Table 3

List of Ecological Profiles Produced by the FWS Biological Services Program

| Title | Publication Date | FWS Publication No. |
|---|---|---|
| "The Ecology of Intertidal Flats of North Carolina" | 1979 | 79/39 |
| "The Ecology of New England Tidal Flats" | 1982 | 81/01 |
| "The Ecology of the Mangroves of South Florida" | 1982 | 81/24 |
| "The Ecology of Bottomland Hardwood Swamps of the Southeast" | 1982 | 81/37 |
| "The Ecology of Southern California Coastal Salt Marshes" | 1982 | 81/54 |
| "The Ecology of New England High Salt Marshes" | 1982 | 81/55 |
| "The Ecology of Southeastern Shrub Bogs (Pocosins) and Carolina Bays" | 1982 | 82/04 |
| "The Ecology of the Apalachicola Bay System" | 1984 | 82/05 |
| "The Ecology of the Pamlico River, North Carolina" | 1984 | 82/06 |
| "The Ecology of the South Florida Coral Reefs" | 1984 | 82/08 |
| "The Ecology of the Sea Grasses of South Florida" | 1982 | 82/25 |
| "The Ecology of Tidal Marshes of the Pacific Northwest Coast" | 1983 | 82/32 |
| "The Ecology of Tidal Freshwater Marshes of the U.S. East Coast" | 1984 | 83/17 |
| "The Ecology of San Francisco Bay Tidal Marshes" | 1983 | 83/23 |
| "The Ecology of Tundra Ponds of the Arctic Coastal Plain" | 1984 | 83/25 |
| "The Ecology of Eelgrass Meadows of the Atlantic Coast" | 1984 | 84/02 |
| "The Ecology of Delta Marshes of Louisiana" | 1984 | 84/09 |

(Continued)

Table 3 (Concluded)

| Title | Publication Date | FWS Publication No. |
|---|---|---|
| "The Ecology of Eelgrass Meadows in the Pacific Northwest" | 1984 | 84/24 |
| "The Ecology of Irregularly Flooded Marshes of Northeastern Gulf of Mexico" | (In press) | 85(7.1) |
| "The Ecology of Giant Kelp Forests in California" | 1985 | 85(7.2) |

in wetlands (Appendix C, Section 2). Either list may be used. Note: A District that, on a subregional basis, questions the indicator status of FAC species may use the following option: When FAC species occur as dominants along with other dominants that are not FAC (either wetter or drier than FAC), the FAC species can be considered as neutral, and the vegetation decision can be based on the number of dominant species wetter than FAC as compared to the number of dominant species drier than FAC. When a tie occurs or all dominant species are FAC, the nondominant species must be considered. The area has hydrophytic vegetation when more than 50 percent of all considered species are wetter than FAC. When either all considered species are FAC or the number of species wetter than FAC equals the number of species drier than FAC, the wetland determination will be based on the soil and hydrology parameters. Districts adopting this option should provide documented support to the Corps representative on the regional plant list panel, so that a change in indicator status of FAC species of concern can be pursued. Corps representatives on the regional and national plant list panels will continually strive to ensure that plant species are properly designated on both a regional and subregional basis.

Sub dominant Rule

b. Other indicators. Although there are several other indicators of hydrophytic vegetation, it will seldom be necessary to use them. However, they may provide additional useful information to strengthen a case for the presence of hydrophytic vegetation. Additional training and/or experience may be required to employ these indicators.

(1) Visual observation of plant species growing in areas of prolonged inundation and/or soil saturation. This indicator can only be applied by experienced personnel who have accumulated information through several years of field experience and written documentation (field notes) that certain species commonly occur in areas of prolonged (>10 percent) inundation and/or soil saturation during the growing season. Species such as *Taxodium distichum*, *Typha latifolia*, and *Spartina alterniflora* normally occur in such areas. Thus, occurrence of species commonly observed in other wetland areas provides a strong indication that hydrophytic vegetation is present. *CAUTION: The presence of standing water or saturated soil on a site is insufficient evidence that the species present are able to tolerate long periods of inundation. The user must relate the observed species to other similar situations and determine whether they are normally found in wet areas, taking into consideration the season and immediately preceding weather conditions.*

(2) Morphological adaptations. Some hydrophytic species have easily recognized physical characteristics that indicate their ability to occur in wetlands. A given species may exhibit several of these characteristics, but not all hydrophytic species have evident morphological

adaptations. A list of such morphological adaptations and a partial list of plant species with known morphological adaptations for occurrence in wetlands are provided in Appendix C, Section 3.

(3) Technical literature. The technical literature may provide a strong indication that plant species comprising the prevalent vegetation are commonly found in areas where soils are periodically saturated for long periods. Sources of available literature include:

(a) Taxonomic references. Such references usually contain at least a general description of the habitat in which a species occurs. A habitat description such as, "Occurs in water of streams and lakes and in alluvial floodplains subject to periodic flooding," supports a conclusion that the species typically occurs in wetlands. Examples of some useful taxonomic references are provided in Table 4.

(b) Botanical journals. Some botanical journals contain studies that define species occurrence in various hydrologic regimes. Examples of such journals include: Ecology, Ecological Monographs, American Journal of Botany, Journal of American Forestry, and Wetlands: The Journal of the Society of Wetland Scientists.

(c) Technical reports. Governmental agencies periodically publish reports (e.g. literature reviews) that contain information on plant species occurrence in relation to hydrologic regimes. Examples of such publications include the CE preliminary regional wetland guides (Table 2) published by the US Army Engineer Waterways Experiment Station (WES) and the wetland community and estuarine profiles of various habitat types (Table 3) published by the FWS.

(d) Technical workshops, conferences, and symposia. Publications resulting from periodic scientific meetings contain valuable information that can be used to support a decision regarding the presence of hydrophytic vegetation. These usually address specific regions or wetland types. For example, distribution of bottomland hardwood forest species in relation to hydrologic regimes was examined at a workshop on bottomland hardwood forest wetlands of the Southeastern United States (Clark and Benforado 1981).

(e) Wetland plant database. The NWI is producing a Plant Database that contains habitat information on approximately 5,200 plant species that occur at some estimated probability in wetlands, as compiled from the technical literature. When completed, this computerized database will be available to all governmental agencies.

Table 4

List of Some Useful Taxonomic References

| Title | Author(s) |
| --- | --- |
| Manual of Vascular Plants of Northeastern United States and Adjacent Canada | Gleason and Cronquist (1963) |
| Gray's Manual of Botany, 8th edition | Fernald (1950) |
| Manual of the Southeastern Flora | Small (1933) |
| Manual of the Vascular Flora of the Carolinas | Radford, Ahles, and Bell (1968) |
| A Flora of Tropical Florida | Long and Lakela (1976) |
| Aquatic and Wetland Plants of the Southwestern United States | Correll and Correll (1972) |
| Arizona Flora | Kearney and Peebles (1960) |
| Flora of the Pacific Northwest | Hitchcock and Cronquist (1973) |
| A California Flora | Munz and Keck (1959) |
| Flora of Missouri | Steyermark (1963) |
| Manual of the Plants of Colorado | Harrington (1979) |
| Intermountain Flora - Vascular Plants of the Intermountain West, USA - Vols I and II | Cronquist et al. (1972) |
| Flora of Idaho | Davis (1952) |
| Aquatic and Wetland Plants of the Southeastern United States - Vols I and II | Godfrey and Wooten (1979) |
| Manual of Grasses of the United States | Hitchcock (1950) |

(4) Physiological adaptations. Physiological adaptations include any features of the metabolic processes of plants that make them particularly fitted for life in saturated soil conditions. *NOTE: It is impossible to detect the presence of physiological adaptations in plant species during onsite visits.* Physiological adaptations known for hydrophytic species and species known to exhibit these adaptations are listed and discussed in Appendix C, Section 3.

(5) Reproductive adaptations. Some plant species have reproductive features that enable them to become established and grow in saturated soil conditions. Reproductive adaptations known for hydrophytic species are presented in Appendix C, Section 3.

## Hydric Soils

### Definition

36. A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation (US Department of Agriculture (USDA) Soil Conservation Service (SCS) 1985, as amended by the National Technical Committee for Hydric Soils (NTCHS) in December 1986).

### Criteria for hydric soils

37. Based on the above definition, the NTCHS developed the following criteria for hydric soils:

a. "All Histosols* except Folists;

b. Soils in Aquic suborders, Aquic subgroups, Albolls suborder, Salorthids great group, or Pell great groups of Vertisols that are:

(1) Somewhat poorly drained and have a water table less than 0.5 ft** from the surface for a significant period (usually a week or more) during the growing season, or

(2) Poorly drained or very poorly drained and have either:

(a) A water table at less than 1.0 ft from the surface for a significant period (usually a week or more) during the growing season if permeability is equal to or greater than 6.0 in/hr in all layers within 20 inches; or

* Soil nomenclature follows USDA-SCS (1975).
** A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 4.

(b) A water table at less than 1.5 ft from the surface for a significant period (usually a week or more) during the growing season if permeability is less than 6.0 in/hr in any layer within 20 inches; or

c. Soils that are ponded for long or very long duration during the growing season; or

d. Soils that are frequently flooded for long duration or very long duration during the growing season."

A hydric soil may be either drained or undrained, and a drained hydric soil may not continue to support hydrophytic vegetation. Therefore, not all areas having hydric soils will qualify as wetlands. Only when a hydric soil supports hydrophytic vegetation and the area has indicators of wetland hydrology may the soil be referred to as a "wetland" soil.

38. A drained hydric soil is one in which sufficient ground or surface water has been removed by artificial means such that the area will no longer support hydrophyte vegetation. Onsite evidence of drained soils includes:

a. Presence of ditches or canals of sufficient depth to lower the water table below the major portion of the root zone of the prevalent vegetation.

b. Presence of dikes, levees, or similar structures that obstruct normal inundation of an area.

c. Presence of a tile system to promote subsurface drainage.

d. Diversion of upland surface runoff from an area.

Although it is important to record such evidence of drainage of an area, a hydric soil that has been drained or partially drained still allows the soil parameter to be met. However, the area will not qualify as a wetland if the degree of drainage has been sufficient to preclude the presence of either hydrophytic vegetation or a hydrologic regime that occurs in wetlands. *NOTE: the mere presence of drainage structures in an area is not sufficient basis for concluding that a hydric soil has been drained; such areas may continue to have wetland hydrology.*

General information

39. Soils consist of unconsolidated, natural material that supports, or is capable of supporting, plant life. The upper limit is air and the lower limit is either bedrock or the limit of biological activity. Some soils have very little organic matter (mineral soils), while others are composed primarily of organic matter (Histosols). The relative proportions of particles (sand, silt, clay, and organic matter) in a soil are influenced by many

interacting environmental factors. As normally defined, a soil must support plant life. The concept is expanded to include substrates that could support plant life. For various reasons, plants may be absent from areas that have well-defined soils.

40. A soil profile (Figure 2) consists of various soil layers described from the surface downward. Most soils have two or more identifiable horizons. A soil horizon is a layer oriented approximately parallel to the soil surface, and usually is differentiated from contiguous horizons by characteristics that can be seen or measured in the field (e.g., color, structure, texture, etc.). Most mineral soils have A-, B-, and C-horizons, and many have surficial organic layers (O-horizon). The A-horizon, the surface soil or topsoil, is a

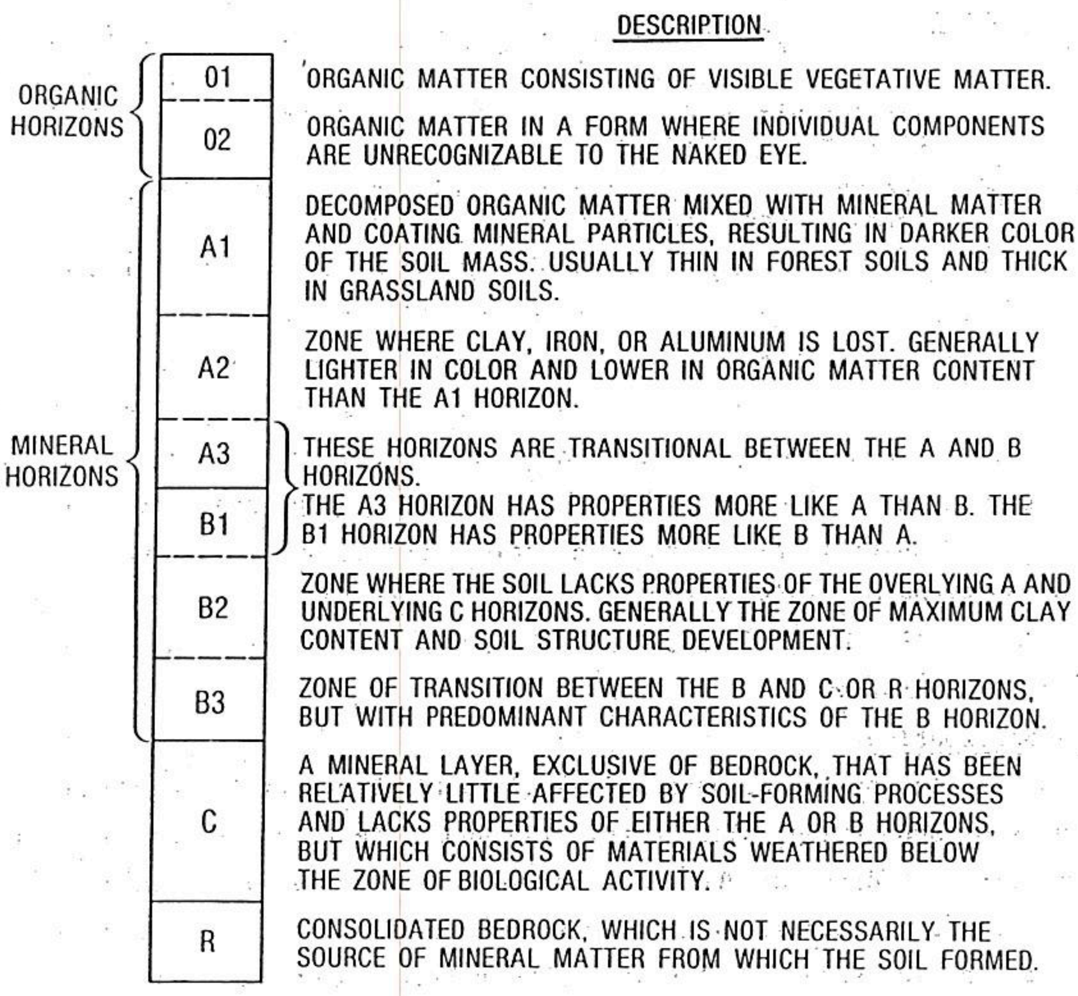


Figure 2. Generalized soil profile

zone in which organic matter is usually being added to the mineral soil. It is also the zone from which both mineral and organic matter are being moved slowly downward. The next major horizon is the B-horizon, often referred to as the subsoil. The B-horizon is the zone of maximum accumulation of materials. It is usually characterized by higher clay content and/or more pronounced soil structure development and lower organic matter than the A-horizon. The next major horizon is usually the C-horizon, which consists of unconsolidated parent material that has not been sufficiently weathered to exhibit characteristics of the B-horizon. Clay content and degree of soil structure development in the C-horizon are usually less than in the B-horizon. The lowest major horizon, the R-horizon, consists of consolidated bedrock. In many situations, this horizon occurs at such depths that it has no significant influence on soil characteristics.

Influencing factors

41. Although all soil-forming factors (climate, parent material, relief, organisms, and time) affect the characteristics of a hydric soil, the overriding influence is the hydrologic regime. The unique characteristics of hydric soils result from the influence of periodic or permanent inundation or soil saturation for sufficient duration to effect anaerobic conditions. Prolonged anaerobic soil conditions lead to a reducing environment, thereby lowering the soil redox potential. This results in chemical reduction of some soil components (e.g. iron and manganese oxides), which leads to development of soil colors and other physical characteristics that usually are indicative of hydric soils.

Classification

42. Hydric soils occur in several categories of the current soil classification system, which is published in Soil Taxonomy (USDA-SCS 1975). This classification system is based on physical and chemical properties of soils that can be seen, felt, or measured. Lower taxonomic categories of the system (e.g. soil series and soil phases) remain relatively unchanged from earlier classification systems.

43. Hydric soils may be classified into two broad categories: organic and mineral. Organic soils (Histosols) develop under conditions of nearly continuous saturation and/or inundation. All organic soils are hydric soils except Folists, which are freely drained soils occurring on dry slopes where excess litter accumulates over bedrock. Organic hydric soils are commonly

known as peats and mucks. All other hydric soils are mineral soils. Mineral soils have a wide range of textures (sandy to clayey) and colors (red to gray). Mineral hydric soils are those periodically saturated for sufficient duration to produce chemical and physical soil properties associated with a reducing environment. They are usually gray and/or mottled immediately below the surface horizon (see paragraph 44d), or they have thick, dark-colored surface layers overlying gray or mottled subsurface horizons.

Wetland indicators (nonsandy soils)

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

a. Organic soils (Histosols). A soil is an organic soil when: (1) more than 50 percent (by volume) of the upper 32 inches of soil is composed of organic soil material;** or (2) organic soil material of any thickness rests on bedrock. Organic soils (Figure 3) are saturated for long periods and are commonly called peats or mucks.

b. Histic epipedons. A histic epipedon is an 8- to 16-inch layer at or near the surface of a mineral hydric soil that is saturated with water for 30 consecutive days or more in most years and contains a minimum of 20 percent organic matter when no clay is present or a minimum of 30 percent organic matter when clay content is 60 percent or greater. Soils with histic epipedons are inundated or saturated for sufficient periods to greatly retard aerobic decomposition of the organic surface, and are considered to be hydric soils.

c. Sulfidic material. When mineral soils emit an odor of rotten eggs, hydrogen sulfide is present. Such odors are only detected in waterlogged soils that are permanently saturated and have sulfidic material within a few centimetres of the soil surface. Sulfides are produced only in a reducing environment.

d. Aquic or peraquic moisture regime. An aquic moisture regime is a reducing one; i.e., it is virtually free of dissolved oxygen because the soil is saturated by ground water or by water of the capillary fringe (USDA-SCS 1975). Because dissolved oxygen is removed from ground water by respiration of microorganisms, roots, and soil fauna, it is also implicit that the soil temperature is above biologic zero (5° C) at some time while the

---

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

** A detailed definition of organic soil material is available in USDA-SCS (1975).

soil is saturated. Soils with peraquic moisture regimes are characterized by the presence of ground water always at or near the soil surface. Examples include soils of tidal marshes and soils of closed, landlocked depressions that are fed by permanent streams.

e. Reducing soil conditions. Soils saturated for long or very long duration will usually exhibit reducing conditions. Under such conditions, ions of iron are transformed from a ferric valence state to a ferrous valence state. This condition can often be detected in the field by a ferrous iron test. A simple colorimetric field test kit has been developed for this purpose. When a soil extract changes to a pink color upon addition of α-α-dipyridil, ferrous iron is present, which indicates a reducing soil environment. *NOTE: This test cannot be used in mineral hydric soils having low iron content, organic soils, and soils that have been desaturated for significant periods of the growing season.*

f. Soil colors. The colors of various soil components are often the most diagnostic indicator of hydric soils. Colors of these components are strongly influenced by the frequency and duration of soil saturation, which leads to reducing soil conditions. Mineral hydric soils will be either gleyed or will have bright mottles and/or low matrix chroma. These are discussed below:

(1) Gleyed soils (gray colors). Gleyed soils develop when anaerobic soil conditions result in pronounced chemical reduction of iron, manganese, and other elements, thereby producing gray soil colors. Anaerobic conditions that occur in waterlogged soils result in the predominance of reduction processes, and such soils are greatly reduced. Iron is one of the most abundant elements in soils. Under anaerobic conditions, iron in converted from the oxidized (ferric) state to the reduced (ferrous) state, which results in the bluish, greenish, or grayish colors associated with the gleying effect (Figure 4). Gleying immediately below the A-horizon or 10 inches (whichever is shallower) is an indication of a markedly reduced soil, and gleyed soils are hydric soils. Gleyed soil conditions can be determined by using the gley page of the Munsell Color Book (Munsell Color 1975).

(2) Soils with bright mottles and/or low matrix chroma. Mineral hydric soils that are saturated for substantial periods of the growing season (but not long enough to produce gleyed soils) will either have bright mottles and a low matrix chroma or will lack mottles but have a low matrix chroma (see Appendix D, Section 1, for a definition and discussion of "chroma" and other components of soil color). Mottled means "marked with spots of contrasting color." Soils that have brightly colored mottles and a low matrix chroma are indicative of a fluctuating water table. The soil matrix is the portion (usually more than 50 percent) of a given soil layer that has the predominant

color (Figure 5). Mineral hydric soils usually have one of the following color features in the horizon immediately below the A-horizon or 10 inches (whichever is shallower):

(a) Matrix chroma of 2 or less* in mottled soils.

(b) Matrix chroma of 1 or less* in unmottled soils.

*NOTE: The matrix chroma of some dark (black) mineral hydric soils will not conform to the criteria described in (a) and (b) above; in such soils, gray mottles occurring at 10 inches or less are indicative of hydric conditions.*

*CAUTION: Soils with significant coloration due to the nature of the parent material (e.g. red soils of the Red River Valley) may not exhibit the above characteristics. In such cases, this indicator cannot be used.*

g. Soil appearing on hydric soils list. Using the criteria for hydric soils (paragraph 37), the NTCHS has developed a list of hydric soils. Listed soils have reducing conditions for a significant portion of the growing season in a major portion of the root zone and are frequently saturated within 12 inches of the soil surface. The NTCHS list of hydric soils is presented in Appendix D, Section 2. *CAUTION: Be sure that the profile description of the mapping unit conforms to that of the sampled soil.*

h. Iron and manganese concretions. During the oxidation-reduction process, iron and manganese in suspension are sometimes segregated as oxides into concretions or soft masses (Figure 6). These accumulations are usually black or dark brown. Concretions >2 mm in diameter occurring within 7.5 cm of the surface are evidence that the soil is saturated for long periods near the surface.

Wetland indicators (sandy soils)

45. Not all indicators listed in paragraph 44 can be applied to sandy soils. In particular, soil color should not be used as an indicator in most sandy soils. However, three additional soil features may be used as indicators of sandy hydric soils, including:

a. High organic matter content in the surface horizon. Organic matter tends to accumulate above or in the surface horizon of sandy soils that are inundated or saturated to the surface for a significant portion of the growing season. Prolonged inundation or saturation creates anaerobic conditions that greatly reduce oxidation of organic matter.

b. Streaking of subsurface horizons by organic matter. Organic matter is moved downward through sand as the water table

---

* Colors should be determined in soils that have been moistened; otherwise, state that colors are for dry soils.

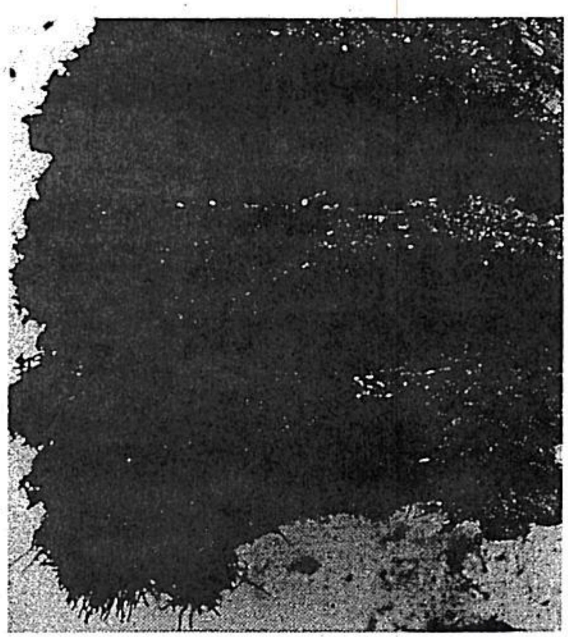

Figure 3. Organic soil

Figure 4. Gleyed soil

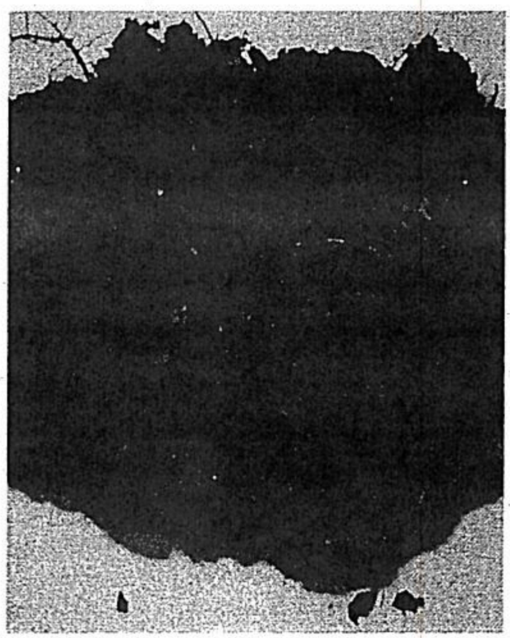

Figure 5. Soil showing matrix (brown) and mottles (reddish-brown)

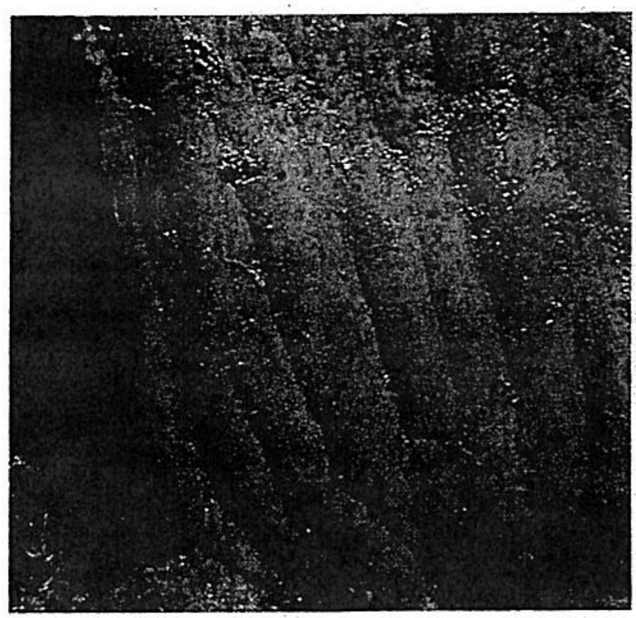

Figure 6. Iron and manganese concretions

fluctuates. This often occurs more rapidly and to a greater degree in some vertical sections of a sandy soil containing high content of organic matter than in others. Thus, the sandy soil appears vertically streaked with darker areas. When soil from a darker area is rubbed between the fingers, the organic matter stains the fingers.

c. Organic pans. As organic matter is moved downward through sandy soils, it tends to accumulate at the point representing the most commonly occurring depth to the water table. This organic matter tends to become slightly cemented with aluminum, forming a thin layer of hardened soil (spodic horizon). These horizons often occur at depths of 12 to 30 inches below the mineral surface. Wet spodic soils usually have thick dark surface horizons that are high in organic matter with dull, gray horizons above the spodic horizon.

*CAUTION: In recently deposited sandy material (e.g. accreting sandbars), it may be impossible to find any of these indicators. In such cases, consider this as a natural atypical situation.*

## Wetland Hydrology

### Definition

46. The term "wetland hydrology" encompasses all hydrologic characteristics of areas that are periodically inundated or have soils saturated to the surface at some time during the growing season. Areas with evident characteristics of wetland hydrology are those where the presence of water has an overriding influence on characteristics of vegetation and soils due to anaerobic and reducing conditions, respectively. Such characteristics are usually present in areas that are inundated or have soils that are saturated to the surface for sufficient duration to develop hydric soils and support vegetation typically adapted for life in periodically anaerobic soil conditions. Hydrology is often the least exact of the parameters, and indicators of wetland hydrology are sometimes difficult to find in the field. However, it is essential to establish that a wetland area is periodically inundated or has saturated soils during the growing season.

### Influencing factors

47. Numerous factors (e.g., precipitation, stratigraphy, topography, soil permeability, and plant cover) influence the wetness of an area. Regardless, the characteristic common to all wetlands is the presence of an abundant supply of water. The water source may be runoff from direct precipitation,

headwater or backwater flooding, tidal influence, ground water, or some combination of these sources. The frequency and duration of inundation or soil saturation varies from nearly permanently inundated or saturated to irregularly inundated or saturated. Topographic position, stratigraphy, and soil permeability influence both the frequency and duration of inundation and soil saturation. Areas of lower elevation in a floodplain or marsh have more frequent periods of inundation and/or greater duration than most areas at higher elevations. Floodplain configuration may significantly affect duration of inundation. When the floodplain configuration is conducive to rapid runoff, the influence of frequent periods of inundation on vegetation and soils may be reduced. Soil permeability also influences duration of inundation and soil saturation. For example, clayey soils absorb water more slowly than sandy or loamy soils, and therefore have slower permeability and remain saturated much longer. Type and amount of plant cover affect both degree of inundation and duration of saturated soil conditions. Excess water drains more slowly in areas of abundant plant cover, thereby increasing frequency and duration of inundation and/or soil saturation. On the other hand, transpiration rates are higher in areas of abundant plant cover, which may reduce the duration of soil saturation.

<u>Classification</u>

48. Although the interactive effects of all hydrologic factors produce a continuum of wetland hydrologic regimes, efforts have been made to classify wetland hydrologic regimes into functional categories. These efforts have focused on the use of frequency, timing, and duration of inundation or soil saturation as a basis for classification. A classification system developed for nontidal areas is presented in Table 5. This classification system was slightly modified from the system developed by the Workshop on Bottomland Hardwood Forest Wetlands of the Southeastern United States (Clark and Benforado 1981). Recent research indicates that duration of inundation and/or soil saturation during the growing season is more influential on the plant community than frequency of inundation/saturation during the growing season (Theriot, in press). Thus, frequency of inundation and soil saturation are not included in Table 5. The WES has developed a computer program that can be used to transform stream gage data to mean sea level elevations representing

Table 5

Hydrologic Zones* - Nontidal Areas

| Zone | Name | Duration** | Comments |
|---|---|---|---|
| I† | Permanently inundated | 100% | Inundation >6.6 ft mean water depth |
| II | Semipermanently to nearly permanently inundated or saturated | >75% - <100% | Inundation defined as ≤6.6 ft mean water depth |
| III | Regularly inundated or saturated | >25% - 75% | |
| IV | Seasonally inundated or saturated | >12.5% - 25% | |
| V | Irregularly inundated or saturated | ≥5% - 12.5% | Many areas having these hydrologic characteristics are not wetlands |
| VI | Intermittently or never inundated or saturated | <5% | Areas with these hydrologic characteristics are not wetlands |

* Zones adapted from Clark and Benforado (1981).

