

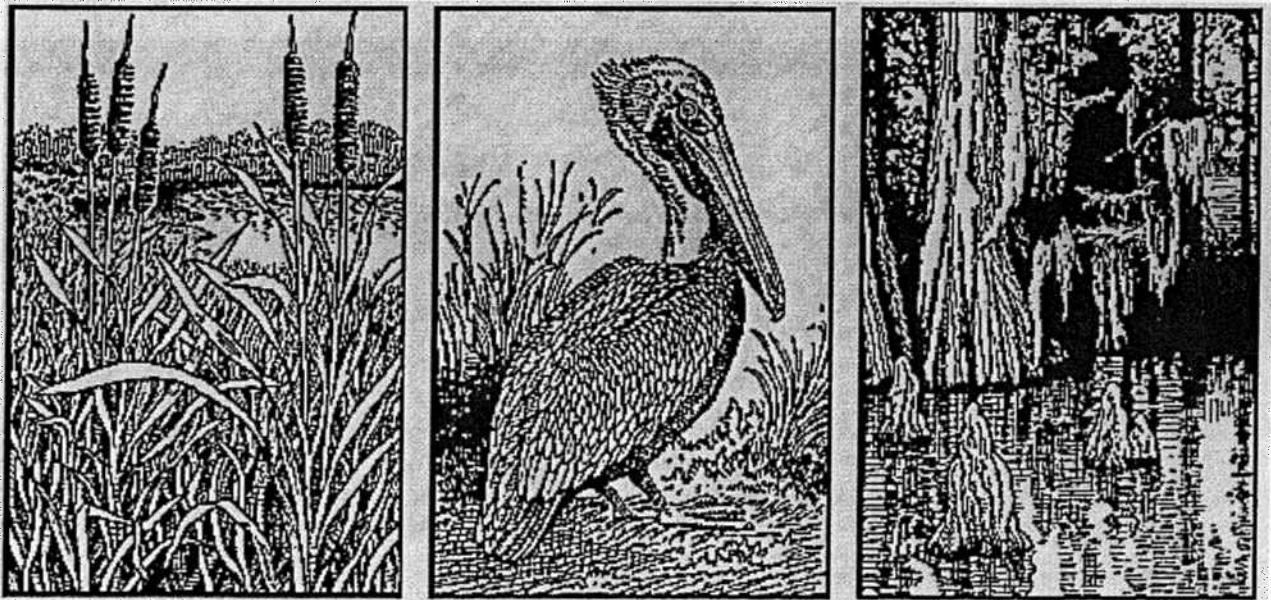


**US Army Corps
of Engineers**
Waterways Experiment
Station

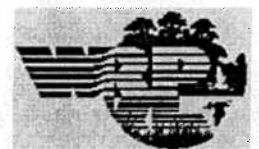
Wetlands Research Program Technical Report Y-87-1 (on-line edition)

Corps of Engineers Wetlands Delineation Manual

by Environmental Laboratory



January 1987 - Final Report
Approved For Public Release; Distribution Is Unlimited



The following two letters used as part of the number designating technical reports of research published under the Wetlands Research Program identify the area under which the report was prepared:

| | <u>Task</u> | | <u>Task</u> |
|----|--------------------------|----|-----------------------------|
| CP | Critical Processes | RE | Restoration & Establishment |
| DE | Delineation & Evaluation | SM | Stewardship & Management |

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.



PRINTED ON RECYCLED PAPER

Wetlands Research Program

Technical Report Y-87-1
January 1987

Corps of Engineers Wetlands Delineation Manual

by Environmental Laboratory

U.S. Army Corps of Engineers
Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Final report

Approved for public release; distribution is unlimited

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

Contents

| | |
|--|-----|
| Preface to the On-Line Edition | v |
| Preface to the Original Edition | vii |
| Conversion Factors, Non-SI to SI Units of Measurement | ix |
| Part I: Introduction | 1 |
| Background | 1 |
| Purpose and Objectives | 1 |
| Scope | 2 |
| Organization | 3 |
| Use | 5 |
| Part II: Technical Guidelines | 9 |
| Wetlands | 9 |
| Deepwater Aquatic Habitats | 10 |
| Nonwetlands | 11 |
| Part III: Characteristics and Indicators of Hydrophytic Vegetation, Hydric Soils, and Wetland Hydrology | 12 |
| Hydrophytic Vegetation | 12 |
| Hydric Soils | 20 |
| Wetland Hydrology | 28 |
| Part IV: Methods | 35 |
| Section A. Introduction | 35 |
| Section B. Preliminary Data Gathering and Synthesis | 36 |
| Section C. Selection of Method | 44 |
| Section D. Routine Determinations | 45 |
| Subsection 1 - Onsite Inspection Unnecessary | 45 |
| Subsection 2 - Onsite Inspection Necessary | 49 |
| Areas Equal To or Less Than 5 Acres in Size | 52 |
| Areas Greater Than 5 Acres in Size | 55 |
| Subsection 3 - Combination of Levels 1 and 2 | 60 |
| Section E. Comprehensive Determinations | 61 |
| Section F. Atypical Situations | 73 |
| Subsection 1 - Vegetation | 74 |

| | |
|--|----|
| Subsection 2 - Soils | 77 |
| Subsection 3 - Hydrology | 80 |
| Subsection 4 - Man-Induced Wetlands | 82 |
| Section G. Problem Areas | 84 |
| References | 87 |
| Bibliography | 90 |
| Appendix A: Glossary | A1 |
| Appendix B: Blank and Example Data Forms | B1 |
| Appendix C: Vegetation | C1 |
| Appendix D: Hydric Soils | D1 |
| SF 298 | |

List of Figures

| | | |
|------------|---|----|
| Figure 1. | General schematic diagram of activities leading to a wetland/ nonwetland determination | 7 |
| Figure 2. | Generalized soil profile | 23 |
| Figure 3. | Organic soil | 24 |
| Figure 4. | Gleyed soil | 26 |
| Figure 5. | Soil showing matrix (brown) and mottles (reddish-brown) | 26 |
| Figure 6. | Iron and manganese concretions | 27 |
| Figure 7. | Watermark on trees | 32 |
| Figure 8. | Absence of leaf litter | 33 |
| Figure 9. | Sediment deposit on plants | 33 |
| Figure 10. | Encrusted detritus | 33 |
| Figure 11. | Drainage pattern | 34 |
| Figure 12. | Debris deposited in stream channel | 34 |
| Figure 13. | Flowchart of steps involved in making a wetland determina- tion when an onsite inspection is unnecessary | 47 |
| Figure 14. | Flowchart of steps involved in making a routine wetland determination when an onsite visit is necessary | 50 |
| 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 | 56 |

| | | |
|------------|---|----|
| Figure 16. | Flowchart of steps involved in making a comprehensive wetland determination (Section E) | 63 |
| 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 | 66 |

List of Tables

| | | |
|----------|---|----|
| Table 1. | Plant Indicator Status Categories | 14 |
| Table 2. | List of CE Preliminary Wetland Guides | 15 |
| Table 3. | List of Ecological Profiles Produced by the FWS Biological Services Program | 16 |
| Table 4. | List of Some Useful Taxonomic References | 19 |
| Table 5. | Hydrologic Zones - Nontidal Areas | 30 |

Preface to the On-Line Edition

This is an electronic version of the 1987 *Corps of Engineers Wetlands Delineation Manual* (the 1987 Manual). The 1987 Manual is the current Federal delineation manual used in the Clean Water Act Section 404 regulatory program for the identification and delineation of wetlands. Except where noted in the manual, the approach requires positive evidence of hydrophytic vegetation, hydric soils, and wetland hydrology for a determination that an area is a wetland.

