sapric, hemic, or fibric. Differentiating criteria are based on the percentage of visible fibers observable with a hand lens in an undisturbed state and after rubbing between thumb and fingers 10 times (Table 5). Sapric, hemic, and fibric correspond to the textures muck, mucky peat, and peat. If there is a conflict between unrubbed and rubbed fiber content, rubbed content is used. *Live roots are not considered.*

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

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

Adapted from USDA Natural Resources Conservation Service (1999).

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

Cautions

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

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

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

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

Procedures for sampling soils

Observe and document the site

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

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

- *Hydrology*–Is standing water observed on the site or is water observed in the soil pit? What is the depth of the water table in the area? Is there indirect evidence of ponding or flooding?

- *Slope*–Is the site level or nearly level so that surface water does not run off readily, or is it steeper where surface water would run off from the soil?

- *Slope shape*–Is the surface concave (e.g., in a depression), where water would tend to collect and possibly pond on the soil surface? On hillsides, are there convergent slopes (Figure 3), where surface or groundwater may be directed toward a central stream or swale? Or is the surface or slope shape convex, causing water to run off or disperse?

- *Landform*–Is the soil in a floodplain, flat, or drainageway that may be subject to seasonal high water tables or flooding? Is it at the toe of a slope (Figure 4) where runoff may tend to collect or groundwater emerge at or near the surface? Has the microtopography been altered by cultivation or other disturbances?

- *Soil materials*–Is there a restrictive layer in the soil that would slow or prevent the infiltration of water? This could include consolidated bedrock, cemented layers such as duripans and petrocalcic horizons, layers of silt or substantial clay content, or strongly contrasting soil textures (e.g., silt over sand). Or is there relatively loose soil material (sand, gravel, or rocks) or fractured bedrock that would allow the water to flow laterally down slope?

- *Vegetation*–Does the vegetation at the site indicate wetter conditions than at other nearby sites, or is it similar to what is found at nearby upland sites?

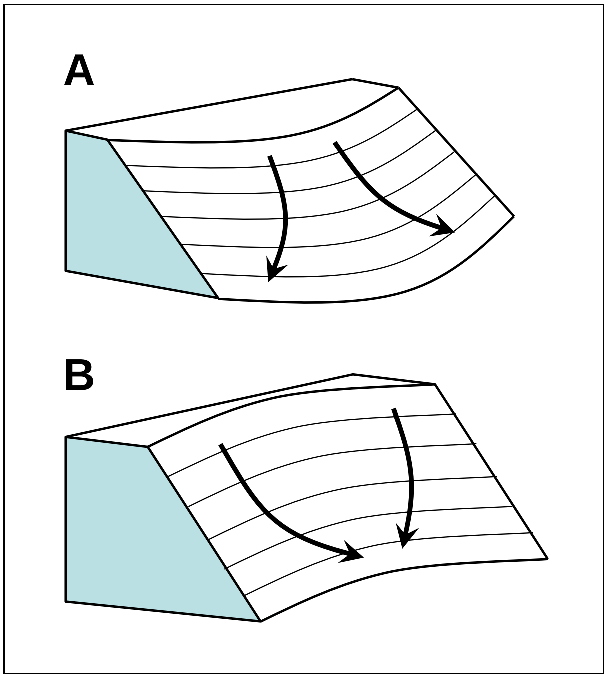

Figure 3. Divergent slopes (A) disperse surface water, whereas convergent slopes (B) concentrate water. Surface flow paths are indicated by the arrows.

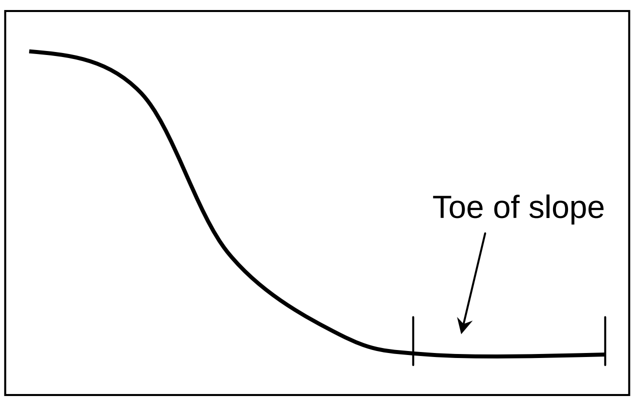

Figure 4. At the toe of a hill slope, the gradient is only slightly inclined or nearly level.

Observe and document the soil

To observe and document a hydric soil, first remove any loose leaves, needles, or bark from the soil surface. Do not remove the organic surface layers of the soil, which usually consist of plant remains in various stages of decomposition. Dig a hole and describe the soil profile. In general, the hole should be dug to the depth needed to document an indicator or to confirm the absence of indicators. For most soils, the recommended excavation depth is approximately 20 in. (50 cm) from the soil surface, although a shallower soil pit may suffice for some indicators (e.g., A2 – Histic Epipedon). Digging may be difficult in some areas due to rocks and hardpans. Use the completed profile description to determine which hydric soil indicators have been met (USDA Natural Resources Conservation Service 2006b).

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

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

Depths used in the indicators are measured from the muck surface, or from the mineral soil surface if a muck surface is absent. For indicators A1 (Histosol), A2 (Histic Epipedon), and A3 (Black Histic), depths are measured from the top of the organic material (peat, mucky peat, or muck).

All colors noted in this supplement refer to moist Munsell® colors (Gretag/Macbeth 2000). Dry soils should be moistened until the color no longer changes and wet soils should be allowed to dry until they no longer glisten. Care should be taken to avoid over-moistening dry soil. Soil colors specified in the indicators do not have decimal points; however, intermediate colors do occur between Munsell chips. Soil chroma should not be rounded to qualify as meeting an indicator. For example, a soil matrix with a chroma between 2 and 3 should be listed as having a chroma of 2+. This soil material does not have a chroma of 2 and would not meet any indicator that requires a chroma of 2 or less. Always examine soil matrix colors in the field immediately after sampling. Ferrous iron, if present, can oxidize rapidly and create colors of higher chroma or redder hue.

Soils that are saturated at the time of sampling may contain reduced iron and/or manganese that are not detectable by eye. Under saturated conditions, redox concentrations may be absent or difficult to see, particularly in dark-colored soils. It may be necessary to let the soil dry to a moist state (5 to 30 minutes or more) for the iron or manganese to oxidize and redox features to become visible.

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

Use of existing soil data

Soil surveys

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

Hydric soils lists

Hydric Soils Lists are developed for each detailed soil survey. Using criteria approved by the NTCHS, these lists rate each soil component as either hydric or non-hydric based on soil property data. If the soil is rated as hydric, information is provided regarding which hydric criteria are met and on what landform the soil typically occurs. Hydric Soils Lists are useful as general background information for an on-site delineation. However, not all areas within a mapping unit or polygon identified as having hydric soils may be hydric. Conversely, inclusions of hydric soils may be found within soil mapping units where no hydric soils have been identified. The Hydric Soils List should be used as a tool, indicating that hydric soil will likely be found within a given area, but should never be used as a substitute for onsite investigation and field indicators of hydric soils.

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

Hydric soil indicators

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

Hydric soil indicators are presented in three groups. Indicators for "All Soils" are used in any soil regardless of texture. Indicators for "Sandy Soils" are used in soil layers with USDA textures of loamy fine sand or coarser. Indicators for "Loamy and Clayey Soils" are used with soil layers of loamy very fine sand and finer. Both sandy and loamy/clayey layers may be present in the same soil profile. Therefore, a soil that contains a loamy surface layer over sand is hydric if it meets all of the requirements of matrix color, amount and contrast of redox concentrations, depth, and thickness for a specific A (All Soils), F (Loamy and Clayey Soils), or S (Sandy Soils) indicator. Helpful diagrams of many of these indicators are available on the web site of the Mid-Atlantic Hydric Soils Committee (http://www.epa.gov/reg3esd1/hydricsoils/).

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

Table 7. Minimum thickness requirements for commonly combined indicators in the Atlantic and Gulf Coastal Plain Region.

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

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

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

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

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

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

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

All soils

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

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

Indicator A1: Histosol

Figure 5. Example of a Histosol, in which muck (sapric soil material) is greater than 3 ft (0.9 m) thick.

Technical Description: Classifies as a Histosol (except Folists)

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

User Notes: A Histosol has 16 in. (40 cm) or more of the upper 32 in. (80 cm) as organic soil material (Figure 5). Histosols also include soils that have organic soil material of any thickness over rock or fragmental soil material that has interstices filled with organic soil material. Organic soil material has an organic carbon content (by weight) of 12 to 18 percent or more, depending on the clay content of the soil. The material includes muck (sapric soil material), mucky peat (hemic soil material), or peat (fibric soil material). See the glossary of *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service 2006b) for definitions of muck, mucky peat, peat, and organic soil material. See the Concepts section of this chapter for field methods to identify organic soil materials.

This indicator is locally common in LRRs T and U but is rare across most of the coastal plain region. It is most likely to be associated with flats and tidal fringe wetlands that are saturated to the surface, and with depressional wetlands that are ponded or saturated nearly all year. Folists are rare or absent in this region. Histosols are generally not found at the boundary between wetlands and non-wetlands.

Indicator A2: Histic Epipedon

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

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

Figure 6. Example of an organic surface layer approximately 8 in. (20 cm) thick.

User Notes: Most histic epipedons are surface horizons 8 in. (20 cm) or more thick of organic soil material (Figure 6). Aquic conditions or artificial drainage are required (see *Soil Taxonomy*, USDA Natural Resources Conservation Service 1999); however, aquic conditions can be assumed if indicators of hydrophytic vegetation and wetland hydrology are present. See the glossary of *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service 2006b) for definitions. See the Concepts section of this chapter for field methods to identify organic soil materials. See indicator A1 for organic carbon requirements. Slightly lower organic carbon contents are allowed in plowed soils.

This indicator is locally common in portions of LRRs T and U but is rare across most of the coastal plain region. It is most likely to be associated with slope wetlands that are saturated to the surface, depressional wetlands that are ponded or saturated nearly all of the growing season in most years, and extensive flats in tidewater areas (e.g., MLRA 153B). Histic epipedons are generally not found at the boundary between wetlands and non-wetlands.

Indicator A3: Black Histic

Technical Description: A layer of peat, mucky peat, or muck 8 in. (20 cm) or more thick that starts within 6 in. (15 cm) of the soil surface; has hue of 10YR or yellower, value of 3 or less, and chroma of 1 or less; and is underlain by mineral soil material with chroma of 2 or less (Figure 7).

Figure 7. In this soil, the organic surface layer is about 9 in. (23 cm) thick.

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

User Notes: This indicator does not require proof of aquic conditions or artificial drainage. See the glossary of *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service 2006b) for definitions of peat, mucky peat, and muck. See the Concepts section of this chapter for field methods to identify organic soil materials. See indicator A1 for organic carbon requirements.

This indicator is locally common in portions of LRRs T and U but is rare across most of the coastal plain region. It is most likely to be associated with slope wetlands that are saturated to the surface, depressional wetlands that are ponded or saturated nearly all of the growing season in most years, and extensive flats in tidewater areas (e.g., MLRA 153B). The Black Histic indicator is generally not found at the boundary between wetlands and non-wetlands.

Indicator A4: Hydrogen Sulfide

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

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

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

Indicator A5: Stratified Layers

Technical Description: Several stratified layers starting within 6 in. (15 cm) of the soil surface. One or more of the layers has value of 3 or less with chroma of 1 or less and/or it is muck, mucky peat, or peat, or has a mucky modified mineral texture. The remaining layers have chroma of 2 or less (Figures 8 and 9).

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

User Notes: Use of this indicator may require assistance from a soil scientist with local experience. An undisturbed sample must be observed. Individual strata are dominantly less than 1 in. (2.5 cm) thick. At least one layer must have at least 70 percent of the soil material covered, coated, or similarly masked with organic matter. A hand lens is an excellent tool to aid in the identification of this indicator. Many alluvial soils have stratified layers at greater depths; these are not hydric soils. Many alluvial soils have stratified layers at the required depths, but lack a chroma of 2 or less; these do not fit this indicator. Stratified layers occur in any type soil material, generally in floodplains and other areas where wet soils are subject to rapid and repeated burial with thin deposits of sediment.

Figure 8. Stratified layers in loamy material.

Figure 9. Stratified layers in sandy material. Scale is in inches.

Indicator A6: Organic Bodies

Technical Description: Presence of 2 percent or more organic bodies of muck or a mucky modified mineral texture, approximately 0.5 to 1 in. (1 to 3 cm) in diameter (Figure 10), starting within 6 in. (15 cm) of the soil surface. In some soils the organic bodies are smaller than 0.5 in. (1 cm).

Applicable Subregions: Applicable to LRRs P, T, and U.

User Notes: Use of this indicator may require assistance from a soil scientist with local experience. The required content of organic carbon in organic bodies is the same as in the muck (e.g., Indicator A8) or mucky texture (e.g., Indicator A7) indicators. The Organic Bodies indicator includes the indicator previously named “accretions” (Florida Soil Survey Staff 1992). Many organic bodies lack the required amount of organic carbon and are not indicative of hydric soils. The content of organic carbon, based on a field estimate, should be known before this indicator is used. See the Concepts section of this chapter for field methods to identify organic soil materials. Organic bodies of hemic material (mucky peat) and/or fibric material (peat) do not meet the requirements of this indicator, nor does material consisting of partially decomposed root tissue.

Figure 10. Organic bodies 0.5 to 1 in. (1 to 3 cm) in size. Scale is in inches (upper) and centimeters (lower).

Indicator A7: 5 cm Mucky Mineral

Technical Description: A layer of mucky modified mineral soil material 2 in. (5 cm) or more thick starting within 6 in. (15 cm) of the soil surface (Figure 11).

Applicable Subregions: Applicable to LRRs P, T, and U.

User Notes: Use of this indicator may require assistance from a soil scientist with local experience. “Mucky” is a USDA texture modifier for mineral soils. The organic carbon content is at least 5 percent and ranges up to 18 percent. The percentage requirement is dependent upon the clay content of the soil; the higher the clay content, the higher the organic carbon requirement. An example is mucky fine sand, which has at least 5 percent but not more than about 12 percent organic carbon. Another example is mucky sandy loam, which has at least 7 percent but not more than about 14 percent organic carbon.

Figure 11. The mucky mineral layer in this example is about 4 in. (10 cm) thick and begins at the soil surface. Scale is in inches (right) and centimeters (left).

Indicator A8: Muck Presence

Technical Description: A layer of muck with a value of 3 or less and chroma of 1 or less within 6 in. (15 cm) of the soil surface.

Applicable Subregions: Applicable to LRR U.

User Notes: The presence of muck of any thickness within 6 in. (15 cm) is the only requirement for this indicator. Normally, the layer is at the soil surface; however, it may occur at any depth within 6 in. (15 cm). Muck is sapric soil material with a minimum content of organic carbon that ranges from 12 to 18 percent, depending on the content of clay. Organic soil material is called muck if virtually all of the material has undergone sufficient decomposition to prevent the identification of plant parts. Hemic (mucky peat) and fibric (peat) soil materials do not qualify. Generally, muck is black and has a greasy feel; sand grains should not be evident. See the Concepts section of this chapter for field methods to identify organic soil materials.

Indicator A9: 1 cm Muck

Figure 12. In this example, the muck layer is about 1.5 in. (4 cm) thick and begins at the soil surface. Scale in inches (right) and centimeters (left).

Technical Description: A layer of muck 0.5 in. (1 cm) or more thick with a value of 3 or less and a chroma of 1 or less starting within 6 in. (15 cm) of the soil surface (Figure 12).

Applicable Subregions: Applicable to LRRs P and T; applicable to problem soils in LRR O.

User Notes: Normally the muck layer is at the soil surface; however, it may occur at any depth within 6 in. (15 cm) of the surface. Muck is sapric soil material with at least 12 to 18 percent organic carbon. Organic soil material is called muck if virtually all of the material has undergone sufficient decomposition to limit recognition of the plant parts. Hemic (mucky peat) and fibric (peat) soil materials do not qualify. To determine if muck is present, first remove loose leaves, needles, bark, and other easily identified plant remains. This is sometimes called leaf litter, a duff layer, or a leaf or root mat. Then examine for decomposed organic soil material. Generally, muck is black and has a greasy feel; sand grains should not be evident (see the Concepts section of this chapter for field methods to identify organic soil materials). Determination of this indicator is made below the leaf or root mat; however, root mats that meet the definition of hemic or fibric soil material are included in the decision-making process for indicators A1 (Histosol) and A2 (Histic Epipedon).

Indicator A11: Depleted Below Dark Surface

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

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

Loamy/clayey layer(s) above the depleted or gleyed matrix must have a value of 3 or less and chroma of 2 or less. Any sandy material above the depleted or gleyed matrix must have a value of 3 or less and chroma of 1 or less, and at least 70 percent of the visible soil particles must be covered, coated, or similarly masked with organic material.

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

User Notes: This indicator often occurs in prairie soils (Mollisols), but also applies to other soils that have dark-colored surface layers, such as umbric epipedons and dark-colored ochric epipedons (Figure 13). For soils that have dark surface layers greater than 12 in. (30 cm) thick, use indicator A12. Two percent or more distinct or prominent redox concentrations, including iron/manganese soft masses, pore linings, or both, are required in soils that have matrix values/chromas of 4/1, 4/2, and 5/2 (Figure A1). If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. Redox concentrations are not required for soils with matrix values of 5 or more and chroma of 1, or values of 6 or more and chromas of 2 or 1. The low-chroma matrix must be caused by wetness and not be a relict or parent material feature. See the Glossary (Appendix A) for definitions of depleted matrix, gleyed matrix, distinct and prominent features, and fragmental soil material.

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

This indicator is common at the boundary between wetlands and non-wetlands in Mollisols or other dark-colored soils.

Figure 13. In this soil, a depleted matrix starts immediately below the black surface layer at approximately 11 in. (28 cm).

Indicator A12: Thick Dark Surface

Technical Description: A layer at least 6 in. (15 cm) thick with a depleted or gleyed matrix that has 60 percent or more chroma of 2 or less starting below 12 in. (30 cm) of the surface. The layer(s) above the depleted or gleyed matrix must have a value of 2.5 or less and chroma of 1 or less to a depth of at least 12 in. (30 cm) and a value of 3 or less and chroma of 1 or less in any remaining layers above the depleted or gleyed matrix. Any sandy material above the depleted or gleyed matrix must have at least 70 percent of the visible soil particles covered, coated, or similarly masked with organic material.

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

User Notes: The soil has a depleted matrix or gleyed matrix below a black or very dark gray surface layer 12 in. (30 cm) or more thick (Figure 14). This indicator is most often associated with overthickened soils in concave landscape positions. Two percent or more distinct or prominent redox concentrations (Table A1), including iron/manganese soft masses, pore linings, or both, are required in soils that have matrix values/chromas of 4/1, 4/2, and 5/2 (Figure A1). If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. Redox concentrations are not required in soils with matrix values of 5 or more and chroma of 1, or values of 6 or more and chromas of 2 or 1. The low-chroma matrix must be caused by wetness and not be a relict or parent material feature. See the Glossary (Appendix A) for the definitions of depleted and gleyed matrix.

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

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

Figure 14. Deep observations may be necessary to identify the depleted or gleyed matrix below the dark surface layer.

Indicator A16: Coast Prairie Redox

Technical Description: A layer starting within 6 in. (15 cm) of the soil surface that is at least 4 in. (10 cm) thick and has a matrix chroma of 3 or less with 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings.

Applicable Subregions: Applicable to MLRA 150A of LRR T (Figure 15).

User Notes: These hydric soils occur mainly on depressional landforms and portions of the intermound landforms on the Lissie Formation. Redox concentrations occur mainly as iron-dominated pore linings. Two percent or more redox concentrations are required. If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. Chroma 3 matrices are allowed because they may be the color of stripped sand grains or because few to common sand-sized reddish chert particles occur and may prevent obtaining a chroma of 2 or less.

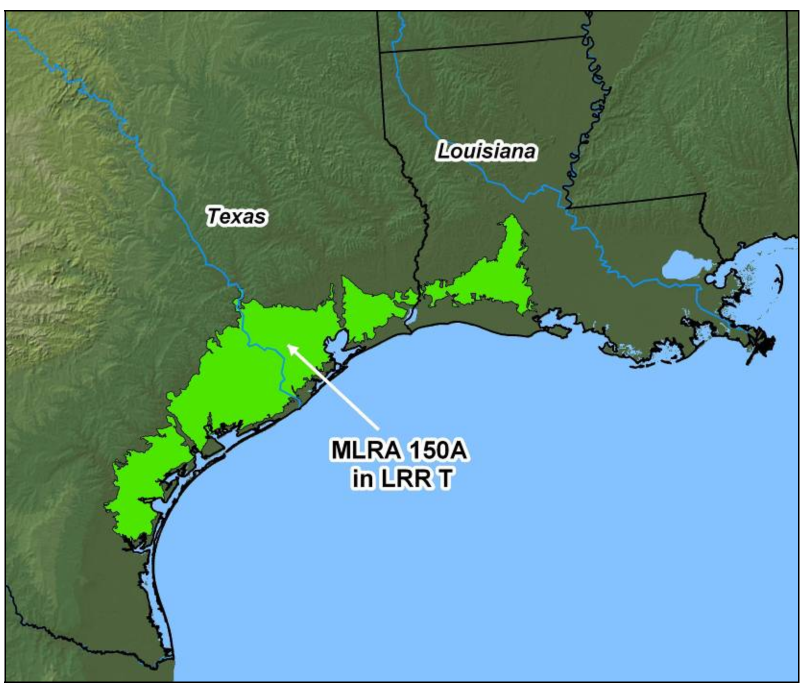

Figure 15. Location of MLRA 150A.