** Refers to duration of inundation and/or soil saturation during the growing season.

† This defines an aquatic habitat zone.

the upper limit of each hydrologic zone shown in Table 5. This program is available upon request.*

Wetland indicators

49. Indicators of wetland hydrology may include, but are not necessarily limited to: drainage patterns, drift lines, sediment deposition, watermarks, stream gage data and flood predictions, historic records, visual observation of saturated soils, and visual observation of inundation. Any of these indicators may be evidence of wetland hydrologic characteristics. Methods for determining hydrologic indicators can be categorized according to the type of indicator. Recorded data include stream gage data, lake gage data, tidal gage data, flood predictions, and historical records. Use of these data is commonly limited to areas adjacent to streams or other similar

* R. F. Theriot, Environmental Laboratory, US Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, Miss. 39180.

areas. Recorded data usually provide both short- and long-term information about frequency and duration of inundation, but contain little or no information about soil saturation, which must be gained from soil surveys or other similar sources. The remaining indicators require field observations. Field indicators are evidence of present or past hydrologic events (e.g. location and height of flooding). Indicators for recorded data and field observations include:*

a. Recorded data. Stream gage data, lake gage data, tidal gage data, flood predictions, and historical data may be available from the following sources:

(1) CE District Offices. Most CE Districts maintain stream, lake, and tidal gage records for major water bodies in their area. In addition, CE planning and design documents often contain valuable hydrologic information. For example, a General Design Memorandum (GDM) usually describes flooding frequencies and durations for a project area. Furthermore, the extent of flooding within a project area is sometimes indicated in the GDM according to elevation (height) of certain flood frequencies (1-, 2-, 5-, 10-year, etc.).

(2) US Geological Survey (USGS). Stream and tidal gage data are available from the USGS offices throughout the Nation, and the latter are also available from the National Oceanic and Atmospheric Administration. CE Districts often have such records.

(3) State, county, and local agencies. These agencies often have responsibility for flood control/relief and flood insurance.

(4) Soil Conservation Service Small Watershed Projects. Planning documents from this agency are often helpful, and can be obtained from the SCS district office in the county.

(5) Planning documents of developers.

b. Field data. The following field hydrologic indicators can be assessed quickly, and although some of them are not necessarily indicative of hydrologic events that occur only during the growing season, they do provide evidence that inundation and/or soil saturation has occurred:

(1) Visual observation of inundation. The most obvious and revealing hydrologic indicator may be simply observing the areal extent of inundation. However, because seasonal

---

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

conditions and recent weather conditions can contribute to surface water being present on a nonwetland site, both should be considered when applying this indicator.

(2) Visual observation of soil saturation. Examination of this indicator requires digging a soil pit (Appendix D, Section 1) to a depth of 16 inches and observing the level at which water stands in the hole after sufficient time has been allowed for water to drain into the hole. The required time will vary depending on soil texture. In some cases, the upper level at which water is flowing into the pit can be observed by examining the wall of the hole. This level represents the depth to the water table. The depth to saturated soils will always be nearer the surface due to the capillary fringe. For soil saturation to impact vegetation, it must occur within a major portion of the root zone (usually within 12 inches of the surface) of the prevalent vegetation. The major portion of the root zone is that portion of the soil profile in which more than one half of the plant roots occur. *CAUTION: In some heavy clay soils, water may not rapidly accumulate in the hole even when the soil is saturated. If water is observed at the bottom of the hole but has not filled to the 12-inch depth, examine the sides of the hole and determine the shallowest depth at which water is entering the hole. When applying this indicator, both the season of the year and preceding weather conditions must be considered.*

(3) Watermarks. Watermarks are most common on woody vegetation. They occur as stains on bark (Figure 7) or other fixed objects (e.g. bridge pillars, buildings, fences, etc.). When several watermarks are present, the highest reflects the maximum extent of recent inundation.

(4) Drift lines. This indicator is most likely to be found adjacent to streams or other sources of water flow in wetlands, but also often occurs in tidal marshes. Evidence consists of deposition of debris in a line on the surface (Figure 8) or debris entangled in aboveground vegetation or other fixed objects. Debris usually consists of remnants of vegetation (branches, stems, and leaves), sediment, litter, and other waterborne materials deposited parallel to the direction of water flow. Drift lines provide an indication of the minimum portion of the area inundated during a flooding event; the maximum level of inundation is generally at a higher elevation than that indicated by a drift line.

(5) Sediment deposits. Plants and other vertical objects often have thin layers, coatings, or depositions of mineral or organic matter on them after inundation (Figure 9). This evidence may remain for a considerable period before it is removed by precipitation or subsequent inundation. Sediment deposition on vegetation and other

Figure 7. Watermark on trees

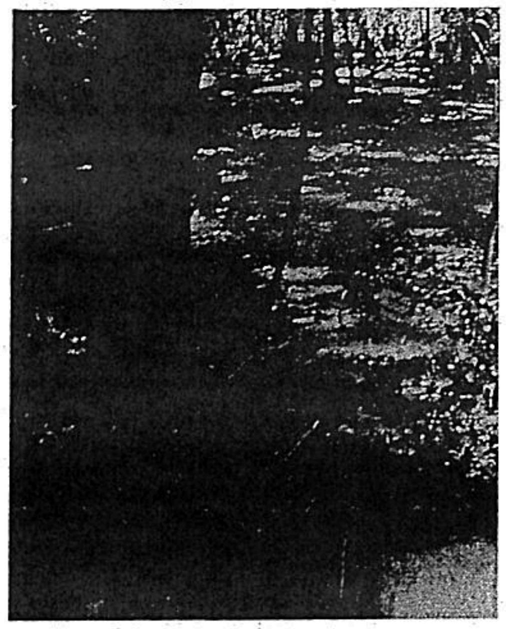

Figure 8. Absence of leaf litter and drift line (extreme left)

Figure 9. Sediment deposit on plants

Figure 10. Encrusted detritus

Figure 11.  Drainage pattern

Figure 12.  Debris deposited in stream channel

objects provides an indication of the minimum inundation level. When sediments are primarily organic (e.g. fine organic material, algae), the detritus may become encrusted on or slightly above the soil surface after dewatering occurs (Figure 10).

(6) Drainage patterns within wetlands. This indicator, which occurs primarily in wetlands adjacent to streams, consists of surface evidence of drainage flow into or through an area (Figure 11). In some wetlands, this evidence may exist as a drainage pattern eroded into the soil, vegetative matter (debris) piled against thick vegetation or woody stems oriented perpendicular to the direction of water flow, or the absence of leaf litter (Figure 8). Scouring is often evident around roots of persistent vegetation. Debris may be deposited in or along the drainage pattern (Figure 12). *CAUTION: Drainage patterns also occur in upland areas after periods of considerable precipitation; therefore, topographic position must also be considered when applying this indicator.*

## PART IV: METHODS

### Section A. Introduction

50. PART IV contains sections on preliminary data gathering, method selection, routine determination procedures, comprehensive determination procedures, methods for determinations in atypical situations, and guidance for wetland determinations in natural situations where the three-parameter approach may not always apply.

51. Significant flexibility has been incorporated into PART IV. The user is presented in Section B with various potential sources of information that may be helpful in making a determination, but not all identified sources of information may be applicable to a given situation. *Note: The user is not required to obtain information from all identified sources.* Flexibility is also provided in method selection (Section C). Three levels of routine determinations are available, depending on the complexity of the required determination and the quantity and quality of existing information. Application of methods presented in both Section D (routine determinations) and Section E (comprehensive determinations) may be tailored to meet site-specific requirements, especially with respect to sampling design.

52. Methods presented in Sections D and E vary with respect to the required level of technical knowledge and experience of the user. Application of the qualitative methods presented in Section D (routine determinations) requires considerably less technical knowledge and experience than does application of the quantitative methods presented in Section E (comprehensive determinations). The user must at least be able to identify the dominant plant species in the project area when making a routine determination (Section D), and should have some basic knowledge of hydric soils when employing routine methods that require soils examination. Comprehensive determinations require a basic understanding of sampling principles and the ability to identify all commonly occurring plant species in a project area, as well as a good understanding of indicators of hydric soils and wetland hydrology. The comprehensive method should only be employed by experienced field inspectors.

## Section B. Preliminary Data Gathering and Synthesis

53. This section discusses potential sources of information that may be helpful in making a wetland determination. When the routine approach is used, it may often be possible to make a wetland determination based on available vegetation, soils, and hydrology data for the area. However, this section deals only with identifying potential information sources, extracting pertinent data, and synthesizing the data for use in making a determination. Based on the quantity and quality of available information and the approach selected for use (Section C), the user is referred to either Section D or Section E for the actual determination. Completion of Section B is not required, but is recommended because the available information may reduce or eliminate the need for field effort and decrease the time and cost of making a determination. However, there are instances in small project areas in which the time required to obtain the information may be prohibitive. In such cases PROCEED to paragraph 55, complete STEPS 1 through 3, and PROCEED to Section D or E.

### Data sources

54. Obtain the following information, when available and applicable:

a. USGS quadrangle maps. USGS quadrangle maps are available at different scales. When possible, obtain maps at a scale of 1:24,000; otherwise, use maps at a scale of 1:62,500. Such maps are available from USGS in Reston, Va., and Menlo Park, Calif., but they may already be available in the CE District Office. These maps provide several types of information:

(1) Assistance in locating field sites. Towns, minor roads, bridges, streams, and other landmark features (e.g. buildings, cemeteries, water bodies, etc.) not commonly found on road maps are shown on these maps.

(2) Topographic details, including contour lines (usually at 5- or 10-ft contour intervals).

(3) General delineation of wet areas (swamps and marshes). *Note: The actual wet area may be greater than that shown on the map because USGS generally maps these areas based on the driest season of the year.*

(4) Latitude, longitude, townships, ranges, and sections. These provide legal descriptions of the area.

(5) Directions, including both true and magnetic north.

(6) Drainage patterns.

(7) General land uses, such as cleared (agriculture or pasture), forested, or urban.

*CAUTION: Obtain the most recent USGS maps. Older maps may show features that no longer exist and will not show new features that have developed since the map was constructed. Also, USGS is currently changing the mapping scale from 1:24,000 to 1:25,000.*

b. National Wetlands Inventory products.

(1) Wetland maps. The standard NWI maps are at a scale of 1:24,000 or, where USGS base maps at this scale are not available, they are at 1:62,500 (1:63,350 in Alaska). Smaller scale maps ranging from 1:100,000 to 1:500,000 are also available for certain areas. Wetlands on NWI maps are classified in accordance with Cowardin et al. (1979). *CAUTION: Since not all delineated areas on NWI maps are wetlands under Department of Army jurisdiction, NWI maps should not be used as the sole basis for determining whether wetland vegetation is present.* NWI "User Notes" are available that correlate the classification system with local wetland community types. An important feature of this classification system is the water regime modifier, which describes the flooding or soil saturation characteristics. Wetlands classified as having a temporarily flooded or intermittently flooded water regime should be viewed with particular caution since this designation is indicative of plant communities that are transitional between wetland and nonwetland. These are among the most difficult plant communities to map accurately from aerial photography. For wetlands "wetter" than temporarily flooded and intermittently flooded, the probability of a designated map unit on recent NWI maps being a wetland (according to Cowardin et al. 1979) at the time of the photography is in excess of 90 percent. *CAUTION: Due to the scale of aerial photography used and other factors, all NWI map boundaries are approximate.* The optimum use of NWI maps is to plan field review (i.e. how wet, big, or diverse is the area?) and to assist during field review, particularly by showing the approximate areal extent of the wetland and its association with other communities. NWI maps are available either as a composite with, or an overlay for, USGS base maps and may be obtained from the NWI Central Office in St. Petersburg, Fla., the Wetland Coordinator at each FWS regional office, or the USGS.

(2) Plant database. This database of approximately 5,200 plant species that occur in wetlands provides information (e.g., ranges, habitat, etc.) about each plant species from the technical literature. The database served as a focal point for development of a national list of plants that occur in wetlands (Appendix C, Section 1).

c. Soil surveys. Soil surveys are prepared by the SCS for political units (county, parish, etc.) in a state. Soil surveys contain several types of information:

(1) General information (e.g. climate, settlement, natural resources, farming, geology, general vegetation types).

(2) Soil maps for general and detailed planning purposes. These maps are usually generated from fairly recent aerial photography. *CAUTION: The smallest mapping unit is 3 acres, and a given soil series as mapped may contain small inclusions of other series.*

(3) Uses and management of soils. Any wetness characteristics of soils will be mentioned here.

(4) Soil properties. Soil and water features are provided that may be very helpful for wetland investigations. Frequency, duration, and timing of inundation (when present) are described for each soil type. Water table characteristics that provide valuable information about soil saturation are also described. Soil permeability coefficients may also be available.

(5) Soil classification. Soil series and phases are usually provided. Published soil surveys will not always be available for the area. If not, contact the county SCS office and determine whether the soils have been mapped.

d. Stream and tidal gage data. These documents provide records of tidal and stream flow events. They are available from either the USGS or CE District office.

e. Environmental impact assessments (EIAs), environmental impact statements (EISs), general design memoranda (GDM), and other similar publications. These documents may be available from Federal agencies for an area that includes the project area. They may contain some indication of the location and characteristics of wetlands consistent with the required criteria (vegetation, soils, and hydrology), and often contain flood frequency and duration data.

f. Documents and maps from State, county, or local governments. Regional maps that characterize certain areas (e.g., potholes, coastal areas, or basins) may be helpful because they indicate the type and character of wetlands.

g. Remote sensing. Remote sensing is one of the most useful information sources available for wetland identification and delineation. Recent aerial photography, particularly color infrared, provides a detailed view of an area; thus, recent land use and other features (e.g. general type and areal extent of plant communities and degree of inundation of the area when the photography was taken) can be determined. The multiagency cooperative National High Altitude Aerial Photography Program (HAP) has 1:59,000-scale color infrared photography for approximately 85 percent (December 1985) of the coterminous United States from 1980 to 1985. This photography has excellent resolution and can be ordered enlarged to 1:24,000 scale from USGS. Satellite images provide similar information as aerial photography, although the much smaller scale makes observation of detail more difficult without sophisticated equipment and extensive training. Satellite images provide more recent coverage than aerial photography (usually at 18-day intervals). Individual satellite images are more expensive than aerial photography, but are not as expensive as having an area flown and photographed at low altitudes. However, better resolution imagery is now available with remote sensing equipment mounted on fixed-wing aircraft.

h. Local individuals and experts. Individuals having personal knowledge of an area may sometimes provide a reliable and readily available source of information about the area, particularly information on the wetness of the area.

i. USGS land use and land cover maps. Maps created by USGS using remotely sensed data and a geographical information system provide a systematic and comprehensive collection and analysis of land use and land cover on a national basis. Maps at a scale of 1:250,000 are available as overlays that show land use and land cover according to nine basic levels. One level is wetlands (as determined by the FWS), which is further subdivided into forested and nonforested areas. Five other sets of maps show political units, hydrologic units, census subdivisions of counties, Federal land ownership, and State land ownership. These maps can be obtained from any USGS mapping center.

j. Applicant's survey plans and engineering designs. In many cases, the permit applicant will already have had the area surveyed (often at 1-ft contours or less) and will also have engineering designs for the proposed activity.

Data synthesis

55. When employing Section B procedures, use the above sources of information to complete the following steps:

- STEP 1 - Identify the Project Area on a Map. Obtain a USGS quadrangle map (1:24,000) or other appropriate map, and locate the area identified in the permit application. PROCEED TO STEP 2.
- STEP 2 - Prepare a Base Map. Mark the project area boundaries on the map. Either use the selected map as the base map or trace the area on a mylar overlay, including prominent landscape features (e.g., roads, buildings, drainage patterns, etc.). If possible, obtain diazo copies of the resulting base map. PROCEED TO STEP 3.
- STEP 3 - Determine Size of the Project Area. Measure the area boundaries and calculate the size of the area. PROCEED TO STEP 4 OR TO SECTION D OR E IF SECTION B IS NOT USED.

• STEP 4 - Summarize Available Information on Vegetation. Examine available sources that contain information about the area vegetation. Consider the following:

a. USGS quadrangle maps. Is the area shown as a marsh or swamp? *CAUTION: Do not use this as the sole basis for determining that hydrophytic vegetation is present.*

b. NWI overlays or maps. Do the overlays or maps indicate that hydrophytic vegetation occurs in the area? If so, identify the vegetation type(s).

c. EIAs, EISs, or GDMs that include the project area. Extract any vegetation data that pertain to the area.

d. Federal, State, or local government documents that contain information about the area vegetation. Extract appropriate data.

e. Recent (within last 5 years) aerial photography of the area. Can the area plant community type(s) be determined from the photography? Extract appropriate data.

f. Individuals or experts having knowledge of the area vegetation. Contact them and obtain any appropriate information. *CAUTION: Ensure that the individual providing the information has firsthand knowledge of the area.*

g. Any published scientific studies of the area plant communities. Extract any appropriate data.

h. Previous wetland determinations made for the area. Extract any pertinent vegetation data.

When the above have been considered, PROCEED TO STEP 5.

• STEP 5 - Determine Whether the Vegetation in the Project Area Is Adequately Characterized. Examine the summarized data (STEP 4) and determine whether the area plant communities are adequately characterized. For routine determinations, the plant community type(s) and the dominant species in each vegetation layer of each community type must be known. Dominant species are those that have the largest relative basal area (overstory),* height (woody understory), number of stems (woody vines), or greatest areal cover (herbaceous understory). For comprehensive determinations, each plant community type present in the

* This term is used because species having the largest individuals may not be dominant when only a few are present. To use relative basal area, consider both the size and number of individuals of a species and subjectively compare with other species present.

project area area must have been quantitatively described within the past 5 years using accepted sampling and analytical procedures, and boundaries between community types must be known. Record information on DATA FORM 1.* In either case, PROCEED TO Section F if there is evidence of recent significant vegetation alteration due to human activities or natural events. Otherwise, PROCEED TO STEP 6.

• STEP 6 - Summarize Available Information on Area Soils. Examine available information and describe the area soils. Consider the following:

a. County soil surveys. Determine the soil series present and extract characteristics for each. *CAUTION: Soil mapping units sometimes include more than one soil series.*

b. Unpublished county soil maps. Contact the local SCS office and determine whether soil maps are available for the area. Determine the soil series of the area, and obtain any available information about possible hydric soil indicators (paragraph 44 or 45) for each soil series.

c. Published EIAs, EISs, or GDMs that include soils information. Extract any pertinent information.

d. Federal, State, and/or local government documents that contain descriptions of the area soils. Summarize these data.

e. Published scientific studies that include area soils data. Summarize these data.

f. Previous wetland determinations for the area. Extract any pertinent soils data.

When the above have been considered, PROCEED TO STEP 7.

• STEP 7 - Determine Whether Soils of the Project Area Have Been Adequately Characterized. Examine the summarized soils data and determine whether the soils have been adequately characterized. For routine determinations, the soil series must be known. For comprehensive determinations, both the soil series and the boundary of each soil series must be known. Record information on DATA FORM 1. In either case, if there is evidence of recent significant soils alteration due to human activities or natural events, PROCEED TO Section F. Otherwise, PROCEED TO STEP 8.

• STEP 8 - Summarize Available Hydrology Data. Examine available information and describe the area hydrology. Consider the following:

---

* A separate DATA FORM 1 must be used for each plant community type.

a. USGS quadrangle maps. Is there a significant, well-defined drainage through the area? Is the area within a major floodplain or tidal area? What range of elevations occur in the area, especially in relation to the elevation of the nearest perennial watercourse?

b. NWI overlays or maps. Is the area shown as a wetland or deepwater aquatic habitat? What is the water regime modifier?

c. EIAs, EISs, or GDMs that describe the project area. Extract any pertinent hydrologic data.

d. Floodplain management maps. These maps may be used to extrapolate elevations that can be expected to be inundated on a 1-, 2-, 3-year, etc., basis. Compare the elevations of these features with the elevation range of the project area to determine the frequency of inundation.

e. Federal, State, and local government documents (e.g. CE floodplain management maps and profiles) that contain hydrologic data. Summarize these data.

f. Recent (within past 5 years) aerial photography that shows the area to be inundated. Record the date of the photographic mission.

g. Newspaper accounts of flooding events that indicate periodic inundation of the area.

h. SCS County Soil Surveys that indicate the frequency and duration of inundation and soil saturation for area soils. *CAUTION: Data provided only represent average conditions for a particular soil series in its natural undrained state, and cannot be used as a positive hydrologic indicator in areas that have significantly altered hydrology.*

i. Tidal or stream gage data for a nearby water body that apparently influences the area. Obtain the gage data and complete (1) below if the routine approach is used, or (2) below if the comprehensive approach is used (OMIT IF GAGING STATION DATA ARE UNAVAILABLE):

   (1) Routine approach. Determine the highest water level elevation reached during the growing season for each of the most recent 10 years of gage data. Rank these elevations in descending order and select the fifth highest elevation. Combine this elevation with the mean sea level elevation of the gaging station to produce a mean sea level elevation for the highest water level reached every other year. *NOTE: Stream gage data are often presented as flow rates in cubic feet per second. In these cases, ask the CE District's Hydrology Branch to convert flow rates to corresponding mean sea level elevations and adjust gage data to the site.* Compare the resulting elevations reached biennially with the project area elevations. If the water level elevation exceeds the area

elevation, the area is inundated during the growing season on average at least biennially.

(2) Comprehensive approach. Complete the following:

(a) Decide whether hydrologic data reflect the apparent hydrology. Data available from the gaging station may or may not accurately reflect the area hydrology. Answer the following questions:

- Does the water level of the area appear to fluctuate in a manner that differs from that of the water body on which the gaging station is located? (In ponded situations, the water level of the area is usually higher than the water level at the gaging station.)
- Are less than 10 years of daily readings available for the gaging station?
- Do other water sources that would not be reflected by readings at the gaging station appear to significantly affect the area? For example, do major tributaries enter the stream or tidal area between the area and gaging station?

If the answer to any of the above questions is YES, the area hydrology cannot be determined from the gaging station data. If the answer to all of the above questions is NO, PROCEED TO (b).

(b) Analyze hydrologic data. Subject the hydrologic data to appropriate analytical procedures. Either use duration curves or a computer program developed by WES (available from the Environmental Laboratory upon request) for determining the mean sea level elevation representing the upper limits of wetland hydrology. In the latter case, when the site elevation is lower than the mean sea level elevation representing a 5-percent duration of inundation and saturation during the growing season, the area has a hydrologic regime that may occur in wetlands. *NOTE: Duration curves do not reflect the period of soil saturation following dewatering.*

When all of the above have been considered, PROCEED TO STEP 9.

- STEP 9 - Determine Whether Hydrology Is Adequately Characterized.

Examine the summarized data and determine whether the hydrology of the project area is adequately characterized. For routine determinations, there must be documented evidence of frequent inundation or soil saturation during the growing season. For comprehensive determinations, there must be documented quantitative evidence of frequent inundation or soil saturation during the growing season, based on at least

10 years of stream or tidal gage data. Record information on DATA FORM 1. In either case, if there is evidence of recent significant hydrologic alteration due to human activities or natural events, PROCEED TO Section F. Otherwise, PROCEED TO Section C.

## Section C. Selection of Method

56. All wetland delineation methods described in this manual can be grouped into two general types: routine and comprehensive. Routine determinations (Section D) involve simple, rapidly applied methods that result in sufficient qualitative data for making a determination. Comprehensive methods (Section E) usually require significant time and effort to obtain the needed quantitative data. The primary factor influencing method selection will usually be the complexity of the required determination. However, comprehensive methods may sometimes be selected for use in relatively simple determinations when rigorous documentation is required.

57. Three levels of routine wetland determinations are described below. Complexity of the project area and the quality and quantity of available information will influence the level selected for use.

- a. Level 1 - Onsite Inspection Unnecessary. This level may be employed when the information already obtained (Section B) is sufficient for making a determination for the entire project area (see Section D, Subsection 1).
- b. Level 2 - Onsite Inspection Necessary. This level must be employed when there is insufficient information already available to characterize the vegetation, soils, and hydrology of the entire project area (see Section D, Subsection 2).
- c. Level 3 - Combination of Levels 1 and 2. This level should be used when there is sufficient information already available to characterize the vegetation, soils, and hydrology of a portion, but not all, of the project area. Methods described for Level 1 may be applied to portions of the area for which adequate information already exists, and onsite methods (Level 2) must be applied to the remainder of the area (see Section D, Subsection 3).

58. After considering all available information, select a tentative method (see above) for use, and PROCEED TO EITHER Section D or E, as appropriate. *NOTE: Sometimes it may be necessary to change to another method described in the manual, depending on the quality of available information and/or recent changes in the project area.*

## Section D. Routine Determinations

59. This section describes general procedures for making routine wetland determinations. It is assumed that the user has already completed all applicable steps in Section B,* and a routine method has been tentatively selected for use (Section C). Subsections 1-3 describe steps to be followed when making a routine determination using one of the three levels described in Section C. Each subsection contains a flowchart that defines the relationship of steps to be used for that level of routine determinations. *NOTE: The selected method must be considered tentative because the user may be required to change methods during the determination.*

. . .

### Subsection 1 - Onsite Inspection Unnecessary

60. This subsection describes procedures for making wetland determinations when sufficient information is already available (Section B) on which to base the determination. A flowchart of required steps to be completed is presented in Figure 13, and each step is described below.

#### Equipment and materials

61. No special equipment is needed for applying this method. The following materials will be needed:

- a. Map of project area (Section B, STEP 2).
- b. Copies of DATA FORM 1 (Appendix B).
- c. Appendices C and D to this manual.

#### Procedure

62. Complete the following steps, as necessary:

- STEP 1 - Determine Whether Available Data Are Sufficient for Entire Project Area. Examine the summarized data (Section B, STEPS 5, 7, and 9) and determine whether the vegetation, soils, and hydrology of the entire project area are adequately characterized. If so, PROCEED TO STEP 2. If all three parameters are adequately characterized for a portion, but not all, of the project area, PROCEED TO Subsection 3. If

---

* If it has been determined that it is more expedient to conduct an onsite inspection than to search for available information, complete STEPS 1 through 3 of Section B, and PROCEED TO Subsection 2.

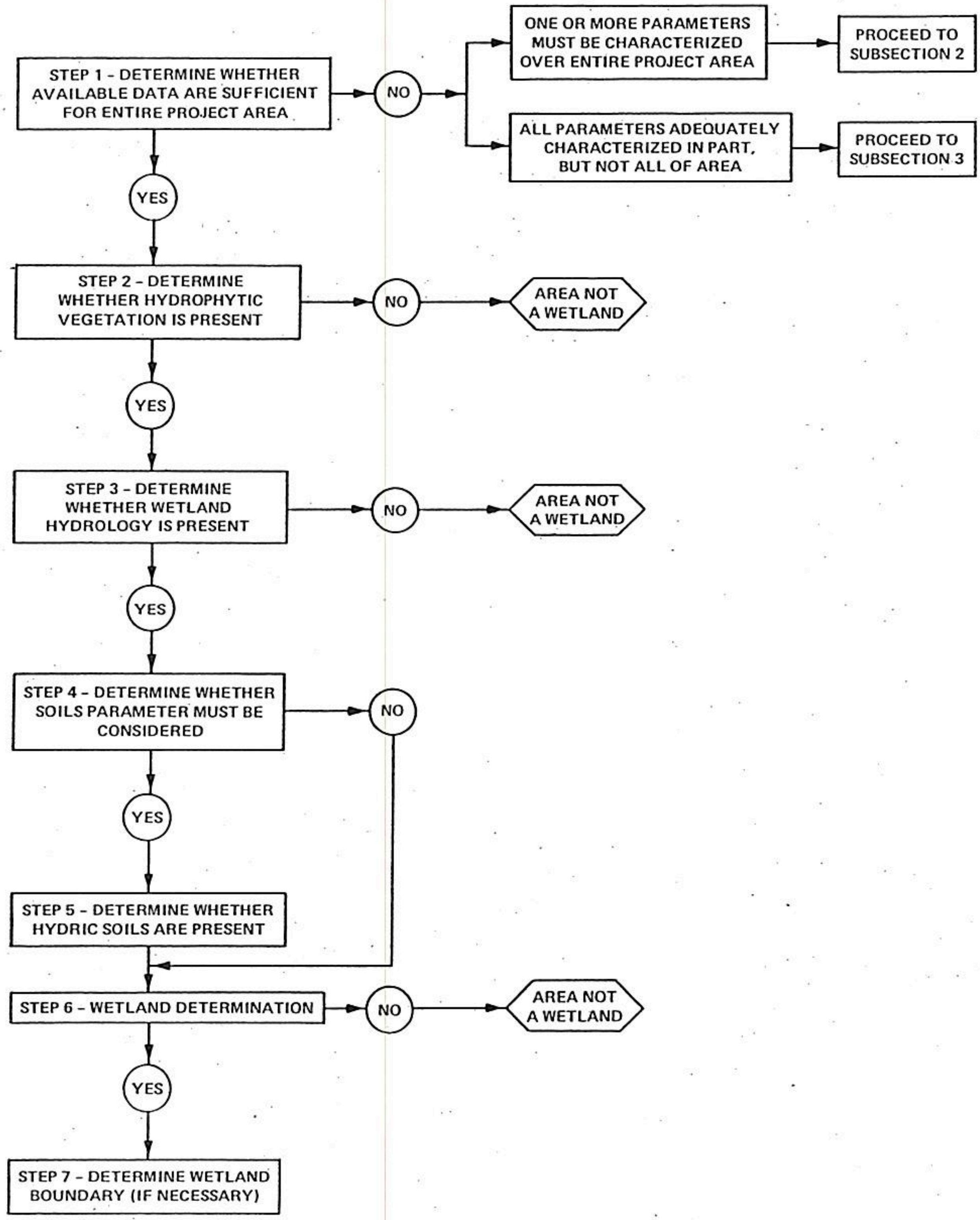


Figure 13. Flowchart of steps involved in making a wetland determination when an onsite inspection is unnecessary

the vegetation, soils, and hydrology are not adequately characterized for any portion of the area, PROCEED TO Subsection 2.