The original manual and this on-line edition were prepared by the Environmental Laboratory (EL) of the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi. The work was sponsored by Headquarters, U.S. Army Corps of Engineers (HQUSACE), through the Wetlands Research Program.

The manual was originally published in January 1987, following several years of development and testing of draft versions. Since that time, the use and interpretation of the 1987 Manual have been clarified and updated through a series of guidance documents and memoranda from HQUSACE. This electronic edition does not change the intent or jurisdictional area of the 1987 Manual. It does, however, attempt to clarify the manual and current guidance by including a number of boxed "USER NOTES" indicating where the original manual has been augmented by more recent information or guidance. USER NOTES were written by Dr. James S. Wakeley, EL, WES. Due to re-formatting of the text and insertion of the USER NOTES, page numbers in this edition do not match those in the original edition. Some obsolete material appears in this document as struck-out text (e.g., ~~obsolete material~~), and hypertext links are provided to sources of important supplementary information (e.g., hydric soils lists, wetland plant lists). References cited in the USER NOTES refer to the following guidance documents from HQUSACE:

"Clarification of the Phrase "Normal Circumstances" as it pertains to Cropped Wetlands," Regulatory Guidance Letter (RGL) 90-7 dated 26 September 1990.

"Implementation of the 1987 Corps Wetland Delineation Manual," memorandum from John P. Elmore dated 27 August 1991.

"Questions & Answers on the 1987 Manual," memorandum from John F. Studt dated 7 October 1991.

"Clarification and Interpretation of the 1987 Manual," memorandum from Major General Arthur E. Williams dated 6 March 1992.

"Revisions to National Plant Lists," memorandum from Michael L. Davis dated 17 January 1996.

"NRCS Field Indicators of Hydric Soils," memorandum from John F. Studt dated 21 March 1997.

Copies of the original published manual are available through the National Technical Information Service (phone 703-487-4650, NTIS document number ADA 176734/2INE). The report should be cited as follows:

Environmental Laboratory. (1987). "Corps of Engineers Wetlands Delineation Manual," Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Useful supplementary information for making wetland determinations can also be found at the following sites on the World Wide Web:

- Hydric soils definition, criteria, and lists
- National list of plant species that occur in wetlands
- Analyses of normal precipitation ranges and growing season limits
- National Wetlands Inventory maps and databases

Preface to the Original Edition

This manual is a product of the Wetlands Research Program (WRP) of the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS. The work was sponsored by the Office, Chief of Engineers (OCE), U.S. Army. OCE Technical monitors for the WRP were Drs. John R. Hall and Robert J. Pierce, and Mr. Phillip C. Pierce.

The manual has been reviewed and concurred in by the Office of the Chief of Engineers and the Office of the Assistant Secretary of the Army (Civil Works) as a method approved for voluntary use in the field for a trial period of 1 year.

~~This manual is not intended to change appreciably the jurisdiction of the Clean Water Act (CWA) as it is currently implemented. Should any District find that use of this method appreciably contracts or expands jurisdiction in their District as the District currently interprets CWA authority, the District should immediately discontinue use of this method and furnish a full report of the circumstances to the Office of the Chief of Engineers.~~

USER NOTES: Use of the 1987 Manual to identify and delineate wetlands potentially subject to regulation under Section 404 is now mandatory. (HQUSACE, 27 Aug 91)

This manual describes technical guidelines and methods using a multiparameter approach to identify and delineate wetlands for purposes of Section 404 of the Clean Water Act. Appendices of supporting technical information are also provided.

The manual is presented in four parts. Part II was prepared by Dr. Robert T. Huffman, formerly of the Environmental Laboratory (EL), WES, and Dr. Dana R. Sanders, Sr., of the Wetland and Terrestrial Habitat Group (WTHG), Environmental Resources Division (ERD), EL. Dr. Huffman prepared the original version of Part II in 1980, entitled "Multiple Parameter Approach to the Field Identification and Delineation of Wetlands." The original version was distributed to all Corps field elements, as well as other Federal resource and environmental regulatory agencies, for review and comments. Dr. Sanders revised the original version in 1982, incorporating review comments. Parts I, III, and IV

were prepared by Dr. Sanders, Mr. William B. Parker (formerly detailed to WES by the U.S. Department of Agriculture (USDA), Soil Conservation Service (SCS)) and Mr. Stephen W. Forsythe (formerly detailed to WES by the U.S. Department of the Interior, Fish and Wildlife Service (FWS)). Dr. Sanders also served as overall technical editor of the manual. The manual was edited by Ms. Jamie W. Leach of the WES Information Products Division.

The authors acknowledge technical assistance provided by: Mr. Russell F. Theriot, Mr. Ellis J. Clairain, Jr., and Mr. Charles J. Newling, all of WTHG, ERD; Mr. Phillip Jones, former SCS detail to WES; Mr. Porter B. Reed, FWS, National Wetland Inventory, St. Petersburg, Fla.; Dr. Dan K. Evans, Marshall University, Huntington, W. Va.; and the USDA-SCS. The authors also express gratitude to Corps personnel who assisted in developing the regional lists of species that commonly occur in wetlands, including Mr. Richard Macomber, Bureau of Rivers and Harbors; Ms. Kathy Mulder, Kansas City District; Mr. Michael Gilbert, Omaha District; Ms. Vicki Goodnight, Southwestern Division; Dr. Fred Weinmann, Seattle District; and Mr. Michael Lee, Pacific Ocean Division. Special thanks are offered to the CE personnel who reviewed and commented on the draft manual, and to those who participated in a workshop that consolidated the field comments.

The work was monitored at WES under the direct supervision of Dr. Hanley K. Smith, Chief, WTHG, and under the general supervision of Dr. Conrad J. Kirby, Jr., Chief, ERD. Dr. Smith, Dr. Sanders, and Mr. Theriot were Managers of the WRP. Dr. John Harrison was Chief, EL.