Sandy soils

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

Unless otherwise indicated (e.g., see indicator S6 – Stripped Matrix), all mineral layers above any of the indicators must have a dominant chroma of 2 or less, or the layer(s) with dominant chroma of more than 2 must be less than 6 in. (15 cm) thick to meet any hydric soil indicator. Nodules and concretions are not considered to be redox concentrations unless otherwise noted.

Indicator S1: Sandy Mucky Mineral

Technical Description: A layer of mucky modified sandy soil material 2 in. (5 cm) or more thick starting within 6 in. (15 cm) of the soil surface (Figure 16).

Applicable Subregions: Applicable to LRRs O and S.

User Notes: Use of this indicator may require assistance from a soil scientist with local experience. "Mucky" is a USDA texture modifier for mineral soils. The content of organic carbon is at least 5 percent and ranges to as high as 14 percent for sandy soils. The percentage requirement is dependent upon the clay content of the soil; the higher the clay content, the higher the organic carbon requirement. An example is mucky fine sand, which has at least 5 percent but not more than about 12 percent organic carbon. See the Concepts section of this chapter for field methods to identify organic soil materials.

Figure 16. This soil meets indicator S1 (Sandy Mucky Mineral). It also meets indicators S5 (Sandy Redox) and F2 (Loamy Gleyed Matrix). Photo by John Gagnon and John Kelley, NRCS.

Indicator S4: Sandy Gleyed Matrix

Technical Description: A gleyed matrix that occupies 60 percent or more of a layer starting within 6 in. (15 cm) of the soil surface (Figure 17).

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

User Notes: There is no thickness requirement for the gleyed layer in this indicator. Gley colors are not synonymous with gray colors. Gley colors are those colors that are on the gley pages (Gretag/Macbeth 2000). They have hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB, with a value of 4 or more. Soils with dark gley colors (value less than 4) do not meet the definition of a gleyed matrix and this indicator would not apply. If dark gley soil colors are present, users should consider indicators involving high organic-matter content (e.g., A1, A2, A3) or dark-surface indicators (e.g., A11, A12, F6). The gleyed matrix only needs to start within 6 in. (15 cm) of the surface. See the Glossary (Appendix A) for the definition of a gleyed matrix.

This indicator is most frequently found on floodplains that are saturated for significant periods. Therefore, it is generally not found at the boundary between wetlands and non-wetlands.

Figure 17. In this example, the gleyed matrix begins at the soil surface.

Indicator S5: Sandy Redox

Technical Description: A layer starting within 6 in. (15 cm) of the soil surface that is at least 4 in. (10 cm) thick and has a matrix with 60 percent or more chroma of 2 or less with 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings (Figure 18).

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

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

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

Figure 18. Redox concentrations (orange areas) in sandy soil material.

Indicator S6: Stripped Matrix

Technical Description: A layer starting within 6 in. (15 cm) of the soil surface in which iron/manganese oxides and/or organic matter have been stripped from the matrix and the primary base color of the soil material has been exposed. The stripped areas and translocated oxides and/or organic matter form a faint, diffuse splotchy pattern of two or more colors. The stripped zones are 10 percent or more of the volume; they are rounded and approximately 0.5 to 1 in. (1 to 3 cm) in diameter.

Figure 19. The layer stripped of organic matter begins beneath the dark surface layer (approximately 2 in. (5 cm)).

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

User Notes: Use of this indicator may require assistance from a soil scientist with local experience. This indicator includes the indicator previously named "polychromatic matrix" as well as the term streaking (Environmental Laboratory 1987). It requires common to many (USDA Natural Resources Conservation Service 2002) areas of stripped (uncoated) soil materials 0.5 to 1 in. (1 to 3 cm) in size, but they may be smaller (Figure 19). Commonly the splotches of color have a value of 5 or more and chroma of 1 and/or 2 (stripped) and chroma of 3 and/or 4 (unstripped). However, there are no specific color requirements for this indicator. The matrix may lack the 3 and/or 4 chroma material. The mobilization and translocation of the oxides and/or organic matter are the important processes involved in this indicator and should result in splotchy coated and uncoated soil areas. A 10-power hand lens can be helpful in seeing stripped and unstripped areas.

This is a very common indicator of hydric soils and is often used to identify the hydric/non-hydric soil boundary in sandy soils. This indicator is found in all wetland types and all wet landscape positions. It is often associated with depressions or swales within dune/swale complexes.

Indicator S7: Dark Surface

Technical Description: A layer 4 in. (10 cm) thick starting within 6 in. (15 cm) of the soil surface with a matrix value of 3 or less and chroma of 1 or less. At least 70 percent of the visible soil particles must be covered, coated, or similarly masked with organic material. The matrix color of the layer immediately below the dark layer must have the same colors as those described above or any color that has a chroma of 2 or less.

Figure 20. This sandy soil has a dark surface approximately 6 in. (15 cm) thick. Scale in inches on right.

Applicable Subregions: Applicable in LRRs P, S, T, and U.

User Notes: If the dark layer is greater than 4 in. (10 cm) thick, then the indicator is met, because any dark soil material in excess of 4 in. (10 cm) meets the requirement that "the layer immediately below the dark layer must have the same colors as those described above... ." If the dark layer is exactly 4 in. (10 cm) thick, then the material immediately below must have a matrix chroma of 2 or less. The organic carbon content of this indicator is slightly less than that required for "mucky." An undisturbed sample must be observed (Figure 20). A 10- or 15-power hand lens is an excellent tool to aid in this decision. Many moderately wet soils have a ratio of about 50 percent of soil particles covered or coated with organic matter to about 50 percent uncoated or uncovered soil particles, giving the soil a salt-and-pepper appearance. Where the percent coverage by organic matter is less than 70 percent, a Dark Surface indicator is not present.

Indicator S8: Polyvalue Below Surface

Technical Description: A layer with a value of 3 or less and chroma of 1 or less, starting within 6 in. (15 cm) of the soil surface, and underlain by a layer(s) in which translocated organic matter unevenly covers the soil material, forming a diffuse splotchy pattern. At least 70 percent of the visible soil particles in the upper layer must be covered, coated, or masked with organic material. Directly below this layer, the organic coating occupies 5 percent or more of the soil volume and has a value of 3 or less and chroma of 1 or less. The rest of the soil volume has a value of 4 or more and chroma of 1 or less to a depth of 12 in. (30 cm) or to the spodic horizon, whichever is less.

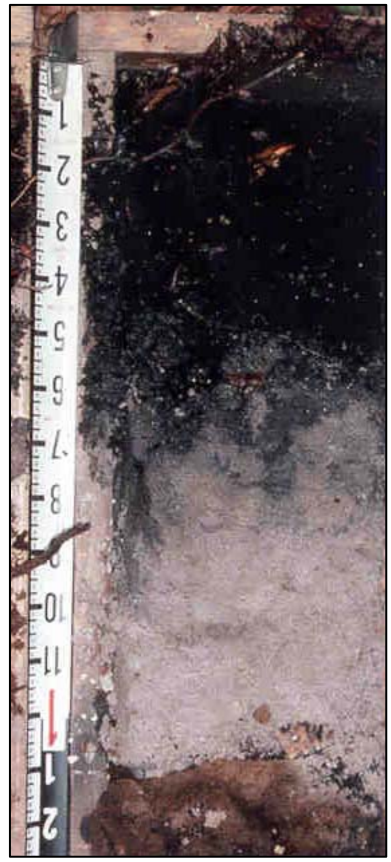

Figure 21. In this soil, the splotchy pattern below the dark surface is due to mobilization and translocation of organic matter. Scale in inches.

Applicable Subregions: Applicable to LRRs S, T, and U.

User Notes: This indicator applies to soils with a very dark gray or black surface or near-surface layer that is underlain by a layer in which organic matter has been differentially distributed within the soil by water movement (Figure 21). The mobilization and translocation of organic matter result in splotchy coated and uncoated soil areas, as described in the Sandy Redox (S5) and Stripped Matrix (S6) indicators, except that for S8 the whole soil is in shades of black and gray. The chroma of 1 or less is critical because it limits application of this indicator to only those soils that are depleted of iron. This indicator includes the indicator previously termed “streaking.”

Indicator S9: Thin Dark Surface

Figure 22. Example of the Thin Dark Surface indicator. Scale in inches.

Technical Description: A layer 2 in. (5 cm) or more thick starting within the upper 6 in. (15 cm) of the soil, with a value of 3 or less and chroma of 1 or less. At least 70 percent of the visible soil particles in this layer must be covered, coated, or masked with organic material. This layer is underlain by a layer(s) with a value of 4 or less and chroma of 1 or less to a depth of 12 in. (30 cm) or to the spodic horizon, whichever is less.

Applicable Subregions: Applicable to LRRs S, T, and U.

User Notes: This indicator applies to soils with a very dark gray or black near-surface layer that is at least 2 in. (5 cm) thick and is underlain by a layer in which organic matter has been carried downward by flowing water (Figure 22). The mobilization and translocation of organic matter result in an even distribution of organic matter in the eluvial (E) horizon. The chroma of 1 or less is critical because it limits application of this indicator to only those soils that are depleted of iron. This indicator commonly occurs in hydric Spodosols; however, a spodic horizon is not required.

Loamy and clayey soils

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

Unless otherwise indicated (e.g., see indicator F8 – Redox Depressions), all mineral layers above any of the indicators must have a dominant chroma of 2 or less, or the layer(s) with dominant chroma of more than 2 must be less than 6 in. (15 cm) thick to meet any hydric soil indicator.

Nodules and concretions are not considered to be redox concentrations unless otherwise noted.

Indicator F1: Loamy Mucky Mineral

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

Applicable Subregions: Applicable to LRR O.

User Notes: Use of this indicator may require assistance from a soil scientist with local experience. "Mucky" is a USDA texture modifier for mineral soils. The organic carbon is at least 8 percent, but can range up to 18 percent. The percentage requirement is dependent upon the clay content of the soil; the higher the clay content, the higher the organic carbon requirement. See the Concepts section of this chapter for guidance on identifying mucky mineral soil materials in the field; however, loamy mucky soil material is difficult to distinguish.

Indicator F2: Loamy Gleyed Matrix

Technical Description: A gleyed matrix that occupies 60 percent or more of a layer starting within 12 in. (30 cm) of the soil surface (Figure 23).

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

User Notes: There is no thickness requirement for this indicator. Gley colors are not synonymous with gray colors. Gley colors are those colors that are on the gley pages (Gretag/Macbeth 2000). They have hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB, with a value of 4 or more. Soils with dark gley colors (value less than 4) do not meet the definition of a gleyed matrix and this indicator would not apply. If dark gley soil colors are present, users should consider indicators for soils with high organic-matter content (e.g., A1, A2, A3) or those with dark surface layers (e.g., A11, A12, F6). The gleyed matrix only has to start within 12 in. (30 cm) of the surface. Soils with gleyed matrices are saturated for significant periods; therefore, no minimum thickness of gleyed layer is required. See the Glossary (Appendix A) for the definition of a gleyed matrix.

This indicator is found in soils that are inundated or saturated for nearly all of the growing season in most years; this indicator is not usually found at the boundary between wetlands and non-wetlands.

Figure 23. In this soil, a gleyed matrix begins immediately below the dark surface layer.

Indicator F3: Depleted Matrix

Technical Description: A layer with a depleted matrix that has 60 percent or more chroma of 2 or less and that has a minimum thickness of either:

- 2 in. (5 cm) if the 2 in. (5 cm) is entirely within the upper 6 in. (15 cm) of the soil, or
- 6 in. (15 cm) starting within 10 in. (25 cm) of the soil surface.

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

User Notes: This is one of the most commonly observed hydric soil indicators at wetland boundaries. Redox concentrations including iron/manganese soft masses or pore linings, or both, are required in soils with matrix values/chromas of 4/1, 4/2, and 5/2 (Figures 24 and 25). If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. Redox concentrations are not required in soils with matrix values of 5 or more and chroma of 1, or values of 6 or more and chromas of 2 or 1. The low-chroma matrix must be caused by wetness and not be a relict or parent material feature. See the Glossary (Appendix A) for the definition of a depleted matrix.

Figure 24. Indicator F3, Depleted Matrix. Redox concentrations are present within a low-chroma matrix.

Figure 25. Redox concentrations at 2 in. (5 cm)

Indicator F6: Redox Dark Surface

Technical Description: A layer that is at least 4 in. (10 cm) thick, is entirely within the upper 12 in. (30 cm) of the mineral soil, and has a:

- Matrix value of 3 or less and chroma of 1 or less and 2 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings, or
- Matrix value of 3 or less and chroma of 2 or less and 5 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings.

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

User Notes: This is a very common indicator used to delineate wetlands in soils with dark-colored surface layers. Redox concentrations in high organic-content mineral soils with dark surfaces are often small and difficult to see (Figure 26). The organic matter masks some or all of the concentrations that may be present. Careful examination is required to see what are often brownish redox concentrations in the darkened materials. If the soil is saturated at the time of sampling, it may be necessary to let it dry at least to a moist condition for redox features to become visible. In some cases, further drying of the samples makes the concentrations (if present) easier to see. A hand lens may be helpful in seeing and describing small redox concentrations. Care should be taken to examine the interior of soil peds for redox concentrations. Dry colors, if used, also must have matrix chromas of 1 or 2, and the redox concentrations must be distinct or prominent (see Glossary, Appendix A).

In soils that are wet because of subsurface saturation, the layer immediately below the dark epipedon will likely have a depleted or gleyed matrix (see the Glossary for definitions). Soils that are wet because of ponding or have a shallow, perched layer of saturation may not always have a depleted/gleyed matrix below the dark surface. It is recommended that delineators evaluate the hydrologic source and examine and describe the layer below the dark-colored epipedon when applying this indicator.

Figure 26. Redox features can be small and difficult to see within a dark soil layer.

Indicator F7: Depleted Dark Surface

Technical Description: Redox depletions with a value of 5 or more and chroma of 2 or less in a layer that is at least 4 in. (10 cm) thick, is entirely within the upper 12 in. (30 cm) of the mineral soil (Figure 27), and has a:

- Matrix value of 3 or less and chroma of 1 or less and 10 percent or more redox depletions, or
- Matrix value of 3 or less and chroma of 2 or less and 20 percent or more redox depletions.

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

User Notes: Care should be taken not to mistake the mixing of eluvial layers that have high value and low chroma (E horizon) or illuvial layers that have accumulated carbonates (calcic horizon) into the surface layer as depletions. Mixing of layers can be caused by burrowing animals or cultivation. Pieces of deeper layers that become incorporated into the surface layer are not redox depletions. Knowledge of local conditions is required in areas where light-colored eluvial layers and/or layers high in carbonates may be present. Redox depletions will usually have associated microsites with redox concentrations that occur as pore linings or masses within the depletion(s) or surrounding the depletion(s). In soils that are wet because of subsurface saturation, the layer immediately below the dark surface is likely to have a depleted or gleyed matrix.

Figure 27. Redox depletions (lighter colored areas) are scattered within the darker matrix. Scale is in centimeters.

Indicator F8: Redox Depressions

Technical Description: In closed depressions subject to ponding, 5 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings in a layer that is 2 in. (5 cm) or more thick and is entirely within the upper 6 in. (15 cm) of the soil.

Applicable Subregions: Applicable throughout the Atlantic and Gulf Coastal Plain Region.

User Notes: This indicator occurs on depressional landforms, such as forested depressions and ephemeral pools (Figure 28); but not microdepressions on convex landscapes. Closed depressions often occur within flats or floodplain landscapes. *Note that there is no color* *requirement for the soil matrix*. The layer containing redox concentrations may extend below 6 in. (15 cm) as long as at least 2 in. (5 cm) occurs within 6 in. (15 cm) of the surface. If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. See the Glossary for definitions of distinct and prominent.

This is a common, but often overlooked indicator at the wetland/non-wetland boundary of depressional sites.

Figure 28. In this example, the layer of redox concentrations begins at the soil surface and is slightly more than 2 in. (5 cm) thick.

Indicator F10: Marl

Technical Description: A layer of marl with a value of 5 or more starting within 4 in. (10 cm) of the soil surface (Figure 29).

Applicable Subregion: Applicable to LRR U.

User Notes: There is no thickness requirement for this indicator. Marl usually occurs directly over limestone. Marl is a limnic material deposited in water by precipitation of $CaCO_3$ by algae as defined in Soil Taxonomy (USDA Natural Resources Conservation Service 1999). It has a Munsell value of 5 or more and reacts with dilute HCl to evolve CO_2. Marl is not the carbonatic substrate material associated with limestone bedrock. Some soils have materials with all of the properties of marl, except for the required Munsell value. These soils are hydric if the required value is present within 4 in. (10 cm) of the soil surface. Normally, this indicator occurs at the soil surface.

Marl is typically found on flats associated with portions of the Everglades in Dade and Collier Counties, Florida, that are normally inundated for 1 to 9 months of the year, or on tidal fringes in Broward, Collier, Dade, Indian River, and Monroe Counties that are inundated regularly by tides. Areas that are usually inundated all year will accumulate organic matter and will have an indicator that reflects organic-matter accumulation (e. g., A1, A2, A3, A5, A7, or A8).

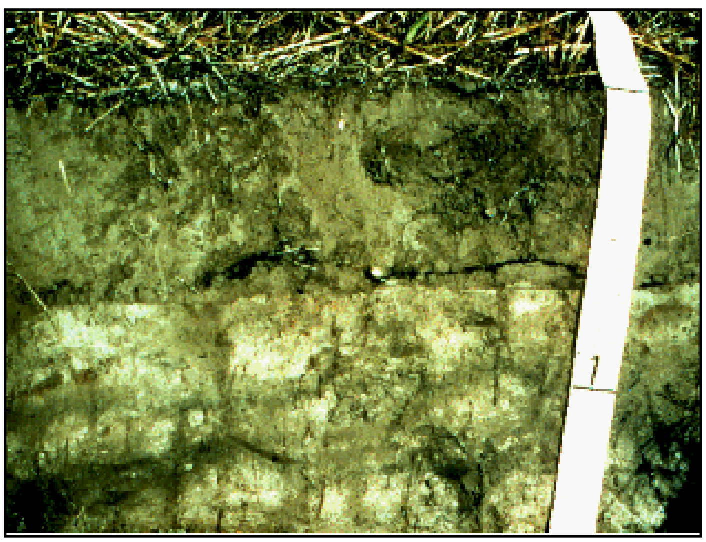

Figure 29. In this example, marl begins at the soil surface and is approximately 1.5 ft (45 cm) thick. Scale is in feet.

Indicator F11: Depleted Ochric

Technical Description: A layer(s) 4 in. (10 cm) or more thick in which 60 percent or more of the matrix has a value of 4 or more and chroma of 1 or less. The layer is entirely within the upper 10 in. (25 cm) of the soil.

Applicable Subregions: Applicable to MLRA 151 of LRR T (Figure 30).

User Notes: This indicator is applicable in accreting deltaic areas along the Mississippi River.

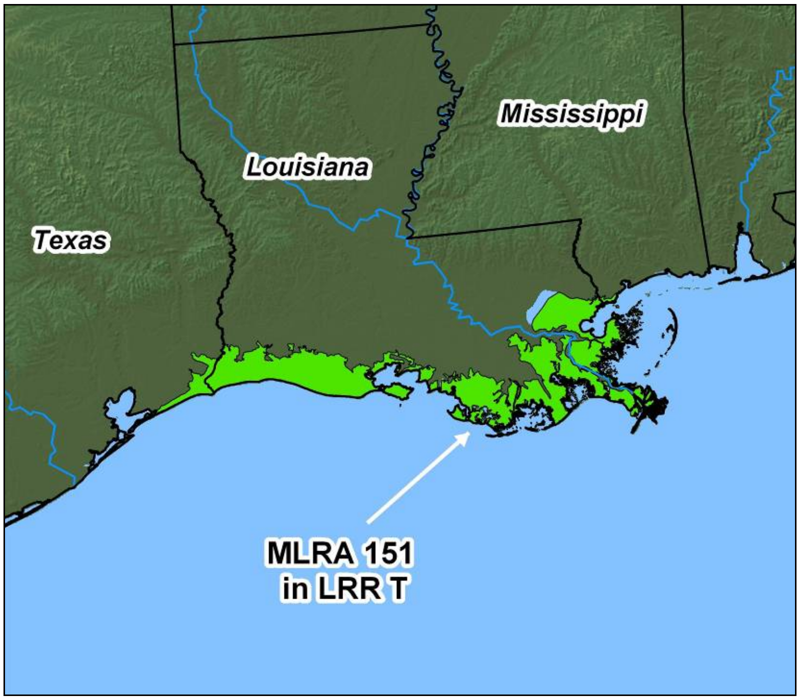

Figure 30. Location of MLRA 151 in LRR T.

Indicator F12: Iron-Manganese Masses

Technical Description: On floodplains, a layer 4 in. (10 cm) or more thick with 40 percent or more chroma of 2 or less and 2 percent or more distinct or prominent redox concentrations occurring as soft iron/manganese masses with diffuse boundaries. The layer occurs entirely within 12 in. (30 cm) of the soil surface. Iron-manganese masses have a value and chroma of 3 or less. Most commonly, they are black. The thickness requirement is waived if the layer is the mineral surface layer.

Applicable Subregions: Applicable to LRRs O, P, and T.

