UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

843B87100

MAY 7 1987

OFFICE OF
WATER

MEMORANDUM

SUBJECT: Field Testing Wetland Identification and Delineation Manual

FROM: David G. Davis, Acting Director
Office of Wetlands Protection

TO: Water Division Directors, Regions I, II, IV, V, VIII, X
Environmental Service Division Directors, Regions III, VI
Assistant Regional Administrators, Regions VII, IX

For the past few years, the Corps of Engineers' Waterways Experiment Station and EPA Headquarters have been independently developing wetland delineation manuals. In 1985, our agencies agreed to try to merge the two draft documents into one joint Federal 404 jurisdictional manual. Although this joint document has not been developed to date, both agencies have progressed substantially on their manuals since 1985, and on February 3, 1987, agreed to field test the manuals for a one-year period (ending January 31, 1988) before further consideration is given to consolidation into a unified procedure (Attachment 1). Please note also the enclosed February 3, 1987 supplemental letter from EPA to the Corps, which clarifies EPA's enforcement authority in relation to special cases (Attachment 2). Ten copies of EPA's manual and four copies of the Corps' manual are attached (Attachments 3 and 4).

The Regional wetland coordinators and their staffs are familiar with this effort to develop a wetland jurisdictional manual. They have seen earlier drafts and staff from Regions 3, 4, 5, 6, and 7 were represented on EPA's Regional Bottomland Hardwood Wetland Delineation Review Team that field tested the basic rationale underlying the field methodology at a number of bottomland hardwood sites in 1986. Actually, the overall field methodology is not all that different from what EPA's field people are already doing when they get involved in jurisdictional determinations. Thus, the manual just formalizes, to a large extent, what is already being done on an _ad hoc_ basis.

EPA's manual is in two volumes. Volume I presents EPA's rationale on wetland jurisdiction, elaborates on the three wetland parameters generally considered when making jurisdictional determinations, and presents an overview of the jurisdictional approaches developed in Volume II, the field methodology. As a training document, Volume I would benefit from additional

conceptual foundation. However, the focus of the effort up to this point has been on the field methodology. If the methodology proves problematic, then it would be premature to fully develop Volume I. Furthermore, the nature of this effort will change if, after the field testing, EPA and the Corps merge their manuals. Although Volume II, the field methodology, should not be utilized in isolation from Volume I, it was designed as a separate document to facilitate its use in the field. It contains a simple approach and a detailed approach for making wetland jurisdictional determinations. Both approaches are aided by a diagnostic key and a flow chart, two tools that will expedite and conceptually guide decisions about jurisdiction for sample plots and vegetation units once the field data have been collected. Either of these tools can be used with the same results. An extra set of the data forms, as well as an extra copy of the key and flow chart, is also attached (Attachment 5).

The purpose of this memorandum is to inform you of the field test agreement and to encourage each Region to test EPA's manual, as well as the Corps' manual, if time allows. If for some reason the approaches in EPA's manual appear inappropriate for a given site, please have your staff contact Bill Sipple, the author of the manual, to discuss any perceived problems prior to applying an alternate jurisdictional approach in an official capacity (vs. a purely "R&D" test situation). Obviously, certain Regions (i.e., those with special cases under the Corps-EPA Memorandum of Understanding on Geographic Jurisdiction) will have more opportunity than others to apply the manual to official jurisdictional determinations. However, Regions without special cases sometimes jointly participate with the Corps in making wetland jurisdictional determinations, make jurisdictional determinations in conjunction with enforcement actions, or verify for their own purposes Corps' determinations. In all these instances, even when formal jurisdictional determinations are not required, the approaches presented in this manual (and if possible, the Corps' manual for comparison) should be followed.