Director of WES during the preparation of this report was COL Allen F. Grum, USA. During publication, COL Dwayne G. Lee, CE, was Commander and Director. Technical Director was Dr. Robert W. Whalin.

This report should be cited as follows:

Environmental Laboratory. (1987). "Corps of Engineers Wetlands Delineation Manual," Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.

Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

| Multiply | By | To Obtain |
|----------------------|--------|------------------------------|
| acres | 0.4047 | hectares |
| Fahrenheit degrees | 5/9 | Celsius degrees ¹ |
| feet | 0.3048 | metres |
| inches | 2.54 | centimetres |
| miles (U.S. statute) | 1.6093 | kilometres |
| square inches | 6.4516 | square centimetres |

¹ To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: $C = (5/9)(F - 32)$.

Part I: Introduction

Background

1. Recognizing the potential for continued or accelerated degradation of the Nation's waters, the U.S. Congress enacted the Clean Water Act (hereafter referred to as the Act), formerly known as the Federal Water Pollution Control Act (33 U.S.C. 1344). The objective of the Act is to maintain and restore the chemical, physical, and biological integrity of the waters of the United States. Section 404 of the Act authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits for the discharge of dredged or fill material into the waters of the United States, including wetlands.

Purpose and Objectives

Purpose

2. The purpose of this manual is to provide users with guidelines and methods to determine whether an area is a wetland for purposes of Section 404 of the Act.

Objectives

3. Specific objectives of the manual are to:
- a. Present technical guidelines for identifying wetlands and distinguishing them from aquatic habitats and other nonwetlands.¹
 - b. Provide methods for applying the technical guidelines.
 - c. Provide supporting information useful in applying the technical guidelines.

¹ Definitions of terms used in this manual are presented in the Glossary, Appendix A.

Scope

4. This manual is limited in scope to wetlands that are a subset of "waters of the United States" and thus subject to Section 404. The term "waters of the United States" has broad meaning and incorporates both deep-water aquatic habitats and special aquatic sites, including wetlands (*Federal Register* 1982), as follows:

- a. The territorial seas with respect to the discharge of fill material.
- b. Coastal and inland waters, lakes, rivers, and streams that are navigable waters of the United States, including their adjacent wetlands.
- c. Tributaries to navigable waters of the United States, including adjacent wetlands.
- d. Interstate waters and their tributaries, including adjacent wetlands.
- e. All others waters of the United States not identified above, such as isolated wetlands and lakes, intermittent streams, prairie potholes, and other waters that are not a part of a tributary system to interstate waters or navigable waters of the United States, the degradation or destruction of which could affect interstate commerce.

Determination that a water body or wetland is subject to interstate commerce and therefore is a "water of the United States" shall be made independently of procedures described in this manual.

Special aquatic sites

5. The Environmental Protection Agency (EPA) identifies six categories of special aquatic sites in their Section 404 b.(1) guidelines (*Federal Register* 1980), including:

- a. Sanctuaries and refuges.
- b. Wetlands.
- c. Mudflats.
- d. Vegetated shallows.
- e. Coral reefs.
- f. Riffle and pool complexes.

Although all of these special aquatic sites are subject to provisions of the Clean Water Act, this manual considers only wetlands. By definition, wetlands are vegetated. Thus, unvegetated special aquatic sites (e.g., mudflats lacking macrophytic vegetation) are not covered in this manual.

Relationship to wetland classification systems

6. The technical guideline for wetlands does not constitute a classification system. It only provides a basis for determining whether a given area is a wetland for purposes of Section 404, without attempting to classify it by wetland type.

7. Consideration should be given to the relationship between the technical guideline for wetlands and the classification system developed for the Fish and Wildlife Service (FWS), U.S. Department of the Interior, by Cowardin et al. (1979). The FWS classification system was developed as a basis for identifying, classifying, and mapping wetlands, other special aquatic sites, and deepwater aquatic habitats. Using this classification system, the National Wetland Inventory (NWI) is mapping the wetlands, other special aquatic sites, and deepwater aquatic habitats of the United States, and is also developing both a list of plant species that occur in wetlands and an associated plant database. These products should contribute significantly to application of the technical guideline for wetlands. The technical guideline for wetlands as presented in the manual includes most, but not all, wetlands identified in the FWS system. The difference is due to two principal factors:

- a. The FWS system includes all categories of special aquatic sites identified in the EPA Section 404 b.(1) guidelines. All other special aquatic sites are clearly within the purview of Section 404; thus, special methods for their delineation are unnecessary.
- b. The FWS system requires that a positive indicator of wetlands be present for any one of the three parameters, while the technical guideline for wetlands requires that a positive wetland indicator be present for each parameter (vegetation, soils, and hydrology), except in limited instances identified in the manual.

Organization

8. This manual consists of four parts and four appendices. Part I presents the background, purpose and objectives, scope, organization, and use of the manual.

9. Part II focuses on the technical guideline for wetlands, and stresses the need for considering all three parameters (vegetation, soils, and hydrology) when making wetland determinations. Since wetlands occur in an intermediate posi-

tion along the hydrologic gradient, comparative technical guidelines are also presented for deepwater aquatic sites and nonwetlands.

10. Part III contains general information on hydrophytic vegetation, hydric soils, and wetland hydrology. Positive wetland indicators of each parameter are included.

11. Part IV, which presents methods for applying the technical guideline for wetlands, is arranged in a format that leads to a logical determination of whether a given area is a wetland. Section A contains general information related to application of methods. Section B outlines preliminary data-gathering efforts. Section C discusses two approaches (routine and comprehensive) for making wetland determinations and presents criteria for deciding the correct approach to use. Sections D and E describe detailed procedures for making routine and comprehensive determinations, respectively. The basic procedures are described in a series of steps that lead to a wetland determination.

12. The manual also describes (Part IV, Section F) methods for delineating wetlands in which the vegetation, soils, and/or hydrology have been altered by recent human activities or natural events, as discussed below:

- a. The definition of wetlands contains the phrase "under normal circumstances," which was included because there are instances in which the vegetation in a wetland has been inadvertently or purposely removed or altered as a result of recent natural events or human activities. Other examples of human alterations that may affect wetlands are draining, ditching, levees, deposition of fill, irrigation, and impoundments. When such activities occur, an area may fail to meet the diagnostic criteria for a wetland. Likewise, positive hydric soil indicators may be absent in some recently created wetlands. In such cases, an alternative method must be employed in making wetland determinations.