User Notes: These iron-manganese masses generally are small (2 to 5 mm in size) and have value and chroma of 3 or less. They can be dominated by manganese and, therefore, have a color approaching black (Figure 31). If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. The low matrix chroma must be the result of wetness and not be a relict or parent material feature. Iron-manganese masses should not be confused with the larger and redder iron nodules associated with plinthite or with concretions that have sharp boundaries. This indicator occurs on floodplains along rivers, such as the Apalachicola, Congaree, Mobile, Savannah, and Tennessee Rivers.

Figure 31. Iron-manganese masses (black spots) in a 40-percent depleted matrix. Scale is in inches.

Indicator F13: Umbric Surface

Technical Description: In depressions and other concave landforms, a layer 10 in. (25 cm) or more thick starting within 6 in. (15 cm) of the soil surface in which the upper 6 in. (15 cm) has a value of 3 or less and chroma of 1 or less and in which the lower 4 in. (10 cm) has the same colors as those described above or any other color that has a chroma of 2 or less (Figure 32).

Applicable Subregions: Applicable to LRRs P, T, and U.

User Notes: The thickness requirements may be slightly less than those for an umbric epipedon. Microlows are not considered to be concave landforms. Umbric surfaces in the higher landscape positions, such as side slopes, are excluded. This indicator is often seen in the interiors of Grady ponds, pocosins, Carolina bays, and Delmarva bays.

Figure 32. This umbric surface is approximately 12 in. (30 cm) thick. Scale is in inches.

Indicator F17: Delta Ochric

Technical Description: A layer 4 in. (10 cm) or more thick in which 60 percent or more of the matrix has a value of 4 or more and chroma of 2 or less and there are no redox concentrations. This layer occurs entirely within the upper 12 in. (30 cm) of the soil.

Applicable Subregion: Applicable to MLRA 151 of LRR T.

User Notes: This indicator is applicable only in accreting areas of the Mississippi River Delta. See Figure 30 for the location of MLRA 151.

Indicator F18: Reduced Vertic

Technical Description: In Vertisols and Vertic intergrades, a positive reaction to alpha, alpha-dipyridyl that:

a. Is the dominant (60 percent or more) condition of a layer at least 4 in. (10 cm) thick within the upper 12 in. (30 cm) (or at least 2 in. (5 cm) thick within the upper 6 in. (15 cm)) of the mineral or muck soil surface,
b. Occurs for at least 7 continuous days and 28 cumulative days, and
c. Occurs during a normal (within 16 to 84 percent of probable precipitation) or drier season and month.

Applicable Subregions: For use in MLRAs 150A and 150B of LRR T (Figure 33) or problem soils in areas containing Vertisols and Vertic intergrades.

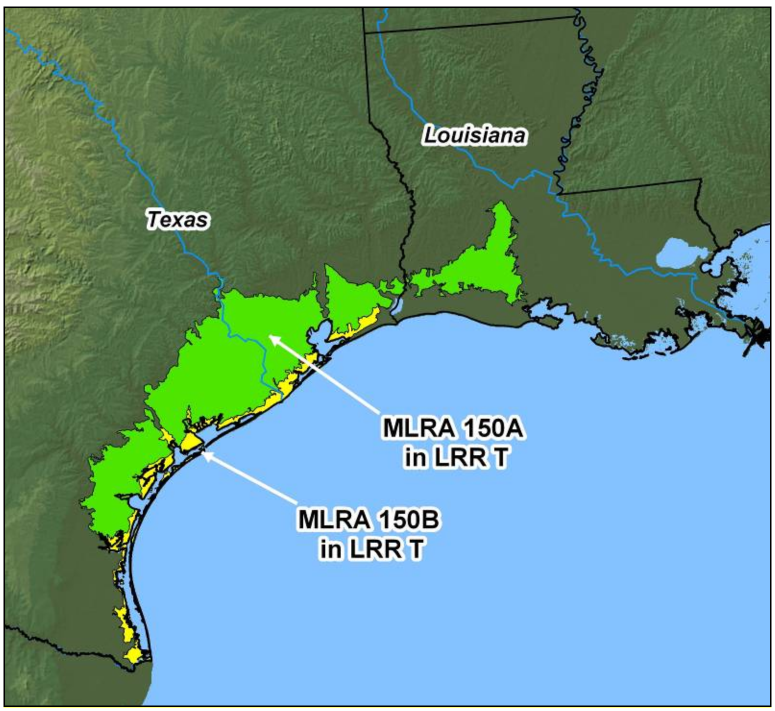

Figure 33. Location of MLRAs 150A and 150B.

User Notes: The time requirements for this indicator were identified from research in MLRA 150A in LRR T (Gulf Coastal Prairies); these or slightly modified time requirements may be found to identify wetland Vertisols and Vertic intergrades in other parts of the nation. These soils usually have thick dark surface horizons but indicators A11, A12, and F6 are often lacking, possibly due to masking of redoximorphic features by organic carbon. Follow the procedures and note the considerations in Hydric Soil Technical Note 8 (http://soils.usda.gov/use/hydric/ntchs/tech_notes/index.html).

Indicator F19: Piedmont Floodplain Soils

Technical Description: On active floodplains, a mineral layer at least 6 in. (15 cm) thick starting within 10 in. (25 cm) of the soil surface with a matrix (60 percent or more of the volume) chroma of less than 4 and 20 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings.

Applicable Subregions: For use in MLRA 149A of LRR S (Figure 34), or problem soils on floodplains subject to Piedmont deposition throughout LRRs P, S, and T.

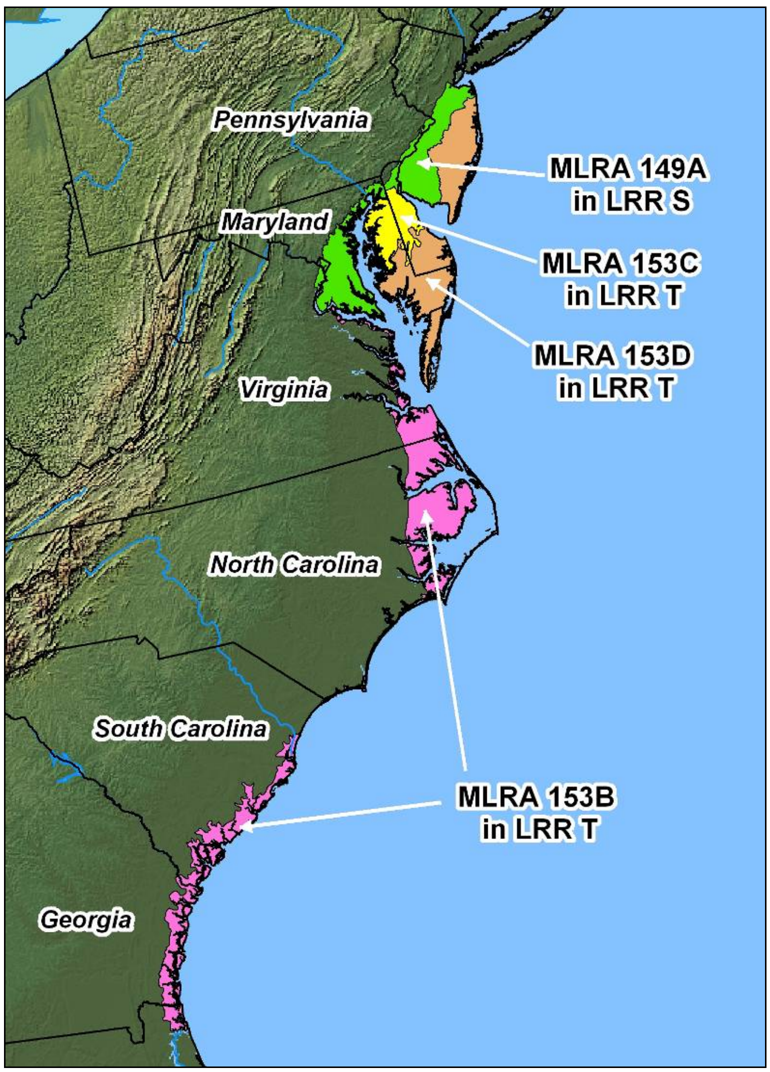

Figure 34. Locations of MLRAs 149A, 153B, 153C, and 153D. Indicator F19 is applicable only in MLRA 149A.

User Notes: This indicator is for use or testing in soils on active floodplains in the Mid-Atlantic and Southern Piedmont provinces and in areas where sediments derived from the Piedmont are being deposited on floodplains on the Coastal Plain (Figure 35). If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible.

Figure 35. This indicator is restricted to floodplains that are actively receiving sediments. Photo by M. Rabenhorst. Scale in 4-in. (10-cm) increments.

Indicator F20: Anomalous Bright Loamy Soils

Technical Description: Within 656 ft (200 m) of estuarine marshes or waters and within 3.28 ft (1 m) of mean high water, a mineral layer at least 4 in. (10 cm) thick starting within 8 in. (20 cm) of the soil surface, with a matrix (60 percent or more of the volume) chroma of less than 5 and 10 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings and/or depletions.

Applicable Subregions: Applicable to MLRAs 149A of LRR S, and 153C and 153D of LRR T; also applicable to problem soils in MLRA 153B of LRR T (Figure 34).

User Notes: These soils usually occur on linear or convex landforms that are adjacent to estuarine marshes or waters (Figure 36).

Figure 36. The Anomalous Bright Loamy Soils indicator is found exclusively near estuarine marshes or waters. Photo by M. Rabenhorst. Scale in 4-in. (10-cm) increments.

Hydric soil indicators for problem soils

The following indicators are not currently recognized for general application by the NTCHS, or they are not recognized in the specified geographic area. However, these indicators may be used in problem wetland situations in the Atlantic and Gulf Coastal Plain Region where there is evidence of wetland hydrology and hydrophytic vegetation, and the soil is believed to meet the definition of a hydric soil despite the lack of other indicators of a hydric soil. To use these indicators, follow the procedure described in the section on Problematic Hydric Soils in Chapter 5. If any of the following indicators is observed, it is recommended that the NTCHS be notified by following the protocol described in the "Comment on the Indicators" section of *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service 2006b).

Indicator A10: 2 cm Muck

Technical Description: A layer of muck 0.75 in. (2 cm) or more thick with value of 3 or less and chroma of 1 or less, starting within 6 in. (15 cm) of the soil surface.

Applicable Subregions: For use with problem soils in LRR S.

User Notes: Normally the muck layer is at the soil surface; however, it may occur at any depth within 6 in. (15 cm) of the surface. Muck is sapric soil material with at least 12 to 18 percent organic carbon. Organic soil material is called muck (sapric soil material) if virtually all of the material has undergone sufficient decomposition to limit recognition of the plant parts. Hemic (mucky peat) and fibric (peat) soil materials do not qualify. To determine if muck is present, first remove loose leaves, needles, bark, and other easily identified plant remains. This is sometimes called leaf litter, a duff layer, or a leaf or root mat. Then examine for decomposed organic soil material. Generally, muck is black and has a greasy feel; sand grains should not be evident (see the Concepts section of this chapter for field methods to identify organic soil materials). Determination of this indicator is made below the leaf or root mat; however, root mats that meet the definition of hemic or fibric soil material are included in the decision-making process for indicators A1 (Histosol) and A2 (Histic Epipedon).

Indicator TF2: Red Parent Material

Technical Description: In parent material with a hue of 7.5YR or redder, a layer at least 4 in. (10 cm) thick with a matrix value and chroma of 4 or less and 2 percent or more redox depletions and/or redox concentrations occurring as soft masses and/or pore linings. The layer is entirely within 12 in. (30 cm) of the soil surface. The minimum thickness requirement is 2 in. (5 cm) if the layer is the mineral surface layer.

Applicable Subregions: For use with problem soils throughout the Atlantic and Gulf Coastal Plain Region in areas containing soils derived from red parent materials.

User Notes: Redox features most noticeable in red material include redox depletions and soft manganese masses that are black or dark reddish black. If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. This indicator is most commonly found in Arkansas, Louisiana, North Carolina, Oklahoma, and Texas. Users of this indicator should document the probable source of red parent materials found on the site.

Indicator TF12: Very Shallow Dark Surface

Technical Description: In depressions and other concave landforms, one of the following:

a. If bedrock occurs between 6 in. (15 cm) and 10 in. (25 cm), a layer at least 6 in. (15 cm) thick starting within 4 in. (10 cm) of the soil surface with a value of 3 or less and chroma of 1 or less, and the remaining soil to bedrock must have the same colors as above or any other color that has a chroma of 2 or less.
b. If bedrock occurs within 6 in. (15 cm), more than half of the soil thickness must have a value of 3 or less and a chroma of 1 or less, and the remaining soil to bedrock must have the same colors as above or any other color that has a chroma of 2 or less.

Applicable Subregions: For use with problem soils in LRRs T and U.

4 Wetland Hydrology Indicators

Introduction

Wetland hydrology indicators are used in combination with indicators of hydric soil and hydrophytic vegetation to determine whether an area is a wetland under the Corps Manual. Indicators of hydrophytic vegetation and hydric soil generally reflect a site's medium- to long-term wetness history. They provide readily observable evidence that episodes of inundation or soil saturation lasting more than a few days during the growing season have occurred repeatedly over a period of years and that the timing, duration, and frequency of wet conditions have been sufficient to produce a characteristic wetland plant community and hydric soil morphology. If hydrology has not been altered, vegetation and soils provide strong evidence that wetland hydrology is present (National Research Council 1995). Wetland hydrology indicators provide evidence that the site has a *continuing* wetland hydrologic regime and that hydric soils and hydrophytic vegetation are not relicts of a past hydrologic regime. Wetland hydrology indicators confirm that an episode of inundation or soil saturation occurred recently, but may provide little additional information about the timing, duration, or frequency of such events (National Research Council 1995).

Hydrology indicators are often the most transitory of wetland indicators. Some hydrology indicators are naturally temporary or seasonal, and many are affected by recent or long-term meteorological conditions. For example, indicators involving direct observation of surface water or saturated soils often are present only during the normal wet portion of the growing season and may be absent during the dry season or during drier-than-normal years. Hydrology indicators also may be subject to disturbance or destruction by natural processes or human activities. Most wetlands in the Atlantic and Gulf Coastal Plain Region will exhibit one or more of the hydrology indicators presented in this chapter. However, some wetlands may lack any of these indicators due to temporarily dry conditions, disturbance, or other factors. Therefore, the lack of an indicator is not evidence for the absence of wetland hydrology. See Chapter 5 (Difficult Wetland Situations in the Atlantic and Gulf Coastal Plain Region) for help in identifying wetlands that may lack wetland hydrology indicators at certain times.

The coastal plain has a humid climate with relatively abundant rainfall during normal years. The area is also affected by occasional tropical storms that can produce very heavy downpours. Some wetland hydrology indicators may be present on non-wetland sites immediately after a heavy rain or during periods of unusually high precipitation, river stages, tides, reservoir releases, or runoff. Therefore, it is important to take weather and climatic conditions prior to the site visit into account to minimize both false-positive and false-negative wetland hydrology decisions. An understanding of normal seasonal and annual variations in rainfall, temperature, and other climatic conditions is important in interpreting hydrology indicators in the region. Some useful sources of climatic data are described in Chapter 5.

Areas that have hydrophytic vegetation and hydric soils generally also have wetland hydrology unless the hydrologic regime has changed due to natural events or human activities (National Research Council 1995). Therefore, when wetland hydrology indicators are absent from an area that has indicators of hydric soil and hydrophytic vegetation, further information may be needed to determine whether or not wetland hydrology is present. If possible, one or more site visits should be scheduled to coincide with the normal wet portion of the growing season, the period of the year when the presence or absence of wetland hydrology indicators is most likely to reflect the true wetland/non-wetland status of the site. In addition, aerial photography or other remote-sensing data, stream gauge data, runoff estimates, scope-and-effect equations for ditches and subsurface drainage systems, or groundwater modeling are tools that may help to determine whether wetland hydrology is present when indicators are equivocal or lacking (e.g., USDA Natural Resources Conservation Service 1997). Off-site procedures developed under the National Food Security Act Manual (USDA Natural Resources Conservation Service 1994), which use wetland mapping conventions developed by NRCS state offices, can help identify areas that have wetland hydrology on agricultural lands. The technique is based on wetness signatures visible on standard high-altitude aerial photographs or on annual crop-compliance slides taken by the USDA Farm Service Agency. Finally, on highly disturbed or problematic sites, direct hydrologic monitoring may be undertaken to determine whether wetland hydrology is present. The U. S. Army Corps of Engineers (2005) provides a technical standard for monitoring hydrology on such sites. This standard requires 14 or more consecutive days of flooding or ponding, or a water table 12 in.

(30 cm) or less below the soil surface, during the growing season at a minimum frequency of 5 years in 10 (50 percent or higher probability) (National Research Council 1995) unless an alternative standard has been established for a particular region or wetland type. See Chapter 5 for further information on these techniques.

Growing season

Beginning and ending dates of the growing season may be needed to evaluate certain wetland indicators, such as visual observations of flooding, ponding, or shallow water tables on potential wetland sites. In addition, growing season dates are needed in the event that recorded hydrologic data, such as stream gauge or water-table monitoring data, must be analyzed to determine whether wetland hydrology is present on highly disturbed or problematic sites.

Depletion of oxygen and the chemical reduction of nitrogen, iron, and other elements in saturated soils during the growing season is the result of biological activity occurring in plant roots and soil microbial populations (National Research Council 1995). Two indicators of biological activity that are readily observable in the field are (1) above-ground growth and development of vascular plants, and (2) soil temperature. Therefore, if information about the growing season is needed and on-site data gathering is practical, the following approaches should be used in this region to determine growing season dates in a given year. The growing season has begun and is ongoing if either of these conditions is met.

1. The growing season has begun on a site in a given year when two or more different non-evergreen vascular plant species growing in the wetland or surrounding areas exhibit one or more of the following indicators of biological activity:

    a. Emergence of herbaceous plants from the ground
    b. Appearance of new growth from vegetative crowns (e.g., in graminoids, bulbs, and corms)
    c. Coleoptile/cotyledon emergence from seed
    d. Bud burst on woody plants (i.e., some green foliage is visible between spreading bud scales)
    e. Emergence or elongation of leaves of woody plants
    f. Emergence or opening of flowers

The end of the growing season is indicated when woody deciduous species lose their leaves and/or the last herbaceous plants cease flowering and their leaves become dry or brown, generally in the fall due to cold temperatures or reduced moisture availability. Early plant senescence due to the initiation of the summer dry season in some areas does not necessarily indicate the end of the growing season and alternative procedures (e.g., soil temperature) should be used.

This determination should not include evergreen species. Observations should be made in the wetland or in surrounding areas subject to the same climatic conditions (e.g., similar elevation and aspect); however, soil moisture conditions may differ. Supporting data should be reported on the data form, in field notes, or in the delineation report, and should include the species observed (if identifiable), their abundance and location relative to the potential wetland, and the type of biological activity observed. A one-time observation of biological activity during a single site visit is sufficient, but is not required unless growing season information is necessary to evaluate particular wetland hydrology indicators. However, if long-term hydrologic monitoring is planned, then plant growth, maintenance, and senescence should be monitored for continuity over the same period.

2. The growing season has begun in spring, and is still in progress, when soil temperature measured at the 12-in. (30-cm) depth is 41 °F (5 °C) or higher. A one-time temperature measurement during a single site visit is sufficient, but is not required unless growing season information is necessary to evaluate particular wetland hydrology indicators. However, if long-term hydrologic monitoring is planned, then soil temperature should also be monitored to ensure that it remains continuously at or above 41 °F during the monitoring period. Soil temperature can be measured directly in the field by inserting a soil thermometer into the wall of a freshly dug soil pit.

   There is evidence that soil temperatures are above 41 °F (5 °C) and soil microbial communities are active throughout the year in some portions of the coastal plain region – for example, in bottomland hardwood forests in parts of Louisiana, Mississippi, and South Carolina (Megonigal et al. 1996), in a freshwater tidal wetland along the James River in Virginia (Seybold et al. 2002), in Virginia's Great Dismal Swamp (Burdt et al. 2005), and in the Texas Gulf Coast Prairie (Miller and Bragg 2007). In these areas, the growing season is essentially year-round or 365 days long. These results may apply to most areas in the region that are near the ocean, but it is not clear how far inland year-round growing seasons occur or how much year-to-year variability exists.

If the timing of the growing season based on vegetation growth and development and/or soil temperature is unknown and on-site data collection is not practical, such as when analyzing previously recorded stream-gauge or monitoring-well data, then growing season dates may be approximated by the median dates (i.e., 5 years in 10, or 50 percent probability) of 28 °F (−2.2 °C) air temperatures in spring and fall, based on long-term records gathered at National Weather Service meteorological stations (U.S. Army Corps of Engineers 2005). These dates are reported in WETS tables available from the NRCS National Water and Climate Center (http://www.wcc.nrcs.usda.gov/climate/wetlands.html) for the nearest appropriate weather station.

Wetland hydrology indicators

In this chapter, wetland hydrology indicators are presented in four groups. Indicators in Group A are based on the direct observation of surface water or groundwater during a site visit. Group B consists of evidence that the site is subject to flooding or ponding, although it may not be inundated currently. These indicators include water marks, drift deposits, sediment deposits, and similar features. Group C consists of other evidence that the soil is saturated currently or was saturated recently. Some of these indicators, such as oxidized rhizospheres surrounding living roots and the presence of reduced iron or sulfur in the soil profile, indicate that the soil has been saturated for an extended period. Group D consists of landscape, vegetation, and soil features that indicate contemporary rather than historical wet conditions. Wetland hydrology indicators are intended as one-time observations of site conditions that are sufficient evidence of wetland hydrology in areas where hydric soils and hydrophytic vegetation are present. Unless otherwise noted, all indicators are applicable throughout the Atlantic and Gulf Coastal Plain Region.