- <u>STEP 2 - Determine Whether Hydrophytic Vegetation Is Present.</u>

Examine the vegetation data and list on DATA FORM 1 the dominant plant species found in each vegetation layer of each community type. *NOTE: A separate DATA FORM 1 will be required for each community type.* Record the indicator status for each dominant species (Appendix C, Section 1 or 2). When more than 50 percent of the dominant species in a plant community have an indicator status of OBL, FACW, and/or FAC,* hydrophytic vegetation is present. If one or more plant communities comprise of hydrophytic vegetation, PROCEED TO STEP 3. If none of the plant communities comprise hydrophytic vegetation, none of the area is a wetland. Complete the vegetation section for each DATA FORM 1.

- <u>STEP 3 - Determine Whether Wetland Hydrology Is Present.</u> When one of the following conditions applies (STEP 2), it is only necessary to confirm that there has been no recent hydrologic alteration of the area:

  <u>a</u>. The entire project area is occupied by a plant community or communities in which all dominant species are OBL (Appendix C, Section 1 or 2).

  <u>b</u>. The project area contains two or more plant communities, all of which are dominated by OBL and/or FACW species, and the wetland-nonwetland boundary is abrupt** (e.g. a *Spartina alterniflora* marsh bordered by a road embankment).

If either <u>a</u> or <u>b</u> applies, look for recorded evidence of recently constructed dikes, levees, impoundments, and drainage systems, or recent avalanches, mudslides, beaver dams, etc., that have significantly altered the area hydrology. If any significant hydrologic alteration is found, determine whether the area is still periodically inundated or

---

* For the FAC-neutral option, see paragraph 35a.

** There must be documented evidence of periodic inundation or saturated soils when the project area:

<u>a</u>. Has plant communities dominated by one or more FAC species;
<u>b</u>. Has vegetation dominated by FACW species but no adjacent community dominated by OBL species;
<u>c</u>. Has a gradual, nondistinct boundary between wetlands and nonwetlands; and/or
<u>d</u>. Is known to have or is suspected of having significantly altered hydrology.

has saturated soils for sufficient duration to support the documented vegetation (a or b above). When a or b applies and there is no evidence of recent hydrologic alteration, or when a or b do not apply and there is documented evidence that the area is periodically inundated or has saturated soils, wetland hydrology is present. Otherwise, wetland hydrology does not occur on the area. Complete the hydrology section of DATA FORM 1 and PROCEED TO STEP 4.

- STEP 4 - Determine Whether the Soils Parameter Must Be Considered. When either a or b of STEP 3 applies and there is either no evidence of recent hydrologic alteration of the project area or if wetland hydrology presently occurs on the area, hydric soils can be assumed to be present. If so, PROCEED TO STEP 6. Otherwise PROCEED TO STEP 5.

- STEP 5 - Determine Whether Hydric Soils Are Present. Examine the soils data (Section B, STEP 7) and record the soil series or soil phase on DATA FORM 1 for each community type. Determine whether the soil is listed as a hydric soil (Appendix D, Section 2). If all community types have hydric soils, the entire project area has hydric soils. *(CAUTION: If the soil series description makes reference to inclusions of other soil types, data must be field verified).* Any portion of the area that lacks hydric soils is a nonwetland. Complete the soils section of each DATA FORM 1 and PROCEED TO STEP 6.

- STEP 6 - Wetland Determination. Examine the DATA FORM 1 for each community type. Any portion of the project area is a wetland that has:

  a. Hydrophytic vegetation that conforms to one of the conditions identified in STEP 3a or 3b and has either no evidence of altered hydrology or confirmed wetland hydrology.

  b. Hydrophytic vegetation that does not conform to STEP 3a or 3b, has hydric soils, and has confirmed wetland hydrology.

If STEP 6a or 6b applies to the entire project area, the entire area is a wetland. Complete a DATA FORM 1 for all plant community types. Portions of the area not qualifying as a wetland based on an office determination might or might not be wetlands. If the data used for the determination are considered to be highly reliable, portions of the area not qualifying as wetlands may properly be considered nonwetlands. PROCEED TO STEP 7. If the available data are incomplete or questionable, an onsite inspection (Subsection 2) will be required.

• STEP 7 - Determine Wetland Boundary. Mark on the base map all community types determined to be wetlands with a W and those determined to be nonwetlands with an N. Combine all wetland community types into a single mapping unit. The boundary of these community types is the interface between wetlands and nonwetlands.

## Subsection 2 - Onsite Inspection Necessary

63. This subsection describes procedures for routine determinations in which the available information (Section B) is insufficient for one or more parameters. If only one or two parameters must be characterized, apply the appropriate steps and return to Subsection 1 and complete the determination. A flowchart of steps required for using this method is presented in Figure 14, and each step is described below.

### Equipment and materials

64. The following equipment and materials will be needed:

a. Base map (Section B, STEP 2).

b. Copies of DATA FORM 1 (one for each community type and additional copies for boundary determinations).

c. Appendices C and D.

d. Compass.

e. Soil auger or spade (soils only).

f. Tape (300 ft).

g. Munsell Color Charts (Munsell Color 1975) (soils only).

### Procedure

65. Complete the following steps, as necessary:

• STEP 1 - Locate the Project Area. Determine the spatial boundaries of the project area using information from a USGS quadrangle map or other appropriate map, aerial photography, and/or the project survey plan (when available). PROCEED TO STEP 2.

• STEP 2 - Determine Whether an Atypical Situation Exists. Examine the area and determine whether there is evidence of sufficient natural or human-induced alteration to significantly alter the area vegetation, soils, and/or hydrology. *NOTE: Include possible offsite modifications that may affect the area hydrology.* If not, PROCEED TO STEP 3.

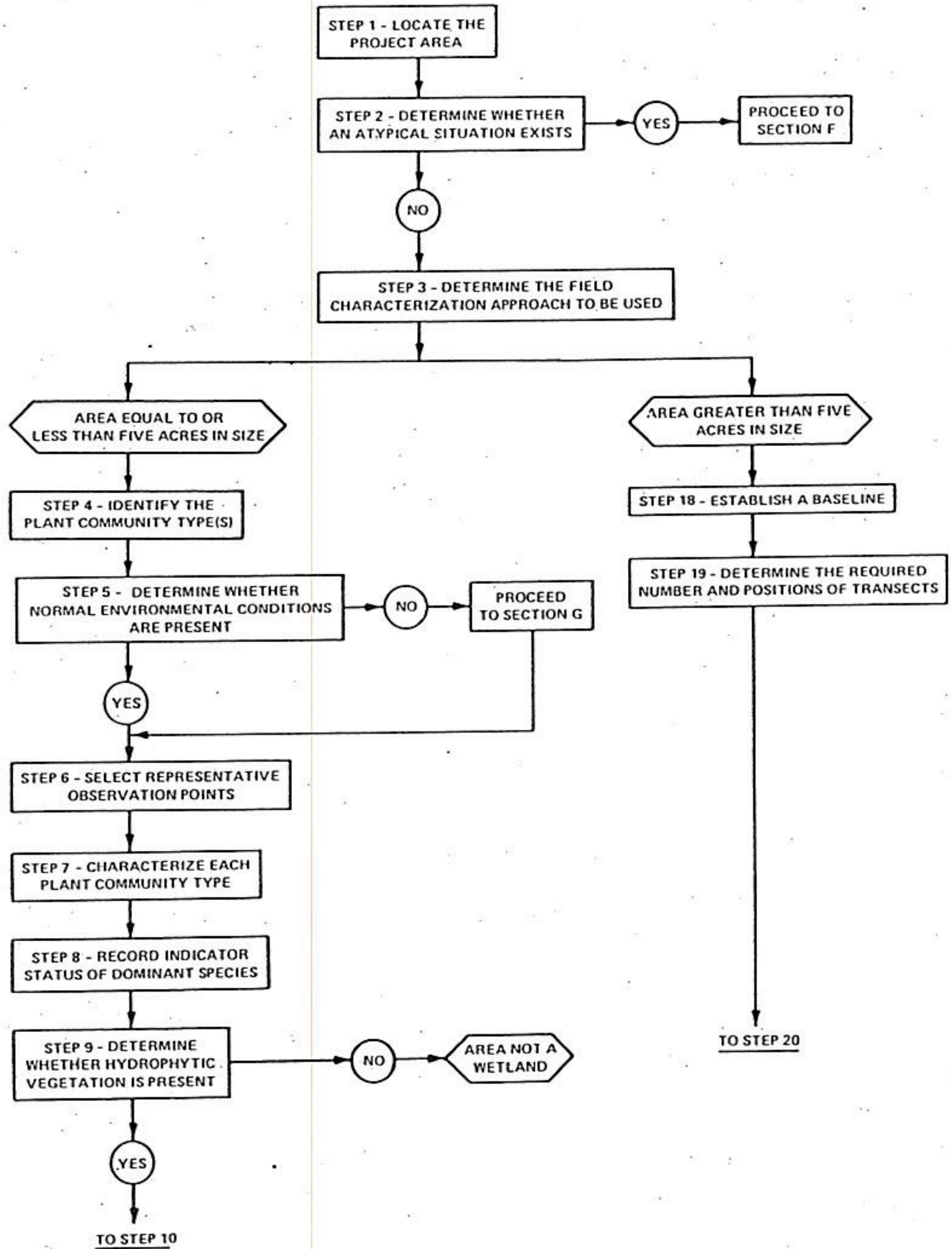


Figure 14. Flowchart of steps involved in making a routine wetland determination when an onsite visit is necessary (Continued)

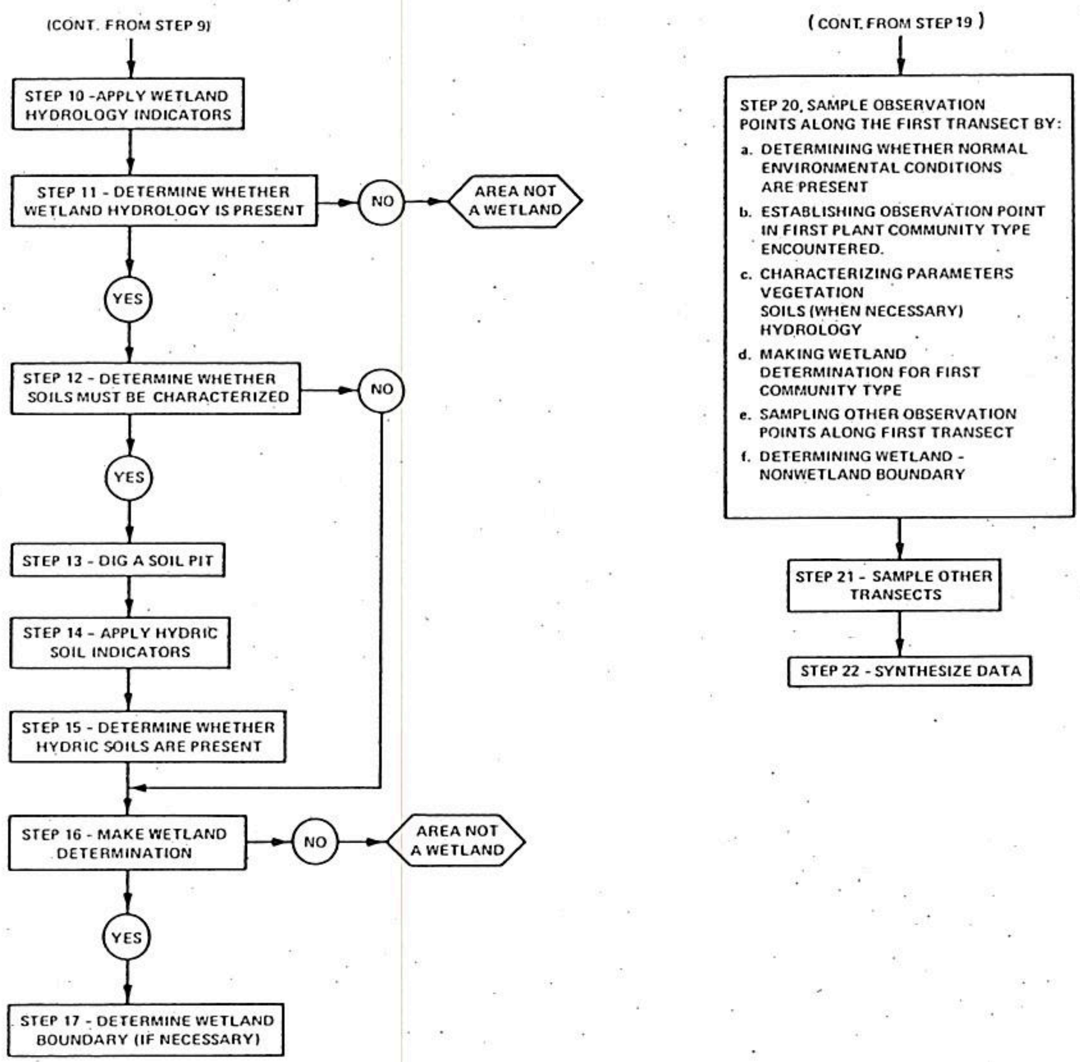


Figure 14. (Concluded)

If one or more parameters have been significantly altered by an activity that would normally require a permit, PROCEED TO Section F and determine whether there is sufficient evidence that hydrophytic vegetation, hydric soils, and/or wetland hydrology were present prior to this alteration. Then, return to this subsection and characterize parameters not significantly influenced by human activities. PROCEED TO STEP 3.

• STEP 3 - Determine the Field Characterization Approach to be Used. Considering the size and complexity of the area, determine the field characterization approach to be used. When the area is equal to or less than 5 acres in size (Section B, STEP 3) and the area is thought to be relatively homogeneous with respect to vegetation, soils, and/or hydrologic regime, PROCEED TO STEP 4. When the area is greater than 5 acres in size (Section B, STEP 3) or appears to be highly diverse with respect to vegetation, PROCEED TO STEP 18.

## Areas Equal to or Less Than 5 Acres in Size

• STEP 4 - Identify the Plant Community Type(s). Traverse the area and determine the number and locations of plant community types. Sketch the location of each on the base map (Section B, STEP 2), and give each community type a name. PROCEED TO STEP 5.

• STEP 5 - Determine Whether Normal Environmental Conditions Are Present. Determine whether normal environmental conditions are present by considering the following:

a. Is the area presently lacking hydrophytic vegetation or hydrologic indicators due to annual or seasonal fluctuations in precipitation or ground-water levels?

b. Are hydrophytic vegetation indicators lacking due to seasonal fluctuations in temperature?

If the answer to either of these questions is thought to be YES, PROCEED TO Section G. If the answer to both questions is NO, PROCEED TO STEP 6.

• STEP 6 - Select Representative Observation Points. Select a representative observation point in each community type. A representative observation point is one in which the apparent characteristics (determine visually) best represent characteristics of the entire community.

Mark on the base map the approximate location of the observation point. PROCEED TO STEP 7.

• <u>STEP 7 - Characterize Each Plant Community Type.</u> Visually determine the dominant plant species in each vegetation layer of each community type and record them on DATA FORM 1 (use a separate DATA FORM 1 for each community type). Dominant species are those having the greatest relative basal area (woody overstory),* greatest height (woody understory), greatest percentage of areal cover (herbaceous understory), and/or greatest number of stems (woody vines). PROCEED TO STEP 8.

• <u>STEP 8 - Record Indicator Status of Dominant Species.</u> Record on DATA FORM 1 the indicator status (Appendix C, Section 1 or 2) of each dominant species in each community type. PROCEED TO STEP 9.

• <u>STEP 9 - Determine Whether Hydrophytic Vegetation Is Present.</u> Examine each DATA FORM 1. When more than 50 percent of the dominant species in a community type have an indicator status (STEP 8) of OBL, FACW, and/or FAC,** hydrophytic vegetation is present. Complete the vegetation section of each DATA FORM 1. Portions of the area failing this test are not wetlands. PROCEED TO STEP 10.

• <u>STEP 10 - Apply Wetland Hydrologic Indicators.</u> Examine the portion of the area occupied by each plant community type for positive indicators of wetland hydrology (PART III, paragraph 49). Record findings on the appropriate DATA FORM 1. PROCEED TO STEP 11.

• <u>STEP 11 - Determine Whether Wetland Hydrology Is Present.</u> Examine the hydrologic information on DATA FORM 1 for each plant community type. Any portion of the area having a positive wetland hydrology indicator has wetland hydrology. If positive wetland hydrology indicators are present in all community types, the entire area has wetland hydrology. If no plant community type has a wetland hydrology indicator, none of the area has wetland hydrology. Complete the hydrology portion of each DATA FORM 1. PROCEED TO STEP 12.

---

* This term is used because species having the largest individuals may not be dominant when only a few are present. To determine relative basal area, consider both the size and number of individuals of a species and subjectively compare with other species present.

** For the FAC-neutral option, see paragraph 35a.

* • STEP 12 - Determine Whether Soils Must Be Characterized. Examine the vegetation section of each DATA FORM 1. Hydric soils are assumed to be present in any plant community type in which:

  a. All dominant species have an indicator status of OBL.

  b. All dominant species have an indicator status of OBL or FACW, and the wetland boundary (when present) is abrupt.*

When either a or b occurs and wetland hydrology is present, check the hydric soils blank as positive on DATA FORM 1 and PROCEED TO STEP 16. If neither a nor b applies, PROCEED TO STEP 13.

• STEP 13 - Dig a Soil Pit. Using a soil auger or spade, dig a soil pit at the representative location in each community type. The procedure for digging a soil pit is described in Appendix D, Section 1. When completed, approximately 16 inches of the soil profile will be available for examination. PROCEED TO STEP 14.

• STEP 14 - Apply Hydric Soil Indicators. Examine the soil at each location and compare its characteristics immediately below the A-horizon or 10 inches (whichever is shallower) with the hydric soil indicators described in PART III, paragraphs 44 and/or 45. Record findings on the appropriate DATA FORM 1's. PROCEED TO STEP 15.

• STEP 15 - Determine Whether Hydric Soils Are Present. Examine each DATA FORM 1 and determine whether a positive hydric soil indicator was found. If so, the area at that location has hydric soil. If soils at all sampling locations have positive hydric soil indicators, the entire area has hydric soils. If soils at all sampling locations lack positive hydric soil indicators, none of the area is a wetland. Complete the soil section of each DATA FORM 1. PROCEED TO STEP 16.

• STEP 16 - Make Wetland Determination. Examine DATA FORM 1. If the entire area presently or normally has wetland indicators of all three parameters (STEPS 9, 11, and 15), the entire area is a wetland. If the entire area presently or normally lacks wetland indicators of one or

---

* The soils parameter must be considered in any plant community in which:

  a. The community is dominated by one or more FAC species.
  b. No community type dominated by OBL species is present.
  c. The boundary between wetlands and nonwetlands is gradual or nondistinct.
  d. The area is known to or is suspected of having significantly altered hydrology.

more parameters, the entire area is a nonwetland. If only a portion of the area presently or normally has wetland indicators for all three parameters, PROCEED TO STEP 17.

• STEP 17 - Determine Wetland-Nonwetland Boundary. Mark each plant community type on the base map with a W if wetland or an N if nonwetland. Combine all wetland plant communities into one mapping unit and all nonwetland plant communities into another mapping unit. The wetland-nonwetland boundary will be represented by the interface of these two mapping units.

## Areas Greater Than 5 Acres in Size

• STEP 18 - Establish a Baseline. Select one project boundary as a baseline. The baseline should parallel the major watercourse through the area or should be perpendicular to the hydrologic gradient (Figure 15). Determine the approximate baseline length. PROCEED TO STEP 19.

• STEP 19 - Determine the Required Number and Position of Transects. Use the following to determine the required number and position of transects (specific site conditions may necessitate changes in intervals):

| Baseline length, miles | Number of Required Transects |
|---|---|
| ≤0.25 | 3 |
| >0.25-0.50 | 3 |
| >0.50-0.75 | 3 |
| >0.75-1.00 | 3 |
| >1.00-2.00 | 3-5 |
| >2.00-4.00 | 5-8 |
| >4.00 | 8 or more* |

* Transect intervals should not exceed 0.5 mile.

Divide the baseline length by the number of required transects. Establish one transect in each resulting baseline increment. Use the

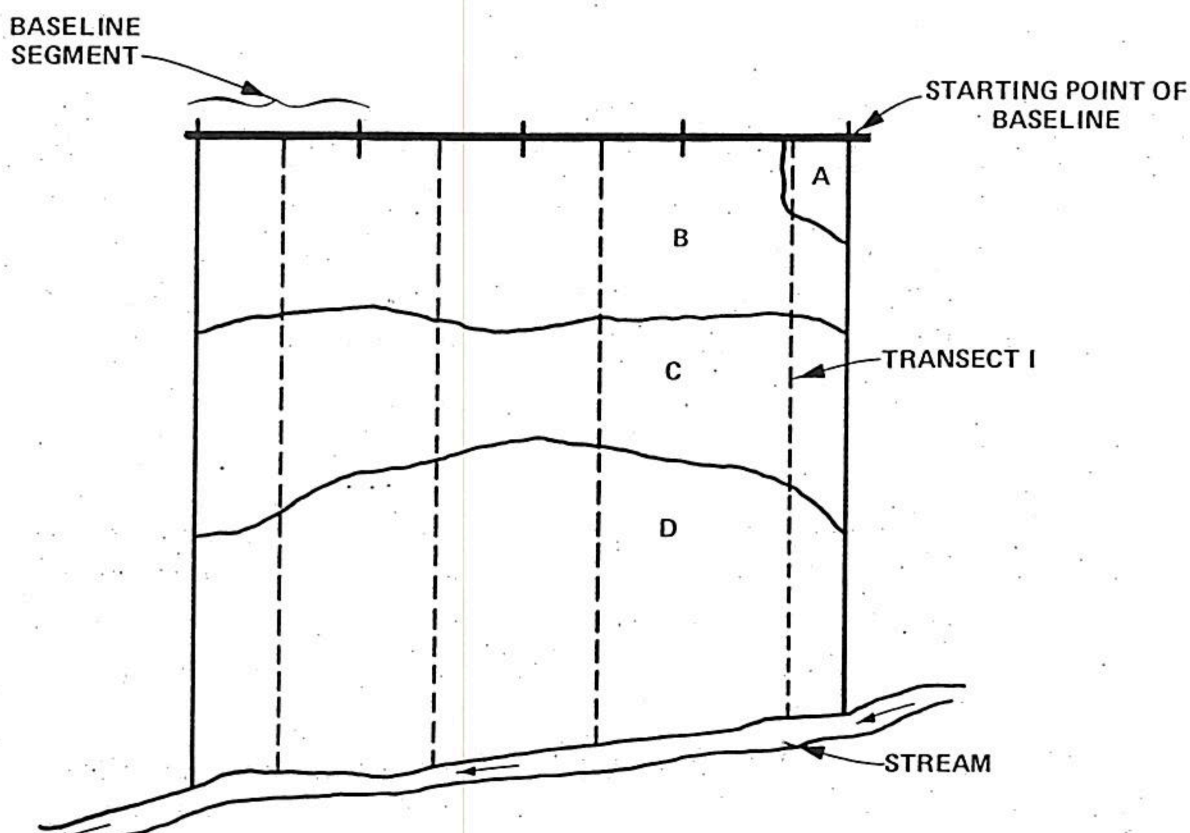


Figure 15. General orientation of baseline and transects (dotted lines) in a hypothetical project area. Alpha characters represent different plant communities. All transects start at the midpoint of a baseline segment except the first, which was repositioned to include community type A

midpoint of each baseline increment as a transect starting point. For example, if the baseline is 1,200 ft in length, three transects would be established--one at 200 ft, one at 600 ft, and one at 1,000 ft from the baseline starting point. *CAUTION: All plant community types must be included. This may necessitate relocation of one or more transect lines.* PROCEED TO STEP 20.

- STEP 20 - Sample Observation Points Along the First Transect. Beginning at the starting point of the first transect, extend the transect at a 90-deg angle to the baseline. Use the following procedure as appropriate to simultaneously characterize the parameters at each observation point. Combine field-collected data with information already available and make a wetland determination at each observation point. A DATA FORM 1 must be completed for each observation point.

a. Determine whether normal environmental conditions are present. Determine whether normal environmental conditions are present by considering the following:

(1) Is the area presently lacking hydrophytic vegetation and/or hydrologic indicators due to annual or seasonal fluctuations in precipitation or ground-water levels?

(2) Are hydrophytic vegetation indicators lacking due to seasonal fluctuations in temperature?

If the answer to either of these questions is thought to be YES, PROCEED TO Section G. If the answer to both questions is NO, PROCEED TO STEP 20b.

b. Establish an observation point in the first plant community type encountered. Select a representative location along the transect in the first plant community type encountered. When the first plant community type is large and covers a significant distance along the transect, select an area that is no closer than 300 ft to a perceptible change in plant community type. PROCEED TO STEP 20c.

c. Characterize parameters. Characterize the parameters at the observation point by completing (1), (2), and (3) below:

(1) Vegetation. Record on DATA FORM 1 the dominant plant species in each vegetation layer occurring in the immediate vicinity of the observation point. Use a 5-ft radius for herbs and saplings/shrubs, and a 30-ft radius for trees and woody vines (when present). Subjectively determine the dominant species by estimating those having the largest relative basal area* (woody overstory), greatest height (woody understory), greatest percentage of areal cover (herbaceous understory), and/or greatest number of stems (woody vines). *NOTE: Plot size may be estimated, and plot size may also be varied when site conditions warrant.* Record on DATA FORM 1 any dominant species observed to have morphological adaptations (Appendix C, Section 3) for occurrence in wetlands, and determine and record dominant species that have known physiological adaptations for occurrence in wetlands (Appendix C, Section 3). Record on DATA FORM 1 the indicator status (Appendix C, Section 1 or 2) of each dominant species. Hydrophytic vegetation is present at the observation point when more than 50 percent of the dominant species have an indicator status of OBL, FACW, and/or FAC**; when two or more dominant species have observed morphological or known physiological adaptations for occurrence in wetlands; or when other indicators of hydrophytic vegetation (PART III, paragraph 35) are

---

* This term is used because species having the largest individuals may not be dominant when only a few are present. To use relative basal area, consider both the size and number of individuals of a species and subjectively compare with other species present.

** For the FAC-neutral option, see paragraph 35a.

present. Complete the vegetation section of DATA FORM 1. PROCEED TO (2).

(2) Soils. In some cases, it is not necessary to characterize the soils. Examine the vegetation of DATA FORM 1. Hydric soils can be assumed to be present when:

(a) All dominant plant species have an indicator status of OBL.

(b) All dominant plant species have an indicator status of OBL and/or FACW (at least one dominant species must be OBL).*

When either (a) or (b) applies, check the hydric soils blank as positive and PROCEED TO (3). If neither (a) nor (b) applies but the vegetation qualifies as hydrophytic, dig a soil pit at the observation point using the procedure described in Appendix D, Section 1. Examine the soil immediately below the A-horizon or 10-inches (whichever is shallower) and compare its characteristics (Appendix D, Section 1) with the hydric soil indicators described in PART III, paragraphs 44 and/or 45. Record findings on DATA FORM 1. If a positive hydric soil indicator is present, the soil at the observation point is a hydric soil. If no positive hydric soil indicator is found, the area at the observation point does not have hydric soils and the area at the observation point is not a wetland. Complete the soils section of DATA FORM 1 for the observation point. PROCEED TO (3) if hydrophytic vegetation (1) and hydric soils (2) are present. Otherwise, PROCEED TO STEP 20d.

(3) Hydrology. Examine the observation point for indicators of wetland hydrology (PART III, paragraph 49), and record observations on DATA FORM 1. Consider the indicators in the same sequence as presented in PART III, paragraph 49. If a positive wetland hydrology indicator is present, the area at the observation point has wetland hydrology. If no positive wetland hydrologic indicator is present, the area at the observation point is not a wetland. Complete the hydrology section of DATA FORM 1 for the observation point. PROCEED TO STEP 20d.

d. Wetland determination. Examine DATA FORM 1 for the observation point. Determine whether wetland indicators of all three parameters are or would normally be present during a significant portion of the growing season. If so, the area at the observation point is a wetland. If no evidence can be found that the area at the observation point normally has wetland indicators for all three parameters, the area is a nonwetland. PROCEED TO STEP 20e.

---

* Soils must be characterized when any dominant species has an indicator status of FAC.

e. Sample other observation points along the first transect. Continue along the first transect until a different community type is encountered. Establish a representative observation point within this community type and repeat STEP 20c - 20d. If the areas at both observation points are either wetlands or nonwetlands, continue along the transect and repeat STEP 20c - 20d for the next community type encountered. Repeat for all other community types along the first transect. If the area at one observation point is wetlands and the next observation point is nonwetlands (or vice versa), PROCEED TO STEP 20f.

f. Determine wetland-nonwetland boundary. Proceed along the transect from the wetland observation point toward the nonwetland observation point. Look for subtle changes in the plant community (e.g. the first appearance of upland species, disappearance of apparent hydrology indicators, or slight changes in topography). When such features are noted, establish an observation point and repeat the procedures described in STEP 20c - 20d. *NOTE: A new DATA FORM 1 must be completed for this observation point, and all three parameters must be characterized by field observation.* If the area at this observation point is a wetland, proceed along the transect toward the nonwetland observation point until upland indicators are more apparent. Repeat the procedures described in STEP 20c - 20d. If the area at this observation point is a nonwetland, move halfway back along the transect toward the last documented wetland observation point and repeat the procedure described in STEP 20c - 20d. Continue this procedure until the wetland-nonwetland boundary is found. It is not necessary to complete a DATA FORM 1 for all intermediate points, but a DATA FORM 1 should be completed for the wetland-nonwetland boundary. Mark the position of the wetland boundary on the base map, and continue along the first transect until all community types have been sampled and all wetland boundaries located. *CAUTION: In areas where wetlands are interspersed among nonwetlands (or vice versa), several boundary determinations will be required.* When all necessary wetland determinations have been completed for the first transect, PROCEED TO STEP 21.