USER NOTES: "Normal circumstances" has been further defined as "the soil and hydrologic conditions that are normally present, without regard to whether the vegetation has been removed." The determination of whether normal circumstances exist in a disturbed area "involves an evaluation of the extent and relative permanence of the physical alteration of wetlands hydrology and hydrophytic vegetation" and consideration of the "purpose and cause of the physical alterations to hydrology and vegetation." (RGL 90-7, 26 Sep 90; HQUSACE, 7 Oct 91)

- b. Natural events may also result in sufficient modification of an area that indicators of one or more wetland parameters are absent. For example, changes in river course may significantly alter hydrology, or beaver dams may create new wetland areas that lack hydric soil conditions. Catastrophic events (e.g., fires, avalanches, mudslides,

and volcanic activities) may also alter or destroy wetland indicators on a site.

Such atypical situations occur throughout the United States, and all of these cannot be identified in this manual.

13. Certain wetland types, under the extremes of normal circumstances, may not always meet all the wetland criteria defined in the manual. Examples include prairie potholes during drought years and seasonal wetlands that may lack hydrophytic vegetation during the dry season. Such areas are discussed in Part IV, Section G, and guidance is provided for making wetland determinations in these areas. However, such wetland areas may warrant additional research to refine methods for their delineation.

14. Appendix A is a glossary of technical terms used in the manual. Definitions of some terms were taken from other technical sources, but most terms are defined according to the manner in which they are used in the manual.

15. Data forms for methods presented in Part IV are included in Appendix B. Examples of completed data forms are also provided.

16. Supporting information is presented in Appendices C and D. ~~Appendix C contains lists of plant species that occur in wetlands. Section 1 consists of regional lists developed by a Federal interagency panel. Section 2 consists of shorter lists of plant species that commonly occur in wetlands of each region.~~

USER NOTES: CE-supplied plant lists are obsolete and have been superseded by the May 1988 version of the "National List of Plant Species that Occur in Wetlands" published by the U.S. Fish and Wildlife Service and available on the World Wide Web. (HQUSACE, 27 Aug 91)

Section 3 describes morphological, physiological, and reproductive adaptations associated with hydrophytic species, as well as a list of some species exhibiting such adaptations. Appendix D discusses procedures for examining soils for hydric soil indicators, ~~and also contains a list of hydric soils of the United States.~~

USER NOTES: The hydric soil list published in the 1987 Corps Manual is obsolete. Current hydric soil definition, criteria, and lists are available over the World Wide Web from the U.S.D.A. Natural Resources Conservation Service (NRCS). (HQUSACE, 27 Aug 91, 6 Mar 92)

Use

17. Although this manual was prepared primarily for use by Corps of Engineers (CE) field inspectors, it should be useful to anyone who makes wetland determinations for purposes of Section 404 of the Clean Water Act. The user is

directed through a series of steps that involve gathering of information and decisionmaking, ultimately leading to a wetland determination. A general flow diagram of activities leading to a determination is presented in Figure 1. However, not all activities identified in Figure 1 will be required for each wetland determination. For example, if a decision is made to use a routine determination procedure, comprehensive determination procedures will not be employed.

Premise for use of the manual

18. Three key provisions of the CE/EPA definition of wetlands include:
 - a. Inundated or saturated soil conditions resulting from permanent or periodic inundation by ground water or surface water.
 - b. A prevalence of vegetation typically adapted for life in saturated soil conditions (hydrophytic vegetation).
 - c. The presence of "normal circumstances."

19. Explicit in the definition is the consideration of three environmental parameters: hydrology, soil, and vegetation. Positive wetland indicators of all three parameters are normally present in wetlands. Although vegetation is often the most readily observed parameter, sole reliance on vegetation or either of the other parameters as the determinant of wetlands can sometimes be misleading. Many plant species can grow successfully in both wetlands and nonwetlands, and hydrophytic vegetation and hydric soils may persist for decades following alteration of hydrology that will render an area a nonwetland. The presence of hydric soils and wetland hydrology indicators in addition to vegetation indicators will provide a logical, easily defensible, and technical basis for the presence of wetlands. The combined use of indicators for all three parameters will enhance the technical accuracy, consistency, and credibility of wetland determinations. Therefore, all three parameters were used in developing the technical guideline for wetlands and all approaches for applying the technical guideline embody the multiparameter concept.

Approaches

20. The approach used for wetland delineations will vary, based primarily on the complexity of the area in question. Two basic approaches described in the manual are (a) routine and (b) comprehensive.

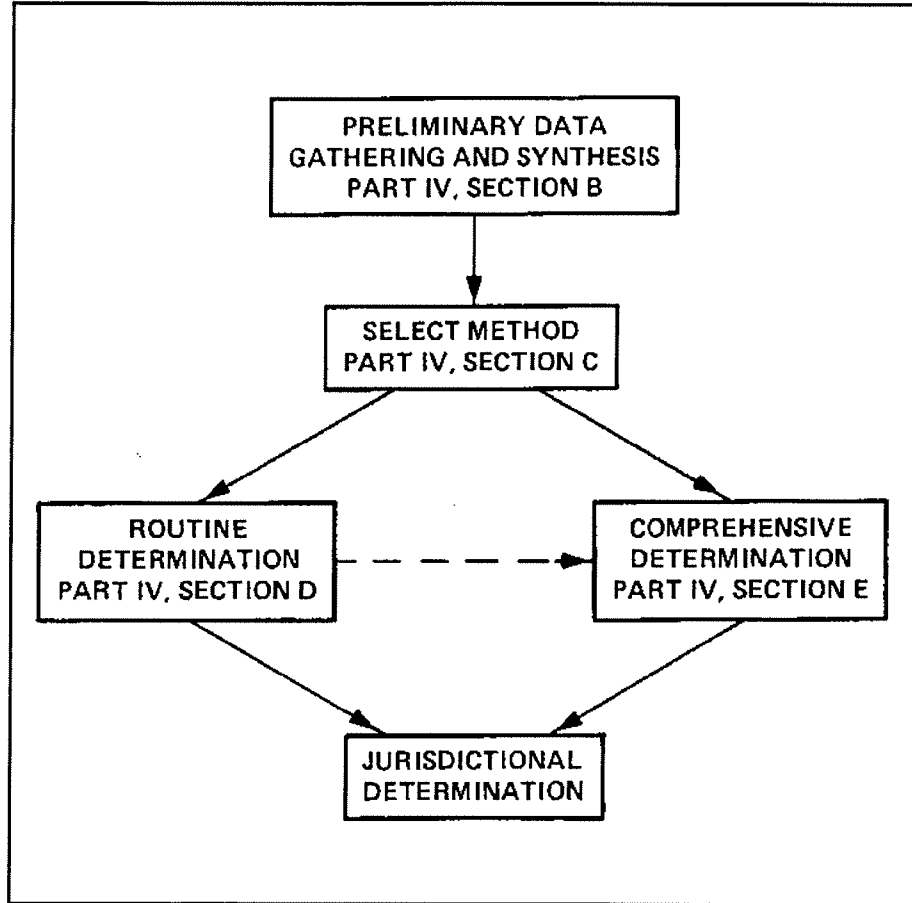


Figure 1. General schematic diagram of activities leading to a wetland/non-wetland determination

21. **Routine approach.** The routine approach normally will be used in the vast majority of determinations. The routine approach requires minimal level of effort, using primarily qualitative procedures. This approach can be further subdivided into three levels of required effort, depending on the complexity of the area and the amount and quality of preliminary data available. The following levels of effort may be used for routine determinations:

- a. *Level 1 - Onsite inspection unnecessary.* (Part IV, Section D, Subsection 1).
- b. *Level 2 - Onsite inspection necessary.* (Part IV, Section D, Subsection 2).
- c. *Level 3 - Combination of Levels 1 and 2.* (Part IV, Section D, Subsection 3).