A comparison of the major differences between EPA's and the Corps' manuals is attached (Attachment 6). I realize that it may take some time for Regional staffs to familiarize themselves with EPA's and the Corps' manual. However, I would like the Regions to initiate their field testing by at least June 1, 1987, to take advantage of the 1987 growing season. Preferably, the manual should be tested in a range of wetland types across the United States. Thus, each Region should attempt to test the manual over a range of wetland communities, hydrologic conditions, and geographic conditions. While we are not establishing any SPMS or other "bean counts" for this work, we would appreciate each Region attempting to complete at least five field tests during this period. We are also simultaneously providing copies of EPA's manual to the Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and Soil Conservation Service for their review and/or testing. Please test both the simple approach and the detailed approach in EPA's method. Although you should concentrate on undisturbed sites, about 20 percent of your determinations should be for significantly disturbed sites.

Although we would be interested in any comments or suggestions that you might have relating to the rationale or the assumptions underlying the basic jurisdictional approaches given in Volume I, our primary interest is in having the methodology (Volume II) field tested. To help you in your evaluation of the effort, we have attached an evaluation form (Attachment 7) that should be filled out for each jurisdictional determination (official or unofficial) made and an overall evaluation form (Attachment 8) for the manual itself. The completed site forms, the related field data sheets, the overall evaluation form, and any other comments or suggestions for each site, should be submitted to Bill Sipple in the Office of Wetlands Protection as they are completed, but in any case not later than February 28, 1988. Bill also expects to conduct some field testing of his own periodically this spring through fall. He will coordinate this with the Regions involved.

The Regions should feel free to distribute copies of the manual to others on request. However, it should be clarified that the manual is an interim final document that is being field tested by agency personnel and that we are not undergoing public review (i.e., it is being provided as a courtesy copy for information purposes only).

Again, I strongly encourage each Region to field test EPA's and, if possible, the Corps' wetland jurisdictional manuals. Such field testing is vital to our efforts to develop a technically sound, useable joint jurisdictional manual with the Corps. If you have general questions, please contact me. If your staff has specific/technical questions, please ask them to contact Bill Sipple on FTS 382-5066.

Thank you for your cooperation.

Attachments

cc: Rebecca Hanmer (w/o Attachments)
Gail Cooper, OGC
Eric Preston, Corvallis ERL
Bernie Goode, OCE (w/o Attachment 4)

Attachment

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

FEB 3 1987

SUBJECT: Wetland Delineation Procedures

SEE DISTRIBUTION

1. Headquarters, Army Corps of Engineers (Corps) and the Environmental Protection Agency (EPA) have been working together during the last year in an effort to develop a unified procedure for delineating the boundary line in wetlands subject to Section 404 (Clean Water Act) jurisdiction. Each agency has drafted a method which utilizes soils, hydrology and vegetation to characterize wetlands.

2. While the two methods are founded on the same fundamental theory (i.e., that use of the three parameters of soils, hydrology and vegetation gives the best indication of the wetland status of an area) and have many similarities, there are some differences between the two. After consideration of the methods, the agencies have concluded that both should be field-tested for a one-year period before further consideration is given to consolidation into a unified procedure.

3. During the implementation period, each agency will be required to test its own method. The specific directions and requirements for your agency's test are enclosed with this letter. Copies of each method will be sent directly to you under separate cover. We are exchanging both methods for informational purposes only. At the conclusion of the test period, we will utilize your data sheets and comments to evaluate the two methods.

4. The fact that each agency is testing its own method for wetland delineation in no way affects the current agreement on jurisdictional calls. Until specifically notified to the contrary, the Corps will make all jurisdictional determinations unless an area falls within a defined special case category.

SUBJECT: Wetland Delineation Procedures

5. Although we have not reached a complete consensus at this time, we remain optimistic that we will conclude this test period with the information necessary to finalize a unified method. We encourage all of you to work together cooperatively during this period so that we can successfully attain that goal.