• STEP 21 - Sample Other Transects. Repeat procedures described in STEP 21 for all other transects. When completed, a wetland determination will have been made for one observation point in each community type along each transect, and all wetland-nonwetland boundaries along each transect will have been determined. PROCEED TO STEP 22.

• STEP 22 - Synthesize Data. Examine all completed copies of DATA FORM 1, and mark each plant community type on the base map. Identify each plant community type as either a wetland (W) or nonwetland (N). If all plant community types are identified as wetlands, the entire area is wetlands. If all plant community types are identified as nonwetlands, the entire area is nonwetlands. If both wetlands and nonwetlands are present, identify observation points that represent wetland boundaries on the base map. Connect these points on the map by generally following contour lines to separate wetlands from nonwetlands. Walk the contour line between transects to confirm the wetland boundary. Should anomalies be encountered, it will be necessary to establish short transects in these areas, apply the procedures described in STEP 20f, and make any necessary adjustments on the base map.

### Subsection 3 - Combination of Levels 1 and 2

66. In some cases, especially for large projects, adequate information may already be available (Section B) to enable a wetland determination for a portion of the project area, while an onsite visit will be required for the remainder of the area. Since procedures for each situation have already been described in Subsections 1 and 2, they will not be repeated. Apply the following steps:

- STEP 1 - Make Wetland Determination for Portions of the Project Area That Are Already Adequately Characterized. Apply procedures described in Subsection 1. When completed, a DATA FORM 1 will have been completed for each community type, and a map will have been prepared identifying each community type as wetland or nonwetland and showing any wetland boundary occurring in this portion of the project area. PROCEED TO STEP 2.
- STEP 2 - Make Wetland Determination for Portions of the Project Area That Require an Onsite Visit. Apply procedures described in Subsection 2. When completed, a DATA FORM 1 will have been completed for each plant community type or for a number of observation points (including wetland boundary determinations). A map of the wetland (if present) will also be available. PROCEED TO STEP 3.
- STEP 3 - Synthesize Data. Using the maps resulting from STEPS 1 and 2, prepare a summary map that shows the wetlands of the entire project area. *CAUTION: Wetland boundaries for the two maps will not always match exactly. When this occurs, an additional site visit will be required to refine the wetland boundaries. Since the degree of*

*resolution of wetland boundaries will be greater when determined on-site, it may be necessary to employ procedures described in Subsection 2 in the vicinity of the boundaries determined from Subsection 1 to refine these boundaries.*

## Section E. Comprehensive Determinations

67. This section describes procedures for making comprehensive wetland determinations. Unlike procedures for making routine determinations (Section D), application of procedures described in this section will result in maximum information for use in making determinations, and the information usually will be quantitatively expressed. Comprehensive determinations should only be used when the project area is very complex and/or when the determination requires rigorous documentation. This type of determination may be required in areas of any size, but will be especially useful in large areas. There may be instances in which only one parameter (vegetation, soil, or hydrology) is disputed. In such cases, only procedures described in this section that pertain to the disputed parameter need be completed. It is assumed that the user has already completed all applicable steps in Section B. *NOTE: Depending on site characteristics, it may be necessary to alter the sampling design and/or data collection procedures.*

68. This section is divided into five basic types of activities. The first consists of preliminary field activities that must be completed prior to making a determination (STEPS 1-5). The second outlines procedures for determining the number and locations of required determinations (STEPS 6-8). The third describes the basic procedure for making a comprehensive wetland determination at any given point (STEPS 9-17). The fourth describes a procedure for determining wetland boundaries (STEP 18). The fifth describes a procedure for synthesizing the collected data to determine the extent of wetlands in the area (STEPS 20-21). A flowchart showing the relationship of various steps required for making a comprehensive determination is presented in Figure 16.

### Equipment and material

69. Equipment and materials needed for making a comprehensive determination include:

- a. Base map (Section B, STEP 2).
- b. Copies of DATA FORMS 1 and 2.
- c. Appendices C and D.
- d. Compass.
- e. Tape (300 ft).
- f. Soil auger or spade.
- g. Munsell Color Charts (Munsell Color 1975).

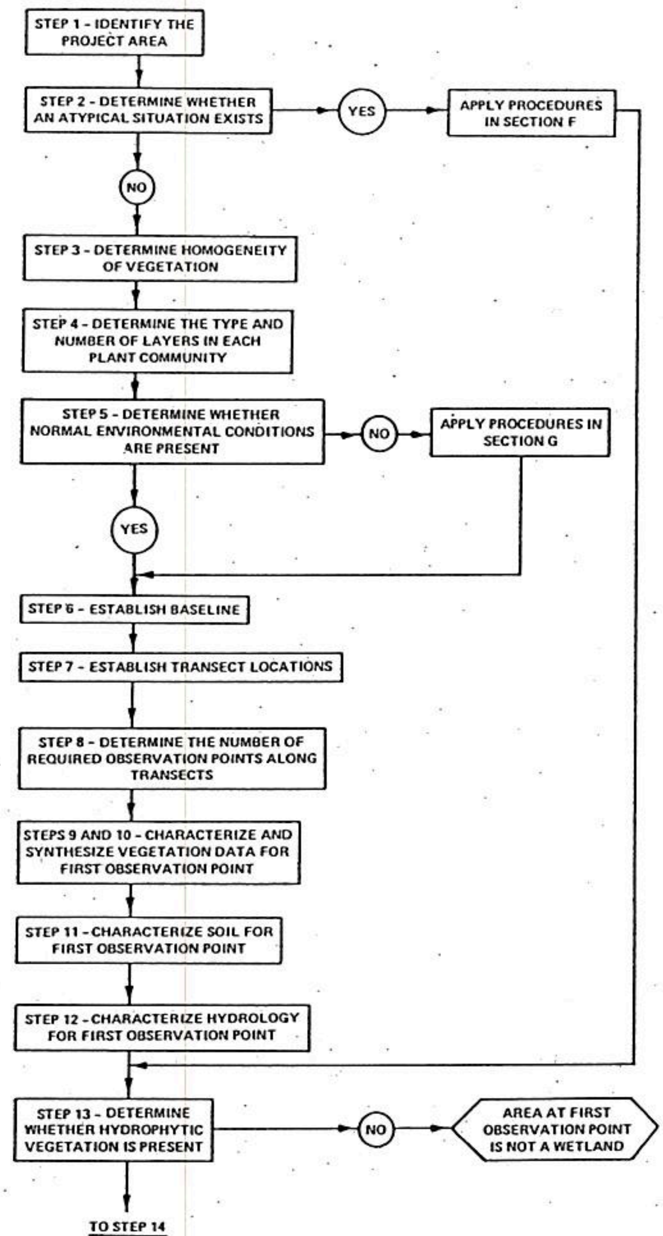


Figure 16. Flowchart of steps involved in making a comprehensive wetland determination (Section E) (Continued)

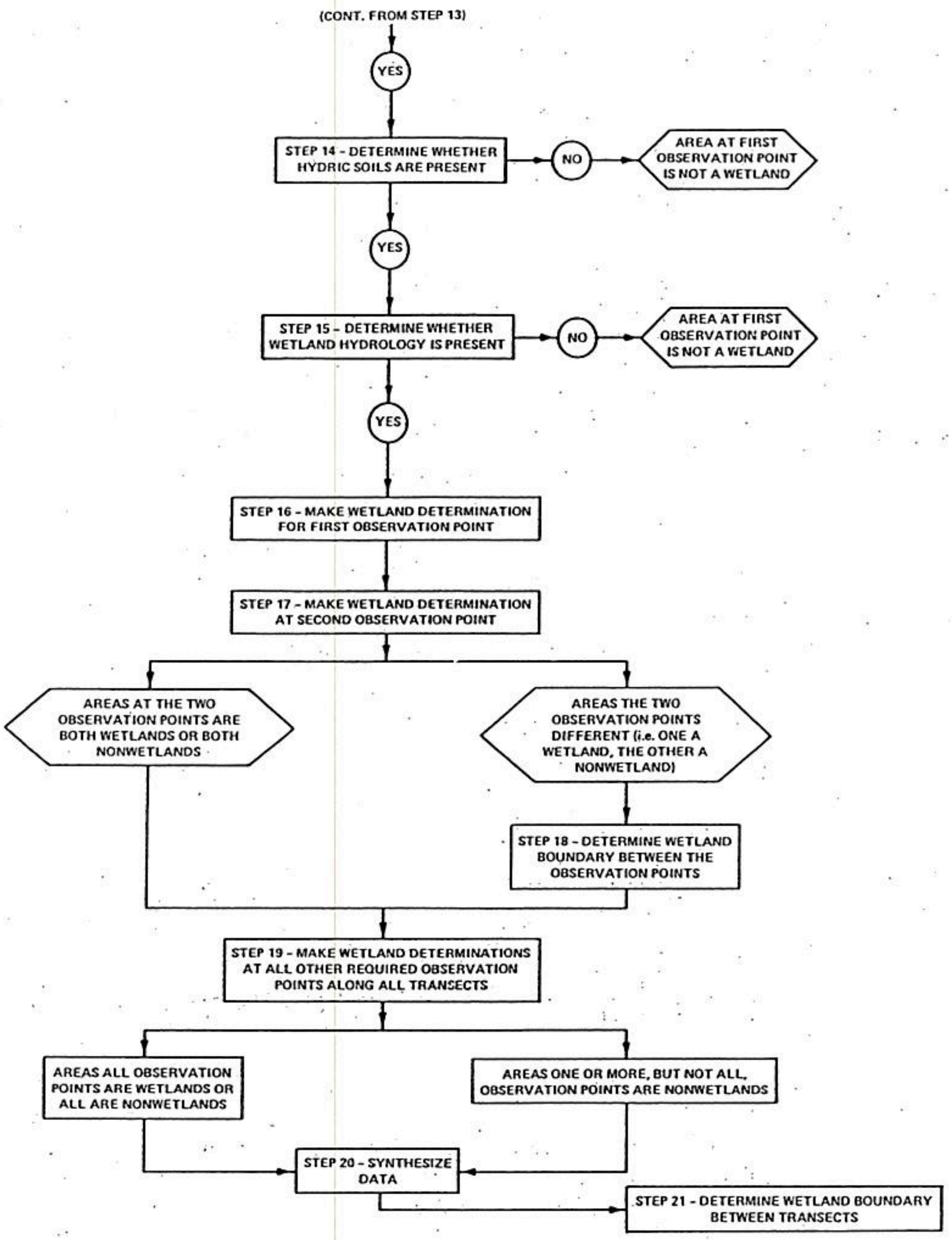


Figure 16. (Concluded)

h. Quadrat (3.28 ft by 3.28 ft).

i. Diameter or basal area tape (for woody overstory).

Field procedures

70. Complete the following steps:

- STEP 1 - Identify the Project Area. Using information from the USGS quadrangle or other appropriate map (Section B), locate and measure the spatial boundaries of the project area. Determine the compass heading of each boundary and record on the base map (Section B, STEP 2). The applicant's survey plan may be helpful in locating the project boundaries. PROCEED TO STEP 2.
- STEP 2 - Determine Whether an Atypical Situation Exists. Examine the area and determine whether there is sufficient natural or human-induced alteration to significantly change the area vegetation, soils, and/or hydrology. If not, PROCEED TO STEP 3. If one or more parameters have been recently altered significantly, PROCEED TO Section F and determine whether there is sufficient evidence that hydrophytic vegetation, hydric soils, and/or wetland hydrology were present on the area prior to alteration. Then return to this section and characterize parameters not significantly influenced by human activities. PROCEED TO STEP 3.
- STEP 3 - Determine Homogeneity of Vegetation. While completing STEP 2, determine the number of plant community types present. Mark the approximate location of each community type on the base map. The number and locations of required wetland determinations will be strongly influenced by both the size of the area and the number and distribution of plant community types; the larger the area and greater the number of plant community types, the greater the number of required wetland determinations. It is imperative that all plant community types occurring in all portions of the area be included in the investigation. PROCEED TO STEP 4.
- STEP 4 - Determine the Type and Number of Layers in Each Plant Community. Examine each identified plant community type and determine the type(s) and number of layers in each community. Potential layers include trees (woody overstory), saplings/shrubs (woody understory), herbs (herbaceous understory), and/or woody vines. PROCEED TO STEP 5.
- STEP 5 - Determine Whether Normal Environmental Conditions Are Present. Determine whether normal environmental conditions are present

at the observation point by considering the following:

a. Is the area at the observation point presently lacking hydrophytic vegetation and/or hydrologic indicators due to annual or seasonal fluctuations in precipitation or groundwater levels?

b. Are hydrophytic vegetation indicators lacking due to seasonal fluctuations in temperature?

If the answer to either of these questions is thought to be YES, PROCEED TO Section G. If the answer to both questions is NO, PROCEED TO STEP 6.

• STEP 6 - Establish a Baseline. Select one project boundary area as a baseline. The baseline should extend parallel to any major watercourse and/or perpendicular to a topographic gradient (see Figure 17). Determine the baseline length and record on the base map both the baseline length and its compass heading. PROCEED TO STEP 7.

• STEP 7. Establish Transect Locations. Divide the baseline into a number of equal segments (Figure 17). Use the following as a guide to determine the appropriate number of baseline segments:

| Baseline Length, ft | Number of Segments | Length of Baseline Segment, ft |
|---|---|---|
| >50 - 500 | 3 | 18 - 167 |
| >500 - 1,000 | 3 | 167 - 333 |
| >1,000 - 5,000 | 5 | 200 - 1,000 |
| >5,000 - 10,000 | 7 | 700 - 1,400 |
| >10,000* | variable | 2,000 |

* If the baseline exceeds 5 miles, baseline segments should be 0.5 mile in length.

Use a random numbers table or a calculator with a random numbers generation feature to determine the position of a transect starting point within each baseline segment. For example, when the baseline is 4,000 ft, the number of baseline segments will be five, and the baseline segment length will be 4,000/5 = 800 ft. Locate the first transect within the first 800 ft of the baseline. If the random numbers table yields 264 as the distance from the baseline starting point, measure 264 ft from the baseline starting point and establish the starting point of the first transect. If the second random number selected is

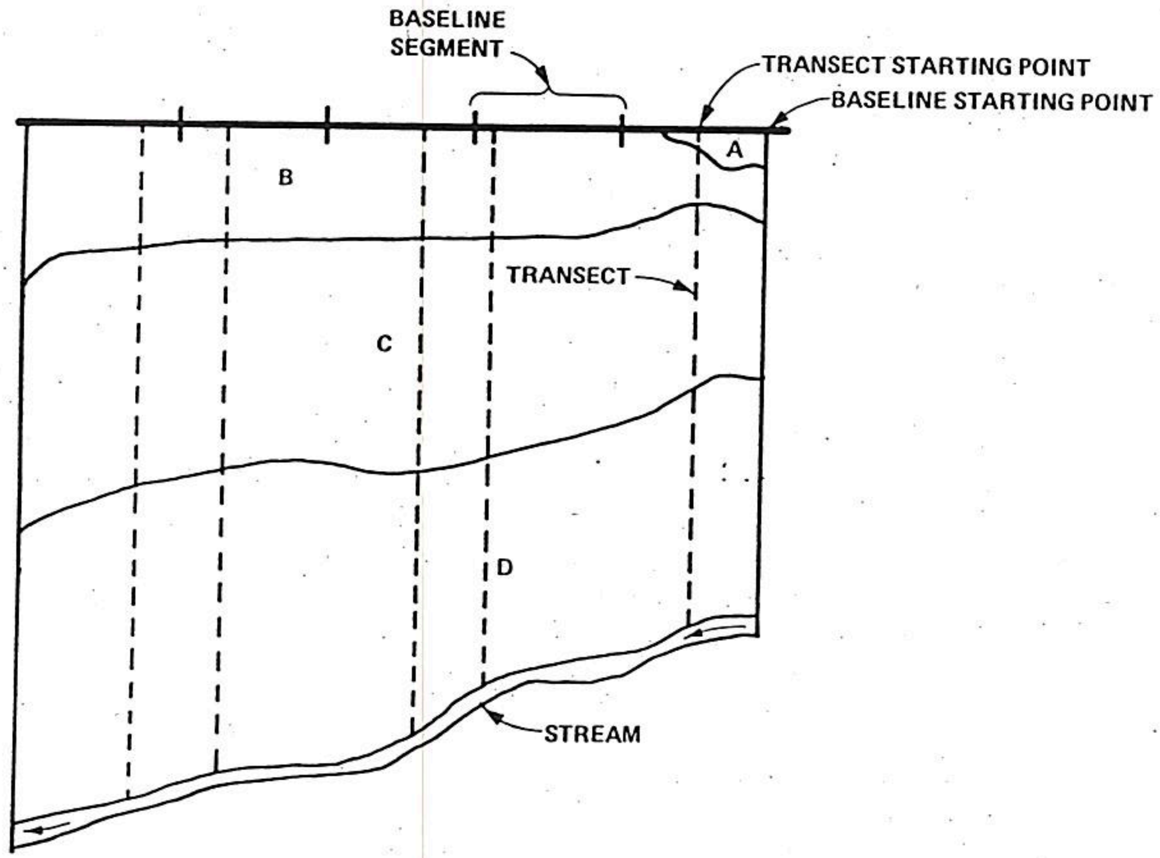


Figure 17. General orientation of baseline and transects in a hypothetical project area. Alpha characters represent different plant communities. Transect positions were determined using a random numbers table

530, the starting point of the second transect will be located at a distance of 1,330 ft (800 + 530 ft) from the baseline starting point. *CAUTION: Make sure that each plant community type is included in at least one transect. If not, modify the sampling design accordingly.* When the starting point locations for all required transects have been determined, PROCEED TO STEP 8.

- STEP 8 - Determine the Number of Required Observation Points Along Transects. The number of required observation points along each transect will be largely dependent on transect length. Establish observation points along each transect using the following as a guide:

| Transect Length, ft | Number of Observation Points | Interval Between Observation Points, ft |
|---|---|---|
| <1,000 | 2-10 | 100 |
| 1,000 - <5,000 | 10 | 100 - 500 |
| 5,000 - <10,000 | 10 | 500 - 1,000 |
| ≥10,000 | >10 | 1,000 |

Establish the first observation point at a distance of 50 ft from the baseline (Figure 17). When obvious nonwetlands occupy a long portion of the transect from the baseline starting point, establish the first observation point in the obvious nonwetland at a distance of approximately 300 ft from the point that the obvious nonwetland begins to intergrade into a potential wetland community type. Additional observation points must also be established to determine the wetland boundary between successive regular observation points when one of the points is a wetland and the other is a nonwetland. *CAUTION: In large areas having a mosaic of plant community types, several wetland boundaries may occur along the same transect.* PROCEED TO STEP 9 and apply the comprehensive wetland determination procedure at each required observation point. Use the described procedure to simultaneously characterize the vegetation, soil, and hydrology at each required observation point along each transect, and use the resulting characterization to make a wetland determination at each point. *NOTE: All required wetland boundary determinations should be made while proceeding along a transect.*

- STEP 9 - Characterize the Vegetation at the First Observation Point Along the First Transect.* Record on DATA FORM 2 the vegetation occurring at the first observation point along the first transect by completing the following (as appropriate):

  a. Trees. Identify each tree occurring within a 30-ft radius** of the observation point, measure its basal area (square inches) or diameter at breast height (DBH) using a basal area tape or

* There is no single best procedure for characterizing vegetation. Methods described in STEP 9 afford standardization of the procedure. However, plot size and descriptors for determining dominance may vary.

** A larger sampling plot may be necessary when trees are large and widely spaced.

diameter tape, respectively, and record. *NOTE: If DBH is measured, convert values to basal area by applying the formula* $A = \pi r^2$. *This must be done on an individual basis.* A tree is any nonclimbing, woody plant that has a DBH of $\geq$3.0 in., regardless of height.

b. Saplings/shrubs. Identify each sapling/shrub occurring within a 10-ft radius of the observation point, estimate its height, and record the midpoint of its class range using the following height classes (height is used as an indication of dominance; taller individuals exert a greater influence on the plant community):

| Height Class | Height Class Range, ft | Midpoint of Range, ft |
|---|---|---|
| 1 | 1 - 3 | 2 |
| 2 | 3 - 5 | 4 |
| 3 | 5 - 7 | 6 |
| 4 | 7 - 9 | 8 |
| 5 | 9 - 11 | 10 |
| 6 | >11 | 12 |

A sapling/shrub is any woody plant having a height >3.2 ft but a stem diameter of <3.0 in., exclusive of woody vines.

c. Herbs. Place a 3.28- by 3.28-ft quadrat with one corner touching the observation point and one edge adjacent to the transect line. As an alternative, a 1.64-ft-radius plot with the center of the plot representing the observation point position may be used. Identify each plant species with foliage extending into the quadrat and estimate its percent cover by applying the following cover classes:

| Cover Class | Class Range, % | Midpoint of Class Range, % |
|---|---|---|
| 1 | 0 - 5 | 2.5 |
| 2 | >5 - 25 | 15.0 |
| 3 | >25 - 50 | 37.5 |
| 4 | >50 - 75 | 62.5 |
| 5 | >75 - 95 | 85.0 |
| 6 | >95 - 100 | 97.5 |

Include all nonwoody plants and woody plants <3.2 ft in height. *NOTE: Total percent cover for all species will often exceed 100 percent.*

d. Woody vines (lianas). Identify species of woody vines climbing each tree and sapling/shrub sampled in STEPS 9a and 9b above, and record the number of stems of each. Since many woody vines branch profusely, count or estimate the number of stems at the ground surface. Include only individuals rooted in the 10-ft radius plot. Do not include individuals <3.2 ft in height. PROCEED TO STEP 10.

• STEP 10 - Analyze Field Vegetation Data. Examine the vegetation data (STEP 9) and determine the dominant species in each vegetation layer* by completing the following:

a. Trees. Obtain the total basal area (square inches) for each tree species identified in STEP 9a by summing the basal area of all individuals of a species found in the sample plot. Rank the species in descending order of dominance based on total basal area. Complete DATA FORM 2 for the tree layer.

b. Saplings/shrubs. Obtain the total height for each sapling/shrub species identified in STEP 9b. Total height, which is an estimate of dominance, is obtained by summing the midpoints of height classes for all individuals of a species found in the sample plot. Rank the species in descending order of dominance based on sums of midpoints of height class ranges. Complete DATA FORM 2 for the sapling/shrub layer.

c. Herbs. Obtain the total cover for each herbaceous and woody seedling species identified in STEP 9c. Total cover is obtained by using the midpoints of the cover class range assigned to each species (only one estimate of cover is made for a species in a given plot). Rank herbs and woody seedlings in descending order of dominance based on percent cover. Complete DATA FORM 2 for the herbaceous layer.

d. Woody vines (lianas). Obtain the total number of individuals of each species of woody vine identified in STEP 9d. Rank the species in descending order of dominance based on number of stems. Complete DATA FORM 2 for the woody vine layer. PROCEED TO STEP 11.

• STEP 11 - Characterize Soil. If a soil survey is available (Section B), the soil type may already be known. Have a soil scientist confirm that the soil type is correct, and determine whether the soil series is a hydric soil (Appendix D, Section 2). *CAUTION: Mapping units on soil surveys sometimes have inclusions of soil series or phases not shown on the soil survey map.* If a hydric soil type is confirmed, record on DATA FORM 1 and PROCEED TO STEP 12. If not, dig a soil pit using a soil auger or spade (See Appendix D, Section 1) and

---

* The same species may occur as a dominant in more than one vegetation layer.

look for indicators of hydric soils immediately below the A-horizon or 10 inches (whichever is shallower) (PART III, paragraphs 44 and/or 45). Record findings on DATA FORM 1. PROCEED TO STEP 12.

• STEP 12 - Characterize Hydrology. Examine the observation point for indicators of wetland hydrology (PART III, paragraph 49), and record observations on DATA FORM 1. Consider indicators in the same sequence as listed in paragraph 49. PROCEED TO STEP 13.

• STEP 13 - Determine Whether Hydrophytic Vegetation Is Present. Record the three dominant species from each vegetation layer (five species if only one or two layers are present) on DATA FORM 1.* Determine whether these species occur in wetlands by considering the following:

a. More than 50 percent of the dominant plant species are OBL, FACW, and/or FAC** on lists of plant species that occur in wetlands. Record the indicator status of all dominant species (Appendix C, Section 1 or 2) on DATA FORM 1. Hydrophytic vegetation is present when the majority of the dominant species have an indicator status of OBL, FACW, or FAC. *CAUTION: Not necessarily all plant communities composed of only FAC species are hydrophytic communities. They are hydrophytic communities only when positive indicators of hydric soils and wetland hydrology are also found.* If this indicator is satisfied, complete the vegetation portion of DATA FORM 1 and PROCEED TO STEP 14. If not, consider other indicators of hydrophytic vegetation.

b. Presence of adaptations for occurrence in wetlands. Do any of the species listed on DATA FORM 1 have observed morphological or known physiological adaptations (Appendix C, Section 3) for occurrence in wetlands? If so, record species having such adaptations on DATA FORM 1. When two or more dominant species have observed morphological adaptations or known physiological adaptations for occurrence in wetlands, hydrophytic vegetation is present. If so, complete the vegetation portion of DATA FORM 1 and PROCEED TO STEP 14. If not, consider other indicators of hydrophytic vegetation.

c. Other indicators of hydrophytic vegetation. Consider other indicators (see PART III, paragraph 35) that the species listed on DATA FORM 1 are commonly found in wetlands. If so, complete the vegetation portion of DATA FORM 1 by recording sources of supporting information, and PROCEED TO STEP 14. If no indicator of hydrophytic vegetation is present, the area at the observation point is not a wetland. In such cases, it is

---

* Record all dominant species when less than three are present in a vegetation layer.

** For the FAC-neutral option, see paragraph 35a.

unnecessary to consider soil and hydrology at that observation point. PROCEED TO STEP 17.

- STEP 14 - Determine Whether Hydric Soils Are Present. Examine DATA FORM 1 and determine whether any indicator of hydric soils is present. If so, complete the soils portion of DATA FORM 1 and PROCEED TO STEP 15. If not, the area at the observation point is not a wetland. PROCEED TO STEP 17.

- STEP 15 - Determine Whether Wetland Hydrology Is Present. Examine DATA FORM 1 and determine whether any indicator of wetland hydrology is present. Complete the hydrology portion of DATA FORM 1 and PROCEED TO STEP 16.

- STEP 16 - Make Wetland Determination. When the area at the observation point presently or normally has wetland indicators of all three parameters, it is a wetland. When the area at the observation point presently or normally lacks wetland indicators of one or more parameters, it is a nonwetland. PROCEED TO STEP 17.

- STEP 17 - Make Wetland Determination at Second Observation Point. Locate the second observation point along the first transect and make a wetland determination by repeating procedures described in STEPS 9-16. When the area at the second observation point is the same as the area at the first observation point (i.e. both wetlands or both nonwetlands), PROCEED TO STEP 19. When the areas at the two observation points are different (i.e. one wetlands, the other nonwetlands), PROCEED TO STEP 18.

- STEP 18 - Determine the Wetland Boundary Between Observation Points. Determine the position of the wetland boundary by applying the following procedure:

  a. Look for a change in vegetation or topography. *NOTE: The changes may sometimes be very subtle.* If a change is noted, establish an observation point and repeat STEPS 9-16. Complete a DATA FORM 1. If the area at this point is a wetland, proceed toward the nonwetland observation point until a more obvious change in vegetation or topography is noted and repeat the procedure. If there is no obvious change, establish the next observation point approximately halfway between the last observation point and the nonwetland observation point and repeat STEPS 9-16.

  b. Make as many additional wetland determinations as necessary to find the wetland boundary. *NOTE: The completed DATA FORM 1's* *for the original two observation points often will provide a clue as to the parameter(s) that change between the two points.*

c. When the wetland boundary is found, mark the boundary location on the base map and indicate on the DATA FORM 1 that this represents a wetland boundary. Record the distance of the boundary from one of the two regular observation points. Since the regular observation points represent known distances from the baseline, it will be possible to accurately pinpoint the boundary location on the base map. PROCEED TO STEP 19.

• STEP 19 - Make Wetland Determinations at All Other Required Observation Points Along All Transects. Continue to locate and sample all required observation points along all transects. *NOTE: The procedure described in STEP 18 must be applied at every position where a wetland boundary occurs between successive observation points.* Complete a DATA FORM 1 for each observation point and PROCEED TO STEP 20.

• STEP 20 - Synthesize Data to Determine the Portion of the Area Containing Wetlands. Examine all completed copies of DATA FORM 1 (STEP 19), and mark on a copy of the base map the locations of all observation points that are wetlands with a W and all observation points that are nonwetlands with an N. Also, mark all wetland boundaries occurring along transects with an X. If all the observation points are wetlands, the entire area is wetlands. If all observation points are nonwetlands, none of the area is wetlands. If some wetlands and some nonwetlands are present, connect the wetland boundaries (X) by following contour lines between transects. *CAUTION: If the determination is considered to be highly controversial, it may be necessary to be more precise in determining the wetland boundary between transects. This is also true for very large areas where the distance between transects is greater. If this is necessary, PROCEED TO STEP 21.*

• STEP 21 - Determine Wetland Boundary Between Transects. Two procedures may be used to determine the wetland boundary between transects, both of which involve surveying:

a. Survey contour from wetland boundary along transects. The first method involves surveying the elevation of the wetland boundaries along transects and then extending the survey to determine the same contour between transects. This procedure will be adequate in areas where there is no significant elevational change between transects. However, if a significant elevational change occurs between transects, either the surveyor must adjust elevational readings to accommodate such changes or the second method must be used. *NOTE: The surveyed* *wetland boundary must be examined to ensure that no anomalies exist. If these occur, additional wetland determinations will be required in the portion of the area where the anomalies occur, and the wetland boundary must be adjusted accordingly.*

b. Additional wetland determinations between transects. This procedure consists of traversing the area between transects and making additional wetland determinations to locate the wetland boundary at sufficiently close intervals (not necessarily standard intervals) so that the area can be surveyed. Place surveyor flags at each wetland boundary location. Enlist a surveyor to survey the points between transects. From the resulting survey data, produce a map that separates wetlands from nonwetlands.