22. **Comprehensive approach.** The comprehensive approach requires application of quantitative procedures for making wetland determinations. It should

seldom be necessary, and its use should be restricted to situations in which the wetland is very complex and/or is the subject of likely or pending litigation. Application of the comprehensive approach (Part IV, Section E) requires a greater level of expertise than application of the routine approach, and only experienced field personnel with sufficient training should use this approach.

Flexibility

23. Procedures described for both routine and comprehensive wetland determinations have been tested and found to be reliable. However, site-specific conditions may require modification of field procedures. For example, slope configuration in a complex area may necessitate modification of the baseline and transect positions. Since specific characteristics (e.g., plant density) of a given plant community may necessitate the use of alternate methods for determining the dominant species, the user has the flexibility to employ sampling procedures other than those described. However, the basic approach for making wetland determinations should not be altered (i.e., the determination should be based on the dominant plant species, soil characteristics, and hydrologic characteristics of the area in question). The user should document reasons for using a different characterization procedure than described in the manual. *CAUTION: Application of methods described in the manual or the modified sampling procedures requires that the user be familiar with wetlands of the area and use his or her training, experience, and good judgment in making wetland determinations.*

Part II: Technical Guidelines

24. The interaction of hydrology, vegetation, and soil results in the development of characteristics unique to wetlands. Therefore, the following technical guideline for wetlands is based on these three parameters, and diagnostic environmental characteristics used in applying the technical guideline are represented by various indicators of these parameters.

25. Because wetlands may be bordered by both wetter areas (aquatic habitats) and by drier areas (nonwetlands), guidelines are presented for wetlands, deepwater aquatic habitats, and nonwetlands. However, procedures for applying the technical guidelines for deepwater aquatic habitats and nonwetlands are not included in the manual.

Wetlands

26. The following definition, diagnostic environmental characteristics, and technical approach comprise a guideline for the identification and delineation of wetlands:

- a. *Definition.* The CE (*Federal Register* 1982) and the EPA (*Federal Register* 1980) jointly define wetlands as: 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.
- b. *Diagnostic environmental characteristics.* Wetlands have the following general diagnostic environmental characteristics:
 - (1) *Vegetation.* The prevalent vegetation consists of macrophytes that are typically adapted to areas having hydrologic and soil conditions described in *a* above. Hydrophytic species, due to morphological, physiological, and/or reproductive adaptation(s), have the ability to grow, effectively compete, reproduce, and/or persist in anaerobic

soil conditions.¹ Indicators of vegetation associated with wetlands are listed in paragraph 35.

(2) *Soil.* Soils are present and have been classified as hydric, or they possess characteristics that are associated with reducing soil conditions. Indicators of soils developed under reducing conditions are listed in paragraphs 44 and 45.

(3) *Hydrology.* The area is inundated either permanently or periodically at mean water depths ≤ 6.6 ft, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation.² Indicators of hydrologic conditions that occur in wetlands are listed in paragraph 49.

c. *Technical approach for the identification and delineation of wetlands.* Except in certain situations defined in this manual, evidence of a minimum of one positive wetland indicator from each parameter (hydrology, soil, and vegetation) must be found in order to make a positive wetland determination.

Deepwater Aquatic Habitats

27. The following definition, diagnostic environmental characteristics, and technical approach comprise a guideline for deepwater aquatic habitats:

a. *Definition.* Deepwater aquatic habitats are areas that are permanently inundated at mean annual water depths >6.6 ft or permanently inundated areas ≤ 6.6 ft in depth that do not support rooted-emergent or woody plant species.³

b. *Diagnostic environmental characteristics.* Deepwater aquatic habitats have the following diagnostic environmental characteristics:

(1) *Vegetation.* No rooted-emergent or woody plant species are present in these permanently inundated areas.

(2) *Soil.* The substrate technically is not defined as a soil if the mean water depth is >6.6 ft or if it will not support rooted emergent or woody plants.

¹ Species (e.g., *Acer rubrum*) having broad ecological tolerances occur in both wetlands and non-wetlands.

² The period of inundation or soil saturation varies according to the hydrologic/soil moisture regime and occurs in both tidal and nontidal situations.

³ Areas ≤ 6.6 ft mean annual depth that support only submergent aquatic plants are vegetated shallows, not wetlands.

- (3) *Hydrology*. The area is permanently inundated at mean water depths >6.6 ft.
- c. *Technical approach for the identification and delineation of deepwater aquatic habitats*. When any one of the diagnostic characteristics identified in *b* above is present, the area is a deepwater aquatic habitat.

Nonwetlands

28. The following definition, diagnostic environmental characteristics, and technical approach comprise a guideline for the identification and delineation of nonwetlands:

- a. *Definition*. Nonwetlands include uplands and lowland areas that are neither deepwater aquatic habitats, wetlands, nor other special aquatic sites. They are seldom or never inundated, or if frequently inundated, they have saturated soils for only brief periods during the growing season, and, if vegetated, they normally support a prevalence of vegetation typically adapted for life only in aerobic soil conditions.
- b. *Diagnostic environmental characteristics*. Nonwetlands have the following general diagnostic environmental characteristics:
 - (1) *Vegetation*. The prevalent vegetation consists of plant species that are typically adapted for life only in aerobic soils. These mesophytic and/or xerophytic macrophytes cannot persist in predominantly anaerobic soil conditions.¹
 - (2) *Soil*. Soils, when present, are not classified as hydric, and possess characteristics associated with aerobic conditions.
 - (3) *Hydrology*. Although the soil may be inundated or saturated by surface water or ground water periodically during the growing season of the prevalent vegetation, the average annual duration of inundation or soil saturation does not preclude the occurrence of plant species typically adapted for life in aerobic soil conditions.
- c. *Technical approach for the identification and delineation of nonwetlands*. When any one of the diagnostic characteristics identified in *b* above is present, the area is a nonwetland.