FOR THE CHIEF OF ENGINEERS:

Peter J. Offringa

PETER J. OFFRINGA
Brigadier General, USA
Deputy Director of Civil Works

Rebecca Hanmer

REBECCA HANMER
Deputy Assistant
Administrator for Water

Encl

DISTRIBUTION:
(See pg. 3)

Attachment

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

FEB 3 1987

OFFICE OF
WATER

General Peter J. Offringa
Brigadier General, U.S. Army
Deputy Director of Civil Works
Attn: DAEN-CWO-N
Office of the Chief of Engineers
Department of the Army
Washington, D.C. 20314-1000

Dear General Offringa:

Enclosed please find the joint memorandum on wetland delineation procedures, which I have signed. I look forward to the ultimate completion of this effort, a joint Section 404 wetlands delineation methodology, following the year of field tests.

I would like to take the opportunity to clarify my understanding of paragraph 4 of this memorandum. The statement that "the Corps will make all jurisdictional determinations unless an area falls within a defined special case category" refers to the permitting process -- permit applications and pre-application inquiries. It is not intended to affect EPA's authority to make jurisdictional determinations as part of an enforcement action, regardless of whether the site is located within a special case. My staff have verified with your staff that this is the mutually intended meaning of paragraph 4.

I appreciate your interest in coordinating on this and other areas of concern to both of us, and I look forward to a positive, effective working relationship.

Sincerely,

Rebecca Hanmer

Rebecca W. Hanmer
Deputy Assistant Administrator
for Water

DATA FORM C-1: HERBACEOUS SPECIES DATA
FOR SIMPLE JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ________________________________ Date: ______________
Project/Site: _______________________ State: ______________ County: ________________
Applicant/Owner: ______________________________ Vegetation Unit #/Name: ________________

****

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					

Sum of Midpoints ________
50% X Sum of Midpoints ________

****

1. Note: Herbaceous species include all graminoids, forbs, ferns, fern allies, bryophytes, woody seedings, and herbaceous vines.
2. Cover classes (midpoints): T<1% (none); 1=1-5% (3.0); 2=6-15% (10.5); 3=16-25% (20.5); 4=26-50% (38.0); 5=51-75% (63.0); 6=76-95% (85.5); 7=96-100% (98.0).
3. To determine the dominants, first rank the species by their midpoints. Then cumulatively sum the midpoints of the ranked species until 50% of the total for all species midpoints is reached or initially exceeded. All species contributing to that cumulative total should be considered dominants and indicated with an asterisk above.
4. Do the dominant herbaceous species indicate that the vegetation unit supports hydrophytic vegetation? Yes ______ No ______ Inconlusive ______.
5. Note: Inconclusive should be checked when only facultative (i.e., facultative wetland, straight facultative, and/or facultative upland) species dominate.
6. Comments: ____
____
____

DATA FORM C-2: SHRUB AND WOODY VINE DATA
FOR SIMPLE JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ______________________________ Date: ____________
Project/Site: ______________________ State: ____________ County: ____________
Applicant/Owner: __________________________ Vegetation Unit #/Name: ____________
****

SHRUBS

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					
6.					
7.					

Sum of Midpoints ________
50% X Sum of Midpoints ________
****

WOODY VINES

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					
6.					
7.					

Sum of Midpoints ________
50% X Sum of Midpoints ________
****

1. Note: A shrub is usually less than 6.1 meters (20 feet) tall and generally exhibits several erect, spreading or prostrate stems and has a bushy appearance. Percent cover of woody vines should be estimated independent of strata and exclusive of seedlings.
2. Cover classes (midpoints): T<1% (none); 1=1-5% (3.0); 2=6-15% (10.5); 3=16-25% (20.5) 4=26-50% (38.0); 5=51-75% (63.0); 6=76-95% (85.5); 7=96-100% (98.0).
3. To determine the dominants, first rank the shrub species by their midpoints. Then cumulatively sum the midpoints of the ranked shrub species until 50% of the total for all shrub species midpoints is reached or initially exceeded. Do the same for woody vines. All species contributing to these cumulative totals should be considered dominants and marked with an asterisk above.
4. Do the dominant shrub species indicate that the vegetation unit supports hydrophytic vegetation? Yes ______ No ______ Inconlusive ______.
5. Do the dominant woody vine species indicate that the vegetation unit supports hydrophytic vegetation? Yes ______ No ______ Inconclusive ______.
6. Note: Inconclusive should be checked when only facultative (i.e., facultative wetland, straight facultative, and/or facultative upland) species dominate.
7. Comments: ____
____
____