Within each group, indicators are divided into two categories – *primary* and *secondary* – based on their estimated reliability in this region. One primary indicator from any group is sufficient to conclude that wetland hydrology is present; the area is a wetland if indicators of hydric soil and hydrophytic vegetation are also present. In the absence of a primary indicator, two or more secondary indicators from any group are required to conclude that wetland hydrology is present. Indicators of wetland hydrology include, but are not necessarily limited to, those listed in Table 10 and described on the following pages. Other evidence of wetland hydrology may also be used with appropriate documentation.

Table 10. Wetland hydrology indicators for the Atlantic and Gulf Coastal Plain Region.

Indicator	Category	
	Primary	Secondary
Group A – Observation of Surface Water or Saturated Soils		
A1 – Surface water	X	
A2 – High water table	X	
A3 – Saturation	X	
Group B – Evidence of Recent Inundation		
B1 – Water marks	X	
B2 – Sediment deposits	X	
B3 – Drift deposits	X	
B4 – Algal mat or crust	X	
B5 – Iron deposits	X	
B7 – Inundation visible on aerial imagery	X	
B9 – Water-stained leaves	X	
B13 – Aquatic fauna	X	
B15 – Marl deposits	X (LRR U)	
B6 – Surface soil cracks		X
B8 – Sparsely vegetated concave surface		X
B10 – Drainage patterns		X
B16 – Moss trim lines		X
Group C – Evidence of Current or Recent Soil Saturation		
C1 – Hydrogen sulfide odor	X	
C3 – Oxidized rhizospheres along living roots	X	
C4 – Presence of reduced iron	X	
C6 – Recent iron reduction in tilled soils	X	
C7 – Thin muck surface	X	
C2 – Dry-season water table		X
C8 – Crayfish burrows		X
C9 – Saturation visible on aerial imagery		X
Group D – Evidence from Other Site Conditions or Data		
D2 – Geomorphic position		X
D3 – Shallow aquitard		X
D5 – FAC-neutral test		X

Group A – Observation of surface water or saturated soils

Indicator A1: Surface water

Category: Primary

General Description: This indicator consists of the direct, visual observation of surface water (flooding or ponding) during a site visit (Figure 37).

Cautions and User Notes: Care must be used in applying this indicator because surface water may be present in non-wetland areas immediately after a rainfall event or during periods of unusually high precipitation, runoff, tides, or river stages. Furthermore, some non-wetlands flood frequently for brief periods. Surface water observed during the non-growing season may be an acceptable indicator if experience and professional judgment suggest that wet conditions normally extend into the growing season for sufficient duration in most years. If this is questionable and other hydrology indicators are absent, a follow-up visit during the growing season may be needed. Note that surface water may be absent from a wetland during the normal dry season or during extended periods of drought. Even under normal rainfall conditions, some wetlands do not become inundated or saturated every year (i.e., wetlands are inundated or saturated at least 5 out of 10 years, or 50 percent or higher probability). In addition, groundwater-dominated wetland systems may never or rarely contain surface water. Use caution in areas with functioning ditches and/or subsurface drains that may remove surface water quickly.

Figure 37. Wetland with surface water present.

Indicator A2: High water table

Category: Primary

General Description: This indicator consists of the direct, visual observation of the water table 12 in. (30 cm) or less below the surface in a soil pit, auger hole, or shallow monitoring well (Figure 38). This indicator includes water tables derived from perched water, throughflow, and discharging groundwater (e.g., in seeps) that may be moving laterally near the soil surface.

Cautions and User Notes: Sufficient time must be allowed for water to infiltrate into a newly dug hole and to stabilize at the water-table level. The required time will vary depending upon soil texture. In some cases, the water table can be determined by examining the wall of the soil pit and identifying the upper level at which water is seeping into the pit. A water table within 12 in. of the surface observed during the non-growing season may be an acceptable indicator if experience and professional judgment suggest that wet conditions normally extend into the growing season for sufficient duration in most years. If this is questionable and other hydrology indicators are absent, a follow-up visit during the growing season may be needed. Care must be used in interpreting this indicator because water-table levels normally vary seasonally and are a function of both recent and long-term precipitation. Even under normal rainfall conditions, some wetlands do not become inundated or saturated every year (i.e., wetlands are inundated or saturated at least 5 out of 10 years, or 50 percent or higher probability). For an accurate determination of the water-table level, the soil pit, auger hole, or well should not penetrate any restrictive soil layer capable of perching water near the surface. Use caution in areas with functioning ditches and/or subsurface drains that may improve soil drainage and reduce the duration of episodes of high water tables.

Figure 38. High water table observed in a soil pit.

Indicator A3: Saturation

Category: Primary

General Description: Visual observation of saturated soil conditions 12 in. (30 cm) or less from the soil surface as indicated by water glistening on the surfaces and broken interior faces of soil samples removed from the pit or auger hole (Figure 39). This indicator must be associated with an existing water table located immediately below the saturated zone; however, this requirement is waived under episaturated conditions if there is a restrictive soil layer or bedrock within 12 in. (30 cm) of the surface.

Cautions and User Notes: Glistening is evidence that the soil sample was taken either below the water table or within the saturated capillary fringe above the water table. Recent rainfall events and the proximity of the water table at the time of sampling must be considered in applying and interpreting this indicator. Water observed in soil cracks or on the faces of soil aggregates (peds) does not meet this indicator unless ped interiors are also saturated. Depth to the water table must be recorded on the data form or in field notes. A water table is not required below the saturated zone under episaturated conditions if the restrictive layer or bedrock is present within 12 in. (30 cm) of the surface. Note the restrictive layer in the soils section of the data form. The restrictive layer may be at the surface. Use caution in areas with functioning ditches and/or subsurface drains.

Figure 39. Water glistens on the surface of a saturated soil sample.

Group B – Evidence of recent inundation

Indicator B1: Water marks

Category: Primary

General Description: Water marks are discolorations or stains on the bark of woody vegetation, rocks, bridge supports, buildings, fences, or other fixed objects as a result of inundation (Figure 40).

Cautions and User Notes: When several water marks are present on an object, the highest reflects the maximum extent of inundation. Water marks indicate a water-level elevation and can be extrapolated from nearby objects across lower elevation areas. Water marks on different trees or other objects should form a level plane that can be viewed from one object to another. Use caution with water marks that may have been caused by extreme, infrequent, or very brief flooding events, or by flooding that occurred outside the growing season. Along streams subject to severe downcutting in recent years, water marks may reflect historic rather than contemporary flooding levels.

Figure 40. Water marks (dark stains) on trees in a seasonally flooded wetland. The top of one water mark is indicated by the arrow.

Indicator B2: Sediment deposits

Category: Primary

General Description: Sediment deposits are thin layers or coatings of fine-grained mineral material (e.g., silt or clay) or organic matter (e.g., pollen), sometimes mixed with other detritus, remaining on tree bark (Figure 41), plant stems or leaves, rocks, and other objects after surface water recedes.

Cautions and User Notes: Sediment deposits most often occur in riverine backwater and ponded situations where water has stood for sufficient time to allow suspended sediment to settle. Sediment deposits may remain for a considerable period before being removed by precipitation or subsequent inundation. Sediment deposits on vegetation or other objects indicate the minimum inundation level. This level can be extrapolated across lower elevation areas. Use caution with sediment left after infrequent high flows or very brief flooding events. This indicator does not include thick accumulations of sand or gravel in fluvial channels that may reflect historic flow conditions or recent extreme events.

Figure 41. Silt deposit left after a recent high-water event forms a tan coating on these tree trunks (upper edge indicated by the arrow).

Indicator B3: Drift deposits

Category: Primary

General Description: Drift deposits consist of rafted debris that has been deposited on the ground surface or entangled in vegetation or other fixed objects. Debris consists of remnants of vegetation (e.g., branches, stems, and leaves), man-made litter, or other waterborne materials. Drift material may be deposited at or near the high water line in ponded or flooded areas, piled against the upstream side of trees, rocks, and other fixed objects (Figure 42), or widely distributed within the dewatered area.

Cautions and User Notes: Deposits of drift material are often found adjacent to streams or other sources of flowing water in wetlands. They also occur in tidal marshes, along lake shores, and in other ponded areas. The elevation of a drift line can be extrapolated across lower elevation areas. Use caution with drift lines that may have been caused by extreme, infrequent, or very brief flooding events, and in areas with functioning drainage systems capable of removing excess water quickly.

Figure 42. Drift deposit in a floodplain wetland.

Indicator B4: Algal mat or crust

Category: Primary

General Description: This indicator consists of a mat or dried crust of algae, perhaps mixed with other detritus, left on or near the soil surface after dewatering.

Cautions and User Notes: Algal deposits include those produced by green algae (Chlorophyta) and blue-green algae (cyanobacteria). They may be attached to low vegetation or other fixed objects, or may cover the soil surface (Figure 43). Dried crusts of blue-green algae may crack and curl at plate margins (Figure 44). Algal deposits are usually seen in seasonally ponded areas, lake fringes, and low-gradient stream margins. They reflect prolonged wet conditions sufficient for algal growth and development.

Figure 43. Dried algal crust in a forested wetland.

Figure 44. Close-up of crust of blue-green algae on the soil surface.

Indicator B5: Iron deposits

Category: Primary

General Description: This indicator consists of a thin orange or yellow crust or gel of oxidized iron on the soil surface or on objects near the surface.

Cautions and User Notes: Iron deposits form in areas where reduced iron discharges with groundwater and oxidizes upon exposure to air. The oxidized iron forms a film or sheen on standing water (Figure 45) and an orange or yellow deposit (Figure 46) on the ground surface after dewatering. Iron sheen on water can be distinguished from an oily film by touching with a stick or finger; iron films are crystalline and will crack into angular pieces.

Figure 45. Iron sheen on the water surface may be deposited as an orange or yellow crust after dewatering.

Figure 46. Iron deposit (orange streaks) in a small channel.

Indicator B7: Inundation visible on aerial imagery

Category: Primary

General Description: One or more recent aerial photographs or satellite images show the site to be inundated.

Cautions and User Notes: Care must be used in applying this indicator because surface water may be present on a non-wetland site immediately after a heavy rain or during periods of unusually high precipitation, runoff, tides, or river stages. See Chapter 5 for procedures to evaluate the normality of precipitation prior to the photo date. Surface water observed during the non-growing season may be an acceptable indicator if experience and professional judgment suggest that wet conditions normally extend into the growing season for sufficient duration in most years. Surface water may be absent from a wetland during the normal dry season or during extended periods of drought. Even under normal rainfall conditions, some wetlands do not become inundated or saturated every year (i.e., wetlands are inundated or saturated at least 5 out of 10 years, or 50 percent or higher probability). If available, it is recommended that multiple years of photography be evaluated. If 5 or more years of aerial photos are available, the procedure described by the USDA Natural Resources Conservation Service (1997, section 650.1903) is recommended (see Chapter 5, section on Wetlands that Periodically Lack Indicators of Wetland Hydrology, for additional information).

Indicator B9: Water-stained leaves

Category: Primary

General Description: Water-stained leaves are fallen or recumbent dead leaves that have turned grayish or blackish in color due to inundation for long periods.

Cautions and User Notes: Water-stained leaves are most often found in depressional wetlands and along streams in shrub-dominated or forested habitats; however, they also occur in herbaceous communities. Staining often occurs in leaves that are in contact with the soil surface while inundated for long periods. Water-stained leaves maintain their grayish or blackish colors when dry (Figure 47). They should contrast strongly with fallen leaves in nearby non-wetland landscape positions.

Figure 47. Water-stained leaves in a depressional wetland (unstained leaf for comparison).

Indicator B13: Aquatic fauna

Category: Primary

General Description: Presence of live individuals, diapausing insect eggs or crustacean cysts, or dead remains of aquatic fauna, such as, but not limited to, sponges, bivalves, aquatic snails, aquatic insects, ostracods, shrimp, other crustaceans, tadpoles, or fish, either on the soil surface or clinging to plants or other emergent objects.

Cautions and User Notes: Examples of dead remains include clam shells, chitinous exoskeletons (e.g., dragonfly nymphs), insect head capsules, aquatic snail shells (Figure 48), and skins or skeletons of aquatic amphibians or fish (Figure 49). Aquatic fauna or their remains should be reasonably abundant; one or two individuals are not sufficient. Use caution in areas where faunal remains may have been transported by high winds, unusually high water, or other animals into non-wetland areas. Shells and exoskeletons are resistant to tillage but may be moved by equipment beyond the boundaries of the wetland. They may also persist in the soil for years after dewatering.

Figure 48. Shells of aquatic snails in a seasonally ponded wetland.

Figure 49. Amphibian tadpoles trapped in a drying pool in a wet meadow.

Indicator B15: Marl deposits

Category: Primary

General Description: This indicator consists of the presence of marl on the soil surface.

Applicable Subregion: Applicable to the Florida Peninsula subregion (LRR U)

Cautions and User Notes: Marl deposits consist mainly of calcium carbonate precipitated from standing or flowing water through the action of algae or diatoms. Marl appears as a tan or whitish deposit on the soil surface after dewatering (Figure 50) and may form thick deposits in some areas. Marl reacts with dilute HCl to evolve CO_2. Subsurface marl layers do not qualify for this indicator.

Figure 50. Marl deposit (tan-colored areas) and iron sheen in a wetland.

Indicator B6: Surface soil cracks

Category: Secondary

General Description: Surface soil cracks consist of shallow cracks that form when fine-grained mineral or organic sediments dry and shrink, often creating a network of cracks or small polygons (Figure 51).

Cautions and User Notes: Surface soil cracks are often seen in recent fine sediments and in concave landscape positions where water has ponded long enough to destroy surface soil structure, such as in depressions, lake fringes, and floodplains. Use caution, however, as they may also occur in temporary ponds and puddles in non-wetlands and in areas that have been effectively drained. This indicator does not include deep cracks due to shrink-swell action in clay soils (e.g., Vertisols).

Figure 51. Surface soil cracks in a seasonally ponded depression.

Indicator B8: Sparsely vegetated concave surface

Category: Secondary

General Description: On concave land surfaces (e.g., depressions and swales), the ground surface is either unvegetated or sparsely vegetated (less than 5 percent ground cover) due to long-duration ponding or flooding during the growing season (Figure 52).

Cautions and User Notes: Sparsely vegetated concave surfaces should contrast with vegetated slopes and convex surfaces in the same area. A woody overstory of trees or shrubs may or may not be present. Examples in the region include, but are not limited to, concave positions on floodplains and seasonally ponded depressions in flat landscapes.

Figure 52. A sparsely vegetated, seasonally ponded depression.

Indicator B10: Drainage patterns

Category: Secondary

General Description: This indicator consists of flow patterns visible on the soil surface or eroded into the soil, low vegetation bent over in the direction of flow, absence of leaf litter or small woody debris due to flowing water, and similar evidence that water flowed across the ground surface.

Cautions and User Notes: Drainage patterns are usually seen in areas where water flows broadly over the surface and is not confined to a channel, such as in areas adjacent to streams, in seeps, slope wetlands, vegetated swales, and tidal flats (Figures 53 and 54). Use caution in areas subject to high winds or affected by recent extreme or unusual flooding events.

Figure 53. Drainage patterns seen during a flooding event. The patterns are also evident when the wetland is dry.

Figure 54. Vegetation bent over in the direction of water flow across a stream terrace.

Indicator B16: Moss trim lines

Category: Secondary

General Description: Presence of moss trim lines on trees or other upright objects in seasonally inundated areas.

Cautions and User Notes: Moss trim lines (Figure 55) are formed when water-intolerant mosses growing on tree trunks and other upright objects are killed by prolonged inundation, forming an abrupt lower edge to the moss community at the high-water level (Carr et al. 2006). Trim lines on different trees in the inundated area should indicate the same water-level elevation. The elevation of a trim line can be extrapolated across lower elevation areas in the vicinity. This indicator does not include lichen trim lines which, due to slow regrowth, may reflect unusually high or infrequent flooding events. Certain species of aquatic mosses and liverworts are tolerant of long-duration inundation and occur on trees and other objects below the high-water level. Therefore, the lack of a trim line does not indicate that the site does not pond or flood.

Figure 55. Moss trim line in a seasonally flooded wetland. The trim line (indicated by the arrow) indicates a recent high-water level.

Group C – Evidence of current or recent soil saturation

Indicator C1: Hydrogen sulfide odor

Category: Primary

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

Cautions and User Notes: Hydrogen sulfide is a gas produced by soil microbes in response to prolonged saturation in soils where oxygen, nitrogen, manganese, and iron have been largely reduced and there is a source of sulfur. For hydrogen sulfide to be detectable, the soil must be saturated at the time of sampling and must have been saturated long enough to become highly reduced. These soils are often permanently saturated and anaerobic at or near the surface. To apply this indicator, dig the soil pit no deeper than 12 in. to avoid release of hydrogen sulfide from deeper in the profile. Hydrogen sulfide odor serves as both an indicator of hydric soil and wetland hydrology. This one observation proves that the soil meets the definition of a hydric soil (i.e., anaerobic in the upper part), plus has an ongoing wetland hydrologic regime. Often these soils have a high water table (wetland hydrology indicator A2), but the hydrogen sulfide odor provides further proof that the soil has been saturated for a long period of time.

Indicator C3: Oxidized rhizospheres along living roots

Category: Primary

General Description: Presence of a layer containing 2 percent or more iron-oxide coatings or plaques on the surfaces of living roots and/or iron-oxide coatings or linings on soil pores immediately surrounding living roots within 12 in. (30 cm) of the soil surface (Figures 56 and 57).

Cautions and User Notes: Oxidized rhizospheres are the result of oxygen leakage from living roots into the surrounding anoxic soil, causing oxidation of ferrous iron present in the soil solution. They are evidence of saturated and reduced soil conditions during the plant's lifetime. Iron concentrations or plaques may form on the immediate root surface or may coat the soil pore adjacent to the root. In either case, the oxidized iron must be associated with living roots to indicate contemporary wet conditions and to distinguish these features from other pore linings. Care must be taken to distinguish iron-oxide coatings from organic matter associated with plant roots. Viewing with a hand lens may help to distinguish mineral from organic material and to identify oxidized rhizospheres along fine roots and root hairs. Iron coatings sometimes show concentric layers in cross section and may transfer iron stains to the fingers when rubbed. Note the location and abundance of oxidized rhizospheres in the soil profile description or remarks section of the data form. There is no minimum thickness requirement for the layer containing oxidized rhizospheres. Oxidized rhizospheres must occupy at least 2 percent of the volume of the layer.

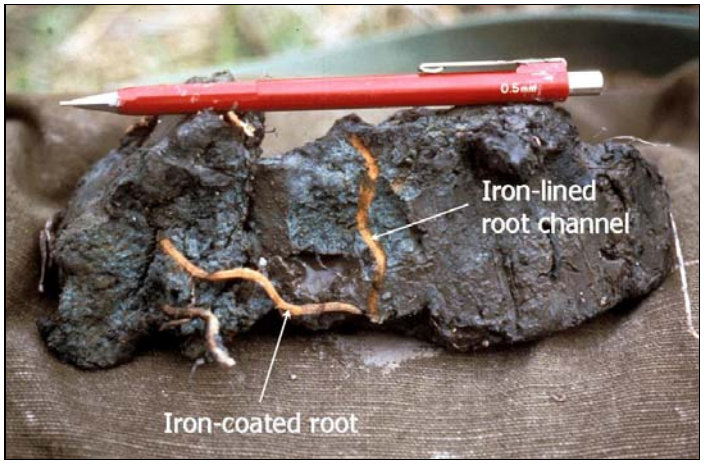

Figure 56. Iron-oxide plaque (orange coating) on a living root. Iron also coats the channel or pore from which the root was removed.

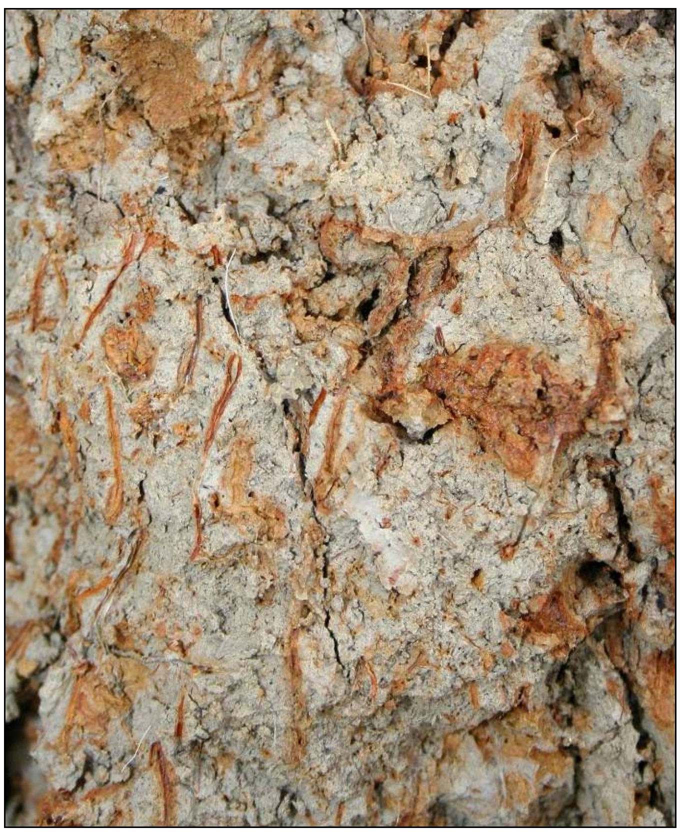

Figure 57. This soil has many oxidized rhizospheres associated with living roots.