¹ Some species, due to their broad ecological tolerances, occur in both wetlands and nonwetlands (e.g., *Acer rubrum*).

Part III: Characteristics and Indicators of Hydrophytic Vegetation, Hydric Soils, and Wetland Hydrology

Hydrophytic Vegetation

Definition

29. **Hydrophytic vegetation.** Hydrophytic vegetation is defined herein as 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. The vegetation occurring in a wetland may consist of more than one plant community (species association). The plant community concept is followed throughout the manual. Emphasis is placed on the assemblage of plant species that exert a controlling influence on the character of the plant community, rather than on indicator species. Thus, the presence of scattered individuals of an upland plant species in a community dominated by hydrophytic species is not a sufficient basis for concluding that the area is an upland community. Likewise, the presence of a few individuals of a hydrophytic species in a community dominated by upland species is not a sufficient basis for concluding that the area has hydrophytic vegetation. *CAUTION: In determining whether an area is "vegetated" for the purpose of Section 404 jurisdiction, users must consider the density of vegetation at the site being evaluated. While it is not possible to develop a numerical method to determine how many plants or how much biomass is needed to establish an area as being vegetated or unvegetated, it is intended that the predominant condition of the site be used to make that characterization. This concept applies to areas grading from wetland to upland, and from wetland to other waters. This limitation would not necessarily apply to areas which have been disturbed by man or recent natural events.*

30. **Prevalence of vegetation.** The definition of wetlands includes the phrase "prevalence of vegetation." Prevalence, as applied to vegetation, is an imprecise, seldom-used ecological term. As used in the wetlands definition, prevalence refers to the plant community or communities that occur in an area at some point in time. Prevalent vegetation is characterized by the dominant species comprising the plant community or communities. Dominant plant species are those that contribute more to the character of a plant community than other species present, as estimated or measured in terms of some ecological parameter or parameters. The two most commonly used estimates of dominance are basal area (trees) and percent areal cover (herbs). Hydrophytic vegetation is prevalent in an area when the dominant species comprising the plant community or communities are typically adapted for life in saturated soil conditions.

USER NOTES: The "50/20 rule" is the recommended method for selecting dominant species from a plant community when quantitative data are available. The rule states that for each stratum in the plant community, dominant species are the most abundant plant species (when ranked in descending order of abundance and cumulatively totaled) that immediately exceed 50% of the total dominance measure for the stratum, plus any additional species that individually comprise 20% or more of the total dominance measure for the stratum. The list of dominant species is then combined across strata. (HQUSACE, 6 Mar 92)

31. **Typically adapted.** The term "typically adapted" refers to a species being normally or commonly suited to a given set of environmental conditions, due to some morphological, physiological, or reproductive adaptation (Appendix C, Section 3). As used in the CE wetlands definition, the governing environmental conditions for hydrophytic vegetation are saturated soils resulting from periodic inundation or saturation by surface or ground water. These periodic events must occur for sufficient duration to result in anaerobic soil conditions. When the dominant species in a plant community are typically adapted for life in anaerobic soil conditions, hydrophytic vegetation is present. Species listed in Appendix C, Section 1 or 2, that have an indicator status of OBL, FACW, or FAC¹ (Table 1) are considered to be typically adapted for life in anaerobic soil conditions (see paragraph 35a).

Influencing factors

32. Many factors (e.g., light, temperature, soil texture and permeability, man-induced disturbance, etc.) influence the character of hydrophytic vegetation. However, hydrologic factors exert an overriding influence on species that can occur in wetlands. Plants lacking morphological, physiological, and/or reproductive adaptations cannot grow, effectively compete, reproduce, and/or persist in areas that are subject to prolonged inundation or saturated soil conditions.

¹ Species having a FAC- indicator status are not considered to be typically adapted for life in anaerobic soil conditions.

| Table 1 Plant Indicator Status Categories¹ | | |
|--|-------------------------|---|
| Indicator Category | Indicator Symbol | Definition |
| Obligate Wetland Plants | OBL | Plants that occur almost always (estimated probability >99 percent) in wetlands under natural conditions, but which may also occur rarely (estimated probability <1 percent) in nonwetlands. Examples: <i>Spartina alterniflora</i> , <i>Taxodium distichum</i> . |
| Facultative Wetland Plants | FACW | Plants that occur usually (estimated probability >67 percent to 99 percent) in wetlands, but also occur (estimated probability 1 percent to 33 percent) in nonwetlands. Examples: <i>Fraxinus pennsylvanica</i> , <i>Cornus stolonifera</i> . |
| Facultative Plants | FAC | Plants with a similar likelihood (estimated probability 33 percent to 67 percent) of occurring in both wetlands and nonwetlands. Examples: <i>Gleditsia triacanthos</i> , <i>Smilax rotundifolia</i> . |
| Facultative Upland Plants | FACU | Plants that occur sometimes (estimated probability 1 percent to <33 percent) in wetlands, but occur more often (estimated probability >67 percent to 99 percent) in nonwetlands. Examples: <i>Quercus rubra</i> , <i>Potentilla arguta</i> . |
| Obligate Upland Plants | UPL | Plants that occur rarely (estimated probability <1 percent) in wetlands, but occur almost always (estimated probability >99 percent) in nonwetlands under natural conditions. Examples: <i>Pinus echinata</i> , <i>Bromus mollis</i> . |

¹ Categories were originally developed and defined by the USFWS National Wetlands Inventory and subsequently modified by the National Plant List Panel. The three facultative categories are subdivided by (+) and (-) modifiers (see Appendix C, Section 1).

Geographic diversity

33. Many hydrophytic vegetation types occur in the United States due to the diversity of interactions among various factors that influence the distribution of hydrophytic species. General climate and flora contribute greatly to regional variations in hydrophytic vegetation. Consequently, the same associations of hydrophytic species occurring in the southeastern United States are not found in the Pacific Northwest. In addition, local environmental conditions (e.g., local climate, hydrologic regimes, soil series, salinity, etc.) may result in broad variations in hydrophytic associations within a given region. For example, a coastal saltwater marsh will consist of different species than an inland freshwater marsh in the same region. An overview of hydrophytic vegetation occurring in each region of the Nation has been published by the CE in a series of eight preliminary wetland guides (Table 2), and a group of wetland and estuarine ecological profiles (Table 3) has been published by FWS.