DATA FORM C-3: TREE AND SAPLING DATA
FOR SIMPLE JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ______________________________ Date: ____________
Project/Site: ______________________ State: ____________ County: ____________
Applicant/Owner: ______________________ Vegetation Unit #/Name: ____________

****

TREES

Species	Indicator Status	Relative Basal Area (%)	Rank
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Total Relative Basal Area Equals 100%

****

SAPLINGS

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					

Sum of Midpoints ________
50% X Sum of Midpoints ________

****

1. Note: A tree is greater than 10 centimeters (4 inches) diameter breast height (dbh). A sapling is from 1-10 centimeters (0.4-4 inches) dbh.
2. Cover classes (midpoints): T<1% (none); 1=1-5% (3.0); 2=6-15% (10.5); 3=16-25% (20.5); 4=26-50% (38.0); 5=51-75% (63.0); 6=76-95% (85.5); 7=96-100% (98.0).
3. To determine the dominants, first rank the tree species by relative basal area. Then cumulatively sum the relative basal area of the ranked tree species until 50% of the total relative basal area for all tree species is reached or initially exceeded. Do the same for saplings using the sum of midpoints. All species contributing to these cumulative totals should be considered dominants and marked with an asterisk above.
4. Do the dominant trees indicate that the vegetation unit supports hydrophytic vegetation Yes ______ No ______ Inconlusive ______.
5. Do the dominant saplings indicate that the vegetation unit supports hydrophytic vegetation? Yes ______ No ______ Inconclusive ______.
6. Note: Inconclusive should be checked when only facultative (i.e., facultative wetland, straight facultative, and/or facultative upland) species dominate.
7. Comments: ____
____
____

DATA FORM C-4: SOIL/HYDROLOGY DATA
FOR SIMPLE JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ________________________________ Date: ______________
Project/Site: ________________________ State: ______________ County: _________________
Applicant/Owner: ____________________________ Vegetation Unit #/Name: _________________

****

SOILS

Is the soil on the national or state hydric soils list? Yes ______ No ______
Series/phase: _____________________________ Subgroup: _______________________________
Is the soil a Histosol or is a histic epipedon present? Yes ______ No ______
Is the soil:
Mottled? Yes ______ No ______ Matrix Color: __________ Mottle Color: _______________
Gleyed? Yes ______ No ______
Other Indicators ____
____

1. Note: Soils should be sample at about 25 centimeters (10 inches) or immediately below the A horizon, whichever comes first. If desired, use the back of the form to diagram or describe the soil profile.
2. Does the sampling indicate that the vegetation unit has hydric soils?
   Yes ______ No ______ Inconclusive ______.
   Rationale: ____
   ____
   ____
   ____
   Comments: ____
   ____
   ____

****

HYDROLOGY

1. Is the ground surface inundated? Yes ______ No ______ Depth of water: ___________
2. Is the soil saturated? Yes ______ No ______ Depth to free-standing water: _______
3. List other field evidence of surface inundation or soil saturation ______________
   ____
   ____
4. Are hydrology indicators present in the vegetation unit?
   Yes _____ No _____ Inconclusive _____.
   Note: It may be necessary to rely on supplemental historical data (e.g., soil surveys) during a dry season or drought year as long as a site has not been significantly modified hydrologically since data collection.
   Rationale: ____
   ____
   ____
5. Comments: ____
   ____
   ____

DATA FORM C-5: SUMMARY OF DATA
FOR SIMPLE JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ________________________________ Date: ______________
Project/Site: ________________________ State: ______________ County: _________________
Applicant/Owner: ___________________________ Vegetation Unit #/Name: _________________