Indicator C4: Presence of reduced iron

Category: Primary

General Description: Presence of a layer containing reduced (ferrous) iron in the upper 12 in. (30 cm) of the soil profile, as indicated by a ferrous iron test or by the presence of a soil that changes color upon exposure to the air.

Cautions and User Notes: The reduction of iron occurs in soils that have been saturated long enough to become anaerobic and chemically reduced. Ferrous iron is converted to oxidized forms when saturation ends and the soil reverts to an aerobic state. Thus, the presence of ferrous iron indicates that the soil is saturated and anaerobic at the time of sampling, and has been saturated for an extended period. The presence of ferrous iron can be verified with alpha, alpha-dipyridyl dye (Figure 58) or by observing a soil that changes color upon exposure to air (i.e., reduced matrix). A positive reaction to alpha, alpha-dipyridyl dye should occur over more than 50 percent of the soil layer in question. Apply the dye to freshly broken samples to avoid any chance of a false positive test due to iron contamination from digging tools. The dye does not react when wetlands are dry; therefore, a negative test result is not evidence that the soil is not reduced at other times of year. Soil samples should be tested or examined immediately after opening the soil pit because ferrous iron may oxidize and colors change soon after the sample is exposed to the air. Soils that contain little weatherable iron may not react even when saturated and reduced. There are no minimum thickness requirements or initial color requirements for the soil layer in question.

Figure 58. When alpha, alpha-dipyridyl dye is applied to a soil containing reduced iron, a positive reaction is indicated by a pink or red coloration to the treated area.

Indicator C6: Recent iron reduction in tilled soils

Category: Primary

General Description: Presence of a layer containing 2 percent or more redox concentrations as pore linings or soft masses in the tilled surface layer of soils cultivated within the last two years. The layer containing redox concentrations must be within the tilled zone or within 12 in. (30 cm) of the soil surface, whichever is shallower.

Cautions and User Notes: Cultivation breaks up or destroys redox features in the plow zone. The presence of redox features that are continuous and unbroken indicates that the soil was saturated and reduced since the last episode of cultivation (Figure 59). Redox features often form around organic material, such as crop residue, incorporated into the tilled soil. Use caution with older features that may be broken up but not destroyed by tillage. The indicator is most reliable in areas that are cultivated regularly, so that soil aggregates and older redox features are more likely to be broken up. If not obvious, information about the timing of last cultivation may be available from the land owner. A plow zone 6 to 8 in. (15 to 20 cm) deep is typical but may extend deeper. There is no minimum thickness requirement for the layer containing redox concentrations.

Figure 59. Redox concentrations in the tilled surface layer of a recently cultivated soil.

Indicator C7: Thin muck surface

Category: Primary

General Description: This indicator consists of a layer of muck 1 in. (2.5 cm) or less thick on the soil surface.

Cautions and User Notes: Muck is highly decomposed organic material (see the Concepts section of Chapter 3 for guidance on identifying muck). In this region, muck accumulates only where soils are saturated to the surface for long periods each year. Thick muck layers can persist for years after wetland hydrology is effectively removed; therefore, a muck layer greater than 1 in. thick does not qualify for this indicator. However, thin muck surfaces disappear quickly or become incorporated into mineral horizons when wetland hydrology is withdrawn. Therefore, the presence of a thin muck layer on the soil surface indicates an active wetland hydrologic regime.

Indicator C2: Dry-season water table

Category: Secondary

General Description: Visual observation of the water table between 12 and 24 in. (30 and 60 cm) below the surface during the normal dry season or during a drier-than-normal year.

Cautions and User Notes: Due to normal seasonal fluctuations, water tables in wetlands often drop below 12 in. during the summer dry season. A water table between 12 and 24 in. during the dry season, or during an unusually dry year, indicates a normal wet-season water table within 12 in. of the surface. Sufficient time must be allowed for water to infiltrate into a newly dug hole and to stabilize at the water-table level. The required time will vary depending upon soil texture. In some cases, the water table can be determined by examining the wall of the soil pit and identifying the upper level at which water is seeping into the pit. For an accurate determination of the water-table level, the soil pit, auger hole, or well should not penetrate any restrictive soil layer capable of perching water near the surface. Water tables in wetlands often drop well below 24 in. during dry periods. Therefore, a dry-season water table below 24 in. does not necessarily indicate a lack of wetland hydrology. Water tables are a function of both recent and long-term precipitation; use caution in interpreting this indicator immediately following an unusually heavy rainfall event. See Chapter 5 (section on Wetlands that Periodically Lack Indicators of Wetland Hydrology) to determine average dry-season dates, periods of below-normal rainfall, and drought periods. In the remarks section of the data form or in a separate report, provide documentation for the conclusion that the site visit occurred during the normal dry season, recent rainfall has been below normal, or the area has been affected by drought.

Indicator C8: Crayfish burrows

Category: Secondary

General Description: Presence of crayfish burrows, as indicated by openings in soft ground up to 2 in. (5 cm) in diameter, often surrounded by chimney-like mounds of excavated mud.

Cautions and User Notes: Crayfish breathe with gills and most species require at least periodic contact with water. Some species dig burrows for refuge and breeding (Figure 60). Crayfish burrows are usually found near streams, ditches, and ponds in areas that are seasonally inundated or have seasonal high water tables at or near the surface. They are also found in wet meadows and pastures where there is no open water. Crayfish may extend their burrows 10 ft (3 m) or more in depth to keep pace with a falling water table; thus, the eventual depth of the burrow does not reflect the level of the seasonal high water table. There are more than 300 species of crayfish in the southeastern United States. Some species (e.g., *Distocambarus crockeri*, Welch and Eversole 2006) are not closely associated with wetlands or aquatic habitats. Therefore, use this indicator only if indicators of hydrophytic vegetation and hydric soil are also present.

Figure 60. Crayfish burrow in a saturated wetland.

Indicator C9: Saturation visible on aerial imagery

Category: Secondary

General Description: One or more recent aerial photographs or satellite images indicate soil saturation. Saturated soil signatures must correspond to field-verified hydric soils, depressions or drainage patterns, differential crop management, or other evidence of a seasonal high water table.

Cautions and User Notes: This indicator is useful when plant cover is sparse or absent and the ground surface is visible from above. Saturated areas generally appear as darker patches within the field (Figure 61). Inundated (indicator B7) and saturated areas may be present in the same field; if they cannot be distinguished, then use indicator C9 for the entire wet area. Care must be used in applying this indicator because saturation may be present on a non-wetland site immediately after a heavy rain or during periods of abnormally high precipitation, runoff, tides, or river stages. Saturation observed during the non-growing season may be an acceptable indicator if experience and professional judgment suggest that wet conditions normally extend into the growing season for sufficient duration in most years. Saturation may be absent from a wetland during the normal dry season or during extended periods of drought. Even under normal rainfall conditions, some wetlands do not become inundated or saturated every year (i.e., wetlands are inundated or saturated at least 5 out of 10 years, or 50 percent or higher probability). If available, it is recommended that multiple years of photography be evaluated. If 5 or more years of aerial photos are available, the procedure described by the USDA Natural Resources Conservation Service (1997, section 650.1903) is recommended. Use caution, as similar signatures may be caused by factors other than saturation. This indicator requires on-site verification that saturation signatures seen on photos correspond to hydric soils or other evidence of a seasonal high water table.

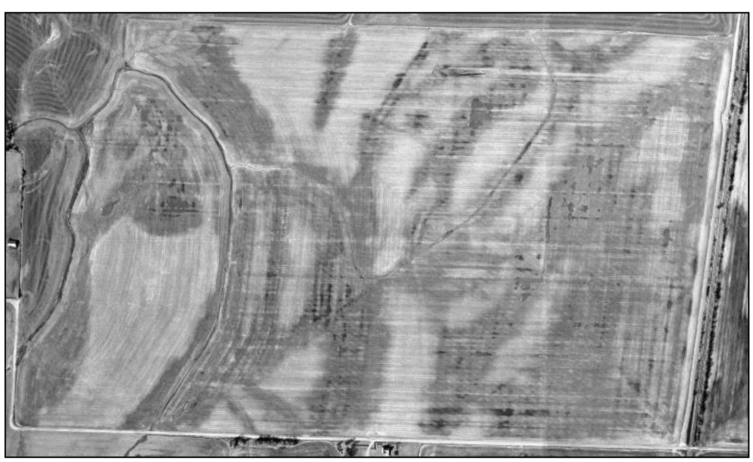

Figure 61. Aerial photograph of an agricultural field with saturated soils indicated by darker colors.

Group D – Evidence from other site conditions or data

Indicator D2: Geomorphic position

Category: Secondary

General Description: This indicator is present if the area in question is located in a localized depression, linear drainageway, concave position within a floodplain, at the toe of a slope, on the low-elevation fringe of a pond or other water body, or in an area where groundwater discharges.

Cautions and User Notes: Excess water from precipitation naturally accumulates in certain geomorphic positions in the landscape, particularly in low-lying areas such as depressions, drainages, toe slopes (Figure 4), and fringes of estuaries, lakes, and other water bodies. In regions with abundant rainfall, these geomorphic positions often, but not always, exhibit wetland hydrology. This indicator is not applicable in areas with functioning drainage systems and does not include concave positions on rapidly permeable soils (e.g., floodplains with sand and gravel substrates, coastal sand dunes) unless the water table is periodically near the surface.

Indicator D3: Shallow aquitard

Category: Secondary

General Description: This indicator occurs in and around the margins of depressions and in flat landscapes, and consists of the presence of an aquitard within the soil profile that is potentially capable of perching water within 12 in. (30 cm) of the surface.

Cautions and User Notes: An aquitard is a relatively impermeable soil layer or bedrock that slows the downward infiltration of water and can produce a perched water table, generally in flat or depressional landforms. In some cases, the aquitard may be at the surface (e.g., in clay soils) and cause water to pond on the surface. Potential aquitards in this region include fragipans, spodic horizons, cemented layers, lacustrine deposits, and clay layers. An aquitard can often be identified by the lack of root penetration through the layer and/or the presence of redoximorphic features in the layer(s) above the aquitard. Local experience and professional judgment should indicate that the perched water table is likely to occur during the growing season for sufficient duration in most years. Use caution in areas with functioning drainage systems that are capable of removing perched water quickly.

Indicator D5: FAC-neutral test

Category: Secondary

General Description: The plant community passes the FAC-neutral test.

Cautions and User Notes: The FAC-neutral test is performed by compiling a list of dominant plant species across all strata in the community, and dropping from the list any species with a facultative indicator status (i.e., FAC, FAC–, and FAC+). The FAC-neutral test is met if more than 50 percent of the remaining dominant species are rated FACW and/or OBL (Figure 62). This indicator may also be used in communities that contain no FAC dominants. If there are an equal number of dominants that are OBL and FACW versus FACU and UPL, or if all dominants are FAC, non-dominant species should be considered.

Step 1: Use the 50/20 rule to select dominant species from each stratum of the community.

Step 2: Combine dominant species from all strata into a single list. Determine the wetland indicator status for each dominant species (Reed 1988, or current list). For example:

Dominant Species	Stratum	Indicator Status
Carya ovata	Tree	FACU
Ulmus americana	Tree	FACW
Liquidambar styraciflua	Sapling	FAC
Celtis laevigata	Sapling	FACW
Carpinus caroliniana	Shrub	FAC
Boehmeria cylindrica	Herb	FACW
Leersia lenticularis	Herb	OBL
Toxicodendron radicans	Woody vine	FAC

Step 3: Drop the FAC species and sort the remaining species into two groups: FACW and OBL species, and FACU and UPL species:

FACW and OBL Species	FACU and UPL Species
Ulmus americana	*Carya ovata*
Celtis laevigata	
Boehmeria cylindrica	
Leersia lenticularis	

Step 4: Count the number of species in each group. If the number of dominant species that are FACW and OBL is greater than the number of dominant species that are FACU and UPL, then the site passes the FAC-neutral test. In the example, four species are FACW and/or OBL, and only one species is FACU or UPL. Therefore, the site passes the FAC-neutral test.

Figure 62. Procedure and example of the FAC-neutral test. This example is from Mississippi and uses the Region 2 (Southeast) plant list.

5 Difficult Wetland Situations in the Atlantic and Gulf Coastal Plain Region

Introduction

Some wetlands can be difficult to identify because wetland indicators may be missing at times due to natural processes or recent disturbances. This chapter provides guidance for making wetland determinations in difficult-to-identify wetland situations in the Atlantic and Gulf Coastal Plain Region. It includes regional examples of problem area wetlands and atypical situations as defined in the Corps Manual, as well as other situations that can make wetland delineation more challenging. Problem area wetlands are naturally occurring wetland types that lack indicators of hydrophytic vegetation, hydric soil, or wetland hydrology periodically due to normal seasonal or annual variability, or permanently due to the nature of the soils or plant species on the site. Atypical situations are wetlands in which vegetation, soil, or hydrology indicators are absent due to recent human activities or natural events. In addition, this chapter addresses certain procedural problems (e.g., wetland/non-wetland mosaics) that can make wetland determinations in the Atlantic and Gulf Coastal Plain Region difficult or confusing. The chapter is organized into the following sections:

- Lands Used for Agriculture and Silviculture
- Problematic Hydrophytic Vegetation
- Problematic Hydric Soils
- Wetlands that Periodically Lack Indicators of Wetland Hydrology
- Wetland/Non-Wetland Mosaics

The list of difficult wetland situations presented in this chapter is not intended to be exhaustive and other problematic situations may exist in the region. See the Corps Manual for general guidance. Furthermore, more than one wetland factor (i.e., vegetation, soil, and/or hydrology) may be disturbed or problematic on a given site. In general, *wetland determinations on difficult or problematic sites must be based on the best information available to the field inspector, interpreted in light of his or her professional experience and knowledge of the ecology of wetlands in the region.*

Lands used for agriculture and silviculture

Agriculture and silviculture are important land uses in the Atlantic and Gulf Coastal Plain Region, and both of these activities present challenges to wetland identification and delineation. Wetlands used for agriculture or silviculture often lack a natural plant community; they may be planted in crops, pasture species, or desirable tree species and may be altered by mowing, grazing, herbicide use, or other management practices. Soils may be disturbed by cultivation, land clearing, grading, or bedding, at least in the surface layers, and hydrology may or may not be manipulated. Some areas that are used for agriculture or silviculture still retain their natural wetland hydrology. In other areas, historic wetlands have been effectively drained and no longer meet wetland hydrology standards. Wetland indicators may still be present in these areas, making it difficult to distinguish current wetlands from those that have been effectively drained.

Agricultural and silvicultural drainage systems use ditches, subsurface drainage lines or "tiles," and water-control structures to manipulate the water table and improve conditions for crops or other desired species. A freely flowing ditch or drainage line depresses the water table within a certain lateral distance or zone of influence (Figure 63). The effectiveness of drainage in an area depends in part on soil characteristics, the timing and amount of rainfall, and the depth and spacing of ditches or drains. Wetland determinations on current and former agricultural or silvicultural lands must consider whether a drainage system is present, how it is designed to function, and whether it is effective in removing wetland hydrology from the area.

A number of information sources and tools are listed below to help determine whether wetlands are present on lands where vegetation, soils, hydrology, or a combination of these factors have been manipulated. Some of these options are discussed in more detail later in this chapter under the appropriate section headings.

1. **Vegetation** – The goal is to determine the plant community that would occupy the site under normal circumstances, if the vegetation were not cleared or manipulated.

    a. Examine the site for volunteer vegetation that emerges between cultivations, plantings, mowings, or other treatments.

b. Examine the vegetation on an undisturbed reference area with soils, hydrology, landscape position, and other conditions similar to those on the site.
c. Check NRCS soil survey reports for information on the typical vegetation on soil map units (hydrology of the site must be unaltered).
d. If the conversion to agriculture or silviculture was recent and the hydrology of the site was not manipulated, examine pre-disturbance aerial photography, NWI maps, and other sources for information on the previous vegetation.
e. Cease the clearing, cultivation, or manipulation of the site for one or more growing seasons and examine the plant community that develops.

2. **Soils** – Tilling of agricultural land mixes the surface layer(s) of the soil and may cause compaction below the tilled zone (i.e., a "plow pan") due to the weight and repeated passage of farm machinery. Similar disturbance to surface soils may also occur in areas managed for silviculture. Nevertheless, a standard soil profile description and examination for hydric soil indicators are often sufficient to determine whether hydric soils are present. Other options and information sources include the following:

   a. Examine NRCS soil survey maps and the local hydric soils list for the likely presence of hydric soils on the site.
   b. Examine the soils on an undisturbed reference area with landscape position, parent materials, and hydrology similar to those on the site.
   c. Use alpha, alpha-dipyridyl dye to check for the presence of reduced iron during the normal wet portion of the growing season in a normal rainfall year, or note whether the soil changes color upon exposure to the air.
   d. Monitor the site in relation to the appropriate wetland hydrology or hydric soils technical standard.

3. **Hydrology** – The goal is to determine whether wetland hydrology is present on a managed site under normal circumstances, as defined in the Corps Manual and subsequent guidance. These sites may or may not have been hydrologically manipulated.

   a. Examine the site for existing indicators of wetland hydrology. If the natural hydrology of the site has been permanently altered, discount

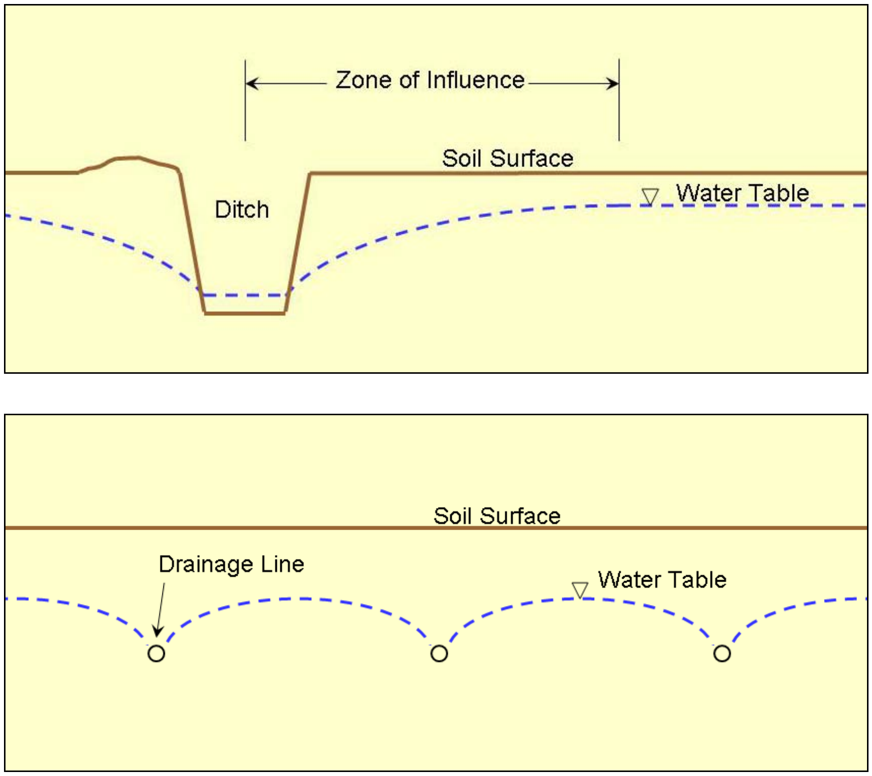

Figure 63. Effects of ditches (upper) and parallel subsurface drainage lines (lower) on the water table.

any indicators known to have been produced before the alteration (e.g., relict water marks or drift lines).

b. In agricultural areas, examine five or more years of annual Farm Service Agency aerial photographs, or aerial photos from other sources, for wetness signatures listed in Part 513.30 of the National Food Security Act Manual (USDA Natural Resources Conservation Service 1994) or in wetland mapping conventions available from NRCS offices or online in the electronic Field Office Technical Guide (eFOTG) (http://www.nrcs.usda.gov/technical/efotg/). Use the procedure given by the USDA Natural Resources Conservation Service (1997) to determine whether wetland hydrology is present.
c. Estimate the effects of ditches and subsurface drainage systems using scope-and-effect equations (USDA Natural Resources Conservation Service 1997). A web application to analyze data using various models is available at http://www.wli.nrcs.usda.gov/technical/web_tool/tools_java.html. Scope-and-effect equations are approximations only and may not reflect actual field conditions. Their results should be verified by comparison with other techniques for evaluating drainage and should not overrule onsite evidence of wetland hydrology.

d. Use state drainage guides to estimate the effectiveness of an existing drainage system (USDA Natural Resources Conservation Service 1997). Drainage guides are available from NRCS offices. Cautions noted in item *c* above also apply to the use of drainage guides. In addition, Corps of Engineers district offices should be consulted for locally developed techniques to evaluate wetland drainage.
e. Use hydrologic models (e.g., runoff, surface water, and groundwater models) to determine whether wetland hydrology is present (USDA Natural Resources Conservation Service 1997).
f. Monitor the hydrology of the site in relation to the appropriate wetland hydrology technical standard (U. S. Army Corps of Engineers 2005).

Problematic hydrophytic vegetation

Description of the problem

Many factors affect the structure and composition of plant communities in the Atlantic and Gulf Coastal Plain Region, including climatic variability, agricultural use, and other human land-use practices. As a result, some wetlands may exhibit indicators of hydric soil and wetland hydrology but lack any of the hydrophytic vegetation indicators presented in Chapter 2, at least at certain times. To identify and delineate these wetlands may require special sampling procedures or additional analysis of factors affecting the site. To the extent possible, the hydrophytic vegetation decision should be based on the plant community that is normally present during the wet portion of the growing season in a normal rainfall year. The following procedure addresses several examples of problematic vegetation situations in the coastal plain region.