## Section F. Atypical Situations

71. Methods described in this section should be used <u>only</u> when a determination has already been made in Section D or E that positive indicators of hydrophytic vegetation, hydric soils, and/or wetland hydrology could not be found due to effects of recent human activities or natural events. This section is applicable to delineations made in the following types of situations:

a. Unauthorized activities. Unauthorized discharges requiring enforcement actions may result in removal or covering of indicators of one or more wetland parameters. Examples include, but are not limited to: (1) alteration or removal of vegetation; (2) placement of dredged or fill material over hydric soils; and/or (3) construction of levees, drainage systems, or dams that significantly alter the area hydrology. *NOTE: This section should not be used for activities that have been previously authorized or those that are exempted from CE regulation. For example, this section is not applicable to areas that have been drained under CE authorization or that did not require CE authorization. Some of these areas may still be wetlands, but procedures described in Section D or E must be used in these cases.*

b. Natural events. Naturally occurring events may result in either creation or alteration of wetlands. For example, recent beaver dams may impound water, thereby resulting in a shift of hydrology and vegetation to wetlands. However, hydric soil indicators may not have developed due to insufficient time having passed to allow their development. Fire, avalanches, volcanic activity, and changing river courses are other examples. *NOTE: It is necessary to determine whether alterations to an area have resulted in changes that are now the "normal circumstances."* The relative permanence of the change and whether the area is now functioning as a wetland must be considered.

c. Man-induced wetlands. Procedures described in Subsection 4 are for use in delineating wetlands that have been purposely or incidentally created by human activities, but in which wetland indicators of one or more parameters are absent. For example, road construction may have resulted in impoundment of water in an area that previously was nonwetland, thereby effecting hydrophytic vegetation and wetland hydrology in the area. However, the area may lack hydric soil indicators. *NOTE: Subsection D is not intended to bring into CE jurisdiction those man-made wetlands that are exempted under CE regulations or policy.* It is also important to consider whether the man-induced changes are now the "normal circumstances" for the area. Both the relative permanence of the change and the functioning of the area as a wetland are implied.

72. When any of the three types of situations described in paragraph 71 occurs, application of methods described in Sections D and/or E will lead to the conclusion that the area is not a wetland because positive wetland indicators for at least one of the three parameters will be absent. Therefore, apply procedures described in one of the following subsections (as appropriate) to determine whether positive indicators of hydrophytic vegetation, hydric soils, and/or wetland hydrology existed prior to alteration of the area. Once these procedures have been employed, RETURN TO Section D or E to make a wetland determination. PROCEED TO the appropriate subsection.

## Subsection 1 - Vegetation

73. Employ the following steps to determine whether hydrophytic vegetation previously occurred:

- STEP 1 - Describe the Type of Alteration. Examine the area and describe the type of alteration that occurred. Look for evidence of selective harvesting, clear cutting, bulldozing, recent conversion to agriculture, or other activities (e.g., burning, discing, or presence of buildings, dams, levees, roads, parking lots, etc.). Determine the approximate date* when the alteration occurred. Record observations on DATA FORM 3, and PROCEED TO STEP 2.
- STEP 2 - Describe Effects on Vegetation. Record on DATA FORM 3 a general description of how the activities (STEP 1) have affected the plant communities. Consider the following:
  - a. Has all or a portion of the area been cleared of vegetation?
  - b. Has only one layer of the plant community (e.g. trees) been removed?
  - c. Has selective harvesting resulted in removal of some species?
  - d. Has all vegetation been covered by fill, dredged material, or structures?
  - e. Have increased water levels resulted in the death of some individuals?

---

* It is especially important to determine whether the alteration occurred prior to implementation of Section 404.

to alteration can be determined, record them on DATA FORM 3 and also record the basis used for the determination. PROCEED TO STEP 4. If it is impossible to determine the plant community types that occurred on the area prior to alteration, a determination cannot be made using all three parameters. In such cases, the determination must be based on the other two parameters. PROCEED TO Subsection 2 or 3 if one of the other parameters has been altered, or return to the appropriate Subsection of Section D or to Section E, as appropriate.

- STEP 4 - Determine Whether Plant Community Types Constitute Hydrophytic Vegetation. Develop a list of species that previously occurred on the site (DATA FORM 3). Subject the species list to applicable indicators of hydrophytic vegetation (PART III, paragraph 35). If none of the indicators are met, the plant communities that previously occurred did not constitute hydrophytic vegetation. If hydrophytic vegetation was present and no other parameter was in question, record appropriate data on the vegetation portion of DATA FORM 3, and return to either the appropriate subsection of Section D or to Section E. If either of the other parameters was also in question, PROCEED TO Subsection 2 or 3.

## Subsection 2 - Soils

74. Employ the following steps to determine whether hydric soils previously occurred:

- STEP 1 - Describe the Type of Alteration. Examine the area and describe the type of alteration that occurred. Look for evidence of:

  a. Deposition of dredged or fill material or natural sedimentation. In many cases the presence of fill material will be obvious. If so, it will be necessary to dig a hole to reach the original soil (sometimes several feet deep). Fill material will usually be a different color or texture than the original soil (except when fill material has been obtained from like areas onsite). Look for decomposing vegetation between soil layers and the presence of buried organic or hydric soil layers. In accreting or recently formed sandbars in riverine situations, the soils may support hydrophytic vegetation but lack hydric soil characteristics.

  b. Presence of nonwoody debris at the surface. This can only be applied in areas where the original soils do not contain rocks.

Nonwoody debris includes items such as rocks, bricks, and concrete fragments.

c. Subsurface plowing. Has the area recently been plowed below the A-horizon or to depths of greater than 10 in.?

d. Removal of surface layers. Has the surface soil layer been removed by scraping or natural landslides? Look for bare soil surfaces with exposed plant roots or scrape scars on the surface.

e. Presence of man-made structures. Are buildings, dams, levees, roads, or parking lots present?

Determine the approximate date* when the alteration occurred. This may require checking aerial photography, examining building permits, etc. Record on DATA FORM 3, and PROCEED TO STEP 2.

• Step 2 - Describe Effects on Soils. Record on DATA FORM 3 a general description of how identified activities in STEP 1 have affected the soils. Consider the following:

a. Has the soil been buried? If so, record the depth of fill material and determine whether the original soil is intact.

b. Has the soil been mixed at a depth below the A-horizon or greater than 10 inches? If so, it will be necessary to examine the original soil at a depth immediately below the plowed zone. Record supporting evidence.

c. Has the soil been sufficiently altered to change the soil phase? Describe these changes.

PROCEED TO STEP 3.

• STEP 3 - Characterize Soils That Previously Occurred. Obtain all possible evidence that may be used to characterize soils that previously occurred on the area. Consider the following potential sources of information:

a. Soil surveys. In many cases, recent soil surveys will be available. If so, determine the soil series that were mapped for the area, and compare these soil series with the list of hydric soils (Appendix D, Section 2). If all soil series are listed as hydric soils, the entire area had hydric soils prior to alteration.

b. Characterization of buried soils. When fill material has been placed over the original soil without physically disturbing the soil, examine and characterize the buried soils. To accomplish this, dig a hole through the fill material until the original soil is encountered. Determine the point at which the original

---

* It is especially important to determine whether the alteration occurred prior to implementation of Section 404.

soil material begins. Remove 12 inches of the original soil from the hole and look for indicators of hydric soils (PART III, paragraphs 44 and/or 45) immediately below the A-horizon or 10 inches (whichever is shallower). Record on DATA FORM 3 the color of the soil matrix, presence of an organic layer, presence of mottles or gleying, and/or presence of iron and manganese concretions. If the original soil is mottled and the chroma of the soil matrix is 2 or less,* a hydric soil was formerly present on the site. If any of these indicators are found, the original soil was a hydric soil. *(NOTE: When the fill material is a thick layer, it might be necessary to use a backhoe or posthole digger to excavate the soil pit.)* If USGS quadrangle maps indicate distinct variation in area topography, this procedure must be applied in each portion of the area that originally had a different surface elevation. Record findings on DATA FORM 3.

c. Characterization of plowed soils. Determine the depth to which the soil has been disturbed by plowing. Look for hydric soil characteristics (PART III, paragraphs 44 and/or 45) immediately below this depth. Record findings on DATA FORM 3.

d. Removal of surface layers. Dig a hole (Appendix D, Section 1) and determine whether the entire surface layer (A-horizon) has been removed. If so, examine the soil immediately below the top of the subsurface layer (B-horizon) for hydric soil characteristics. As an alternative, examine an undisturbed soil of the same soil series occurring in the same topographic position in an immediately adjacent area that has not been altered. Look for hydric soil indicators immediately below the A-horizon or 10 inches (whichever is shallower), and record findings on DATA FORM 3.

If sufficient data on soils that existed prior to alteration can be obtained to determine whether a hydric soil was present, PROCEED TO STEP 4. If not, a determination cannot be made using soils. Use the other parameters (Subsections 1 and 3) for the determination.

- STEP 4 - Determine Whether Hydric Soils Were Formerly Present.

Examine the available data and determine whether indicators of hydric soils (PART III, paragraphs 44 and/or 45) were formerly present. If no indicators of hydric soils were found, the original soils were not hydric soils. If indicators of hydric soils were found, record the appropriate indicators on DATA FORM 3 and PROCEED TO Subsection 3 if the hydrology of the area has been significantly altered or return either to the appropriate subsection of Section D or to Section E and characterize the area hydrology.

---

* The matrix chroma must be 1 or less if no mottles are present (see paragraph 44). The soil must be moist when colors are determined.

## Subsection 3 - Hydrology

75. Apply the following steps to determine whether wetland hydrology previously occurred:

- STEP 1 - Describe the Type of Alteration. Examine the area and describe the type of alteration that occurred. Look for evidence of:

  a. Dams. Has recent construction of a dam or some natural event (e.g. beaver activity or landslide) caused the area to become increasingly wetter or drier? *NOTE: This activity could have occurred a considerable distance away from the site in question.*

  b. Levees, dikes, and similar structures. Have levees or dikes recently been constructed that prevent the area from becoming periodically inundated by overbank flooding?

  c. Ditching. Have ditches been constructed recently that cause the area to drain more rapidly following inundation?

  d. Filling of channels or depressions (land-leveling). Have natural channels or depressions been recently filled?

  e. Diversion of water. Has an upstream drainage pattern been altered that results in water being diverted from the area?

  f. Ground-water extraction. Has prolonged and intensive pumping of ground water for irrigation or other purposes significantly lowered the water table and/or altered drainage patterns?

  g. Channelization. Have feeder streams recently been channelized sufficiently to alter the frequency and/or duration of inundation?

Determine the approximate date* when the alteration occurred. Record observations on DATA FORM 3 and PROCEED TO STEP 2.

- STEP 2 - Describe Effects of Alteration on Area Hydrology. Record on DATA FORM 3 a general description of how the observed alteration (STEP 1) has affected the area. Consider the following:

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

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

PROCEED TO STEP 3.

- STEP 3 - Characterize the Hydrology That Previously Existed in the Area. Obtain all possible evidence that may be used to characterize

---

* It is especially important to determine whether the alteration occurred prior to implementation of Section 404.

the hydrology that previously occurred. Potential sources of information include:

a. Stream or tidal gage data. If a stream or tidal gaging station is located near the area, it may be possible to calculate elevations representing the upper limit of wetlands hydrology based on duration of inundation. Consult hydrologists from the local CE District Office for assistance. The resulting mean sea level elevation will represent the upper limit of inundation for the area in the absence of any alteration. If fill material has not been placed on the area, survey this elevation from the nearest USGS benchmark. Record elevations representing zone boundaries on DATA FORM 3. If fill material has been placed on the area, compare the calculated elevation with elevations shown on a USGS quadrangle or any other survey map that predated site alteration.

b. Field hydrologic indicators. Certain field indicators of wetland hydrology (PART III, paragraph 49) may still be present. Look for watermarks on trees or other structures, drift lines, and debris deposits. Record these on DATA FORM 3. If adjacent undisturbed areas are in the same topographic position and are similarly influenced by the same sources of inundation, look for wetland indicators in these areas.

c. Aerial photography. Examine any available aerial photography and determine whether the area was inundated at the time of the photographic mission. Consider the time of the year that the aerial photography was taken and use only photography taken during the growing season and prior to site alteration.

d. Historical records. Examine any available historical records for evidence that the area has been periodically inundated. Obtain copies of any such information and record findings on DATA FORM 3.

e. Floodplain Management Maps. Determine the previous frequency of inundation of the area from Floodplain Management Maps (if available). Record flood frequency on DATA FORM 3.

f. Public or local government officials. Contact individuals who might have knowledge that the area was periodically inundated.

If sufficient data on hydrology that existed prior to site alteration can be obtained to determine whether wetland hydrology was previously present, PROCEED TO STEP 4. If not, a determination involving hydrology cannot be made. Use other parameters (Subsections 1 and 2) for the wetland determination. Return to either the appropriate subsection of Section D or to Section E and complete the necessary data forms. PROCEED TO STEP 4 if the previous hydrology can be characterized.

- STEP 4 - Determine Whether Wetland Hydrology Previously Occurred.

Examine the available data and determine whether indicators of wetland hydrology (PART III, paragraph 49) were present prior to site alteration. If no indicators of wetland hydrology were found, the original hydrology of the area was not wetland hydrology. If indicators of wetland hydrology were found, record the appropriate indicators on DATA FORM 3 and return either to the appropriate subsection of Section D or to Section E and complete the wetland determination.

## Subsection 4 - Man-Induced Wetlands

76. A man-induced wetland is an area that has developed at least some characteristics of naturally occurring wetlands due to either intentional or incidental human activities. Examples of man-induced wetlands include irrigated wetlands, wetlands resulting from impoundment (e.g. reservoir shorelines), wetlands resulting from filling of formerly deepwater habitats, dredged material disposal areas, and wetlands resulting from stream channel realignment. Some man-induced wetlands may be subject to Section 404. In virtually all cases, man-induced wetlands involve a significant change in the hydrologic regime, which may either increase or decrease the wetness of the area. Although wetland indicators of all three parameters (i.e. vegetation, soils, and hydrology) may be found in some man-induced wetlands, indicators of hydric soils are usually absent. Hydric soils require long periods (hundreds of years) for development of wetness characteristics, and most man-induced wetlands have not been in existence for a sufficient period to allow development of hydric soil characteristics. Therefore, application of the multiparameter approach in making wetland determinations in man-induced wetlands must be based on the presence of hydrophytic vegetation and wetland hydrology.* There must also be documented evidence that the wetland resulted from human activities. Employ the following steps to determine whether an area consists of wetlands resulting from human activities:

- STEP 1 - Determine Whether the Area Represents a Potential Man-Induced Wetland. Consider the following questions:

  a. Has a recent man-induced change in hydrology occurred that caused the area to become significantly wetter?

---

* Uplands that support hydrophytic vegetation due to agricultural irrigation and that have an obvious hydrologic connection to other "waters of the United States" should not be delineated as wetlands under this subsection.

b. Has a major man-induced change in hydrology that occurred in the past caused a former deepwater aquatic habitat to become significantly drier?

c. Has man-induced stream channel realignment significantly altered the area hydrology?

d. Has the area been subjected to long-term irrigation practices?

If the answer to any of the above questions is YES, document the approximate time during which the change in hydrology occurred, and PROCEED TO STEP 2. If the answer to all of the questions is NO, procedures described in Section D or E must be used.

- STEP 2 - Determine Whether a Permit Will be Needed if the Area is Found to be a Wetland. Consider the current CE regulations and policy regarding man-induced wetlands. If the type of activity resulting in the area being a potential man-induced wetland is exempted by regulation or policy, no further action is needed. If not exempt, PROCEED TO STEP 3.
- STEP 3 - Characterize the Area Vegetation, Soils, and Hydrology. Apply procedures described in Section D (routine determinations) or Section E (comprehensive determinations) to the area. Complete the appropriate data forms and PROCEED TO STEP 4.
- STEP 4 - Wetland Determination. Based on information resulting from STEP 3, determine whether the area is a wetland. When wetland indicators of all three parameters are found, the area is a wetland. When indicators of hydrophytic vegetation and wetland hydrology are found and there is documented evidence that the change in hydrology occurred so recently that soils could not have developed hydric characteristics, the area is a wetland. In such cases, it is assumed that the soils are functioning as hydric soils. *CAUTION: If hydrophytic vegetation is being maintained only because of man-induced wetland hydrology that would no longer exist if the activity (e.g. irrigation) were to be terminated, the area should not be considered a wetland.*

## Section G - Problem Areas

77. There are certain wetland types and/or conditions that may make application of indicators of one or more parameters difficult, at least at certain times of the year. These are not considered to be atypical situations. Instead, they are wetland types in which wetland indicators of one or more parameters may be periodically lacking due to normal seasonal or annual variations in environmental conditions that result from causes other than human activities or catastrophic natural events.

### Types of problem areas

78. Representative examples of potential problem areas, types of variations that occur, and their effects on wetland indicators are presented in the following subparagraphs. Similar situations may sometimes occur in other wetland types. *Note: This section is not intended to bring nonwetland areas having wetland indicators of two, but not all three, parameters into Section 404 jurisdiction.*

a. Wetlands on drumlins. Slope wetlands occur in glaciated areas in which thin soils cover relatively impermeable glacial till or in which layers of glacial till have different hydraulic conditions that produce a broad zone of ground-water seepage. Such areas are seldom, if ever, flooded, but downslope ground-water movement keeps the soils saturated for a sufficient portion of the growing season to produce anaerobic and reducing soil conditions. This fosters development of hydric soil characteristics and selects for hydrophytic vegetation. Indicators of wetland hydrology may be lacking during the drier portion of the growing season.

b. Seasonal wetlands. In many regions (especially in western states), depression areas occur that have wetland indicators of all three parameters during the wetter portion of the growing season, but normally lack wetland indicators of hydrology and/or vegetation during the drier portion of the growing season. Obligate hydrophytes and facultative wetland plant species (Appendix C, Section 1 or 2) normally are dominant during the wetter portion of the growing season, while upland species (annuals) may be dominant during the drier portion of the growing season. These areas may be inundated during the wetter portion of the growing season, but wetland hydrology indicators may be totally lacking during the drier portion of the growing season. It is important to establish that an area truly is a water body. Water in a depression normally must be sufficiently persistent to exhibit an ordinary high-water mark or the presence of wetland characteristics before it can be considered as a water body potentially subject to Clean Water Act jurisdiction. The determination that an area exhibits wetland characteristics for a sufficient portion of the growing season to qualify as a wetland under the Clean Water Act must be made on a case-by-case basis. Such determinations should consider the respective length of time that the area exhibits upland and wetland characteristics, and the manner in which the area fits into the overall ecological system as a wetland. Evidence concerning the persistence of an area's wetness can be obtained from its history, vegetation, soil, drainage characteristics, uses to which it has been subjected, and weather or hydrologic records.

c. Prairie potholes. Prairie potholes normally occur as shallow depressions in glaciated portions of the north-central United States. Many are landlocked, while others have a drainage outlet to streams or other potholes. Most have standing water for much of the growing season in years of normal or above normal precipitation, but are neither inundated nor have saturated soils during most of the growing season in years of below normal precipitation. During dry years, potholes often become incorporated into farming plans, and are either planted to row crops (e.g. soybeans) or are mowed as part of a haying operation. When this occurs, wetland indicators of one or more parameters may be lacking. For example, tillage would eliminate any onsite hydrologic indicator, and would make detection of soil and vegetation indicators much more difficult.

d. Vegetated flats. In both coastal and interior areas throughout the Nation, vegetated flats are often dominated by annual species that are categorized as OBL. Application of procedures described in Sections D and E during the growing season will clearly result in a positive wetland determination. However, these areas will appear to be unvegetated mudflats when examined during the nongrowing season, and the area would not qualify at that time as a wetland due to an apparent lack of vegetation.

Wetland determinations in problem areas

79. Procedures for making wetland determinations in problem areas are presented below. Application of these procedures is appropriate only when a decision has been made in Section D or E that wetland indicators of one or more parameters were lacking, probably due to normal seasonal or annual variations in environmental conditions. Specific procedures to be used will vary according to the nature of the area, site conditions, and parameter(s) affected by the variations in environmental conditions. A determination must be based on the best evidence available to the field inspector, including:

a. Available information (Section B).

b. Field data resulting from an onsite inspection.

c. Basic knowledge of the ecology of the particular community type(s) and environmental conditions associated with the community type.

*NOTE: The procedures described below should only be applied to parameters not adequately characterized in Section D or E.* Complete the following steps:

- STEP 1 - Identify the Parameter(s) to be Considered. Examine the DATA FORM 1 (Section D or E) and identify the parameter(s) that must be given additional consideration. PROCEED TO STEP 2.

- STEP 2 - Determine the Reason for Further Consideration. Determine the reason why the parameter(s) identified in STEP 1 should be given further consideration. This will require a consideration and documentation of:

  a. Environmental condition(s) that have impacted the parameter(s).

  b. Impacts of the identified environmental condition(s) on the parameter(s) in question.

Record findings in the comments section of DATA FORM 1. PROCEED TO STEP 3.

- STEP 3 - Document Available Information for Parameter(s) in Question. Examine the available information and consider personal ecological knowledge of the range of normal environmental conditions of the area. Local experts (e.g. university personnel) may provide additional information. Record information on DATA FORM 1. PROCEED TO STEP 4.

- STEP 4 - Determine Whether Wetland Indicators are Normally Present During a Portion of the Growing Season. Examine the information resulting from STEP 3 and determine whether wetland indicators are normally present during part of the growing season. If so, record on DATA FORM 1 the indicators normally present and return to Section D or Section E and make a wetland determination. If no information can be found that wetland indicators of all three parameters are normally present during part of the growing season, the determination must be made using procedures described in Section D or Section E.

REFERENCES

Clark, J. R., and Benforado, J., eds. 1981. Wetlands of Bottomland Hardwood Forests, Proceedings of a Workshop on Bottomland Hardwood Forest Wetlands of the Southeastern United States, Elsevier Scientific Publishing Company, New York.

Correll, D. S., and Correll, H. B. 1972. Aquatic and Wetland Plants of the Southwestern United States, Publ. No. 16030 DNL 01/72, Environmental Protection Agency, Washington, D.C.

Cowardin, L. M., Carter, V., Golet, F. C., and LaRoe, E. T. 1979. "Classification of Wetlands and Deepwater Habitats of the United States," FWS/OBS-79/31, US Fish and Wildlife Service, Office of Biological Services, Washington, D.C.

Cronquist, A., Holmgren, A. H., Holmgren, N. H., and Reveal, J. L. 1972. Intermountain Flora - Vascular Plants of the Intermountain West, USA, Vols I and II, Hafner Publishing Company, New York.

Davis, R. J. 1952. Flora of Idaho, William C. Brown Company, Dubuque, Iowa.

Federal Register. 1980. "40 CFR Part 230: Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material," Vol 45, No. 249, pp 85352-85353, US Government Printing Office, Washington, D.C.

__________. 1982. "Title 33: Navigation and Navigable Waters; Chapter II, Regulatory Programs of the Corps of Engineers," Vol 47, No. 138, p 31810, US Government Printing Office, Washington, D.C.

Fernald, M. L. 1950. Gray's Manual of Botany, 8th ed., American Book Company, New York.

Gleason, H. A., and Cronquist, A. 1963. Manual of Vascular Plants of Northeastern United States and Adjacent Canada, Van Nostrand, Princeton, N. J.

Godfrey, R. K., and Wooten, J. W. 1979. Aquatic and Wetland Plants of the Southeastern United States, Vols I and II, University of Georgia Press, Athens, Ga.

Harrington, H. D. 1979. Manual of the Plants of Colorado, 2nd ed., Sage Books, Denver, Colo.

Hitchcock, A. S. 1950. Manual of Grasses of the United States, US Department of Agriculture Miscellaneous Publication No. 200, US Government Printing Office, Washington, D.C.

Hitchcock, C. L., and Cronquist, A. 1973. Flora of the Pacific Northwest, University of Washington Press, Seattle, Wash.

Kearney, T. H., and Peebles, R. H. 1960. Arizona Flora, 2nd ed., University of California Press, Berkeley, Calif.

Long, R. W., and Lakela, O. 1976. A Flora of Tropical Florida, Banyan Books, Miami, Fla.

Munsell Color. 1975. Munsell Soil Color Charts, Kollmorgen Corporation, Baltimore, Md.

Munz, P. A., and Keck, D. D. 1959. A California Flora, University of California Press, Berkeley, Calif.

Radford, A. E., Ahles, H. E., and Bell, C. R. 1968. Manual of the Vascular Flora of the Carolinas, The University of North Carolina Press, Chapel Hill, N. C.

Small, J. K. 1933. Manual of the Southeastern Flora, The University of North Carolina Press, Chapel Hill, N. C.

Steyermark, J. A. 1963. Flora of Missouri, The Iowa State University Press, Ames, Iowa.

Theriot, R. F. In Review. "Flood Tolerance Indices of Plant Species of Southeastern Bottomland Forests," Technical Report, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

US Department of Agriculture - Soil Conservation Service. 1975. Soil Taxonomy, Agriculture Handbook No. 436, US Government Printing Office, Washington, D.C.

__________. 1983. "List of Soils with Actual or High Potential for Hydric Conditions," National Bulletin No. 430-3-10, Washington, D.C.

__________. 1985. "Hydric Soils of the United States," USDA-SCS National Bulletin No. 430-5-9, Washington, D.C.

US Department of the Interior. 1970. National Atlas of the United States, US Geological Survey, US Government Printing Office, Washington, D.C., pp 110-111.

BIBLIOGRAPHY


Copeland, B. J., Hodson, R. G., and Riggs, S. R. 1984. "The Ecology of the Pamlico River, North Carolina: An Estuarine Profile," FWS/OBS-82/06, US Fish and Wildlife Service, Washington, D.C.

Foster, M. S., and Schiel, D. R. 1985. "The Ecology of Giant Kelp Forests in California: A Community Profile," FWS/OBS-85(7.2), US Fish and Wildlife Service, Washington, D.C.

Gosselink, J. G. 1984. "The Ecology of Delta Marshes of Coastal Louisiana: A Community Profile," FWS/OBS-84/09, US Fish and Wildlife Service, Washington, D.C.

Hobbie, J. E. 1984. "The Ecology of Tundra Ponds of the Arctic Coastal Plain: A Community Profile," FWS/OBS-83/25, US Fish and Wildlife Service, Washington, D.C.

Huffman, R. T., and Tucker, G. E. 1984. "Preliminary Guide to the Onsite Identification and Delineation of the Wetlands of Alaska," Technical Report Y-78-9, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Huffman, R. T., Tucker, G. E, Wooten, J. W., Kilmas, C. V., Freel, M. W., Forsythe, S. W., and Wilson, J. S. 1982. "Preliminary Guide to the Onsite Identification and Delineation of the Wetlands of the South Atlantic United States," Technical Report Y-78-7, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

__________. 1982. "Preliminary Guide to the Onsite Identification and Delineation of the Wetlands of the North Atlantic United States," Technical Report Y-78-8, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Japp, W. C. 1984. "The Ecology of the South Florida Coral Reefs: A Community Profile," FWS/OBS-82/08, US Fish and Wildlife Service, Washington, D.C.

Josselyn, M. 1983. "The Ecology of San Francisco Bay Tidal Marshes: A Community Profile," FWS/OBS-83/23, US Fish and Wildlife Service, Washington, D.C.

Livingston, R. J. 1984. "The Ecology of the Apalachicola Bay System: An Estuarine Profile," FWS/OBS-82/05, US Fish and Wildlife Service, Washington, D.C.

Nixon, S. W. 1982. "The Ecology of New England High Salt Marshes: A Community Profile," FWS/OBS-81/55, US Fish and Wildlife Service, Washington, D.C.

Odum, W. E., McIvor, C. C., and Smith, T. J., III. 1982. "The Ecology of the Mangroves of South Florida: A Community Profile," FWS/OBS-81/24, US Fish and Wildlife Service, Washington, D.C.

Odum, W. E., Smith, T. J., III, Hoover, J. K., and McIvor, C. C. 1984. "The Ecology of Tidal Freshwater Marshes of the United States East Coast: A Community Profile," FWS/OBS-83/17, US Fish and Wildlife Service, Washington, D.C.

Peterson, C. H., and Peterson, N. M. 1979. "The Ecology of Intertidal Flats of North Carolina: A Community Profile," FWS/OBS-79/39, US Fish and Wildlife Service, Washington, D.C.

Phillips, R. C. 1984. "The Ecology of Eelgrass Meadows in the Pacific Northwest: A Community Profile," FWS/OBS-84/24, US Fish and Wildlife Service, Washington, D.C.

Seliskar, D. M., and Gallagher, J. L. 1983. "The Ecology of Tidal Marshes of the Pacific Northwest Coast: A Community Profile," FWS/OBS-82/32, US Fish and Wildlife Service, Washington, D.C.

Sharitz, R. R., and Gibbons, J. W. 1982. "The Ecology of Southeastern Shrub Bogs (Pocosins) and Carolina Bays: A Community Profile," FWS/OBS-82/04, US Fish and Wildlife Service, Washington, D.C.

Thayer, G. W., Kenworthy, W. J., and Fonseca, M. S. 1984. "The Ecology of Eelgrass Meadows of the Atlantic Coast: A Community Profile," FWS/OBS-84/02, US Fish and Wildlife Service, Washington, D.C.

US Army Corps of Engineers. 1978. "Preliminary Guide to Wetlands of Peninsular Florida," Technical Report Y-78-2, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

__________. 1978. "Preliminary Guide to Wetlands of Puerto Rico," Technical Report Y-78-3, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

__________. 1978. "Preliminary Guide to Wetlands of the West Coast States," Technical Report Y-78-4, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

__________. 1978. "Preliminary Guide to Wetlands of the Gulf Coastal Plain," Technical Report Y-78-5, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

__________. 1982. "Preliminary Guide to the Onsite Identification and Delineation of the Wetlands of the Interior United States," Technical Report Y-78-6, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Witlatch, R. B. 1982. "The Ecology of New England Tidal Flats: A Community Profile," FWS/OBS-81/01, US Fish and Wildlife Service, Washington, D.C.