****

Dominant Species | Indicator Status

1. ____ _______________
2. ____ _______________
3. ____ _______________
4. ____ _______________
5. ____ _______________
6. ____ _______________
7. ____ _______________
8. ____ _______________
9. ____ _______________
10. ____ _______________
11. ____ _______________
12. ____ _______________
13. ____ _______________
14. ____ _______________
15. ____ _______________
16. ____ _______________
17. ____ _______________
18. ____ _______________
19. ____ _______________
20. ____ _______________

****

1. Is hydrophytic vegetation present? Yes ______ No ______ Inconclusive ______
2. Are hydric soils present? Yes ______ No ______ Inconclusive ______
3. Are hydrology indicators present? Yes ______ No ______ Inconclusive ______
4. Overall, is the vegetation unit wetland? Yes ______ No ______ Inconclusive ______
5. Comments: ____
____
____

DATA FORM D-1: HERBACEOUS SPECIES DATA
FOR DETAILED JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ______________________________ Date: ____________
Project/Site: ______________________ State: _____________ County: ____________
Applicant/Owner: __________________________ Transect #: __________ Plot #: _________

****

PERCENT AREAL COVER

Species	Status	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	$\overline{X}$	Rank
1.											
2.											
3.											
4.											
5.											
6.											
7.											
8.											
9.											
10.											
11.											
12.											
13.											
14.											
15.											
16.											
17.											
18.											
19.											
20.											

Total of Averages (X's) of Percent Areal Cover __
50% X Total of Averages (X's) of Percent Areal Cover __

****

1. Note: Herbaceous species include all graminoids, forbs, ferns, fern allies, bryophytes, woody seedlings, and herbaceous vines.
2. To determine the dominants, first rank the species by their average percent areal cover. Then cumulatively sum the percent areal cover averages (X's) of the ranked species until 50% of the total of all the species averages is reached or initially exceeded. All species contributing to that cumulative total should be considered dominants and indicated with an asterisk above.
3. Do the dominant herbaceous species indicate that the vegetation unit supports hydrophytic vegetation? Yes _____ No _____ Inconclusive _____.
4. Note: Inconclusive should be checked when only facultative (facultative wetland, straight facultative, and/or facultative upland) species dominate.
5. Comments: ____

DATA FORM D-2: SHRUB AND WOODY VINE
DATA FOR DETAILED JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ______________________________ Date: ____________
Project/Site: ______________________ State: ____________ County: ____________
Applicant/Owner: __________________________ Transects #: ________ Plot #: ________

****

SHRUBS

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					

Sum of Midpoints ________
50% X Sum of Midpoints ________

****

WOODY VINES

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					

Sum of Midpoints ________
50% X Sum of Midpoints ________

****

1. Note: A shrub usually is less than 6.1 meters (20 feet) tall and generally exhibits several erect, spreading or prostrate stems and has a bushy appearance. Percent cover of woody vines should be estimated independent of strata and exclusive of seedlings.
2. Cover classes (midpoints): T=<1% (none); 1=1-5% (3.0); 2=6-15% (10.5); 3=16-25% (20.5) 4=26-50% (38.0); 5=51-75% (63.0); 6=76-95% (85.5); 7=96-100% (98.0).
3. To determine dominants, first rank the shrub species by their midpoints. Then cumulatively sum the midpoints of the ranked shrub species until 50% of the total for all shrub species midpoints is reached or initially exceeded. Do the same for woody vines. All species contributing to these cumulative totals should be considered dominants and marked with an asterisk above.
4. Do the dominant shrubs indicate that the vegetation unit supports hydrophytic vegetation? Yes ______ No ______ Inconclusive ______.
5. Do the dominant woody vine species indicate that the vegetation unit supports hydrophytic vegetation? Yes ______ No ______ Inconclusive ______.
6. Note: Inconclusive should be checked when only facultative (i.e., facultative wetland, straight facultative, and/or facultative upland) species dominate.
7. Comments: ____