Procedure

Problematic hydrophytic vegetation can be identified using a combination of observations made in the field and/or supplemental information from the scientific literature and other sources. These procedures should be applied only where indicators of hydric soil and wetland hydrology are present, unless one or both of these factors is also disturbed or problematic, but no indicators of hydrophytic vegetation are evident. The following procedures are recommended:

1. Verify that at least one indicator of hydric soil and one primary or two secondary indicators of wetland hydrology are present. If indicators of

either hydric soil or wetland hydrology are absent, the area is likely non-wetland unless soil and/or hydrology are also disturbed or problematic. If indicators of hydric soil and wetland hydrology are present (or are absent due to disturbance or other problem situations), proceed to step 2.

2. Verify that the area is in a landscape position that is likely to collect or concentrate water. Appropriate settings include the following. If the landscape setting is appropriate, proceed to step 3.

    a. Concave surface (e.g., depression or swale)
    b. Floodplain
    c. Level or nearly level area (e.g., 0- to 3-percent slope)
    d. Toe slope (Figure 4) or an area of convergent slopes (Figure 3)
    e. Fringe of another wetland or water body
    f. Area with a restrictive soil layer or aquitard capable of perching water within 12 in. (30 cm) of the surface
    g. Area where groundwater discharges (e.g., a seep)
    h. Other (explain in field notes why this area is likely to be inundated or saturated for long periods)

3. Use one or more of the approaches described in step 4 (Specific Problematic Vegetation Situations below) or step 5 (General Approaches to Problematic Hydrophytic Vegetation on page 120) to determine whether the vegetation is hydrophytic. In the remarks section of the data form or in the delineation report, explain the rationale for concluding that the plant community is hydrophytic even though indicators of hydrophytic vegetation described in Chapter 2 were not observed.

4. Specific Problematic Vegetation Situations

    a. *Temporal shifts in vegetation.* As mentioned in Chapter 2, the species composition of some wetland plant communities on the coastal plain can change in response to seasonal weather patterns and long-term climatic fluctuations. Wetland types in the region that are influenced by these shifts include ephemeral pools, depressions in flatwoods and coastal prairies, flats, salt pans, seeps, and springs. During the dry season, when surface water dries up and water tables drop, these wetlands may be invaded and dominated by FACU and UPL plant species, particularly annuals. Therefore, the lack of hydrophytic vegetation during the dry season should not immediately eliminate a site from consideration as a wetland, because the site may have been dominated by wetland species earlier in the growing season. A site qualifies for further consideration if the plant community at the time of sampling does not exhibit hydrophytic vegetation indicators, but indicators of hydric soil and wetland hydrology are present or known to be disturbed or problematic. The following sampling and analytical approaches are recommended in these situations:

(1) Seasonal Shifts in Plant Communities

(a) If possible, return to the site during the normal wet portion of the growing season and re-examine the site for indicators of hydrophytic vegetation.
(b) Examine the site for identifiable plant remains, either alive or dead, or other evidence that the plant community that was present during the normal wet portion of the growing season was hydrophytic.
(c) Use offsite data sources to determine whether the plant community that is normally present during the wet portion of the growing season is hydrophytic. Appropriate data sources include early growing season aerial photography, NWI maps, soil survey reports, remotely sensed data, public interviews, state wetland conservation plans, and previous reports about the site. If necessary, re-examine the site at a later date to verify the hydrophytic vegetation determination.
(d) If the vegetation on the site is substantially the same as that on a wetland reference site having similar soils, landscape position, and known wetland hydrology, then consider the vegetation to be hydrophytic (see step 5b in this procedure for more information).

(2) Drought Conditions (lasting more than one growing season)

(a) Investigate climate records (e.g., WETS tables, drought indices) to determine if the area is under the influence of a drought (for more information, see the section on Wetlands That Periodically Lack Indicators of Wetland Hydrology later in this chapter). If so, evaluate any offsite data that provide information on the plant community that exists on the site during normal years, including aerial photography, Farm

Service Agency annual crop slides, NWI maps, other remote sensing data, soil survey reports, public interviews, NRCS hydrology tools (USDA Natural Resources Conservation Service 1997), and previous site reports. Determine whether the vegetation that is present during normal years is hydrophytic.

(b) If the vegetation on the drought-affected site is substantially the same as that on a wetland reference site in the same general area having similar soils and known wetland hydrology, then consider the vegetation to be hydrophytic (see step 5b in this procedure).

b. *Areas affected by grazing.* Both short- and long-term grazing can cause shifts in dominant species in the vegetation. For instance, trampling by large herbivores can cause soil compaction, altering soil permeability and infiltration rates, and affecting the plant community. Grazers can also influence the abundance of plant species by selectively grazing certain species. For example, soft rush (*Juncus effusus*) often increases at the expense of other herbaceous species under heavy grazing pressure. Shifts in species composition due to grazing can influence the hydrophytic vegetation determination. Be aware that shifts in both directions, favoring either wetland species or upland species, can occur in these situations. Limited grazing does not necessarily affect the outcome of a hydrophytic vegetation decision. However, the following procedure is recommended in cases where the effects of grazing are so great that the hydrophytic vegetation determination would be unreliable or misleading.

(1) Examine the vegetation on a nearby, ungrazed reference site having similar soils and hydrologic conditions. Ungrazed areas may be present on adjacent properties or in fenced exclosures or streamside management zones. Assume that the same plant community would exist on the grazed site, in the absence of grazing.

(2) If feasible, remove livestock or fence representative livestock exclusion areas to allow the vegetation time to recover from grazing, and reevaluate the vegetation during the next growing season.

(3) If grazing was initiated recently, use offsite data sources such as aerial photography, NWI maps, and interviews with the land owner

and other persons familiar with the site or area to determine what plant community was present on the site before grazing began. If the previously ungrazed community was hydrophytic, then consider the current vegetation to be hydrophytic.

(4) If an appropriate ungrazed area cannot be located or if the ungrazed vegetation condition cannot be determined, make the wetland determination based on indicators of hydric soils and wetland hydrology.

c. *Managed plant communities.* Plant communities throughout the coastal plain region have been altered and are managed to meet human goals. Examples include clearing of woody vegetation on rangelands, periodic disking or plowing, planting of native and non-native species (including cultivars or planted species that have escaped and become established on other sites), improving pastures, developing pine plantations, applying silvicultural treatments, using herbicides, and suppressing wildfires. These actions can result in elimination of certain species and their replacement with other species, changes in abundance of certain plants, and shifts in dominant species, possibly influencing a hydrophytic vegetation determination. The following options are recommended if the natural vegetation has been altered through management to such an extent that a hydrophytic vegetation determination is not possible or would be unreliable:

(1) Examine the vegetation on a nearby, unmanaged reference site having similar soils and hydrologic conditions. Assume that the same plant community would exist on the managed site in the absence of human alteration.

(2) To determine whether managed plant communities would support hydrophytic vegetation, omit planted species when evaluating hydrophytic vegetation indicators.

(3) For recently cleared or tilled areas (not planted or seeded), leave representative areas unmanaged for at least one growing season with normal rainfall and reevaluate the vegetation.

(4) Use offsite data sources such as aerial photography, NWI maps, and interviews with the land owner and other persons familiar with the site or area to determine the plant community present on the site before the management occurred.

(5) If the unmanaged vegetation condition cannot be determined, make the wetland determination based on indicators of hydric soil and wetland hydrology.

d. *Areas affected by fires, floods, and other natural disturbances.* Fires, floods, and other catastrophic disturbances can dramatically alter the vegetation on a site. Vegetation can be completely or partially removed, or its composition altered, depending upon the intensity of the disturbance. Fires in coastal plain forests and prairies often burn to the margins of the embedded wetlands, and may destroy the vegetation near the wetland boundary. Limited disturbance does not necessarily affect the investigator's ability to determine whether the plant community is or is not hydrophytic. However, if the vegetation on a site has been removed or made unidentifiable by a recent fire, flood, or other disturbance, then one or more of the following procedures may be used to determine whether the vegetation present before the disturbance was hydrophytic. Additional guidance can be found in Part IV, Section F (Atypical Situations) of the Corps Manual.

(1) Examine the vegetation on a nearby, undisturbed reference site having similar soils and hydrologic conditions. Assume that the same plant community would exist on the disturbed site in the absence of disturbance.
(2) Use offsite data sources such as aerial photography, NWI maps, and interviews with knowledgeable people to determine the plant community present on the site before the disturbance.
(3) If the undisturbed vegetation condition cannot be determined, make the wetland determination based on indicators of hydric soil and wetland hydrology.

5. General Approaches to Problematic Hydrophytic Vegetation. The following general procedures are provided to identify hydrophytic vegetation in difficult situations not necessarily associated with specific vegetation types or management practices, including wetlands dominated by FACU, NI, NO, or unlisted species that are functioning as hydrophytes. Examples of FACU species that sometimes dominate wetlands in the coastal plain region include, but are not limited to, American beech, pitch pine, eastern red cedar (*Juniperus virginiana*), winged elm (*Ulmus alata*), shag-bark hickory (*Carya ovata*), live oak (*Quercus virginiana*), and white oak. The following procedures should be applied only where

indicators of hydric soil and wetland hydrology are present (or are absent due to disturbance or other problem situations) but indicators of hydrophytic vegetation are not evident. The following approaches are recommended:

a. *Direct hydrologic observations.* Verify that the plant community occurs in an area subject to prolonged inundation or soil saturation during the growing season. This can be done by visiting the site at 2- to 3-day intervals during the portion of the growing season when surface water is most likely to be present or water tables are normally high. Hydrophytic vegetation is considered to be present, and the site is a wetland, if surface water is present and/or the water table is 12 in. (30 cm) or less from the surface for 14 or more consecutive days during the growing season during a period when antecedent precipitation has been normal or drier than normal. If necessary, microtopographic highs and lows should be evaluated separately. The normality of the current year's rainfall must be considered in interpreting field results, as well as the likelihood that wet conditions will occur on the site at least every other year (for more information, see the section on "Wetlands that Periodically Lack Indicators of Wetland Hydrology" in this chapter).
b. *Reference sites.* If indicators of hydric soil and wetland hydrology are present, the site may be considered to be a wetland if the landscape setting, topography, soils, and vegetation are substantially the same as those on nearby wetland reference areas. Hydrologic characteristics of wetland reference areas should be documented through long-term monitoring or by repeated application of the procedure described in item 5a above. Reference sites should be minimally disturbed and provide long-term access. Soils, vegetation, and hydrologic conditions should be thoroughly documented and the data kept on file in the district or field office.
c. *Technical literature.* Published and unpublished scientific literature may be used to support a decision to treat specific FACU species or species with no assigned indicator status (e.g., NI, NO, or unlisted) as hydrophytes or certain plant communities as hydrophytic. Preferably, this literature should discuss the species' natural distribution along the moisture gradient, its capabilities and adaptations for life in wetlands, wetland types in which it is typically found, or other wetland species with which it is commonly associated.

Problematic hydric soils

Description of the problem

Soils with faint or no indicators

Some soils that meet the hydric soil definition may not exhibit any of the indicators presented in Chapter 3. These problematic hydric soils exist for a number of reasons and require additional information, such as landscape position, presence or absence of restrictive soil layers, or information about hydrology, to identify properly. This section describes several soil situations in the Atlantic and Gulf Coastal Plain Region that are considered to be hydric if additional requirements are met. In some cases, these hydric soils may appear to be non-hydric due to the color of the parent material from which the soils developed. In others, the lack of hydric soil indicators is due to conditions that inhibit the development of redoximorphic features despite prolonged soil saturation and anoxia. In addition, recently developed wetlands may lack hydric soil indicators because insufficient time has passed for their development. Examples of problematic hydric soils in the coastal plain region include, but are not limited to, the following.

1. **Recently Developed Wetlands.** Recently developed wetlands include mitigation sites, wetland management areas (e.g., for waterfowl), other wetlands intentionally or unintentionally produced by human activities, and naturally occurring wetlands that have not been in place long enough to develop hydric soil indicators.

2. **Seasonally Ponded Soils.** Seasonally ponded, depressional wetlands occur in basins, floodplains, and flats throughout the coastal plain region. Many are perched systems, with water ponding above a restrictive soil layer, such as a hardpan or clay layer that is at or near the surface (e.g., in Vertisols). Some of these wetlands lack hydric soil indicators due to the limited saturation depth, saline conditions, or other factors.

3. **Slightly to Strongly Alkaline Bottomland-Hardwood Vertisols in Texas.** Hydric Vertisols (clay soils) in current and former bottomland hardwood communities in the Gulf Coast Prairies and Gulf Coast Saline Prairies of Texas (MLRAs 150A and 150B; see Figure 33) may not show identifiable redox features due to alkaline conditions (pH of 7.5 or higher) that inhibit their development even in areas that are ponded and saturated

at the surface for long periods each year (Miller and Bragg 2007). In these problem soils, redox features may be few, faint, or absent. If the pH is 7.5 or higher within 12 in. (30 cm) of the surface, indicators of hydrophytic vegetation and wetland hydrology are present, and the area is subject to ponding, the soil is likely hydric even without a recognized hydric soil indicator. In the absence of an approved indicator, thoroughly document soil conditions, including pH, and follow the procedure described later in this section. This problematic soil situation is limited to MLRAs 150A and 150B in Texas.

4. **Red Parent Material.** Soils derived from red parent materials are common in the floodplains of the Arkansas, Brazos, Colorado, Ouachita, and Red Rivers and their tributaries in Arkansas, Louisiana, Oklahoma, and Texas. These soils contain very low amounts of organic matter, high amounts of manganese, and a crystalline form of iron that is difficult to break down. In addition, these soils are high in clay and may continue to receive new deposits from flooding. All of these factors make the development of redoximorphic features problematic (Figure 64). Typical soil colors in depressed landscape positions have a hue of 5YR with values of 2 or 3 and chromas of 2 or 3, or 7.5YR with a value of 3 and chroma of 2. On adjacent flats or very slightly convex landscape positions, typical colors are 5YR 3/4, 7.5YR 3/4, or brighter. Other soils derived from red parent materials occur in scattered locations throughout the region where residue from the erosion of Triassic rock formations has been deposited on the coastal plain.

5. **Black Parent Material.** Fine-textured sediments derived from the Blackland Prairie region of Texas (MLRAs 86A and 86B) are deposited on the coastal plain in the floodplains of the Trinity and Sulphur Rivers and their tributaries. These soils typically have colors (value/chroma) of 2/1 and 3/1. They have high pH, high cation-exchange capacity, high organic-matter content, and often receive new deposits, making them problematic for the development of observable redoximorphic features. Soils in some areas contain as much as 5 percent visible redoximorphic features, whereas other soils under similar hydrologic conditions have no visible redoximorphic features (Figure 65).

Figure 64. Observing redoximorphic features in soils developed from red parent materials can be problematic.

Figure 65. Black parent materials can mask redoximorphic features.

6. **Glauconitic Soils.** These soils contain silt- to sand-sized aggregates containing the clay mineral glauconite, which has a characteristic green color (Figure 66). Glauconitic sediments are deposited on marine terraces and are exposed when sea level drops. Glauconitic parent materials are most commonly found in Maryland, Delaware, and New Jersey in MLRA 149A (Figure 67), but are also known to occur in Arkansas and Louisiana.

Where sufficient glauconite is present, the soil matrix often has a chroma of 2 or less and the matrix color can match those found on the gley pages of the Munsell Soil Color Book (Gretag/Macbeth 2000 or current version). For this reason, glauconitic soils are excluded from the definition of "gleyed matrix" in the *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service 2006b). At the same time, these inherited low-chroma and gleyed matrix colors can mask true low-chroma depletions attributable to anaerobiosis and reduction. Therefore, the colors of glauconitic soils can be mistaken for a depleted matrix in areas where wetland hydrology is not present. On the other hand, in areas where wetland hydrology is present and the soil is hydric, the low-chroma colors can be overlooked as a parent material feature. Glauconitic parent materials also contain sulfides that, through weathering and oxidation, can produce iron concentrations that are not associated with a seasonal high water table or wet conditions and may even be evident in well-drained soils (Robinette et al. 2004).

Figure 66. Non-hydric soils that are high in glauconite can have colors similar to hydric soils. In hydric soils, glauconite can mask redoximorphic features.

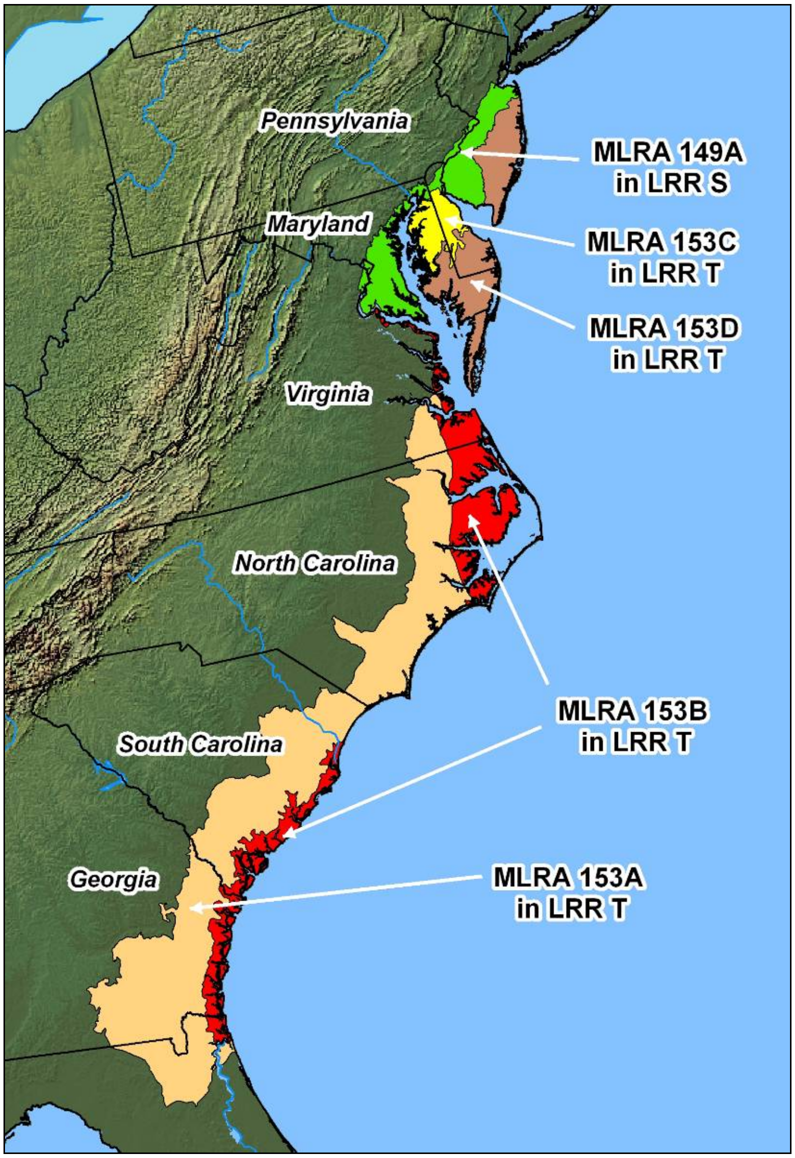

Figure 67. Locations of MLRAs 149A, 153A, 153B, 153C, and 153D.

7. **Interdunal Swales with Mucky-Peat Surfaces.** These hydric sandy soils are found in swales between coastal dunes in New Jersey, Delaware, Maryland, and Virginia in MLRAs 153B, 153C, and 153D (Figure 67), and may occur elsewhere in LRR T. They typically have a thin layer (generally 2 in. (5 cm) or less) of mucky peat over sand (Figure 68). Many of these soils do not meet indicator S5 (Sandy Redox) because they lack redox concentrations in the underlying sands. If a dark mineral surface layer is present, it often has a chroma greater than 1 or is too thin to meet the dark-surface indicators (e.g., S7 – Dark Surface, or S9 – Thin Dark Surface). In some cases, the soil may meet indicator S6 (Stripped Matrix). These soils would meet indicator S2 (2.5 cm Mucky Peat or Peat) or S3

(5 cm Mucky Peat or Peat) if one of these indicators was approved for use in the region. The organic surface is too thin to meet the requirements of A1 (Histosol), A2 (Histic Epipedon), or A3 (Black Histic) and not decomposed enough to meet A9 (1 cm Muck).

Figure 68. Soil with a mucky-peat surface over sand. Increments on tape are 4 in. (10 cm).

8. **Soils with Shallow Spodic Material.** These soils form in sandy materials with very low iron contents and typically occur on broad, nearly level interstream divides in MLRAs 153A, 153B, 153C, and 153D (Figure 67). They have black surface layers that are underlain directly by soil materials (spodic materials) that have a chroma of 3 or more. Some of these soils are hydric and others are not. However, due to the presence of soil material with a chroma greater than 2, the absence of muck or mucky-modified soil textures within 6 in. (15 cm) of the surface, and absence of redox concentrations, these soils generally do not meet any hydric soil indicator.

9. **Anomalous Bright Sandy Soils.** These bright sandy soils (Figure 69) are found on the coastal plain adjacent to tidal areas. Their landscape position and morphology are similar to the fine-textured hydric soils identified by the F20 (Anomalous Bright Loamy Soils) indicator. They are thought to occur along the coastline of New Jersey, Delaware, Maryland, and Virginia in MLRAs 149A, 153A, 153B, 153C, and 153D (Figure 67), and may occur elsewhere in LRR T. These sandy soils typically do not have the quantity (i.e., 10 percent or more) of redox features found in their loamy counterparts. Dark surface layers typically have chromas greater than 1 or are too thin to meet the sandy dark surface indicators (e.g., S7 – Dark Surface, and S9 – Thin Dark Surface). Chromas beneath the dark surface are typically greater than 2 and do not have stripped zones that would meet S6 (Stripped Matrix).