Wharton, C. H., Kitchens, W. M., and Sipe, T. W. 1982. "The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile," FWS/OBS-81/37, US Fish and Wildlife Service, Washington, D.C.

Zedler, J. B. 1984. "The Ecology of Southern California Coastal Salt Marshes: A Community Profile," FWS/OBS-81/54, US Fish and Wildlife Service, Washington, D.C.

Zieman, J. C. 1982. "The Ecology of the Seagrasses of South Florida: A Community Profile," FWS/OBS-82/25, US Fish and Wildlife Service, Washington, D.C.

# APPENDIX A: GLOSSARY

Active water table - A condition in which the zone of soil saturation fluctuates, resulting in periodic anaerobic soil conditions. Soils with an active water table often contain bright mottles and matrix chromas of 2 or less.

Adaptation - A modification of a species that makes it more fit for existence under the conditions of its environment. These modifications are the result of genetic selection processes.

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

Aerenchymous tissue - A type of plant tissue in which cells are unusually large and arranged in a manner that results in air spaces in the plant organ. Such tissues are often referred to as spongy and usually provide increased buoyancy.

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

Anaerobic - A situation in which molecular oxygen is absent (or effectively so) from the environment.

Aquatic roots - Roots that develop on stems above the normal position occupied by roots in response to prolonged inundation.

Aquic moisture regime - A mostly reducing soil moisture regime nearly free of dissolved oxygen due to saturation by ground water or its capillary fringe and occurring at periods when the soil temperature at 19.7 in. is greater than 5° C.

Arched roots - Roots produced on plant stems in a position above the normal position of roots, which serve to brace the plant during and following periods of prolonged inundation.

Areal cover - A measure of dominance that defines the degree to which above-ground portions of plants (not limited to those rooted in a sample plot) cover the ground surface. It is possible for the total areal cover in a community to exceed 100 percent because (a) most plant communities consist of two or more vegetative strata; (b) areal cover is estimated by vegetative layer; and (c) foliage within a single layer may overlap.

Atypical situation - As used herein, this term refers to areas in which one or more parameters (vegetation, soil, and/or hydrology) have been sufficiently altered by recent human activities or natural events to preclude the presence of wetland indicators of the parameter.

Backwater flooding - Situations in which the source of inundation is overbank flooding from a nearby stream.

Basal area - The cross-sectional area of a tree trunk measured in square inches, square centimetres, etc. Basal area is normally measured at 4.5 ft above the ground level and is used as a measure of dominance. The most easily used tool for measuring basal area is a tape marked in square inches. When plotless methods are used, an angle gauge or prism will provide a means for rapidly determining basal area. This term is also applicable to the cross-sectional area of a clumped herbaceous plant, measured at 1.0 in. above the soil surface.

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

Biennial - An event that occurs at 2-year intervals.

Buried soil - A once-exposed soil now covered by an alluvial, loessal, or other deposit (including man-made).

Canopy layer - The uppermost layer of vegetation in a plant community. In forested areas, mature trees comprise the canopy layer, while the tallest herbaceous species constitute the canopy layer in a marsh.

Capillary fringe - A zone immediately above the water table (zero gauge pressure) in which water is drawn upward from the water table by capillary action.

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

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

Comprehensive wetland determination - A type of wetland determination that is based on the strongest possible evidence, requiring the collection of quantitative data.

Concretion - A local concentration of chemical compounds (e.g. calcium carbonate, iron oxide) in the form of a grain or nodule of varying size, shape, hardness, and color. Concretions of significance in hydric soils are usually iron and/or manganese oxides occurring at or near the soil surface, which develop under conditions of prolonged soil saturation.

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

Criteria - Standards, rules, or tests on which a judgment or decision may be based.

Deepwater aquatic habitat - Any open water area that has a mean annual water depth >6.6 ft, lacks soil, and/or is either unvegetated or supports only floating or submersed macrophytes.

Density - The number of individuals of a species per unit area.

Detritus - Minute fragments of plant parts found on the soil surface. When fused together by algae or soil particles, this is an indicator that surface water was recently present.

Diameter at breast height (DBH) - The width of a plant stem as measured at 4.5 ft above the ground surface.

Dike - A bank (usually earthen) constructed to control or confine water.

Dominance - As used herein, a descriptor of vegetation that is related to the standing crop of a species in an area, usually measured by height, areal cover, or basal area (for trees).

Dominant species - As used herein, a plant species that exerts a controlling influence on or defines the character of a community.

Drained - A condition in which ground or surface water has been reduced or eliminated from an area by artificial means.

Drift line - An accumulation of debris along a contour (parallel to the water flow) that represents the height of an inundation event.

Duration (inundation/soil saturation) - The length of time during which water stands at or above the soil surface (inundation), or during which the soil is saturated. As used herein, duration refers to a period during the growing season.

Ecological tolerance - The range of environmental conditions in which a plant species can grow.

Emergent plant - A rooted herbaceous plant species that has parts extending above a water surface.

Field capacity - The percentage of water remaining in a soil after it has been saturated and after free drainage is negligible.

Fill material - Any material placed in an area to increase surface elevation.

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

Flora - A list of all plant species that occur in an area.

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

Frequency (vegetation) - The distribution of individuals of a species in an area. It is quantitatively expressed as

$$\frac{\text{Number of samples containing species A}}{\text{Total number of samples}} \times 100$$

More than one species may have a frequency of 100 percent within the same area.

Frequently flooded - A flooding class in which flooding is likely to occur often under normal weather conditions (more than 50-percent chance of flooding in any year or more than 50 times in 100 years).

Gleyed - A soil condition resulting from prolonged soil saturation, which is manifested by the presence of bluish or greenish colors through the soil mass or in mottles (spots or streaks) among other colors. Gleying occurs under reducing soil conditions resulting from soil saturation, by which iron is reduced predominantly to the ferrous state.

Ground water - That portion of the water below the ground surface that is under greater pressure than atmospheric pressure.

Growing season - The portion of the year when soil temperatures at 19.7 inches below the soil surface are higher than biologic zero (5° C) (US Department of Agriculture - Soil Conservation Service 1985).* For ease of determination this period can be approximated by the number of frost-free days (US Department of the Interior 1970).

Habitat - The environment occupied by individuals of a particular species, population, or community.

Headwater flooding - A situation in which an area becomes inundated directly by surface runoff from upland areas.

Herb - A nonwoody individual of a macrophytic species. In this manual, seedlings of woody plants (including vines) that are less than 3.2 ft in height are considered to be herbs.

---

* See references at the end of the main text.

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

Histic epipedon - An 8- to 16-in. soil layer at or near the surface that is saturated for 30 consecutive days or more during the growing season in most years and contains a minimum of 20 percent organic matter when no clay is present or a minimum of 30 percent organic matter when 60 percent or greater clay is present.

Histosols - An order in soil taxonomy composed of organic soils that have organic soil materials in more than half of the upper 80 cm or that are of any thickness if directly overlying bedrock.

Homogeneous vegetation - A situation in which the same plant species association occurs throughout an area.

Hue - A characteristic of color that denotes a color in relation to red, yellow, blue, etc; one of the three variables of color. Each color chart in the Munsell Color Book (Munsell Color 1975) consists of a specific hue.

Hydric soil - A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation (US Department of Agriculture-Soil Conservation Service 1985). Hydric soils that occur in areas having positive indicators of hydrophytic vegetation and wetland hydrology are wetland soils.

Hydric soil condition - A situation in which characteristics exist that are associated with soil development under reducing conditions.

Hydrologic regime - The sum total of water that occurs in an area on average during a given period.

Hydrologic zone - An area that is inundated or has saturated soils within a specified range of frequency and duration of inundation and soil saturation.

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

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

Hydrophytic vegetation - The sum total of macrophytic plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content. When hydrophytic vegetation comprises a community where indicators of hydric soils and wetland hydrology also occur, the area has wetland vegetation.

Hypertrophied lenticels - An exaggerated (oversized) pore on the surface of stems of woody plants through which gases are exchanged between the plant and the atmosphere. The enlarged lenticels serve as a mechanism for increasing oxygen to plant roots during periods of inundation and/or saturated soils.

Importance value - A quantitative term describing the relative influence of a plant species in a plant community, obtained by summing any combination of relative frequency, relative density, and relative dominance.

Indicator - As used in this manual, an event, entity, or condition that typically characterizes a prescribed environment or situation; indicators determine or aid in determining whether or not certain stated circumstances exist.

Indicator status - One of the categories (e.g. OBL) that describes the estimated probability of a plant species occurring in wetlands.

Intercellular air space - A cavity between cells in plant tissues, resulting from variations in cell shape and configuration. Aerenchymous tissue (a morphological adaptation found in many hydrophytes) often has large intercellular air spaces.

Inundation - A condition in which water from any source temporarily or permanently covers a land surface.

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

Liana - As used in this manual, a layer of vegetation in forested plant communities that consists of woody vines. The term may also be applied to a given species.

Limit of biological activity - With reference to soils, the zone below which conditions preclude normal growth of soil organisms. This term often is used to refer to the temperature (5° C) in a soil below which metabolic processes of soil microorganisms, plant roots, and animals are negligible.

Long duration (flooding) - A flooding class in which the period of inundation for a single event ranges from 7 days to 1 month.

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

Macrophytic - A term referring to a plant species that is a macrophyte.

Major portion of the root zone. The portion of the soil profile in which more than 50 percent of plant roots occur. In wetlands, this usually constitutes the upper 12 in. of the profile.

Man-induced wetland - Any area that develops wetland characteristics due to some activity (e.g., irrigation) of man.

Mapping unit - As used in this manual, some common characteristic of soil, vegetation, and/or hydrology that can be shown at the scale of mapping for the defined purpose and objectives of a survey.

Mean sea level - A datum, or "plane of zero elevation," established by averaging all stages of oceanic tides over a 19-year tidal cycle or "epoch." This plane is corrected for curvature of the earth and is the standard reference for elevations on the earth's surface. The correct term for mean sea level is the National Geodetic Vertical Datum (NGVD).

Mesophytic - Any plant species growing where soil moisture and aeration conditions lie between extremes. These species are typically found in habitats with average moisture conditions, neither very dry nor very wet.

Metabolic processes - The complex of internal chemical reactions associated with life-sustaining functions of an organism.

Method - A particular procedure or set of procedures to be followed.

Mineral soil - A soil consisting predominantly of, and having its properties determined predominantly by, mineral matter usually containing less than 20-percent organic matter.

Morphological adaptation - A feature of structure and form that aids in fitting a species to its particular environment (e.g. buttressed base, adventitious roots, aerenchymous tissue).

Mottles - Spots or blotches of different color or shades of color interspersed within the dominant color in a soil layer, usually resulting from the presence of periodic reducing soil conditions.

Muck - Highly decomposed organic material in which the original plant parts are not recognizable.

Multitrunk - A situation in which a single individual of a woody plant species has several stems.

Nonhydric soil - A soil that has developed under predominantly aerobic soil conditions. These soils normally support mesophytic or xerophytic species.

Nonwetland - Any area that has sufficiently dry conditions that indicators of hydrophytic vegetation, hydric soils, and/or wetland hydrology are lacking. As used in this manual, any area that is neither a wetland, a deepwater aquatic habitat, nor other special aquatic site.

Organic pan - A layer usually occurring at 12 to 30 inches below the soil surface in coarse-textured soils, in which organic matter and aluminum (with or without iron) accumulate at the point where the top of the water table most often occurs. Cementing of the organic matter slightly reduces permeability of this layer.

Organic soil - A soil is classified as an organic soil when it is: (1) saturated for prolonged periods (unless artificially drained) and has more than 30-percent organic matter if the mineral fraction is more than 50-percent clay, or more than 20-percent organic matter if the mineral fraction has no clay; or (2) never saturated with water for more than a few days and having more than 34-percent organic matter.

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

Oxidation-reduction process - A complex of biochemical reactions in soil that influences the valence state of component elements and their ions. Prolonged soil saturation during the growing season elicits anaerobic conditions that shift the overall process to a reducing condition.

Oxygen pathway - The sequence of cells, intercellular spaces, tissues, and organs, through which molecular oxygen is transported in plants. Plant species having pathways for oxygen transport to the root system are often adapted for life in saturated soils.

Parameter - A characteristic component of a unit that can be defined. Vegetation, soil, and hydrology are three parameters that may be used to define wetlands.

Parent material - The unconsolidated and more or less weathered mineral or organic matter from which a soil profile develops.

Ped - A unit of soil structure (e.g. aggregate, crumb, prism, block, or granule) formed by natural processes.

Peraquic moisture regime - A soil condition in which a reducing environment always occurs due to the presence of ground water at or near the soil surface.

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

Permeability - A soil characteristic that enables water or air to move through the profile, measured as the number of inches per hour that water moves downward through the saturated soil. The rate at which water moves through the least permeable layer governs soil permeability.

Physiognomy - A term used to describe a plant community based on the growth habit (e.g., trees, herbs, lianas) of the dominant species.

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

Plant community - All of the plant populations occurring in a shared habitat or environment.

Plant cover - See areal cover.

Pneumatophore - Modified roots that may function as a respiratory organ in species subjected to frequent inundation or soil saturation (e.g., cypress knees).

Ponded - A condition in which water stands in a closed depression. Water may be removed only by percolation, evaporation, and/or transpiration.

Poorly drained - Soils that commonly are wet at or near the surface during a sufficient part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these conditions.

Population - A group of individuals of the same species that occurs in a given area.

Positive wetland indicator - Any evidence of the presence of hydrophytic vegetation, hydric soil, and/or wetland hydrology in an area.

Prevalent vegetation - The plant community or communities that occur in an area during a given period. The prevalent vegetation is characterized by the dominant macrophytic species that comprise the plant community.

Quantitative - A precise measurement or determination expressed numerically.

Range - As used herein, the geographical area in which a plant species is known to occur.

Redox potential - A measure of the tendency of a system to donate or accept electrons, which is governed by the nature and proportions of the oxidizing and reducing substances contained in the system.

Reducing environment - An environment conducive to the removal of oxygen and chemical reduction of ions in the soils.

Relative density - A quantitative descriptor, expressed as a percent, of the relative number of individuals of a species in an area; it is calculated by

$$\frac{\text{Number of individuals of species A}}{\text{Total number of individuals of all species}} \times 100$$

Relative dominance - A quantitative descriptor, expressed as a percent, of the relative size or cover of individuals of a species in an area; it is calculated by

$$\frac{\text{Amount* of species A}}{\text{Total amount of all species}} \times 100$$

Relative frequency - A quantitative descriptor, expressed as a percent, of the relative distribution of individuals of a species in an area; it is calculated by

$$\frac{\text{Frequency of species A}}{\text{Total frequency of all species}} \times 100$$

---

* The "amount" of a species may be based on percent areal cover, basal area, or height.

Relief - The change in elevation of a land surface between two points; collectively, the configuration of the earth's surface, including such features as hills and valleys.

Reproductive adaptation - A feature of the reproductive mechanism of a species that results in it being better fitted to its environment (e.g. ability for seed germination under water).

Respiration - The sum total of metabolic processes associated with conversion of stored (chemical) energy into kinetic (physical) energy for use by an organism.

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

Root zone - The portion of a soil profile in which plant roots occur.

Routine wetland determination - A type of wetland determination in which office data and/or relatively simple, rapidly applied onsite methods are employed to determine whether or not an area is a wetland. Most wetland determinations are of this type, which usually does not require collection of quantitative data.

Sample plot - An area of land used for measuring or observing existing conditions.

Sapling/shrub - A layer of vegetation composed of woody plants <3.0 in. in diameter at breast height but greater than 3.2 ft in height, exclusive of woody vines.

Saturated soil conditions - A condition in which all easily drained voids (pores) between soil particles in the root zone are temporarily or permanently filled with water to the soil surface at pressures greater than atmospheric.

Soil - Unconsolidated mineral and organic material that supports, or is capable of supporting, plants, and which has recognizable properties due to the integrated effect of climate and living matter acting upon parent material, as conditioned by relief over time.

Soil horizon - A layer of soil or soil material approximately parallel to the land surface and differing from adjacent genetically related layers in physical, chemical, and biological properties or characteristics (e.g. color, structure, texture, etc.).

Soil matrix - The portion of a given soil having the dominant color. In most cases, the matrix will be the portion of the soil having more than 50 percent of the same color.

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

Soil phase - A subdivision of a soil series having features (e.g. slope, surface texture, and stoniness) that affect the use and management of the soil, but which do not vary sufficiently to differentiate it as a separate series. These are usually the basic mapping units on detailed soil maps produced by the Soil Conservation Service.

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

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

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

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

Soil surface - The upper limits of the soil profile. For mineral soils, this is the upper limit of the highest (A1) mineral horizon. For organic soils, it is the upper limit of undecomposed, dead organic matter.

Soil texture - The relative proportions of the various sizes of particles in a soil.

Somewhat poorly drained - Soils that are wet near enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted unless artificial drainage is provided. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, wet conditions high in the profile, additions of water through seepage, or a combination of these conditions.

Stilted roots - Aerial roots arising from stems (e.g., trunk and branches), presumably providing plant support (e.g., *Rhizophora mangle*).

Stooling - A form of asexual reproduction in which new shoots are produced at the base of senescing stems, often resulting in a multitrunk growth habit.

Stratigraphy - Features of geology dealing with the origin, composition, distribution, and succession of geologic strata (layers).

Substrate - The base or substance on which an attached species is growing.

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

Tidal - A situation in which the water level periodically fluctuates due to the action of lunar and solar forces upon the rotating earth.

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

Transect - As used herein, a line on the ground along which observations are made at some interval.

Transition zone - The area in which a change from wetlands to nonwetlands occurs. The transition zone may be narrow or broad.

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

Tree - A woody plant >3.0 in. in diameter at breast height, regardless of height (exclusive of woody vines).

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

Typically adapted - A term that refers to a species being normally or commonly suited to a given set of environmental conditions, due to some feature of its morphology, physiology, or reproduction.

Unconsolidated parent material - Material from which a soil develops, usually formed by weathering of rock or placement in an area by natural forces (e.g. water, wind, or gravity).

Under normal circumstances - As used in the definition of wetlands, this term refers to situations in which the vegetation has not been substantially altered by man's activities.

Uniform vegetation - As used herein, a situation in which the same group of dominant species generally occurs throughout a given area.

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

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

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

Vegetation layer - A subunit of a plant community in which all component species exhibit the same growth form (e.g., trees, saplings/shrubs, herbs).

Very long duration (flooding) - A duration class in which the length of a single inundation event is greater than 1 month.

Very poorly drained - Soils that are wet to the surface most of the time. These soils are wet enough to prevent the growth of important crops (except rice) unless artificially drained.

Watermark - A line on a tree or other upright structure that represents the maximum static water level reached during an inundation event.

Water table - The upper surface of ground water or that level below which the soil is saturated with water. It is at least 6 in. thick and persists in the soil for more than a few weeks.

Wetlands - Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Wetland boundary - The point on the ground at which a shift from wetlands to nonwetlands or aquatic habitats occurs. These boundaries usually follow contours.

Wetland determination - The process or procedure by which an area is adjudged a wetland or nonwetland.

Wetland hydrology - The sum total of wetness characteristics in areas that are inundated or have saturated soils for a sufficient duration to support hydrophytic vegetation.

Wetland plant association - Any grouping of plant species that recurs wherever certain wetland conditions occur.

Wetland soil - A soil that has characteristics developed in a reducing atmosphere, which exists when periods of prolonged soil saturation result in anaerobic conditions. Hydric soils that are sufficiently wet to support hydrophytic vegetation are wetland soils.

Wetland vegetation - The sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanently or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present. As used herein, hydrophytic vegetation occurring in areas that also have hydric soils and wetland hydrology may be properly referred to as wetland vegetation.

Woody vine - See liana.

Xerophytic - A plant species that is typically adapted for life in conditions where a lack of water is a limiting factor for growth and/or reproduction. These species are capable of growth in extremely dry conditions as a result of morphological, physiological, and/or reproductive adaptations.

# APPENDIX B: BLANK AND EXAMPLE DATA FORMS

DATA FORM 1

WETLAND DETERMINATION

Applicant Name:________________________ Application Number:______________ Project Name:________________

State:__________County:__________Legal Description: Township:_____Range:_____

Date:________________ Plot No.:__________________ Section:__________________

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)]. Indicate species with observed morphological or known physiological adaptations with an asterisk.

| Species | Indicator Status | Species | Indicator Status |
|---|---|---|---|
| Trees | | Herbs | |
| 1. | | 7. | |
| 2. | | 8. | |
| 3. | | 9. | |
| Saplings/shrubs | | Woody vines | |
| 4. | | 10. | |
| 5. | | 11. | |
| 6. | | 12. | |

% of species that are OBL, FACW, and/or FAC:____. Other indicators:_________.

Hydrophytic vegetation: Yes ____ No ____. Basis:____________________________.

Soil

Series and phase:___________________ On hydric soils list? Yes_____; No____.

Mottled: Yes_____; No_____. Mottle color:__________; Matrix color:_________.

Gleyed: Yes_____ No_____ Other indicators:________________________________.

Hydric soils: Yes_____ No_____; Basis:_____________________________________.

Hydrology

Inundated: Yes_____; No_____. Depth of standing water:_____________________.

Saturated soils: Yes_____; No_____. Depth to saturated soil:_______________.

Other indicators:__________________________________________________________.

Wetland hydrology: Yes_____; No_____. Basis:______________________________.

Atypical situation: Yes____; No_____.

Normal Circumstances? Yes_____ No_____.

Wetland Determination: Wetland__________________; Nonwetland_______________.

Comments:

Determined by:________________________

DATA FORM 2

VEGETATION-COMPREHENSIVE DETERMINATION

Applicant Name:____________ Application No.:____________ Project Name:____________

Location:__________ Plot #:__________ Date:__________ Determined By:____________

VEGETATION LAYER

| TREES | BASAL AREA | TOTAL BASAL AREA | RANK | HERBS | MIDPOINT OF % COVER CLASS | RANK |
|---|---|---|---|---|---|---|
| 1 | | | | 1 | | |
| 2 | | | | 2 | | |
| 3 | | | | 3 | | |
| 4 | | | | 4 | | |
| 5 | | | | 5 | | |
| 6 | | | | 6 | | |
| 7 | | | | 7 | | |
| 8 | | | | 8 | | |
| 9 | | | | 9 | | |
| 10 | | | | 10 | | |

| SAPLINGS/SHRUBS | MIDPOINT OF HEIGHT CLASS | TOTAL HEIGHT CLASS | RANK | WOODY VINES | NUMBER OF STEMS | RANK |
|---|---|---|---|---|---|---|
| 1 | | | | 1 | | |
| 2 | | | | 2 | | |
| 3 | | | | 3 | | |
| 4 | | | | 4 | | |
| 5 | | | | 5 | | |
| 6 | | | | 6 | | |
| 7 | | | | 7 | | |
| 8 | | | | 8 | | |
| 9 | | | | 9 | | |
| 10 | | | | 10 | | |

DATA FORM 3

ATYPICAL SITUATIONS

Applicant Name:______________________ Application Number:______________ Project Name:______________

Location:________________ Plot Number:________________ Date:________________

A. VEGETATION:

1. Type of Alteration:________________________________________________
________________________________________________
________________________________________________.

2. Effect on Vegetation:________________________________________________
________________________________________________
________________________________________________.

3. Previous Vegetation:________________________________________________
(Attach documentation) ________________________________________________
________________________________________________.

4. Hydrophytic Vegetation? Yes_______________No_______________.

B. SOILS:

1. Type of Alteration:________________________________________________
________________________________________________
________________________________________________.

2. Effect on Soils:________________________________________________
________________________________________________
________________________________________________.

3. Previous Soils:________________________________________________
(Attach documentation) ________________________________________________
________________________________________________.

4. Hydric Soils? Yes_______________No_______________.

C. HYDROLOGY:

1. Type of Alteration:________________________________________________
________________________________________________
________________________________________________.

2. Effect on Hydrology:________________________________________________
________________________________________________
________________________________________________.

3. Previous Hydrology:________________________________________________
(Attach documentation) ________________________________________________
________________________________________________.

4. Wetland Hydrology? Yes_______________No_______________.

Characterized By:________________________

DATA FORM 1

WETLAND DETERMINATION

Applicant Name: John Doe  Application Number: R-85-1421  Project Name: Zena Acricultural Land

State: LA  County: Choctaw  Legal Description: Township: 7N  Range: 2E

Date: 10/08/85  Plot No.: 1-1  Section: 32

Vegetation [list the three dominant species in each vegetation layer (5 if only 1 or 2 layers)]. Indicate species with observed morphological or known physiological adaptations with an asterisk.

| Species | Indicator Status | Species | Indicator Status |
|---|---|---|---|
| **Trees** | | **Herbs** | |
| 1. *Quercus lyrata* | OBL | 7. *Polygonum hydropiperoides* | OBL |
| 2. *Carya aquatica* | OBL | 8. *Boehmeria cylindrica* | FACW+ |
| 3. *Gleditsia aquatica* | OBL | 9. *Brunnichia cirrhosa* | -- |
| **Saplings/shurbs** | | **Woody vines** | |
| 4. *Forestiera acuminata* | OBL | 10. *Toxicodendron radicans* | FAC |
| 5. *Planera aquatica* | OBL | 11. -- | -- |
| 6. -- | -- | 12. -- | -- |

% of species that are OBL, FACW, and/or FAC: 100%. Other indicators: --.

Hydrophytic vegetation: Yes X No ____. Basis: 50% of dominants are OBL, FACW, and/or FAC on plant list.

Soil

Series and phase: Sharkey, frequently flooded On hydric soils list? Yes X; No ___.

Mottled: Yes X; No ____. Mottle color: 5YR4/6; Matrix color: 10YR4/1.

Gleyed: Yes ____ No X. Other indicators: ____________.

Hydric soils: Yes X No ____; Basis: On hydric soil list and matrix color.

Hydrology

Inundated: Yes ____; No X. Depth of standing water: --.

Saturated soils: Yes X; No ____. Depth to saturated soil: 6".

Other indicators: Drift lines and sediment deposits present on trees.

Wetland hydrology: Yes X; No ____. Basis: Saturated soils.

Atypical situation: Yes ____; No X.

Normal Circumstances?: Yes X No ____.

Wetland Determination: Wetland X; Nonwetland ____________.

Comments: No rain reported from area in previous two weeks.

Determined by: Zelda Schmell (Signed)

DATA FORM 2

VEGETATION-COMPREHENSIVE DETERMINATION

Applicant Name: John Doe Application No.: R-85-1421 Project Name: Zena Agricultural Land

Location: LA (Choctaw Parish) Plot #: 1-1 Date: 10/08/85 Determined By: Zelda Schmell

VEGETATION LAYER

| | TREES | BASAL AREA ($in^2$) | TOTAL BASAL AREA | RANK | | HERBS | MIDPOINT OF % COVER CLASS | RANK |
|---|---|---|---|---|---|---|---|---|
| 1 | *Quercus lyrata* | 465 | 1,145 | 1 | 1 | *Boehmeria cylindrica* | 37.5 | 2 |
| 2 | *Quercus lyrata* | 680 | | | 2 | *Polygonum hydropiperoides* | 62.5 | 1 |
| 3 | *Carya aquatica* | 85 | 243 | 3 | 3 | *Brunnichia ovata* | 37.5 | 3 |
| 4 | *Carya aquatica* | 120 | | | 4 | *Gleditsia aquatica* (seedling) | 2.5 | |
| 5 | *Carya aquatica* | 38 | | | 5 | *Eclipta alba* | 2.5 | |
| 6 | *Gleditsia aquatica* | 235 | 253 | 2 | 6 | | | |
| 7 | *Gleditsia aquatica* | 18 | | | 7 | | | |
| 8 | *Diospyros virginiana* | 46 | 46 | | 8 | | | |
| 9 | | | | | 9 | | | |
| 10 | | | | | 10 | | | |

| | SAPLINGS/SHRUBS | MIDPOINT OF HEIGHT CLASS | TOTAL HEIGHT CLASS | RANK | | WOODY VINES | NUMBER OF STEMS | RANK |
|---|---|---|---|---|---|---|---|---|
| 1 | *Forestiera acuminata* | 4.5 | 13.0 | 1 | 1 | *Toxicodendron radicans* | 35 | 1 |
| 2 | *Forestiera acuminata* | 4.5 | | | 2 | (only woody vine present) | | |
| 3 | *Forestiera acuminata* | 1.5 | | | 3 | | | |
| 4 | *Forestiera acuminata* | 2.5 | | | 4 | | | |
| 5 | *Planera aquatica* | 4.5 | 8.0 | 2 | 5 | | | |
| 6 | *Planera aquatica* | 3.5 | | | 6 | | | |
| 7 | *Carya aquatica* | 1.5 | 1.5 | | 7 | | | |
| 8 | | | | | 8 | | | |
| 9 | | | | | 9 | | | |
| 10 | | | | | 10 | | | |

DATA FORM 3

ATYPICAL SITUATIONS

Applicant Name: Wetland Developers, Inc.  Application Number: R-85-12  Project Name: Big Canal

Location: Joshua Co., MT  Plot Number: 2  Date: 10/08/85

A. VEGETATION:

1. Type of Alteration: Vegetation totally removed or covered by placement of fill from canal (1984).

2. Effect on Vegetation: None remaining.

3. Previous Vegetation: *Carex nebrascensis* - *Juncus effusus* freshwater (Attach documentation) marsh (based on contiguous plant communities and aerial photography predating fill).

4. Hydrophytic Vegetation? Yes X No ____.

B. SOILS:

1. Type of Alteration: Original soil covered by 4 feet of fill material excavated from canal.

2. Effect on Soils: Original soil buried in 1984.

3. Previous Soils: Original soil examined at 10 inches below (Attach documentation) original soil surface. Soil gleyed (color notation 5Y2/0).

4. Hydric Soils? Yes X No ____.

C. HYDROLOGY:

1. Type of Alteration: 4 feet of fill material placed on original surface.

2. Effect on Hydrology: Area no longer is inundated.

3. Previous Hydrology: Examination of color IR photography taken on 6/5/84 (Attach documentation) showed the area to be inundated. Gaging station data from gage 2 miles upstream indicated the area has been inundated for as much as 3 months of the growing season during 8 of the past 12 years.