Classification

34. Numerous efforts have been made to classify hydrophytic vegetation. Most systems are based on general characteristics of the dominant species occurring in each vegetation type. These range from the use of general physiognomic categories (e.g., overstory, subcanopy, ground cover, vines) to specific vegetation types (e.g., forest type numbers as developed by the Society of American Foresters). In other cases, vegetational characteristics are combined with hydrologic features to produce more elaborate systems. The most recent example of such a system was developed for the FWS by Cowardin et al. (1979).

| Table 2 | | |
|--|-------------------------|-----------------------|
| List of CE Preliminary Wetland Guides | | |
| Region | Publication Date | WES Report No. |
| Peninsular Florida | February 1978 | TR Y-78-2 |
| Puerto Rico | April 1978 | TR Y-78-3 |
| West Coast States | April 1978 | TR-Y-78-4 |
| Gulf Coastal Plain | May 1978 | TR Y-78-5 |
| Interior | May 1982 | TR Y-78-6 |
| South Atlantic States | May 1982 | TR Y-78-7 |
| North Atlantic States | May 1982 | TR Y-78-8 |
| Alaska | February 1984 | TR Y-78-9 |

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 | 82/23 |
| "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 |
| "The Ecology of Eelgrass Meadows in the Pacific Northwest" | 1984 | 84/24 |
| "The Ecology of Irregularly Flooded Marshes of North-eastern Gulf of Mexico" | (In press) | 85(7.1) |
| "The Ecology of Giant Kelp Forests in California" | 1985 | 85(7.2) |

Indicators of hydrophytic vegetation

35. Several indicators may be used to determine whether hydrophytic vegetation is present on a site. However, the presence of a single individual of a hydrophytic species does not mean that hydrophytic vegetation is present. The strongest case for the presence of hydrophytic vegetation can be made when

several indicators, such as those in the following list, are present. However, any one of the following is indicative that hydrophytic vegetation is present:¹

- a. *More than 50 percent of the dominant species are OBL, FACW, or FAC² (Table 1) on lists of plant species that occur in wetlands.* A national interagency panel has prepared a National List of Plant Species that occur in wetlands. This list categorizes species according to their affinity for occurrence in wetlands. ~~Regional subset lists of the national list, including only species having an indicator status of OBL, FACW, or FAC, are presented in Appendix C, Section 1. The CE has also developed regional lists of plant species that commonly occur in wetlands (Appendix C, Section 2). Either list may be used.~~

USER NOTES: CE-supplied plant lists are obsolete and have been superseded by the May 1988 version of the "National List of Plant Species that Occur in Wetlands" published by the U.S. Fish and Wildlife Service and available on the World Wide Web. Subsequent changes to the May 1988 national plant list, or regional versions of the national list, should not be used until they receive official review and approval. (HQUSACE, 27 Aug 91 and 17 Jan 96)

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.

¹ Indicators are listed in order of decreasing reliability. Although all are valid indicators, some are stronger than others. When a decision is based on an indicator appearing in the lower portion of the list, re-evaluate the parameter to ensure that the proper decision was reached.

² FAC+ species are considered to be wetter (i.e., have a greater estimated probability of occurring in wetlands) than FAC species, while FAC- species are considered to be drier (i.e., have a lesser estimated probability of occurring in wetlands) than FAC species.

USER NOTES: The FAC-neutral option can not be used to exclude areas as wetlands that meet the basic vegetation rule (i.e., more than 50% of dominant species are FAC, FACW, or OBL) and meet wetland hydrology and hydric soil requirements. Presence of a plant community that satisfies the FAC-neutral option may be used as a secondary indicator of wetland hydrology. (HQUSACE, 6 Mar 92)

- 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.

| 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 U.S. | Hitchcock (1950) |

- (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 U.S. 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.
- (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 (U.S. 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 Histosols¹ 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 ft² 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 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.

USER NOTES: The hydric soil definition and criteria published in the 1987 Corps Manual are obsolete. Current hydric soil definition, criteria, and lists are available over the World Wide Web from the U.S.D.A. Natural Resources Conservation Service (NRCS). (HQUSACE, 27 Aug 91, 6 Mar 92)

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:

¹ Soil nomenclature follows USDA-SCS (1975).

² A table of factors for converting Non-SI Units of Measurement to SI (metric) units is presented on page x.

- 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 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 consoli-

dated bedrock. In many situations, this horizon occurs at such depths that it has no significant influence on soil characteristics.

| | | <u>DESCRIPTION</u> |
|------------------|----|--|
| ORGANIC HORIZONS | O1 | ORGANIC MATTER CONSISTING OF VISIBLE VEGETATIVE MATTER. |
| | O2 | ORGANIC MATTER IN A FORM WHERE INDIVIDUAL COMPONENTS ARE UNRECOGNIZABLE TO THE NAKED EYE. |
| | A1 | DECOMPOSED ORGANIC MATTER MIXED WITH MINERAL MATTER AND COATING MINERAL PARTICLES, RESULTING IN DARKER COLOR OF THE SOIL MASS. USUALLY THIN IN FOREST SOILS AND THICK IN GRASSLAND SOILS. |
| MINERAL HORIZONS | A2 | ZONE WHERE CLAY, IRON, OR ALUMINUM IS LOST. GENERALLY LIGHTER IN COLOR AND LOWER IN ORGANIC MATTER CONTENT THAN THE A1 HORIZON. |
| | A3 | THESE HORIZONS ARE TRANSITIONAL BETWEEN THE A AND B HORIZONS. THE A3 HORIZON HAS PROPERTIES MORE LIKE A THAN B. THE B1 HORIZON HAS PROPERTIES MORE LIKE B THAN A. |
| | B1 | |
| | B2 | ZONE WHERE THE SOIL LACKS PROPERTIES OF THE OVERLYING A AND UNDERLYING C HORIZONS. GENERALLY THE ZONE OF MAXIMUM CLAY CONTENT AND SOIL STRUCTURE DEVELOPMENT. |
| | B3 | ZONE OF TRANSITION BETWEEN THE B AND C OR R HORIZONS, BUT WITH PREDOMINANT CHARACTERISTICS OF THE B HORIZON. |
| | C | A MINERAL LAYER, EXCLUSIVE OF BEDROCK, THAT HAS BEEN RELATIVELY LITTLE AFFECTED BY SOIL-FORMING PROCESSES AND LACKS PROPERTIES OF EITHER THE A OR B HORIZONS, BUT WHICH CONSISTS OF MATERIALS WEATHERED BELOW THE ZONE OF BIOLOGICAL ACTIVITY. |
| | R | CONSOLIDATED BEDROCK, WHICH IS NOT NECESSARILY THE SOURCE OF MINERAL MATTER FROM WHICH THE SOIL FORMED. |

Figure 2. Generalized soil profile

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 44*d*), 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:¹

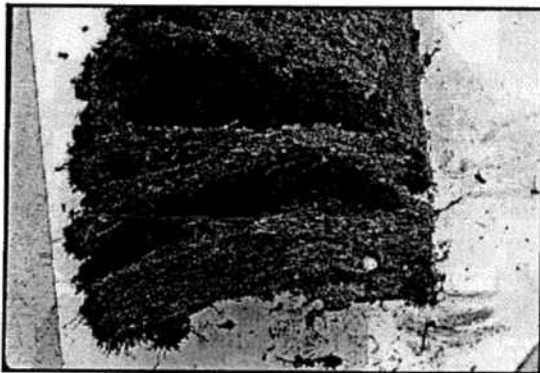


Figure 3. Organic soil

- 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;² 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

¹ 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.