Figure 69. An anomalous bright sandy soil. This example has a relatively thick surface layer. Scale in 4-in. (10-cm) increments.

Soils with relict or induced hydric soil indicators

Some soils in the coastal plain region exhibit redoximorphic features and hydric soil indicators that formed in the recent or distant past when conditions may have been wetter than they are today. These features have persisted even though wetland hydrology may no longer be present. For example, wetlands drained for agricultural purposes starting in the 1700s, such as large areas of North Carolina, South Carolina, and Georgia, may contain persistent hydric soil features. Wetland soils drained during historic times are still considered to be hydric but they may no longer support wetlands. Relict hydric soil features may be difficult to distinguish from contemporary features. However, if indicators of hydrophytic vegetation and wetland hydrology are present, then hydric soil indicators can be assumed to be contemporary.

Relict redoximorphic features are no longer active due to geologic or other changes that have permanently altered the hydrologic regime. Only on close examination is it evident that hydric soil morphologies are not present. Several morphological characteristics that can help distinguish between contemporary and relict redoximorphic features (Vepraskas 1992) are described below.

1. Contemporary hydric soils may have nodules or concretions with diffuse boundaries or irregular surfaces. If surfaces are smooth and round, then red to yellow coronas should be present. Relict hydric soils may have nodules or concretions with abrupt boundaries and smooth surfaces without accompanying coronas.

2. Contemporary hydric soils may have Fe depletions along stable macropores in which roots repeatedly grow that are not overlain by iron-rich coatings (redox concentrations). Relict hydric soils may have Fe depletions along stable macropores in which roots repeatedly grow that are overlain by iron-rich coatings.

3. Contemporary hydric soils may have iron-enriched redox concentrations with Munsell colors of 5YR or yellower and with a value and chroma of 4 or more. Relict hydric soils may have iron-enriched redox concentrations with colors redder than 5YR and a value and chroma less than 4.

4. Contemporary pore linings may be continuous while relict pore linings may be broken or discontinuous (Hurt and Galbraith 2005).

There are also areas where hydric soil features have developed in former uplands due to human activities, such as the diversion of water for irrigation, soil compaction by vehicular traffic, or other causes. The application of irrigation water to upland areas can create wetland hydrology and, given adequate time, induce the formation of hydric soil indicators. In some cases, a soil scientist can distinguish naturally occurring hydric soil features from those induced by irrigation. Characterizing the naturally occurring hydrology is often important to the determination, and the timing of field observations can be critical. Observations made during the early part of the growing season, when natural hydrology is often at its peak and irrigation has not yet begun, may help to differentiate naturally occurring and irrigation-induced hydric soil features.

Procedure

Soils that are thought to meet the definition of a hydric soil but do not exhibit any of the indicators described in Chapter 3 can be identified by the following recommended procedure. This procedure should be used only where indicators of hydrophytic vegetation and wetland hydrology are present (or are absent due to disturbance or other problem situations), but indicators of hydric soil are not evident.

1. Verify that one or more indicators of hydrophytic vegetation are present or that the vegetation is problematic or disturbed (e.g., by tillage or other land alteration). If so, proceed to step 2.

2. Verify that at least one primary or two secondary indicators of wetland hydrology are present or that indicators are absent due to disturbance or other factors. If so, proceed to step 3. If indicators of hydrophytic vegetation and/or wetland hydrology are absent, then the area is probably non-wetland and no further analysis is required.

3. Thoroughly describe and document the soil profile and landscape setting. Verify that the area is in a landscape position that is likely to collect or concentrate water. Appropriate settings include the following. If the landscape setting is appropriate, proceed to step 4.

    a. Concave surface (e.g., depression or swale)
    b. Floodplains
    c. Level or nearly level area (e.g., 0- to 3-percent slope)
    d. Toe slope (Figure 4) or an area of convergent slopes (Figure 3)
    e. Fringe of another wetland or water body
    f. Area with a restrictive soil layer or aquitard capable of perching water within 12 in. (30 cm) of the surface

g. Area where groundwater discharges (e.g., a seep)
h. Other (explain in field notes why this area is likely to be inundated or saturated for long periods)

4. Use one or more of the following approaches to determine whether the soil is hydric. In the remarks section of the data form or in the delineation report, explain why it is believed that the soil lacks any of the NTCHS hydric soil indicators described in Chapter 3 and why it is believed that the soil meets the definition of a hydric soil.

   a. Determine whether one or more of the following indicators of problematic hydric soils is present. See the descriptions of each indicator given in Chapter 3. If one or more indicators is present, then the soil is hydric.

      (1) 1 cm Muck (A9) (applicable to LRR O)
      (2) 2 cm Muck (A10) (applicable to LRR S)
      (3) Reduced Vertic (F18) (applicable throughout the Atlantic and Gulf Coastal Plain Region in areas with Vertisols and Vertic intergrades)
      (4) Piedmont Floodplain Soils (F19) (applicable to LRRs P, S, and T in floodplains subject to deposition of Piedmont material)
      (5) Anomalous Bright Loamy Soils (F20) (applicable to MLRA 153B of LRR T (Figure 34))
      (6) Red Parent Material (TF2) (applicable throughout the Atlantic and Gulf Coastal Plain Region in areas containing soils derived from red parent materials)
      (7) Very Shallow Dark Surface (TF12) (applicable to LRRs T and U)

   b. Determine whether one or more of the following problematic soil situations is present. If present, consider the soil to be hydric.

      (1) Recently Developed Wetlands
      (2) Seasonally Ponded Soils
      (3) Slightly to Strongly Alkaline Bottomland-Hardwood Vertisols in Texas
      (4) Red Parent Material (also see indicator TF2)
      (5) Black Parent Material
      (6) Glauconitic Soils
      (7) Interdunal Swales with Mucky-Peat Surfaces
      (8) Soils with Shallow Spodic Material

(9) Anomalous Bright Sandy Soils
(10) Other (in field notes, describe the problematic soil situation and explain why it is believed that the soil meets the hydric soil definition)

c. Soils that have been saturated for long periods and have become chemically reduced may change color when exposed to air due to the rapid oxidation of ferrous iron (Fe^{2+}) to Fe^{3+} (i.e., a reduced matrix) (Figures 70 and 71). If the soil contains sufficient iron, this can result in an observable color change, especially in hue or chroma. The soil is hydric if a mineral layer 4 in. (10 cm) or more thick starting within 12 in. (30 cm) of the soil surface that has a matrix value of 4 or more and chroma of 2 or less becomes redder by one or more pages in hue and/or increases one or more in chroma when exposed to air within 30 minutes (Vepraskas 1992).

Care must be taken to obtain an accurate color of the soil sample immediately upon excavation. The colors should be observed closely and examined again after several minutes. Do not allow the sample to become dry. Dry soils will usually have a different color than wet or moist soils. As always, do not obtain colors while wearing sunglasses. Colors must be obtained in the field under natural light and not under artificial light.

d. If the soil is saturated at the time of sampling, alpha, alpha-dipyridyl dye can be used in the following procedure to determine if reduced (ferrous) iron is present. If ferrous iron is present as described below, then the soil is hydric.

Alpha, alpha-dipyridyl is a dye that reacts with reduced iron. In some cases, it can be used to provide evidence that a soil is hydric when it lacks other hydric soil indicators. The soil is likely to be hydric if application of alpha, alpha-dipyridyl dye to mineral soil material in at least 60 percent of a layer at least 4 in. (10 cm) thick within a depth of 12 in. (30 cm) of the soil surface results in a positive reaction within 30 seconds evidenced by a pink or red coloration to the dye during the growing season.

Using a dropper, apply a small amount of dye to a freshly broken ped face to avoid any chance of a false positive test due to iron contamination from digging tools. Look closely at the treated soil for evidence of color change. If in doubt, apply the dye to a sample of known upland soil and compare the reaction to the sample of interest. A positive reaction will not occur in soils that lack iron and may not occur in soils with high pH. The lack of a positive reaction to the dye does not preclude the presence of a hydric soil. Specific information about the use of alpha, alpha-dipyridyl can be found in NRCS Hydric Soils Technical Note 8 (http://soils.usda.gov/use/hydric/ntchs/tech_notes/index.html).

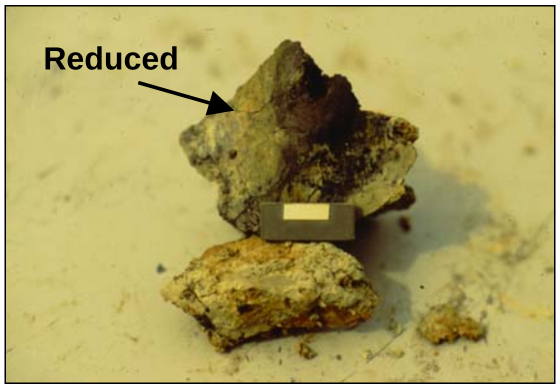

Figure 70. This soil exhibits colors associated with reducing conditions. Scale is 1 cm.

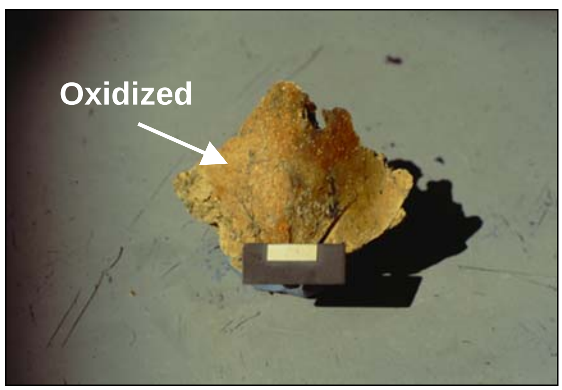

Figure 71. The same soil as in Figure 70 after exposure to the air and oxidation has occurred.

e. Using gauge data, water-table monitoring data, or repeated direct hydrologic observations, determine whether the soil is ponded or flooded, or the water table is 12 in. (30 cm) or less from the surface, for 14 or more consecutive days during the growing season in most years (at least 5 years in 10, or 50 percent or higher probability) (U. S. Army Corps of Engineers 2005). If so, then the soil is hydric. Furthermore, any soil that meets the NTCHS hydric soil technical standard (NRCS Hydric Soils Technical Note 11, http://soils.usda.gov/use/hydric/ntchs/tech_notes/index.html) is hydric.

Wetlands that periodically lack indicators of wetland hydrology

Description of the problem

Wetlands are areas that are flooded or ponded, or have soils that are saturated with water, for long periods during the growing season in most years. If the site is visited during a time of normal precipitation amounts and it is inundated or the water table is near the surface, then the wetland hydrology determination is straightforward. During the dry season, however, surface water recedes from wetland margins, water tables drop, and many wetlands dry out completely. Furthermore, not all wetlands become inundated or saturated every year. Wetlands in general are inundated or saturated at least 5 years in 10 (50 percent or higher probability) over a long-term record. Therefore, some wetlands in the Atlantic and Gulf Coastal Plain Region may not become inundated or saturated in some years.

Wetland hydrology determinations are based on indicators, many of which were designed to be used during dry periods when the direct observation of surface water or a shallow water table is not possible. However, some wetlands may lack any of the listed hydrology indicators, particularly during the dry season or in a dry year. The evaluation of wetland hydrology requires special care on any site where indicators of hydrophytic vegetation and hydric soil are present but hydrology indicators appear to be absent. Among other factors, this evaluation should consider the timing of the site visit in relation to normal seasonal and annual hydrologic variability, and whether the amount of rainfall prior to the site visit has been normal. This section describes a number of approaches that can be used to determine whether wetland hydrology is present on sites where indicators of hydrophytic vegetation and hydric soil are present but hydrology indicators may be lacking due to normal variations in rainfall or runoff, human activities that destroy hydrology indicators, and other factors.

Procedure

1. Verify that indicators of hydrophytic vegetation and hydric soil are present, or are absent due to disturbance or other problem situations. If so, proceed to step 2.

2. Verify that the site is in a geomorphic position that is likely to collect or concentrate water. Appropriate settings are listed below. If the landscape setting is appropriate, proceed to step 3.

   a. Concave surface (e.g., depression or swale)
   b. Floodplain
   c. Level or nearly level area (e.g., 0- to 3-percent slope)
   d. Toe slope (Figure 4) or an area of convergent slopes (Figure 3)
   e. Fringe of another wetland or water body
   f. Area with a restrictive soil layer or aquitard capable of perching water within 12 in. (30 cm) of the surface
   g. Area where groundwater discharges (e.g., a seep)
   h. Other (explain in field notes why this area is likely to be inundated or saturated for long periods)

3. Use one or more of the following approaches to determine whether wetland hydrology is present and the site is a wetland. In the remarks section of the data form or in the delineation report, explain the rationale for concluding that wetland hydrology is present even though indicators of wetland hydrology described in Chapter 4 were not observed.

   a. *Site visits during the dry season.* Determine whether the site visit occurred during the normal annual "dry season." The dry season, as used in this supplement, is the period of the year when soil moisture is normally being depleted and water tables are falling to low levels in response to decreased precipitation and/or increased evapotranspiration. This generally occurs in late spring and summer except in southern Florida, where the dry season typically extends from October to May. Examples of regional wetland types that may dry out completely during the annual dry season include seasonally saturated flatwoods along the Atlantic coast and around Chesapeake Bay; wet pine flats and savannas in Florida, along the Gulf coast, and in the western coastal plain of Arkansas, Louisiana, and Texas; pine barrens in New Jersey; coastal prairies in Texas and Louisiana; and bottomland hardwood wetlands in the Mississippi Alluvial Valley and in floodplains throughout the region.

      The Web-Based Water-Budget Interactive Modeling Program (WebWIMP) is one source for approximate dates of wet and dry seasons for any terrestrial location based on average monthly precipitation and estimated evapotranspiration (http://climate.geog.udel.edu/~wimp/). In general, the dry season in a typical year is indicated when potential evapotranspiration exceeds precipitation (indicated by negative values of DIFF in the WebWIMP output), resulting in drawdown of soil moisture storage (negative values of DST) and/or a moisture deficit (positive values of DEF, also called the unmet atmospheric demand for moisture). Actual dates for the dry season vary by locale and year.

In many wetlands, direct observation of flooding, ponding, or a shallow water table would be unexpected during the dry season. Wetland hydrology indicators, if present, would most likely be limited to indirect evidence, such as water marks, drift deposits, or surface cracks. In some situations, particularly in seasonally saturated wetland systems, hydrology indicators may be absent during the dry season. At such times, the wetland determination should be based on the preponderance of evidence that the site either is or is not wetland. If the site visit occurred during the dry season on a site that contains hydric soils and hydrophytic vegetation and no evidence of hydrologic manipulation (e.g., no dams, levees, water diversions, land grading, etc., and the site is not within the zone of influence of any ditches or subsurface drains), then consider the site to be a wetland. If necessary, revisit the site during the normal wet season and check again for the presence or absence of wetland hydrology indicators. If wetland hydrology indicators are absent during the wet portion of the growing season in a normal or wetter-than-normal rainfall year, the site is probably non-wetland.

b. *Periods with below-normal rainfall.* Determine whether the amount of rainfall that occurred in the 2-3 months preceding the site visit was normal, above normal, or below normal based on the normal range reported in WETS tables. WETS tables are provided by the NRCS National Water and Climate Center (http://www.wcc.nrcs.usda.gov/climate/wetlands.html) and are calculated from long-term (30-year) weather records gathered at National Weather Service meteorological stations. To determine whether precipitation was normal prior to the site visit, actual rainfall in the current month and previous 2-3 months should be compared with the normal ranges for each month given in the WETS table (USDA Natural Resources Conservation Service 1997, Sprecher and Warne 2000). The lower and upper limits of the normal range are indicated by the columns labeled "30% chance will have less than" and "30% chance will have more than" in the WETS table. The USDA Natural Resources Conservation Service (1997, Section 650.1903) also gives a procedure that can be used to weight the information from each month and determine whether the entire period was normal, wet, or dry.

When precipitation has been below normal, wetlands may not flood, pond, or develop shallow water tables even during the typical wet portion of the growing season and may not exhibit other indicators of wetland hydrology. Therefore, if precipitation was below normal prior to the site visit, and the site contains hydric soils and hydrophytic vegetation and no evidence of hydrologic manipulation (e.g., no dams, levees, water diversions, land grading, etc., and the site is not within the zone of influence of any ditches or subsurface drains), it should be identified as a wetland. If necessary, the site can be revisited during a period of normal rainfall and checked again for hydrology indicators.

c. *Drought years*. Determine whether the area has been subject to drought. Drought periods can be identified by comparing annual rainfall totals with the normal range of annual rainfall given in WETS tables or by examining trends in drought indices, such as the Palmer Drought Severity Index (PDSI) (Sprecher and Warne 2000). PDSI takes into account not only precipitation but also temperature, which affects evapotranspiration, and soil moisture conditions. The index is usually calculated on a monthly basis for major climatic divisions within each state. Therefore, the information is not site-specific. PDSI ranges potentially between –6 and +6 with negative values indicating dry periods and positive values indicating wet periods. An index of –1.0 indicates mild drought, –2.0 indicates moderate drought, –3.0 indicates severe drought, and –4.0 indicates extreme drought. Time-series plots of PDSI values by month or year are available from the National Climatic Data Center at (http://www.ncdc.noaa.gov/oa/climate/onlineprod/drought/xmgr.html#ds). If wetland hydrology indicators appear to be absent on a site that has hydrophytic vegetation and hydric soils, there is no evidence of hydrologic manipulation (e.g., no dams, levees, water diversions, land grading, etc., and the site is not within the zone of influence of any ditches or subsurface drains), and the region has been affected by drought, then the area should be identified as a wetland.

d. *Reference sites*. If indicators of hydric soil and hydrophytic vegetation are present on a site that lacks wetland hydrology indicators, the site may be considered to be a wetland if the landscape setting, topography, soils, and vegetation are substantially the same as those on nearby wetland reference areas. Hydrology of wetland reference areas should be documented through long-term monitoring (see item *h* below) or by application of the procedure described in item *5a* on page 121 (Direct Hydrologic Observations) of the procedure for Problematic Hydrophytic Vegetation in this chapter. Reference sites should be minimally disturbed and provide long-term access. Soils, vegetation, and hydrologic conditions should be thoroughly documented and the data kept on file in the District or field office.

e. *Hydrology tools*. The "Hydrology Tools" (USDA Natural Resources Conservation Service 1997) is a collection of methods that can be used to determine whether wetland hydrology is present on a potential wetland site that lacks indicators due to disturbance or other reasons, particularly on lands used for agriculture. Generally they require additional information, such as aerial photographs or stream-gauge data, or involve hydrologic modeling and approximation techniques. They should be used only when an indicator-based wetland hydrology determination is not possible or would give misleading results. A hydrologist may be needed to help select and carry out the proper analysis. The seven hydrology tools are used to:

(1) Analyze stream and lake gauge data
(2) Estimate runoff volumes to determine duration and frequency of ponding in depressional areas
(3) Evaluate the frequency of wetness signatures on aerial photography (see item *f* below for additional information)
(4) Model water-table fluctuations in fields with parallel drainage systems using the DRAINMOD model
(5) Estimate the "scope and effect" of ditches or subsurface drain lines
(6) Use NRCS state drainage guides to estimate the effectiveness of agricultural drainage systems

(7) Analyze data from groundwater monitoring wells (see item *h* below for additional information)

f. *Evaluating multiple years of aerial photography*. Each year, the Farm Service Agency (FSA) takes low-level aerial photographs in agricultural areas to monitor the acreages planted in various crops for USDA programs. NRCS has developed an off-site procedure that uses these photos, or repeated aerial photography from other sources, to make wetland hydrology determinations (USDA Natural Resources Conservation Service 1997, Section 650.1903). The method is intended for use on agricultural lands where human activity has altered or destroyed other wetland indicators. However, the same approach may be useful in other environments.

The procedure uses five or more years of growing-season photography and evaluates each photo for wetness signatures that are listed in "wetland mapping conventions" developed by NRCS state offices. Wetland mapping conventions can be found in the electronic Field Office Technical Guide (eFOTG) for each state (http://www.nrcs.usda.gov/technical/efotg/). From the national web site, choose the appropriate state, then select any county (the state's wetland mapping conventions are the same in every county). Wetland mapping conventions are listed among the references in Section I of the eFOTG. However, not all states have wetland mapping conventions.

Wetness signatures for a particular state may include surface water, saturated soils, flooded or drowned-out crops, stressed crops due to wetness, differences in vegetation patterns due to different planting dates, inclusion of wet areas into set-aside programs, unharvested crops, isolated areas that are not farmed with the rest of the field, patches of greener vegetation during dry periods, and other evidence of wet conditions (see Part 513.30 of USDA Natural Resources Conservation Service 1994). For each photo, the procedure described in item *b* above is used to determine whether the amount of rainfall in the 2-3 months prior to the date of the photo was normal, below normal, or above normal. Only photos taken in normal rainfall years, or an equal number of wetter-than-normal and drier-than-normal years, are used in the analysis. If wetness signatures are observed in photos in more than half of the years included in the analysis, then wetland hydrology is present. Data forms that may be used to document the wetland hydrology determination are given in section 650.1903 of USDA Natural Resources Conservation Service (1997).

g. *Mycorrhizal mantles on tree root tips as indicators of drainage effectiveness*. Mycorrhizal fungi in the soil form mutually beneficial symbiotic relationships with the roots of higher plants. In forest trees, the relationship is visible to the naked eye as mycorrhizal "mantles" that form each spring and cover the root tips (Figure 72). However, the development of mycorrhizal mantles is inhibited in saturated soils. Therefore, the presence of mantles in the soil at certain depths can be used as an indicator of effective drainage in areas that have been hydrologically manipulated and where wetland hydrology is questionable (Vasilas et al. 2004).