4. Wetland Hydrology? Yes X No ____.

Characterized By: Joe Zook

# APPENDIX C: VEGETATION

1. This appendix contains three sections. Section 1 is a subset of the regional list of plants that occur in wetlands, but includes only those species having an indicator status of OBL, FACW, or FAC. Section 2 is a list of plants that commonly occur in wetlands of a given region. Since many geographic areas of Section 404 responsibility include portions of two or more plant list regions, users will often need more than one regional list; thus, Sections 1 and 2 will be published separately from the remainder of the manual. Users will be furnished all appropriate regional lists.

2. Section 3, which is presented herein, describes morphological, physiological, and reproductive adaptations that can be observed or are known to occur in plant species that are typically adapted for life in anaerobic soil conditions.

## Section 3 - Morphological, Physiological, and Reproductive Adaptations of Plant Species for Occurrence in Areas Having Anaerobic Soil Conditions

### Morphological adaptations

3. Many plant species have morphological adaptations for occurrence in wetlands. These structural modifications most often provide the plant with increased buoyancy or support. In some cases (e.g. adventitious roots), the adaptation may facilitate the uptake of nutrients and/or gases (particularly oxygen). However, not all species occurring in areas having anaerobic soil conditions exhibit morphological adaptations for such conditions. The following is a list of morphological adaptations that a species occurring in areas having anaerobic soil conditions may possess (a partial list of species with such adaptations is presented in Table C1):

a. Buttressed tree trunks. Tree species (e.g. *Taxodium distichum*) may develop enlarged trunks (Figure C1) in response to frequent inundation. This adaptation is a strong indicator of hydrophytic vegetation in nontropical forested areas.

b. Pneumatophores. These modified roots may serve as respiratory organs in species subjected to frequent inundation or soil saturation. Cypress knees (Figure C2) are a classic example, but other species (e.g., *Nyssa aquatica*, *Rhizophora mangle*) may also develop pneumatophores.

c. Adventitious roots. Sometimes referred to as "water roots," adventitious roots occur on plant stems in positions where roots normally are not found. Small fibrous roots protruding from the base of trees (e.g. *Salix nigra*) or roots on stems of herbaceous plants and tree seedlings in positions immediately above the soil surface (e.g. *Ludwigia* spp.) occur in response to inundation or soil saturation (Figure C3). These usually develop during periods of sufficiently prolonged soil saturation to destroy most of the root system. *CAUTION: Not all adventitious roots develop as a result of inundation or soil saturation. For example, aerial roots on woody vines are not normally produced as a response to inundation or soil saturation.*

d. Shallow root systems. When soils are inundated or saturated for long periods during the growing season, anaerobic conditions develop in the zone of root growth. Most species with deep root systems cannot survive in such conditions. Most species capable of growth during periods when soils are oxygenated only near the surface have shallow root systems. In forested wetlands, windthrown trees (Figure C4) are often indicative of shallow root systems.

e. Inflated leaves, stems, or roots. Many hydrophytic species, particularly herbs (e.g. *Limnobium spongia*, *Ludwigia* spp.), have or develop spongy (aerenchymous) tissues in leaves, stems, and/or roots that provide buoyancy or support and serve as a reservoir or passageway for oxygen needed for metabolic processes. An example of inflated leaves is shown in Figure C5.

f. Polymorphic leaves. Some herbaceous species produce different types of leaves, depending on the water level at the time of leaf formation. For example, *Alisma* spp. produce strap-shaped leaves when totally submerged, but produce broader, floating leaves when plants are emergent. *CAUTION: Many upland species also produce polymorphic leaves.*

g. Floating leaves. Some species (e.g. *Nymphaea* spp.) produce leaves that are uniquely adapted for floating on a water surface (Figure C6). These leaves have stomata primarily on the upper surface and a thick waxy cuticle that restricts water penetration. The presence of species with floating leaves is strongly indicative of hydrophytic vegetation.

h. Floating stems. A number of species (e.g., *Alternanthera philoxeroides*) produce matted stems that have large internal air spaces when occurring in inundated areas. Such species root in shallow water and grow across the water surface into deeper areas. Species with floating stems often produce adventitious roots at leaf nodes.

i. Hypertrophied lenticels. Some plant species (e.g. *Gleditsia aquatica*) produce enlarged lenticels on the stem in response to prolonged inundation or soil saturation. These are thought to increase oxygen uptake through the stem during such periods.

j. Multitrunks or stooling. Some woody hydrophytes characteristically produce several trunks of different ages (Figure C7) or produce new stems arising from the base of a senescing individual (e.g. *Forestiera acuminata*, *Nyssa ogechee*) in response to inundation.

Figure C1. Buttressed tree truck (bald cypress)

Figure C2. Pneumatophores (bald cypress)

Figure C3. Adventitious roots

Figure C4. Wind-thrown tree with shallow root system

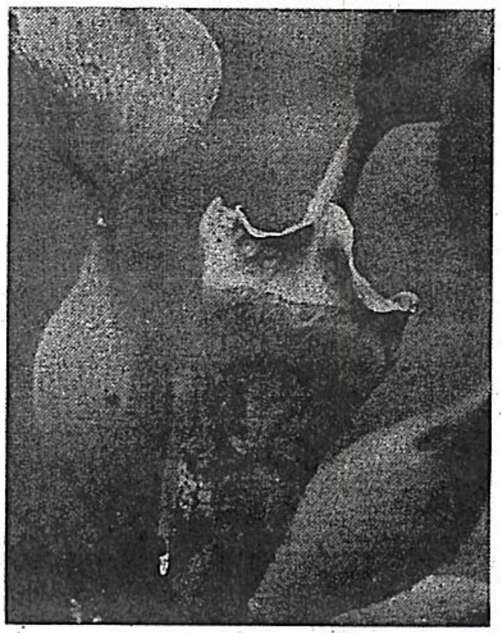

Figure C5. Inflated leaves

Figure C6. Floating leaves

Figure C7. Multitrunk plant

k. Oxygen pathway to roots. Some species (e.g. *Spartina alterniflora*) have a specialized cellular arrangement that facilitates diffusion of gaseous oxygen from leaves and stems to the root system.

Physiological adaptations

4. Most, if not all, hydrophytic species are thought to possess physiological adaptations for occurrence in areas that have prolonged periods of anaerobic soil conditions. However, relatively few species have actually been proven to possess such adaptations, primarily due to the limited research that has been conducted. Nevertheless, several types of physiological adaptations known to occur in hydrophytic species are discussed below, and a list of species having one or more of these adaptations is presented in Table C2. *NOTE: Since it is impossible to detect these adaptations in the field, use of this indicator will be limited to observing the species in the field and checking the list in Table C2 to determine whether the species is known to have a physiological adaptation for occurrence in areas having anaerobic soil conditions*):

a. Accumulation of malate. Malate, a nontoxic metabolite, accumulates in roots of many hydrophytic species (e.g. *Glyceria maxima*, *Nyssa sylvatica* var. *biflora*). Nonwetland species concentrate ethanol, a toxic by-product of anaerobic respiration, when growing in anaerobic soil conditions. Under such conditions, many hydrophytic species produce high concentrations of malate and unchanged concentrations of ethanol, thereby avoiding accumulation of toxic materials. Thus, species having the ability to concentrate malate instead of ethanol in the root system under anaerobic soil conditions are adapted for life in such conditions, while species that concentrate ethanol are poorly adapted for life in anaerobic soil conditions.

b. Increased levels of nitrate reductase. Nitrate reductase is an enzyme involved in conversion of nitrate nitrogen to nitrite nitrogen, an intermediate step in ammonium production. Ammonium ions can accept electrons as a replacement for gaseous oxygen in some species, thereby allowing continued functioning of metabolic processes under low soil oxygen conditions. Species that produce high levels of nitrate reductase (e.g. *Larix laricina*) are adapted for life in anaerobic soil conditions.

c. Slight increases in metabolic rates. Anaerobic soil conditions effect short-term increases in metabolic rates in most species. However, the rate of metabolism often increases only slightly in wetland species, while metabolic rates increase significantly in nonwetland species. Species exhibiting only slight increases in metabolic rates (e.g. *Larix laricina*, *Senecio vulgaris*) are adapted for life in anaerobic soil conditions.

d. Rhizosphere oxidation. Some hydrophytic species (e.g. *Nyssa aquatica*, *Myrica gale*) are capable of transferring gaseous oxygen from the root system into soil pores immediately surrounding the roots. This adaptation prevents root deterioration and maintains the rates of water and nutrient absorption under anaerobic soil conditions.

e. Ability for root growth in low oxygen tensions. Some species (e.g. *Typha angustifolia*, *Juncus effusus*) have the ability to maintain root growth under soil oxygen concentrations as low as 0.5 percent. Although prolonged (>1 year) exposure to soil oxygen concentrations lower than 0.5 percent generally results in the death of most individuals, this adaptation enables some species to survive extended periods of anaerobic soil conditions.

f. Absence of alcohol dehydrogenase (ADH) activity. ADH is an enzyme associated with increased ethanol production. When the enzyme is not functioning, ethanol production does not increase significantly. Some hydrophytic species (e.g. *Potentilla anserina*, *Polygonum amphibium*) show only slight increases in ADH activity under anaerobic soil conditions. Therefore, ethanol production occurs at a slower rate in species that have low concentrations of ADH.

Reproductive adaptations

5. Some plant species have reproductive features that enable them to become established and grow in saturated soil conditions. The following have been identified in the technical literature as reproductive adaptations that occur in hydrophytic species:

a. Prolonged seed viability. Some plant species produce seeds that may remain viable for 20 years or more. Exposure of these seeds to atmospheric oxygen usually triggers germination. Thus, species (e.g., *Taxodium distichum*) that grow in very wet areas may produce seeds that germinate only during infrequent periods when the soil is dewatered. *NOTE: Many upland species also have prolonged seed viability, but the trigger mechanism for germination is not exposure to atmospheric oxygen.*

b. Seed germination under low oxygen concentrations. Seeds of some hydrophytic species germinate when submerged. This enables germination during periods of early-spring inundation, which may provide resulting seedlings a competitive advantage over species whose seeds germinate only when exposed to atmospheric oxygen.

c. Flood-tolerant seedlings. Seedlings of some hydrophytic species (e.g. *Fraxinus pennsylvanica*) can survive moderate periods of total or partial inundation. Seedlings of these species have a competitive advantage over seedlings of flood-intolerant species.

Table C1

Partial List of Species With Known Morphological Adaptations for Occurrence in Wetlands*

| Species | Common Name | Adaptation |
|---|---|---|
| *Acer negundo* | Box elder | Adventitious roots |
| *Acer rubrum* | Red maple | Hypertrophied lenticels |
| *Acer saccharinum* | Silver maple | Hypertrophied lenticels; adventitious roots (juvenile plants) |
| *Alisma* spp. | Water plantain | Polymorphic leaves |
| *Alternanthera philoxeroides* | Alligatorweed | Adventitious roots; inflated, floating stems |
| *Avicennia nitida* | Black mangrove | Pneumatophores; hypertrophied lenticels |
| *Brasenia schreberi* | Watershield | Inflated, floating leaves |
| *Cladium mariscoides* | Twig rush | Inflated stems |
| *Cyperus* spp. (most species) | Flat sedge | Inflated stems and leaves |
| *Eleocharis* spp. (most species) | Spikerush | Inflated stems and leaves |
| *Forestiera acuminata* | Swamp privet | Multi-trunk, stooling |
| *Fraxinus pennsylvanica* | Green ash | Buttressed trunks; adventitious roots |
| *Gleditsia aquatica* | Water locust | Hypertrophied lenticels |
| *Juncus* spp. | Rush | Inflated stems and leaves |
| *Limnobium spongia* | Frogbit | Inflated, floating leaves |
| *Ludwigia* spp. | Waterprimrose | Adventitious roots; inflated floating stems |
| *Menyanthes trifoliata* | Buckbean | Inflated stems (rhizome) |
| *Myrica gale* | Sweetgale | Hypertrophied lenticels |
| *Nelumbo* spp. | Lotus | Floating leaves |
| *Nuphar* spp. | Cowlily | Floating leaves |

(Continued)

* Many other species exhibit one or more morphological adaptations for occurrence in wetlands. However, not all individuals of a species will exhibit these adaptations under field conditions, and individuals occurring in uplands characteristically may not exhibit them.

Table C1 (Concluded)

| Species | Common Name | Adaptation |
|---|---|---|
| *Nymphaea* spp. | Waterlily | Floating leaves |
| *Nyssa aquatica* | Water tupelo | Buttressed trunks; pneumatophores; adventitious roots |
| *Nyssa ogechee* | Ogechee tupelo | Buttressed trunks; multi-trunk; stooling |
| *Nyssa sylvatica* var. *biflora* | Swamp blackgum | Buttressed trunks |
| *Platanus occidentalis* | Sycamore | Adventitious roots |
| *Populus deltoides* | Cottonwood | Adventitious roots |
| *Quercus laurifolia* | Laurel oak | Shallow root system |
| *Quercus palustris* | Pin oak | Adventitious roots |
| *Rhizophora mangle* | Red mangrove | Pneumatophores |
| *Sagittaria* spp. | Arrowhead | Polymorphic leaves |
| *Salix* spp. | Willow | Hypertrophied lenticels; adventitious roots; oxygen pathway to roots |
| *Scirpus* spp. | Bulrush | Inflated stems and leaves |
| *Spartina alterniflora* | Smooth cordgrass | Oxygen pathway to roots |
| *Taxodium distichum* | Bald cypress | Buttressed trunks; pneumatophores |

Table C2

Species Exhibiting Physiological Adaptations for Occurrence in Wetlands

| Species | Physiological Adaptation |
|---|---|
| *Alnus incana* | Increased levels of nitrate reductase; malate accumulation |
| *Alnus rubra* | Increased levels of nitrate reductase |
| *Baccharis viminea* | Ability for root growth in low oxygen tensions |
| *Betula pubescens* | Oxidizes the rhizosphere; malate accumulation |
| *Carex arenaria* | Malate accumulation |
| *Carex flacca* | Absence of ADH activity |
| *Carex lasiocarpa* | Malate accumulation |
| *Deschampsia cespitosa* | Absence of ADH activity |
| *Filipendula ulmaria* | Absence of ADH activity |
| *Fraxinus pennsylvanica* | Oxidizes the rhizosphere |
| *Glyceria maxima* | Malate accumulation; absence of ADH activity |
| *Juncus effusus* | Ability for root growth in low oxygen tensions; absence of ADH activity |
| *Larix laricina* | Slight increases in metabolic rates; increased levels of nitrate reductase |
| *Lobelia dortmanna* | Oxidizes the rhizosphere |
| *Lythrum salicaria* | Absence of ADH activity |
| *Molinia caerulea* | Oxidizes the rhizosphere |
| *Myrica gale* | Oxidizes the rhizosphere |
| *Nuphar lutea* | Organic acid production |
| *Nyssa aquatica* | Oxidizes the rhizosphere |
| *Nyssa sylvatica* var. *biflora* | Oxidizes the rhizosphere; malate accumulation |
| *Phalaris arundinacea* | Absence of ADH activity; ability for root growth in low oxygen tensions |
| *Phragmites australis* | Malate accumulation |
| *Pinus contorta* | Slight increases in metabolic rates; increased levels of nitrate reductase |
| *Polygonum amphibium* | Absence of ADH activity |
| *Potentilla anserina* | Absence of ADH activity; ability for root growth in low oxygen tensions |

(Continued)

Table C2 (Concluded)

| Species | Physiological Adaptation |
|---|---|
| *Ranunculus flammula* | Malate accumulation; absence of ADH activity |
| *Salix cinerea* | Malate accumulation |
| *Salix fragilis* | Oxidizes the rhizosphere |
| *Salix lasiolepis* | Ability for root growth in low oxygen tensions |
| *Scirpus maritimus* | Ability for root growth in low oxygen tensions |
| *Senecio vulgaris* | Slight increases in metabolic rates |
| *Spartina alterniflora* | Oxidizes the rhizosphere |
| *Trifolium subterraneum* | Low ADH activity |
| *Typha angustifolia* | Ability for root growth in low oxygen tensions |

# APPENDIX D: HYDRIC SOILS

1. This appendix consists of two sections. Section 1 describes the basic procedure for digging a soil pit and examining for hydric soil indicators. Section 2 is a list of hydric soils of the United States.

## Section 1 - Procedures for Digging a Soil Pit and Examining for Hydric Soil Indicators

### Digging a soil pit

2. Apply the following procedure: Circumscribe a 1-ft-diam area, preferably with a tile spade (sharpshooter). Extend the blade vertically downward, cut all roots to the depth of the blade, and lift the soil from the hole. This should provide approximately 16 inches of the soil profile for examination. *Note: Observations are usually made immediately below the A-horizon or 10 inches (whichever is shallower).* In many cases, a soil auger or probe can be used instead of a spade. If so, remove successive cores until 16 inches of the soil profile have been removed. Place successive cores in the same sequence as removed from the hole. *Note: An auger or probe cannot be effectively used when the soil profile is loose, rocky, or contains a large volume of water (e.g. peraquic moisture regime).*

### Examining the soil

3. Examine the soil for hydric soils indicators (paragraphs 44 and/or 45 of main text (for sandy soils)). *Note: It may not be necessary to conduct a classical characterization (e.g. texture, structure, etc.) of the soil.* Consider the hydric soil indicators in the following sequence *(Note: THE SOIL EXAMINATION CAN BE TERMINATED WHEN A POSITIVE HYDRIC SOIL INDICATOR IS FOUND)*:

Nonsandy soils.

a. Determine whether an organic soil is present (see paragraph 44 of the main text). If so, the soil is hydric.

b. Determine whether the soil has a histic epipedon (see paragraph 44 of the main text). Record the thickness of the histic epipedon on DATA FORM 1.

c. Determine whether sulfidic materials are present by smelling the soil. The presence of a "rotten egg" odor is indicative of hydrogen sulfide, which forms only under extreme reducing conditions associated with prolonged inundation/soil saturation.

d. Determine whether the soil has an aquic or peraquic moisture regime (see paragraph 44 of the main text). If so, the soil is hydric.

e. Conduct a ferrous iron test. A colorimetric field test kit has been developed for this purpose. A reducing soil environment is present when the soil extract turns pink upon addition of $\alpha$-$\alpha$-dipyridil.

f. Determine the color(s) of the matrix and any mottles that may be present. Soil color is characterized by three features: hue, value, and chroma. Hue refers to the soil color in relation to red, yellow, blue, etc. Value refers to the lightness of the hue. Chroma refers to the strength of the color (or departure from a neutral of the same lightness). Soil colors are determined by use of a Munsell Color Book (Munsell Color 1975).* Each Munsell Color Book has color charts of different hues, ranging from 10R to 5Y. Each page of hue has color chips that show values and chromas. Values are shown in columns down the page from as low as 0 to as much as 8, and chromas are shown in rows across the page from as low as 0 to as much as 8. In writing Munsell color notations, the sequence is always hue, value, and chroma (e.g. 10YR5/2). To determine soil color, place a small portion of soil** in the openings behind the color page and match the soil color to the appropriate color chip. *Note: Match the soil to the nearest color chip.* Record on DATA FORM 1 the hue, value, and chroma of the best matching color chip. *CAUTION: Never place soil on the face or front of the color page because this might smear the color chips.* Mineral hydric soils usually have one of the following color features immediately below the A-horizon or 10 inches (whichever is shallower):

(1) Gleyed soil.

Determine whether the soil is gleyed. If the matrix color best fits a color chip found on the gley page of the Munsell soil color charts, the soil is gleyed. This indicates prolonged soil saturation, and the soil is highly reduced.

(2) Nongleyed soil.

(a) Matrix chroma of 2 or less in mottled soils.**

(b) Matrix chroma of 1 or less in unmottled soils.**

(c) Gray mottles within 10 inches of the soil surface in dark (black) mineral soils (e.g., Mollisols) that do not have characteristics of (a) or (b) above.

Soils having the above color characteristics are normally saturated for significant duration during the growing season. However, hydric soils with significant coloration due to the nature of the parent material (e.g. red soils of the Red River Valley) may not exhibit chromas within the range indicated above. In such cases, this indicator cannot be used.

---

* See references at the end of the main text.

** The soil must be moistened if dry at the time of examination.

g. Determine whether the mapped soil series or phase is on the national list of hydric soils (Section 2). *CAUTION: It will often be necessary to compare the profile description of the soil with that of the soil series or phase indicated on the soil map to verify that the soil was correctly mapped. This is especially true when the soil survey indicates the presence of inclusions or when the soil is mapped as an association of two or more soil series.*

h. Look for iron and manganese concretions. Look for small (>0.08-inch) aggregates within 3 inches of the soil surface. These are usually black or dark brown and reflect prolonged saturation near the soil surface.

Sandy soils.

Look for one of the following indicators in sandy soils:

a. A layer of organic material above the mineral surface or high organic matter content in the surface horizon (see paragraph 45a of the main text). This is evidenced by a darker color of the surface layer due to organic matter interspersed among or adhering to the sand particles. This is not observed in upland soils due to associated aerobic conditions.

b. Streaking of subsurface horizons (see paragraph 45c of the main text). Look for dark vertical streaks in subsurface horizons. These streaks represent organic matter being moved downward in the profile. When soil is rubbed between the fingers, the organic matter will leave a dark stain on the fingers.

c. Organic pans (see paragraph 45b of the main text). This is evidenced by a thin layer of hardened soil at a depth of 12 to 30 inches below the mineral surface.

## Section 2 - Hydric Soils of the United States

4. The list of hydric soils of the United States (Table D1) was developed by the National Technical Committee for Hydric Soils (NTCHS), a panel consisting of representatives of the Soil Conservation Service (SCS), Fish and Wildlife Service, Environmental Protection Agency, Corps of Engineers, Auburn University, University of Maryland, and Louisiana State University. Keith Young of SCS was committee chairman.

5. The NTCHS developed the following definition of hydric soils:

> A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation" (US Department of Agriculture (USDA) Soil Conservation Service 1985, as amended by the NTCHS in December 1986).

### Criteria for hydric soils

6. Based on the above definition, the NTCHS developed the following criteria for hydric soils, and all soils appearing on the list will meet at least one criterion:

- a. "All Histosols* except Folists;
- b. Soils in Aquic suborders, Aquic subgroups, Albolls suborder, Salorthids great group, or Pell great groups of Vertisols that are:
  - (1) Somewhat poorly drained and have water table less than 0.5 ft from the surface for a significant period (usually a week or more) during the growing season, or
  - (2) Poorly drained or very poorly drained and have either:
    - (a) A water table at less than 1.0 ft from the surface for a significant period (usually a week or more) during the growing season if permeability is equal to or greater than 6.0 in/hr in all layers within 20 inches; or
    - (b) A water table at less than 1.5 ft from the surface for a significant period (usually a week or more) during the growing season if permeability is less than 6.0 in/hr in any layer within 20 inches; or
- c. Soils that are ponded for long duration or very long duration during part of the growing season; or
- d. Soils that are frequently flooded for long duration or very long duration during the growing season.

---

* Soil taxa conform to USDA-SCS (1975).

7. The hydric soils list was formulated by applying the above criteria to soil properties documented in USDA-SCS (1975) and the SCS Soil Interpretation Records (SOI-5).

Use of the list

8. The list of hydric soils of the United States (Table D1) is arranged alphabetically by soil series. Unless otherwise specified, all phases of a listed soil series are hydric. In some cases, only those phases of a soil series that are ponded, frequently flooded, or otherwise designated as wet are hydric. Such phases are denoted in Table D1 by the following symbols in parentheses after the series name:

F - flooded

FF - frequently flooded

P - ponded

W - wet

D - depressional

9. Drained phases of some soil series retain their hydric properties even after drainage. Such phases are identified in Table D1 by the symbol "DR" in parentheses following the soil series name. In such cases, both the drained and undrained phases of the soil series are hydric.

*CAUTION: Be sure that the profile description of the mapping unit conforms to that of the sampled soil. Also, designation of a soil series or phase as hydric does not necessarily mean that the area is a wetland. An area having a hydric soil is a wetland only if positive indicators of hydrophytic vegetation and wetland hydrology are also present.*

Table D1

Hydric Soils

| Soil Phase | Classification | Soil Phase | Classification |
|---|---|---|---|
| ABCAL | Typic Fluvaquents | ALTDORF (DR) | Aeric Glossaqualfs |
| ACASCO | Typic Haplaquolls | ALUSA | Typic Albaqualfs |
| ACKERMAN (DR) | Histic Humaquepts | ALVISO | Tropic Fluvaquents |
| ACREDALE (DR) | Typic Ochraqualfs | ALVOR | Cumulic Haplaquolls |
| ADATON | Typic Ochraqualfs | AMAGON | Typic Ochraqualfs |
| ADDICKS | Typic Argiaquolls | AMALU | Histic Placaquepts |
| ADEN | Aeric Ochraqualfs | AMBIA | Vertic Fluvaquents |
| ADLER (FF) | Aquic Udifluvents | AMBRAW (DR) | Fluvaquentic Haplaquolls |
| ADOLPH (DR) | Typic Haplaquolls | AMES | Typic Albaqualfs |
| ADRIAN (DR) | Terric Medisaprists | AMY | Typic Ochraquults |
| AFTON | Cumulic Haplaquolls | ANACOCO | Vertic albaqualfs |
| AGNAL | Cumulic Haplaquolls | ANCHOR POINT | Typic Cryaquents |
| AGUIRRE | Udic Pellusterts | ANCLOTE | Typic Haplaquolls |
| AHOLT | Vertic Haplaquolls | ANDOVER | Typic Fragiaquults |
| AHTANUM | Typic Duraquolls | ANDRY (DR) | Typic Argiaquolls |
| AIRPORT | Typic Natraquolls | ANGELICA (DR) | Aeric Haplaquepts |
| AKAN (DR) | Typic Haplaquepts | ANGELINA | Typic Fluvaquents |
| ALAKAI | Terric Troposaprists | ANKONA | Arenic Ultic Haplaquods |
| ALAMO | Typic Duraquolls | ANSGAR | Mollic Ochraqualfs |
| ALAMOSA | Typic Argiaquolls | ANTERO | Typic Haplaquepts |
| ALAPAHA | Arenic Plinthic | APALACHEE | Fluvaquentic Dystrochrepts |
| ALBANO | Typic Ochraqualfs | APISHAPA | Vertic Fluvaquents |
| ALBATON | Vertic Fluvaquents | APPANOOSE | Mollic Albaqualfs |
| ALBURZ | Fluvaquentic Haplaquolls | ARANSAS | Vertic Haplaquolls |
| ALDEN | Mollic Haplaquepts | ARAPAHOE (DR) | Typic Humaquepts |
| ALGANSEE (FF) | Aquic Udipsamments | ARAT | Typic Hydraquents |
| ALGOMA | Mollic Halaquepts | ARABE | Aquic Natrustalfs |
| ALIKCHI | Typic Glossaqualfs | ARBELA | Argiaquic Argialbolls |
| ALLANTON | Grossarenic Haplaquods | ARENA | Aquentic Durorthids |
| ALLEMANDS | Terric Medisaprists | ARGENT (DR) | Typic Ochraqualfs |
| ALLIGATOR | Vertic Haplaquepts | ARKABUTLA (FF) | Aeric Fluvaquents |
| ALLIS | Aeric Haplaquepts | ARLO | Typic Calciaquolls |
| ALMAVILLE | Typic Fragiaqualfs | ARMAGH | Typic Ochraquults |
| ALMO | Typic Fragiaqualfs | ARMENIA | Typic Argiaquolls |
| ALMONT | Pergelic Cryaquolls | ARMIESBURG | Fluventic Hapludolls |

(Continued)

Table D1 (Continued)

| Soil Phase | Classification | Soil Phase | Classification |
|---|---|---|---|
| ARMIJO | Typic Torrerts | BALMAN | Aquic Calciorthids |
| ARNHEIM | Aeric Fluvaquents | BALSORA (FF) | Typic Ustifluvents |
| AROL | Typic Albaqualfs | BALTIC (DR) | Cumulic Haplaquolls |
| ARRADA | Typic Salorthids | BARATARI (DR) | Aeric Haplaquods |
| ARVESON (DR) | Typic Calciaquolls | BARBARY | Typic Hydraquents |
| ASHFORD | Vertic Ochraqualfs | BARBERT | Typic Argialbolls |
| ASHGROVE | Aeric Ochraqualfs | BARBOUR (FF) | Fluventic Dystrochrepts |
| ASHKUM (DR) | Typic Haplaquolls | BARNEY | Mollic Fluvaquents |
| ASTOR | Cumulic Haplaquolls | BARODA | Typic Argiaquolls |
| ATHERTON | Aeric Haplaquepts | BARRADA | Aquollic Salorthids |
| ATKINS | Typic Fluvaquents | BARRE | Udollic Orchraqualfs |
| ATLAS | Aeric Ochraqualfs | BARRONETT (DR) | Mollic Ochraqualfs |
| ATMORE | Plinthic Paleaquults | BARRY (DR) | Typic Argiaquolls |
| ATSION (DR) | Aeric Haplaquods | BASH | Fluvaquentic Dystrochrepts |
| AUBURNDALE (DR) | Typic Glossaqualfs | BASHAW | Typic Pelloxererts |
| AUFCO | Aeric Fluvaquents | BASILE | Typic Glossaqualfs |
| AUGSBERG (DR) | Typic Calciaquolls | BASINGER | Spodic Psammaquents |
| AURELIE (DR) | Aeric Haplaquepts | BATZA | Pergelic Cryaquents |
| AURELIUS (DR) | Histic Humaquepts | BAYBORO (DR) | Umbric Paleaquults |
| AUSMUS | Aquic Natrargids | BAYOU | Typic Paleaquults |
| AUSTWELL | Typic Haplaquepts | BAYSHORE | Typic Calciaquolls |
| AWBRIG | Vertic Albaqualfs | BAYUCOS | Typic Fluvaquents |
| AXIS | Typic Sulfaquents | BAYVI | Cumulic Haplaquolls |
| BACH (DR) | Mollic Haplaquepts | BEAR LAKE | Typic Calciaquolls |
| BACKBAY | Histic Fluvaquents | BEARVILLE (DR) | Typic Ochraqualfs |
| BACLIFF | Entic Pelluderts | BEAUCOUP (DR) | Fluvaquentic Haplaquolls |
| BADO | Typic Fragiaqualfs | BEAUFORD | Typic Haplaquolls |
| BADUS (DR) | Cumulic Haplaquolls | BEAUMONT | Entic Pelluderts |
| BAILE | Typic Ochraquults | BECKWITH | Typic Albaqualfs |
| BAJURA (DR) | Vertic Tropaquepts | BELHAVEN (DR) | Terric Medisaprists |
| BAKERSVILLE | Cumulic Humaquepts | BELINDA | Mollic Albaqualfs |
| BALDOCK | Typic Haplaquepts | BELKNAP (FF) | Aeric Fluvaquents |
| BALDWIN | Vertic Ochraqualfs | BELLEVILLE (DR) | Typic Haplaquolls |
| BALLAHACK (DR) | Cumulic Humaquepts | BELLINGHAM | Mollic Haplaquepts |
| BALM | Fluvaquentic Haploxerolls | BELLPASS | Terric Medisaprists |