² A detailed definition of organic soil material is available in USDA-SCS (1975).

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 centimeters 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 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' -dipyridyl, 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 is converted from the oxidized (ferric)



Figure 4. Gleyed soil

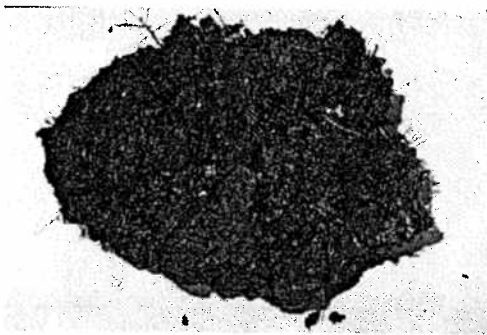


Figure 5. Soil showing matrix (brown) and mottles (reddish-brown)

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 less¹ in mottled soils.
- (b) Matrix chroma of 1 or less¹ 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.

¹ Colors should be determined in soils that have been moistened; otherwise, state that colors are for dry soils.

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.

USER NOTES: The NRCS has developed local lists of hydric soil mapping units that are available from NRCS county and area offices. These local lists are the preferred hydric soil lists to use in making wetland determinations. (HQUSACE, 6 Mar 92)

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.



Figure 6. Iron and manganese concretions

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 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.

USER NOTES: The NRCS has developed regional lists of "Field Indicators of Hydric Soils in the United States" (Version 3.2, July 1996, or later). Until approved, these indicators do not supersede those given in the 1987 Corps Manual and supplemental guidance but may be used as supplementary information. Several of the NRCS indicators were developed specifically to help in identifying hydric soils in certain problem soil types (e.g., sandy soils, soils derived from red parent materials, soils with thick, dark surfaces). These indicators may be used under procedures given in the Problem Area section of the 1987 Manual. (HQUSACE, 21 Mar 97)

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.

USER NOTES: The 1987 Manual (see glossary, Appendix A) defines "growing season" as the portion of the year when soil temperature (measured 20 inches below the surface) is above biological zero (5° C or 41° F). This period "can be approximated by the number of frost-free days." Estimated starting and ending dates for the growing season are based on 28° F air temperature thresholds at a frequency of 5 years in 10 (HQUSACE, 6 Mar 92). This information is available in NRCS county soil survey reports or from the NRCS Water and Climate Center in Portland, Oregon, for most weather stations in the country.

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.

Classification

48. Although the interactive effects of all hydrologic factors produce a continuum of wetland hydrologic regimes, efforts have been made to classify wet-

land 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 the upper limit of each hydrologic zone shown in Table 5. This program is available upon request.¹

USER NOTES: Based on Table 5 and on paragraph 55, Step 8.i., an area has wetland hydrology if it is inundated or saturated to the surface continuously for at least 5% of the growing season in most years (50% probability of recurrence). These areas are wetlands if they also meet hydrophytic vegetation and hydric soil requirements. (HQUSACE, 7 Oct 91 and 6 Mar 92)

| Table 5 Hydrologic Zones¹ - Nontidal Areas | | | |
|--|--|-----------------------------|---|
| Zone | Name | Duration² | Comments |
| I ³ | Permanently inundated | 100 percent | Inundation >6.6 ft mean water depth |
| II | Semipermanently to nearly permanently inundated or saturated | >75 - <100 percent | Inundation defined as \leq 6.6 ft mean water depth |
| III | Regularly inundated or saturated | >25 - 75 percent | |
| IV | Seasonally inundated or saturated | >12.5 - 25 percent | |
| V | Irregularly inundated or saturated | \geq 5 - 12.5 percent | Many areas having these hydrologic characteristics are not wetlands |
| VI | Intermittently or never inundated or saturated | <5 percent | Areas with these hydrologic characteristics are not wetlands |

¹ Zones adapted from Clark and Benforado (1981).
² Refers to duration of inundation and/or soil saturation during the growing season.
³ This defines an aquatic habitat zone.

Wetland indicators

49. Indicators of wetland hydrology may include, but are not necessarily limited to: drainage patterns, drift lines, sediment deposition, watermarks,

¹ R. F. Theriot, Environmental Laboratory, U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, MS 39180.

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 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:¹

- 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) *U.S. 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 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.

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



Figure 7. Watermark on trees

- (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.



Figure 8. Absence of leaf litter

- (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 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).



Figure 9. Sediment deposit on plants

- (6) *Drainage patterns within wetlands.* This indicator, which occurs primarily in wetlands

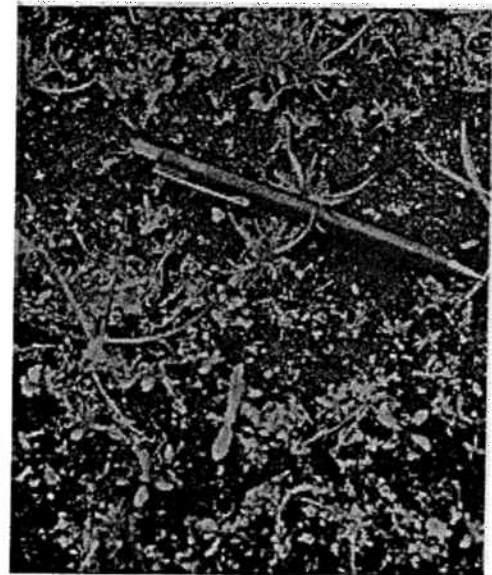


Figure 10. Encrusted detritus

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).



Figure 11. Drainage pattern



Figure 12. Debris deposited in stream channel

CAUTION: Drainage patterns also occur in upland areas after periods of considerable precipitation; therefore, topographic position must also be considered when applying this indicator.

USER NOTES: The hydrology indicators described above are considered to be "primary indicators", any one of which is sufficient evidence that wetland hydrology is present when combined with a hydrophytic plant community and hydric soils. In addition, the following "secondary indicators" may also be used to determine whether wetland hydrology is present. In the absence of a primary indicator, any two secondary indicators must be present to conclude that wetland hydrology is present. Secondary indicators are: presence of oxidized rhizospheres associated with living plant roots in the upper 12 inches of the soil, presence of water-stained leaves, local soil survey hydrology data for identified soils, and the FAC-neutral test of the vegetation. (HQUSACE, 6 Mar 92)