Figure 72. Photographs of mycorrhizal mantles on tree root tips (close-up view on left) and visible in a soil sample (tip of the pencil on right).

Vasilas et al. (2004) developed the following procedure to estimate whether wetland hydrology was present during the current year on a hydrologically altered site. The study was done on the Delmarva Peninsula in Maryland and Delaware and focused mainly on loblolly pine. Additional work is needed to determine whether the method is applicable elsewhere, although many other species are known to form mantles. The original paper should be consulted for details. This procedure should be considered experimental and should not be used to refute other evidence of wetland hydrology.

(1) Collect six spade slices of soil from the drip lines (i.e., beneath the outer margins of tree canopies) of individual trees. Avoid willows (*Salix* spp.) and alders (*Alnus* spp.), which may form mantles even in saturated soil conditions.
(2) Remove leaf litter and any organic surface layers from each soil sample.
(3) Starting at the mineral soil surface, measure down and mark each soil sample at a depth of exactly 2 in. (5 cm) from the mineral surface and again at a depth of 8 in. (20 cm) from the mineral surface.
(4) Carefully examine the soil material between 2 and 8 in. from the mineral surface for mycorrhizal mantles (Figure 72). Focus on the tips of fine to medium roots; mantles rarely form on coarse roots. Mantles are visible with the naked eye and generally contrast in color with the root. Mantles may be black, tan, white, cream, copper, or purple. Do not confuse mycorrhizal mantles with free-living soil fungi that form long, white, filamentous strands, often in association with decaying wood or leaves.
(5) According to Vasilas et al. (2004), for six spade slices, the probability of finding at least one mantle below a depth of 2 in. in an area where wetland hydrology did not occur that year is 82 percent. In an area where wetland hydrology did occur that year, the probability of finding at least one mantle is 11 percent. Therefore, the presence of mycorrhizal mantles on a site is strong, but not conclusive, evidence that the site was not saturated that year long enough to meet wetland hydrology standards. This procedure considers only the current year's wetness conditions and cannot determine whether the site meets the frequency standard for wetland hydrology (i.e., at least 5 years in 10, or 50 percent or higher probability). Thus, the presence of mycorrhizal mantles is useful evidence but should not be interpreted as proof positive of non-wetland conditions.

h. *Long-term hydrologic monitoring.* On sites where the hydrology has been manipulated by man (e.g., with ditches, subsurface drains, dams, levees, water diversions, land grading or bedding) or where natural events (e.g., downcutting of streams) have altered conditions such that hydrology indicators may be missing or misleading, direct monitoring of surface and groundwater may be needed to determine the presence or absence of wetland hydrology. The U. S. Army Corps of Engineers (2005) provides minimum standards for the design, construction, and installation of water-table monitoring wells, and for the collection and interpretation of groundwater monitoring data, in cases where direct hydrologic measurements are needed to determine whether wetlands are present on highly disturbed or problematic sites. This standard calls for 14 or more consecutive days of flooding, ponding, or a water table 12 in. (30 cm) or less below the soil surface during the growing season at a minimum frequency of 5 years in 10 (50 percent or higher probability), unless a different standard has been established for a particular geographic area or wetland type. A disturbed or problematic site that meets this standard has wetland hydrology. If the site in question is naturally hummocky or has been graded to enhance microtopography (e.g., bedded pine plantations), then topographic highs and lows should be evaluated separately. This standard is not intended (1) to overrule an indicator-based wetland determination on a site that is not disturbed or problematic, or (2) to test or validate existing or proposed wetland indicators.

Wetland/non-wetland mosaics

Description of the problem

In this supplement, “mosaic” refers to a landscape where wetland and non-wetland components are too closely associated to be easily delineated or mapped separately. These areas often have complex microtopography, with repeated small changes in elevation occurring over short distances. Tops of ridges and hummocks are often non-wetland but are interspersed with wetlands having clearly hydrophytic vegetation, hydric soils, and wetland hydrology. Examples of wetland/non-wetland mosaics in the Atlantic and Gulf Coastal Plain Region include ridge-and-swale topography in large floodplains, coastal flatwoods and savannas containing numerous shallow depressions, gilgai relief in Vertisols, pimple mounds in Louisiana and Arkansas, and coastal dune/swale systems.

Wetland components of a mosaic are often not difficult to identify. The problem for the wetland delineator is that microtopographic features are too small and intermingled, and there are too many such features per acre, to delineate and map them accurately. Instead, the following sampling approach can be used to estimate the percentage of wetland in the mosaic. From this, the number of acres of wetland on the site can be calculated, if needed.

Procedure

First, identify and flag all contiguous areas of either wetland or non-wetland on the site that are large enough to be delineated and mapped separately. The remaining area should be mapped as "wetland/non-wetland mosaic" and the approximate percentage of wetland within the area determined by the following procedure.

1. Establish one or more continuous line transects across the mosaic area, as needed. Measure the total length of each transect. A convenient method is to stretch a measuring tape along the transect and leave it in place while sampling. If the site is shaped appropriately and multiple transects are used, they should be arranged in parallel with each transect starting from a random point along one edge of the site. However, other arrangements of transects may be needed for oddly shaped sites.

2. Use separate data forms for the swale or trough and for the ridges or hummocks. Sampling of vegetation, soil, and hydrology should follow the general procedures described in the Corps Manual and this supplement. Plot sizes and shapes for vegetation sampling must be adjusted to fit the microtopographic features on the site. Plots intended to sample the troughs should not overlap adjacent hummocks, and vice versa. Only one or two data forms are required for each microtopographic position, and do not need to be repeated for similar features or plant communities.

3. Identify every wetland boundary in every trough or swale encountered along each transect. Each boundary location may be marked with a pin flag or simply recorded as a distance along the stretched tape.

4. Determine the total distance along each transect that is occupied by wetlands and non-wetlands until the entire length of the line has been accounted for. Sum these distances across transects, if needed. Determine the percentage of wetland in the wetland/non-wetland mosaic by the following formula.

$$\%\ wetland = \frac{Total\ wetland\ distance\ along\ all\ transects}{Total\ length\ of\ all\ transects} \times 100$$

An alternative approach involves point-intercept sampling at fixed intervals along transects across the area designated as wetland/non-wetland mosaic. This method avoids the need to identify wetland boundaries in each swale, and can be carried out by pacing rather than stretching a measuring tape across the site. The investigator uses a compass or other means to follow the selected transect line. At a fixed number of paces (e.g., every two steps) the wetland status of that point is determined by observing indicators of hydrophytic vegetation, hydric soil, and wetland hydrology. Again, a completed data form is not required at every point but at least one representative swale and hummock should be documented with completed forms. After all transects have been sampled, the result is a number of wetland sampling points and a number of non-wetland points. Estimate the percentage of wetland in the wetland/non-wetland mosaic by the following formula:

$$\%\ wetland = \frac{Number\ of\ wetland\ points\ along\ all\ transects}{Total\ number\ of\ points\ sampled\ along\ all\ transects} \times 100$$

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Appendix A: Glossary

This glossary is intended to supplement those given in the Corps Manual and other available sources. See the following publications for terms not listed here:

- Corps Manual (Environmental Laboratory 1987) (http://el.erdc.usace.army.mil/wetlands/pdfs/wlman87.pdf).
- Field Indicators of Hydric Soils in the United States (USDA Natural Resources Conservation Service 2006b) (http://soils.usda.gov/use/hydric/).
- National Soil Survey Handbook, Part 629 (USDA Natural Resources Conservation Service 2005) (ftp://ftp-fc.sc.egov.usda.gov/NSSC/Soil_Survey_Handbook/629_glossary.pdf).

Absolute cover. In vegetation sampling, the percentage of the ground surface that is covered by the aerial portions (leaves and stems) of a plant species when viewed from above. Due to overlapping plant canopies, the sum of absolute cover values for all species in a community or stratum may exceed 100 percent. In contrast, "relative cover" is the absolute cover of a species divided by the total coverage of all species in that stratum, expressed as a percent. Relative cover cannot be used to calculate the prevalence index.

Aquitard. A layer of soil or rock that retards the downward flow of water and is capable of perching water above it. For the purposes of this supplement, the term aquitard also includes the term aquiclude, which is a soil or rock layer that is incapable of transmitting significant quantities of water under ordinary hydraulic gradients.

Contrast. The color difference between a redox concentration and the dominant matrix color. Differences are classified as faint, distinct, or prominent and are defined in the glossary of USDA Natural Resources Conservation Service (2006b) and illustrated in Table A1.

Table A1. Tabular key for contrast determinations using Munsell notation.

Hues are the same (Δ h = 0)		
Δ Value	Δ Chroma	Contrast
0	≤1	Faint
0	2	Distinct
0	3	Distinct
0	≥4	Prominent
1	≤1	Faint
1	2	Distinct
1	3	Distinct
1	≥4	Prominent
≤2	≤1	Faint
≤2	2	Distinct
≤2	3	Distinct
≤2	≥4	Prominent
3	≤1	Distinct
3	2	Distinct
3	3	Distinct
3	≥4	Prominent
≥4	---	Prominent

Hues differ by 2 (Δ h = 2)		
Δ Value	Δ Chroma	Contrast
0	0	Faint
0	1	Distinct
0	≥2	Prominent
1	≤1	Distinct
1	≥2	Prominent
≥2	---	Prominent

Hues differ by 1 (Δ h = 1)		
Δ Value	Δ Chroma	Contrast
0	≤1	Faint
0	2	Distinct
0	≥3	Prominent
1	≤1	Faint
1	2	Distinct
1	≥3	Prominent
2	≤1	Distinct
2	2	Distinct
2	≥3	Prominent
≥3	---	Prominent

Hues differ by 3 or more (Δ h ≥ 3)		
Δ Value	Δ Chroma	Contrast
Color contrast is prominent, except for low chroma and value.		Prominent

Note: If both colors have values of ≤3 and chromas of ≤2, the color contrast is faint (regardless of the difference in hue).

Adapted from USDA Natural Resources Conservation Service (2002)

Depleted matrix. The volume of a soil horizon or subhorizon from which iron has been removed or transformed by processes of reduction and translocation to create colors of low chroma and high value. A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix. However, they are excluded from the concept of a depleted matrix unless common or many, distinct or prominent redox concentrations as soft masses or pore linings are present. In some places the depleted matrix may change color upon exposure to air (reduced matrix); this phenomenon is included in the concept of a depleted matrix. The following combinations of value and chroma identify a depleted matrix:

- Matrix value of 5 or more and chroma of 1, with or without redox concentrations occurring as soft masses and/or pore linings, or
- Matrix value of 6 or more and chroma of 2 or 1, with or without redox concentrations occurring as soft masses and/or pore linings, or
- Matrix value of 4 or 5 and chroma of 2, with 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings, or
- Matrix value of 4 and chroma of 1, with 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings (USDA Natural Resources Conservation Service 2006b).

Common (2 to less than 20 percent) to many (20 percent or more) redox concentrations (USDA Natural Resources Conservation Service 2002) are required in soils with matrix colors of 4/1, 4/2, and 5/2 (Figure A1). Redox concentrations include iron and manganese masses and pore linings (Vepraskas 1992). See “contrast” in this glossary for the definitions of “distinct” and “prominent.”

Diapause. A period during which growth or development is suspended and physiological activity is diminished, as in certain aquatic invertebrates in response to drying of temporary wetlands.

Distinct. See Contrast.

Figure A1. Illustration of values and chromas that require 2 percent or more distinct or prominent redox concentrations and those that do not, for hue 10YR, to meet the definition of a depleted matrix. *Due to inaccurate color reproduction, do not use this page to determine soil colors in the field.* Background image from the Munsell Soil Color Charts reprinted courtesy of Munsell Color Services Lab, a part of X-Rite, Inc.

Episaturation. Condition in which the soil is saturated with water at or near the surface, but also has one or more unsaturated layers below the saturated zone. The zone of saturation is perched on top of a relatively impermeable layer.

Fragmental soil material. Soil material that consists of 90 percent or more rock fragments; less than 10 percent of the soil consists of particles 2 mm or smaller (USDA Natural Resources Conservation Service 2006b).

Gilgai. Microtopography that is produced by the expansion and contraction of certain clay soils upon repeated wetting and drying.

Gleyed matrix. A gleyed matrix has one of the following combinations of hue, value, and chroma and the soil is not glauconitic (Figure A2):

- 10Y, 5GY, 10GY, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value of 4 or more and chroma of 1; or
- 5G with value of 4 or more and chroma of 1 or 2; or
- N with value of 4 or more (USDA Natural Resources Conservation Service 2006b).

Growing season. In the Atlantic and Gulf Coastal Plain Region, growing season dates are determined through onsite observations of the following indicators of biological activity in a given year: (1) above-ground growth and development of vascular plants, and/or (2) soil temperature (see Chapter 4 for details). If onsite data gathering is not practical, growing season dates may be approximated by using WETS tables available from the NRCS National Water and Climate Center to determine the median dates of 28 °F (−2.2 °C) air temperatures in spring and fall based on long-term records gathered at the nearest appropriate National Weather Service meteorological station.

High pH. pH of 7.5 or higher. Includes slightly alkaline, moderately alkaline, strongly alkaline, and very strongly alkaline (USDA Natural Resources Conservation Service 2002).

Figure A2. For hydric soil determinations, a gleyed matrix has the hues and chroma identified in this illustration with a value of 4 or more. *Due to inaccurate color reproduction, do not use this page to determine soil colors in the field.* Background image from the Munsell Soil Color Charts reprinted courtesy of Munsell Color Services Lab, a part of X-Rite, Inc.

Nodules and concretions. Irregularly shaped, firm to extremely firm accumulations of iron and manganese oxides. When broken open, nodules have uniform internal structure whereas concretions have concentric layers (Vepraskas 1992).

Prominent. See Contrast.

Reduced matrix. Soil matrix that has a low chroma in situ due to the presence of reduced iron, but whose color changes in hue or chroma when exposed to air as Fe^{2+} is oxidized to Fe^{3+} (Vepraskas 1992).

Saturation. For wetland delineation purposes, a soil layer is saturated if virtually all pores between soil particles are filled with water (National Research Council 1995, Vepraskas and Sprecher 1997). This definition includes part of the capillary fringe above the water table (i.e., the tension-saturated zone) in which soil water content is approximately equal to that below the water table (Freeze and Cherry 1979).

Appendix B: Point-Intercept Sampling Procedure for Determining Hydrophytic Vegetation

The following procedure for point-intercept sampling is an alternative to plot-based sampling methods to estimate the abundance of plant species in a community. The approach may be used with the approval of the appropriate Corps of Engineers District to evaluate vegetation as part of a wetland delineation. Advantages of point-intercept sampling include better quantification of plant species abundance and reduced bias compared with visual estimates of cover. The method is useful in communities with high species diversity, and in areas where vegetation is patchy or heterogeneous, making it difficult to identify representative locations for plot sampling. Disadvantages include the increased time required for sampling and the need for vegetation units large enough to permit the establishment of one or more transect lines within them. The approach also assumes that soil and hydrologic conditions are uniform across the area where transects are located. In particular, transects should not cross the wetland boundary. Point-intercept sampling is generally used with a transect-based prevalence index (see below) to determine whether vegetation is hydrophytic.

In point-intercept sampling, plant occurrence is determined at points located at fixed intervals along one or more transects established in random locations within the plant community or vegetation unit. If a transect is being used to sample the vegetation near a wetland boundary, the transect should be placed parallel to the boundary and should not cross the wetland boundary or extend into other communities. Usually a measuring tape is laid on the ground and used for the transect line. Transect length depends upon the size and complexity of the plant community and may range from 100 to 300 ft (30 to 90 m) or more. Plant occurrence data are collected at fixed intervals along the line, for example every 2 ft (0.6 m). At each interval, a “hit” on a species is recorded if a vertical line at that point would intercept the stem or foliage of that species. Only one “hit” is recorded for a species at a point even if the same species would be intercepted more than once at that point. Vertical intercepts can be determined using a long pin or rod protruding into and through the various vegetation layers, a sighting device (e.g., for the canopy), or an imaginary vertical line. The total number of "hits" for each species along the transect is then determined. The result is a list of species and their frequencies of occurrence along the line (Mueller-Dombois and Ellenberg 1974, Tiner 1999). Species are then categorized by wetland indicator status (i.e., OBL, FACW, FAC, FACU, or UPL), the total number of hits is determined within each category, and the data are used to calculate a transect-based prevalence index. The formula is similar to that given in Chapter 2 for the plot-based prevalence index (see Indicator 2), except that frequencies are used in place of cover estimates. The community is hydrophytic if the prevalence index is 3.0 or less. To be valid, more than 80 percent of "hits" on the transect must be of species that have been identified correctly and placed in an indicator category.

The transect-based prevalence index is calculated using the following formula:

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

where:

PI = Prevalence index
F_{OBL} = Frequency of obligate (OBL) plant species
F_{FACW} = Frequency of facultative wetland (FACW) plant species
F_{FAC} = Frequency of facultative (FAC) plant species
F_{FACU} = Frequency of facultative upland (FACU) plant species
F_{UPL} = Frequency of upland (UPL) plant species.

Appendix C: Data Form

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: ______________________ City/County: ______________ Sampling Date: ________

Applicant/Owner: ______________________________ State: ______ Sampling Point: ________

Investigator(s): ______________________ Section, Township, Range: ____________________

Landform (hillslope, terrace, etc.): ______________ Local relief (concave, convex, none): __________ Slope (%): _____

Subregion (LRR or MLRA): ____________ Lat: ____________ Long: ______________ Datum: _____

Soil Map Unit Name: ______________________________ NWI classification: ____________

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ______ No ______ (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? Are "Normal Circumstances" present? Yes ______ No ______

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ______	No ______	**Is the Sampled Area within a Wetland?** **Yes ______ No ______**
Hydric Soil Present?	Yes ______	No ______	
Wetland Hydrology Present?	Yes ______	No ______	

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15) **(LRR U)**
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes _____	No _____	Depth (inches): __________
Water Table Present?	Yes _____	No _____	Depth (inches): __________
Saturation Present? (includes capillary fringe)	Yes _____	No _____	Depth (inches): __________

Wetland Hydrology Present? Yes ______ No ______

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: ___________

Tree Stratum (Plot size: _______________)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	________ = Total Cover		

Sapling Stratum (Plot size: _______________)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	________ = Total Cover		

Shrub Stratum (Plot size: _______________)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	________ = Total Cover		

Herb Stratum (Plot size: _______________)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	________ = Total Cover		

Woody Vine Stratum (Plot size: _______________)			
1.			
2.			
3.			
4.			
5.			
	________ = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ____________ (A)

Total Number of Dominant Species Across All Strata: ____________ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ____________ (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	__________	x 1 = __________
FACW species	__________	x 2 = __________
FAC species	__________	x 3 = __________
FACU species	__________	x 4 = __________
UPL species	__________	x 5 = __________
Column Totals:	__________ (A)	__________ (B)

Prevalence Index = B/A = ______________

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub – Woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb – All herbaceous (non-woody) plants, including herbaceous vines, regardless of size. Includes woody plants, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vine – All woody vines, regardless of height.

Hydrophytic Vegetation Present? **Yes** ______ **No** ______

Remarks: (If observed, list morphological adaptations below).

SOIL

Sampling Point: ___________

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features				Texture	Remarks
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Organic Bodies (A6) **(LRR P, T, U)**
___ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
___ Muck Presence (A8) **(LRR U)**
___ 1 cm Muck (A9) **(LRR P, T)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Coast Prairie Redox (A16) **(MLRA 150A)**
___ Sandy Mucky Mineral (S1) **(LRR O, S)**
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) **(LRR P, S, T, U)**
___ Polyvalue Below Surface (S8) **(LRR S, T, U)**
___ Thin Dark Surface (S9) **(LRR S, T, U)**
___ Loamy Mucky Mineral (F1) **(LRR O)**
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) **(LRR U)**
___ Depleted Ochric (F11) **(MLRA 151)**
___ Iron-Manganese Masses (F12) **(LRR O, P, T)**
___ Umbric Surface (F13) **(LRR P, T, U)**
___ Delta Ochric (F17) **(MLRA 151)**
___ Reduced Vertic (F18) **(MLRA 150A, 150B)**
___ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
___ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

___ 1 cm Muck (A9) **(LRR O)**
___ 2 cm Muck (A10) **(LRR S)**
___ Reduced Vertic (F18) **(outside MLRA 150A,B)**
___ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
___ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12) **(LRR T, U)**
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________________________

Depth (inches): ______________________

Hydric Soil Present? Yes ______ No ______

Remarks:

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14. ABSTRACT
This document is one of a series of Regional Supplements to the Corps of Engineers Wetland Delineation Manual, which provides technical guidance and procedures for identifying and delineating wetlands that may be subject to regulatory jurisdiction under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act. The development of Regional Supplements is part of a nationwide effort to address regional wetland characteristics and improve the accuracy and efficiency of wetland-delineation procedures. This supplement is applicable to the Atlantic and Gulf Coastal Plain Region, which consists of all or portions of the District of Columbia and 19 states: Alabama, Arkansas, Delaware, Florida, Georgia, Illinois, Kentucky, Louisiana, Maryland, Mississippi, Missouri, New Jersey, North Carolina, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, and Virginia

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