(Continued)

Table D1 (Continued)

| Soil Phase | Classification | Soil Phase | Classification |
|---|---|---|---|
| BELUGA (DR) | Typic Cryaquents | BLEND | Fluvaquentic Haplaquolls |
| BENITO | Udorthentic Pellusterts | BLICHTON | Arenic Plinthic Paleaquults |
| BERGLAND (DR) | Aeric Haplaquepts | BLOMFORD (DR) | Arenic Ochraqualfs |
| BERGSVIK | Terric Tropohemists | BLUE EARTH (DR) | Mollic Fluvaquents |
| BERINO (P) | Typic Haplargids | BLUFF | Typic Haplaquolls |
| BERNARD | Vertic Argiaquolls | BLUFFTON (DR) | Typic Haplaquolls |
| BERRYLAND | Typic Haplaquods | BOARDMAN | Typic Ochraqualfs |
| BERVILLE (DR) | Typic Argiaquolls | BOASH | Typic Haplaquolls |
| BESEMAN (DR) | Terric Borosaprists | BOCA | Arenic Ochraqualfs |
| BESSIE | Terric Medisaprists | BOGGY | Aeric Fluvaquents |
| BETHERA (DR) | Typic Paleaquults | BOHICKET | Typic Sulfaquents |
| BEZO | Aeric Halaquepts | BOHNLY | Mollic Fluvaquents |
| BIBB | Typic Fluvaquents | BOLFAR (F) | Cumulic Haplaquolls |
| BICKETT | Histic Humaquepts | BOLIO | Pergelic Cryohemists |
| BICONDOA | Fluvaquentic Haplaquolls | BONAIR | Humic Haplaquepts |
| BIDDEFORD | Histic Humaquepts | BONN | Glossic Natraqualfs |
| BIG BLUE | Typic Haplaquolls | BONNIE (DR) | Typic Fluvaquents |
| BIGWINDER | Typic Fluvaquents | BONO | Typic Haplaquolls |
| BINGHAMVILLE | Typic Haplaquepts | BOOKER (DR) | Vertic Haplaquolls |
| BIRCHFIELD | Histic Haplaquolls | BOOTJACK | Aeric Cryaquepts |
| BIRDS (DR) | Typic Fluvaquents | BOOTS (DR) | Typic Medihemists |
| BIRDSALL (DR) | Typic Humaquepts | BORGES | Typic Humaquepts |
| BISCAY (P,DR) | Typic Haplaquolls | BORUP (DR) | Typic Calciaquolls |
| BISHOP | Cumulic Haplaquolls | BOSSBURG | Mollic Andaquepts |
| BIVANS | Typic Albaqualfs | BOSWORTH | Vertic Haplaquolls |
| BLACK CANYON | Typic Haplaquolls | BOULDER LAKE | Aquic Chromoxererts |
| BLACKFOOT (FF) | Fluvaquentic Haploxerolls | BOWDOIN (P) | Udorthentic Chromusterts |
| BLACKHOOF (DR) | Histic Humaquepts | BOWDRE (F) | Fluvaquentic Hapludolls |
| BLACKLOCK | Typic Sideraquuods | BOWMANSVILLE | Aeric Fluvaquents |
| BLACKOAR | Fluvaquentic Haplaquolls | BOWSTRING | Fluvaquentic Borosaprists |
| BLACKWELL | Typic Cryaquolls | BOYCE | Cumulic Haplaquolls |
| BLADEN (DR) | Typic Albaquults | BRADENTON | Typic Ochraqualfs |
| BLAGO | Typic Umbraquults | BRADWAY | Pergelic Cryaquepts |
| BLANCHESTER | Typic Orchraqualfs | BRALLIER | Typic Tropohemists |
| BLEAKWOOD | Typic Fluvaquents | BRAND | Aeric Haplaquepts |

(Continued)

Table D1 (Continued)

| Soil Phase | Classification | Soil Phase | Classification |
|---|---|---|---|
| BRAZORIA (D) | Typic Chromuderts | CABARTON | Typic Cryaquolls |
| BRECKENRIDGE (DR) | Mollic Haplaquepts | CABLE (DR) | Typic Haplaquepts |
| BREMER | Typic Argiaquolls | CADDO | Typic Glossaqualfs |
| BRENNER | Aeric Tropaquepts | CAIRO (DR) | Vertic Haplaquolls |
| BREVORT (DR) | Mollic Haplaquents | CALAMINE (DR) | Typic Argiaquolls |
| BRIDGESON | Fluvaquentic Haplaquolls | CALCO (DR) | Cumulic Haplaquolls |
| BRIGHTON | Typic Medifibrists | CALCOUSTA (DR) | Typic Haplaquolls |
| BRIMSTONE | Glossic Natraqualfs | CALHOUN | Typic Glossaqualfs |
| BRINKERTON | Typic Fragiaqualfs | CALLOWAY (F) | Glossaquic Fragiudalfs |
| BRINNUM | Typic Halaquepts | CANADICE | Typic Ochraqualfs |
| BRISCOT (FF) | Aeric Fluvaquents | CANADAIGUA (DR) | Mollic Haplaquepts |
| BRITTO | Typic Natraqualfs | CANBURN | Cumulic Haplaquolls |
| BROCKTON | Humic Fragiaquepts | CANISTEO (DR) | Typic Haplaquolls |
| BROOKLYN (DR) | Mollic Albaqualfs | CANOVA | Typic Glossaqualfs |
| BROOKMAN (DR) | Typic Umbraqualfs | CANTEY (DR) | Typic Albaquults |
| BROOKSTON (DR) | Typic Argiaquolls | CAPAY (F) | Typic Chromoxererts |
| BROPHY (DR) | Hemic Borofibrists | CAPE | Typic Fluvaquents |
| BROWNSDALE (DR) | Mollic Ochraqualfs | CAPE FEAR (DR) | Typic Umbraquults |
| BROWNTON | Typic Haplaquolls | CAPEHORN | Aeric Cryaquepts |
| BRUCE (DR) | Mollic Haplaquepts | CAPERS | Typic Sulfaquents |
| BRUIN (F) | Fluvaquentic Eutrochrepts | CAPLEN | Typic Hydraquents |
| BRUNEEL | Aquic Haploxerolls | CAPLES | Mollic Fluvaquents |
| BRYCE | Typic Haplaquolls | CAPTIVA | Mollic Psammaquents |
| BUCKLEY | Typic Humaquepts | CARBONDALE (DR) | Hemic Borosaprists |
| BULLWINKLE | Terric Borosaprists | CARLIN | Hydric Medihemists |
| BUNKERHILL | Typic Salorthids | CARLISLE (DR) | Typic Medisaprists |
| BURKEVILLE | Aquentic Chromuderts | CARLOS (DR) | Limnic Borohemists |
| BURLEIGH (DR) | Mollic Haplaquents | CARLOW | Vertic Haplaquolls |
| BURNHAM | Typic Haplaquepts | CARON (DR) | Limnic Medihemists |
| BURR | Typic Calciaquolls | CARTECAY (P) | Aquic Udifluvents |
| BURSLEY | Aeric Glossaqualfs | CARTERET | Typic Psammaquents |
| BURT | Lithic Psammaquents | CARUTHERSVILLE (FF) | Typic Udifluvents |
| BUTTON | Aeric Haplaquents | CARWILE | Typic Argiaquolls |
| BUXIN (FF) | Vertic Hapludolls | CARYTOWN | Albic Natraqualfs |
| BYARS (DR) | Umbric Paleaquults | CASCILLA (FF) | Fluventic Dystrochrepts |

(Continued)

Table D1 (Continued)

| Soil Phase | Classification | Soil Phase | Classification |
|---|---|---|---|
| CATHRO (DR) | Terric Borosaprists | CHUMMY | Typic Humaquepts |
| CATMAN | Vertic Ustifluvents | CIENO | Typic Ochraqualfs |
| CAYAGUA | Aeric Tropaqualfs | CISNE | Mollic Albaqualfs |
| CEBOYA | Typic Haplaquolls | CLAM GULCH | Humic Cryaquepts |
| CERESCO (FF) | Fluvaquentic Hapludolls | CLAMO (DR) | Cumulic Haplaquolls |
| CHAIRES | Alfic Haplaquods | CLARINDA | Typic Argiaquolls |
| CHALMERS (DR) | Typic Haplaquolls | CLATSOP | Histic Humaquepts |
| CHANCE | Mollic Haplaquepts | CLEAR LAKE | Typic Pelloxererts |
| CHANCELLOR | Typic Argiaquolls | CLEARBROOK | Aeric Ochraquults |
| CHARITON | Mollic Albaqualfs | CLEARWATER | Typic Haplaquolls |
| CHARLES | Aeric Fluvaquents | CLERMONT | Typic Ochraqualfs |
| CHARLOTTE | Entic Sideraquods | CLODINE | Typic Ochraqualfs |
| CHASTAIN | Typic Fluvaquents | CLOTHO | Typic Haplaquolls |
| CHATEAU (P) | Aquic Xerochrepts | CLOVELLY | Terric Medisaprists |
| CHATUGE (DR) | Typic Ochraquults | CLUNIE | Terric Borofibrists |
| CHAUNCEY | Typic Argialbolls | CLYDE | Typic Haplaquolls |
| CHEEKTOWAGA | Typic Haplaquolls | COAL CREEK (DR) | Humic Cryaquepts |
| CHENNEBY (P) | Fluvaquentic Dystrochrepts | COATSBURG | Typic Argiaquolls |
| CHEQUEST | Typic Haplaquolls | COBBSFORK | Typic Ochraqualfs |
| CHEROKEE | Typic Albaqualfs | COCHINA (FF) | Entic Chromusterts |
| CHETCO | Fluvaquentic Humaquepts | COCODRIE (FF) | Aquic Udifluvents |
| CHIA | Terric Tropohemists | COCOLALLA | Mollic Andaquepts |
| CHICKAHOMINY (DR) | Typic Ochraquults | COESSE (DR) | Aeric Fluvaquents. |
| CHICKREEK | Andaqueptic Cryaquents | COHOCTAH (DR) | Fluvaquentic Haplaquolls |
| CHILGREN | Typic Ochraqualfs | COKESBURY | Typic Fragiaquults |
| CHILKOOT | Typic Cryaquents | COLAND | Cumulic Haplaquolls |
| CHINCHALLO | Andic Cryaquepts | COLEMANTOWN (DR) | Typic Ochraquults |
| CHINKOTEAGUE | Typic Sulfaquents | COLITA | Typic Glossaqualfs |
| CHIPPENY | Lithic Borosaprists | COLLINS (FF) | Aquic Udifluvents |
| CHIPPEWA | Typic Fragiaquepts | COLO | Cumulic Haplaquolls |
| CHIVATO | Cumulic Haplaquolls | COLUMBIA (FF) | Aquic Xerofluvents |
| CHOBEE | Typic Argiaquolls | COLUMBUS (FF) | Aquic Hapludults |
| CHOCK | Andaqueptic Cryaquents | COLVILLE | Fluvaquentic Haplaquolls |
| CHOCORUA (DR) | Terric Borohemists | COLVIN (DR) | Typic Calciaquolls |
| CHOWAN | Thapto-Histic Fluvaquents | COLWOOD (DR) | Typic Haplaquolls |

(Continued)

Table D1 (Continued)

| Soil Phase | Classification | Soil Phase | Classification |
|---|---|---|---|
| COMFREY (DR) | Cumulic Haplaquolls | CRAIGMILE (DR) | Fluvaquentic Haplaquolls |
| COMMERCE (FF) | Aeric Fluvaquents | CREOLE | |
| CONABY (DR) | Histic Humaquepts | CRIMS | Terric Medihemists |
| CONBOY | Aeric Mollic Andaquepts | CROATAN (DR) | Terric Medisaprists |
| CONCORD | Typic Ochraqualfs | CROOKED CREEK | Cumulic Haplaquolls |
| CONDIT | Typic Ochraqualfs | CROQUIB | Typic Tropaquepts |
| CONNEAUT | Aeric Haplaquepts | CROSSPLAIN | Typic Argiaquolls |
| CONRAD (DR) | Typic Psammaquents | CROTON | Typic Fragiaqualfs |
| CONSER | Typic Argiaquolls | CROWCAMP | Calcic Pachic Argixerolls |
| CONTEE | Vertic Haplaquepts | CROWTHER | Typic Calciaquolls |
| CONVENT (FF) | Aeric Fluvaquents | CRUMP | Histic Humaquepts |
| COOK | Mollic Haplaquents | CUDAHY | Petrocalcic Calciaquolls |
| COPANO | Vertic Albaqualfs | CUMMINGS | Mollic Andaquepts |
| COPELAND | Typic Argiaquolls | CURRITUCK | Terric Medisaprists |
| COPPER RIVER | Histic Pergelic Cryaquepts | CURTISVILLE | Typic Haplaquolls |
| COPSEY | Vertic Haplaquolls | CUSTER | Typic Sideraquods |
| COQUAT | Udorthentic Chromusterts | CYCLONE (DR) | Typic Argiaquolls |
| COQUILLE | Aeric Tropic Fluvaquents | DACOSTA | Vertic Ochraqualfs |
| CORDOVA | Typic Argiaquolls | DADINA | Histic Pergelic Cryaquepts |
| CORIFF | Typic Haplaquolls | DALEVILLE | Typic Paleaquults |
| CORLEY | Argiaquic Argialbolls | DAMASCUS | Typic Ochraqualfs |
| CORMANT (P,DR) | Mollic Psammaquents | DAMON | Cumulic Cryaquolls |
| COROZAL | Aquic Tropudults | DANCY (DR) | Aeric Glossaqualfs |
| CORRIGAN | Typic Albaqualfs | DANGBURG (W) | Aquic Haplic Nadurargids |
| CORUNNA (DR) | Typic Haplaquolls | DANIA | Lithic Medisaprists |
| COSUMNES (FF) | Aquic Xerofluvents | DANNEMORA | Typic Fragiaquepts |
| COUGARBAY | Fluvaquentic Haplaquolls | DARE (DR) | Typic Medisaprists |
| COURTNEY | Abruptic Argiaquolls | DARFUR | Typic Haplaquolls |
| COUSHATTA (F) | Fluventic Eutrochrepts | DARWIN (DR) | Vertic Haplaquolls |
| COVE | Vertic Haplaquolls | DASHER (DR) | Typic Medihemists |
| COVELAND | Aquic Palexeralfs | DASSEL | Typic Haplaquolls |
| COVINGTON | Mollic Ochraqualfs | DAWHOO (DR) | Typic Humaquepts |
| COWDEN | Mollic Albaqualfs | DAWSON | Terric Borosaprists |
| COXVILLE (DR) | Typic Paleaquults | DAYTON | Typic Albaqualfs |
| CRADLEBAUGH | Duric Haplaquolls | DEBORAH | Histic Pergelic Cryaquepts |

(Continued)

Table D1 (Continued)

| Soil Phase | Classification | Soil Phase | Classification |
|---|---|---|---|
| DECHEL | Tropic Fluvaquents | DORAVAN | Typic Medisaprists |
| DECKERVILLE | Cumulic Humaquepts | DOSPALOS (F) | Vertic Haplaquolls |
| DEERWOOD (DR) | Histic Humaquepts | DOTLAKE | Pergalic Cryaquepts |
| DEFORD (DR) | Typic Psammaquents | DOUGCLIFF | Typic Borofibrists |
| DEKOVEN | Fluvaquentic Haplaquolls | DOVRAY (DR) | Cumulic Haplaquolls |
| DELCOMB | Terric Medisaprists | DOWELLTON | Vertic Ochraqualfs |
| DELENA | Humic Fragiaquepts | DOWNATA | Cumulic Haplaquolls |
| DELEPLAIN | Aeric Fluvaquents | DOYLESTOWN | Typic Fraqiaqualfs |
| DELFT | Cumulic Haplaquolls | DRIFTWOOD | Typic FLuvaquents |
| DELKS | Ultic Haplaquods | DRUMMER (DR) | Typic Haplaquolls |
| DELOSS (DR) | Typic Umbraquults | DUNNING | Fluvaquentic Haplaquolls |
| DELRAY | Grossarenic Argiaquolls | DUPONT | Limnic Medisaprists |
| DENAUD | Histic Humaquepts | DURBIN | Typic Sulfihemists |
| DENNY (DR) | Mollic Albaqualfs | DURRSTEIN | Typic Natraquolls |
| DEPOE | Typic Tropaquods | DYLAN | Aquentic Chromuderts |
| DEPORT | Udorthentic Pellusterts | EACHUSTON | Typic Cryaquents |
| DERLY | Typic Glossaqualfs | EARLE | Vertic Haplaquepts |
| DESHA (FF) | Vertic Hapludolls | EARLMONT | Typic Fluvaquents |
| DEVILSGAIT | Cumulic Haplaquolls | EASBY | Typic Calciaquolls |
| DEVOIGNES | Histic Humaquepts | EASLEY | Histic Pergelic Cryaquepts |
| DEWEYVILLE | Typic Medihemists | EASTON (DR) | Aeric Haplaquepts |
| DIANOLA | Typic Psammaquents | EATON | Arenic Albaqualfs |
| DILMAN | Typic Cryaquolls | EAUGALLIE | Alfic Haplaquods |
| DILTON | Lithic Haplaquolls | EBBERT (DR) | Argiaquic Argialbolls |
| DIMMICK (DR) | Typic Haplaquolls | EBRO | Typic Medisaprists |
| DINGLISHNA | Typic Cryaquods | EDGINGTON (DR) | Argiaquic Argialbolls |
| DIPMAN | Typic Cryaquolls | EDINA | Typic Argialbolls |
| DIREGO | Terric Sulfihemists | EDINBURG (DR) | Typic Argiaquolls |
| DITHOD | Fluvaquentic Haploxerolls | EDMINSTER | Glossic Natraqualfs |
| DOBROW | Cumulic Cryaquolls | EDMONDS | Entic Sideraquods |
| DOCKERY (FF) | Aquic Udifluvents | EDMORE (DR) | Mollic Haplaquents |
| DOGIECREEK | Typic Fluvaquents | EDNA | Vertic Albaqualfs |
| DOLBEE | Typic Haplaquolls | EDROY | Vertic Haplaquolls |
| DORA (DR) | Terric Borosaprists | EDWARDS (DR) | Liminic Medisaprists |
| DOROSHIN | Terric Borohemists | EGAS | Typic Haplaquolls |

(Continued)

Table D1 (Continued)

| Soil Phase | Classification | Soil Phase | Classification |
|---|---|---|---|
| EGBERT | Cumulic Haplaquolls | EVADALE | Typic Glossaqualfs |
| ELBERT | Typic Ochraqualfs | EVANSHAM (DR) | Typic Pelluderts |
| ELIZA | Sulfic Fluvaquents | EVANSVILLE | Typic Haplaquepts |
| ELKINS | Humaqueptic Fluvaquents | EVART | Fluvaquentic Haplaquolls |
| ELKTON | Typic Ochraquults | EVERGLADES (DR) | Typic Medihemists |
| ELLABELLE (DR) | Arenic Umbric Paleaquults | EVERSON | Mollic Haplaquepts |
| ELLOREE | Arenic Ochraqualfs | EYAK | Typic Cryaquents |
| ELLZEY | Arenic Ochraqualfs | FALAYA (FF) | Aeric Fluvaquents |
| ELM LAKE (DR) | Typic Haplaquents | FALBA | Typic Albaqualfs |
| ELPAM | Typic Haplaquepts | FALLON (F) | Aquic Xerofluvents |
| ELRED | Alfic Sideraquods | FALLSINGTON | Typic Ochraquults |
| ELRICK (FF) | Typic Hapludolls | FALOMA | Fluvaquentic Haplaquolls |
| ELVERS (DR) | Thapto-Histic Fluvaquents | FARGO (DR) | Vertic Haplaquolls |
| ELVIRA . . . | Typic Haplaquolls | FARMTON | Arenic Ultic Haplaquods |
| EMDENT | Mollic Halaquepts | FAUSSE | Typic Fluvaquents |
| EMERALDA | Mollic Albaqualfs | FAXON (DR) | Typic Haplaquolls |
| EMORY (P) | Fluventic Umbric Dystrochrepts | FEATHERSTONE | Typic Hydraquents |
| ENGLEHARD (DR) | Humaqueptic Fluvaquents | FEDORA | Typic Calciaquolls |
| ENLOE (DR) | Argiaquic Argialbolls | FELDA | Arenic Ochraqualfs |
| ENOCHVILLE | Cumulic Cryaquolls | FELLOWSHIP | Typic Umbraqualfs |
| ENOREE (DR) | Aeric Fluvaquents | FERRON | Typic Fluvaquents |
| ENOSBURG (DR) | Mollic Haplaquents | FIELDON | Typic Haplaquolls |
| ENSLEY (DR) | Aeric Haplaquepts | FILION | Typic Haplaquepts |
| EPOUFETTE (DR) | Mollic Ochraqualfs | FILLMORE | Typic Argialbolls |
| EQUIS | Typic Halaquepts | FISHTRAP | Terric Medisaprists |
| ERAMOSH | Histic Haplaquolls | FLAGSTAFF | Haploxerollic Durargids |
| ESHAMY | Typic Cryaquents | FLEER | Cumulic Cryaquolls |
| ESPELIE | Typic Haplaquolls | FLEMINGTON | Typic Albaqualfs |
| ESRO | Cumulic Haplaquolls | FLOM (DR) | Typic Haplaquolls |
| ESSEXVILLE (DR) | Typic Haplaquolls | FLORIDANA | Arenic Argiaquolls |
| ESTER | Histic Pergelic Cryaquepts | FOLEY | Albic Glossic Natraqualfs |
| ESTERO | Typic Haplaquods | FOLLET | Typic Haplaquents |
| ESTES | Aeric Haplaquepts | FONDA | Mollic Haplaquepts |
| ETTRICK (DR) | Fluvaquentic Haplaquolls | FORADA | Typic Haplaquolls |
| EUREKA | Typic Albaqualfs | FORD (DR) | Aeric Calciaquolls |
| EUTAW | Entic Pelluderts | | |

(Continued)

Table D1 (Continued)

| Soil Phase | Classification | Soil Phase | Classification |
|---|---|---|---|
| FORDUM | Mollic Fluvaquents | GAY (DR) | Aeric Haplaquepts |
| FORELAND | Histic Cryaquepts | GAYLESVILLE | Aeric Ochraqualfs |
| FORESTDALE | Typic Ochraqualfs | GAZELLE | Aquic Durothids |
| FORNEY | Vertic Fluvaquents | GED | Typic Ochraqualfs |
| FORTESCUE (DR) | Cumulic Humaquepts | GENTILLY | Typic Hydraquents |
| FOSSUM (DR) | Typic Haplaquolls | GENTRY | Arenic Argiaquolls |
| FOUNTAIN | Typic Glossaqualfs | GERRARD | Typic Haplaquolls |
| FOURLOG | Typic Cryaquolls | GESSNER | Typic Glossaqualfs |
| FOXCREEK | Typic Cryaquolls | GETZVILLE | Aeric Haplaquepts |
| FRANCITAS | Typic Pelluderts | GIDEON | Mollic Fluvaquents |
| FRANKFORT | Udollic Ochraqualfs | GIFFORD | Vertic Ochraqualfs |
| FREDON | Aeric Haplaquepts | GILBERT | Typic Glossaqualfs |
| FREE (DR) | Typic Haplaquolls | GILFORD (DR) | Typic Haplaquolls |
| FREETOWN | Typic Medisaprists | GILLSBURG (FF) | Aeric Fluvaquents |
| FRENCHTOWN | Typic Fragiaqualfs | GINAT | Typic Fragiaqualfs |
| FRIES | Typic Umbraquults | GIRARD | Cumulic Haplaquolls |
| FROLIC (F) | Cumulic Haploborolls | GIRARDOT | Typic Cryaquepts |
| FROST | Typic Glossaqualfs | GLADEWATER | Vertic Haplaquepts |
| FT. DRUM | Aeric Haplaquepts | GLENCOE (DR) | Cumulic Haplaquolls |
| FT. GREEN | Arenic Ochraqualfs | GLENDORA (DR) | Mollic Psammaquents |
| FULDA (DR) | Typic Haplaquolls | GLENROSS | Typic Natraqualfs |
| FULMER | Typic Haplaquolls | GLENSTED | Mollic Albaqualfs |
| FULTS | Vertic Haplaquolls | GODFREY | Typic Fluvaquents |
| FUNTER | Terric Sphagnofibrists | GOLD CREEK | Vertic Haplaquolls |
| FURNISS | Typic Cryaquolls | GOLDSTREAM | Histic Pergelic Cryaquepts |
| FURY | Cumulic Haplaquolls | GOODPASTER | Histic Pergelic Cryaquepts |
| GALLION (FF) | Typic Hapludalfs | GOOSE LAKE | Typic Argialbolls |
| GALT (F,P) | Typic Chromoxererts | GOREEN | Typic Albaquults |
| GANNETT | Typic Haplaquolls | GORHAM (DR) | Fluvaquentic Haplaquolls |
| GANSNER (P) | Typic Haplaquolls | GOTHENBURG | Typic Psammaquents |
| GAPO | Typic Cryaquolls | GRADY | Typic Paleaquults |
| GARROCHALES | Liminic Troposaprists | GRANBY (DR) | Typic Haplaquolls |
| GARWIN | Typic Haplaquolls | GRANO (DR) | Vertic Haplaquolls |
| GAS CREEK | Typic Haplaquolls | GRANTHAM (DR) | Typic Paleaquults |
| GATOR (DR) | Terric Medisaprists | GRAVELTON (DR) | Fluvaquentic Haplaquolls |

(Continued)

Table D1 (Continued)

| Soil Phase | Classification | Soil Phase | Classification |
|---|---|---|---|
| GRAYLAND | Haplic Andaquepts | HATBORO | Typic Fluvaquents |
| GREENWOOD (DR) | Typic Borohemists | HAUG (DR) | Histic Humaquepts |
| GRENADA (F) | Glossic Fragiudalfs | HAULINGS | Histic Haplaquolls |
| GRIFTON (DR) | Typic Ochraqualfs | HAVELOCK | Cumulic Haplaquolls |
| GRIVER | Aquic Xerofluvents | HAVERHILL | Typic Haplaquolls |
| GROOM | Aeric Ochraqualfs | HAYNIE (FF) | Mollic Udifluvents |
| GRULLA | Vertic Fluvaquents | HAYSPUR | Fluvaquentic Haplaquolls |
| GRYGLA (DR) | Mollic Haplaquents | HAYTI | Typic Fluvaquents |
| GUANICA | Udic Pellusterts | HEBO | Umbric Tropaquults |
| GUFFIN | Mollic Haplaquepts | HECETA | Typic Psammaquents |
| GULF | Aeric Haplaquepts | HEGNE (DR) | Typic Calciaquolls |
| GUMBOOT | Typic Humaquepts | HEIGHTS | Arenic Ochraqualfs |
| GUTHRIE | Typic Fragiaquults | HEIL | Typic Natraquolls |
| GUYTON | Typic Glossaqualfs | HENCO | Grossarenic Paleaquults |
| HAGGA | Typic Fluvaquents | HENRIETTA (DR) | Histic Humaquepts |
| HAGGERTY | Aeric Ochraquults | HENRY | Typic Fragiaqualfs |
| HAIG | Typic Argiaquolls | HEROD | Typic Fluvaquents |
| HALBERT | Histic Placaquepts | HERSHAL | Cumulic Haplaquolls |
| HALLANDALE | Lithic Psammaquents | HERTY | Vertic Albaqualfs |
| HALLECK | Cumulic Haplaquolls | HESSEL (DR) | Mollic Haplaquepts |
| HALSEY (DR) | Mollic Haplaquepts | HETTINGER (DR) | Mollic Haplaquepts |
| HAMAR | Typic Haplaquolls | HEWITT | Terric Borohemists |
| HAMEL | Typic Argiaquolls | HIGGINS | Typic Haplaquepts |
| HAMRE (DR) | Histic Humaquepts | HILINE | Typic Cryaquents |
| HANDSBORO | Typic Sulfihemists | HILLET | Typic Haplaquolls |
| HANSKA | Typic Haplaquolls | HILOLO | Mollic Ochraqualfs |
| HAPUR | Typic Calciaquolls | HOBCAW (DR) | Typic Umbraquults |
| HARAHAN | Vertic Haplaquepts | HOBONNY | Typic Medisaprists |
| HARCOT | Typic Calciaquolls | HOBUCKEN | Typic Hydraquents |
| HARJO | Typic Fluvaquents | HODGE | Typic Udipsamments |
| HARPS | Typic Calciaquolls | HODGINS (D) | Ustollic Camborthids |
| HARPSTER (DR) | Typic Calciaquolls | HOFFLAND | Typic Calciaquolls |
| HARRIET | Typic Natraquolls | HOLILLIPAH (FF) | Typic Xerofluvents |
| HARRIS | Typic Haplaquolls | HOLLOW | Typic Cryofluvents |
| HARTSBURG (DR) | Typic Haplaquolls | HOLLY | Typic Fluvaquents |

(Continued)