____

DATA FORM D-3: TREE AND SAPLING DATA
FOR DETAILED JURISDICTIONAL DETERMINATION

EPA Region: _______ Recorder: ____________________________ Date: __________
Project/Site: ____________________ State: ____________ County: ____________
Applicant/Owner: ________________________ Transect #: __________ Plot #: ________

****

TREES (Bitterlich Method)

Individual Tree (Species Name)	Indicator Status	DBH (cm/ft)	Basal Area Per Tree (sq ft)	Basal Area Per Species (sq ft)	Ran
1.		/			
2.		/			
3.		/			
4.		/			
5.		/			
6.		/			
7.		/			
8.		/			
9.		/			
10.		/			

Total Basal Area of All Species Combined __________
50% X Total Basal Area of All Species Combined __________

****

SAPLINGS

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					

Sum of Midpoints __________
50% X Sum of Midpoints __________

****

1. Note: A tree is greater than 10 centimeters (4 inches) diameter breast height (dbh). A sapling is from 1-10 centimeters (0.4-4 inches) dbh.
2. Cover classes (midpoints): T<1% (none); 1=1-5% (3.0); 2=6-15% (10.5); 3=16-25% (20.5); 4=26-50% (38.0); 5=51-75% (63.0); 6=76-95 (85.5); 7=96-100% (98.0).
3. To determine the dominants, first rank the tree species by their basal areas. Then cumulatively sum the basal areas of the ranked tree species until 50% of the total basal area for all tree species is reached or initially exceeded. Do the same for saplings using the sum of midpoints. All species contributing to these cumulative totals should be considered dominants and marked with an asterisk above.
4. Do the dominant trees indicate that the vegetation unit supports hydrophytic vegetation Yes _____ No _____ Inconclusive _____.
5. Do the dominant samplings indicate that the vegetation unit supports hydrophytic vegetation? Yes _____ No _____ Inconclusive _____.
6. Note: Inconclusive should be checked when only facultative (i.e., facultative wetland, straight facultative, and/or facultative upland) species dominate.
7. Comments: ____
____
____

DATA FORM D-4: SOIL/HYDROLOGY DATA FOR DETAILED JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ________________________________ Date: ______________
Project/Site: _______________________ State: ______________ County: ______________
Applicant/Owner: ___________________________ Transect #: ___________ Plot #: ________

****

SOILS

Is the soil on the national or state hydric soils list? Yes _____ No _____
Series/phase: _____________________________ Subgroup: ______________________________
Is the soil a Histosol or is a histic epipedon present? Yes _____ No _____
Is the soil:
Mottled? Yes _____ No _____ Matrix Color: __________ Mottle Color: __________
Gleyed? Yes _____ No _____
Other Indicators ____

1. Note: Soils should be sampled at about 25 centimeters (10 inches) or immediately below the A horizon, whichever comes first. If desired, use the back of the form to diagram or describe the soil profile.
2. Does the sampling indicate that the vegetation unit has hydric soils?
   Yes _____ No _____ Inconclusive ______
3. Rationale: ____
4. Comments: ____

****

HYDROLOGY

1. Is the ground surface inundated? Yes _____ No _____ Depth of water: ___________
2. Is the soil saturated? Yes _____ No _____ Depth of free-standing water: _______
3. List other field evidence of surface inundation of soil saturation ___________
4. Are hydrology indicators present in the vegetation unit?
   Yes _____ No _____ Inconclusive _____
   Note: It may be necessary to rely on supplemental historical data (e.g., soil surveys) during a dry season or drought year as long as a site has not been significantly modified hydrologically since data collection.
   Rationale: ____
5. Comments: ____

DATA FORM D-5: SUMMARY OF DATA
FOR DETAILED JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ________________________________ Date: ______________
Project/Site: ______________________ State: ______________ County: ________________
Applicant/Owner: ___________________________ Transect #: ____________ Plot #: ________

****

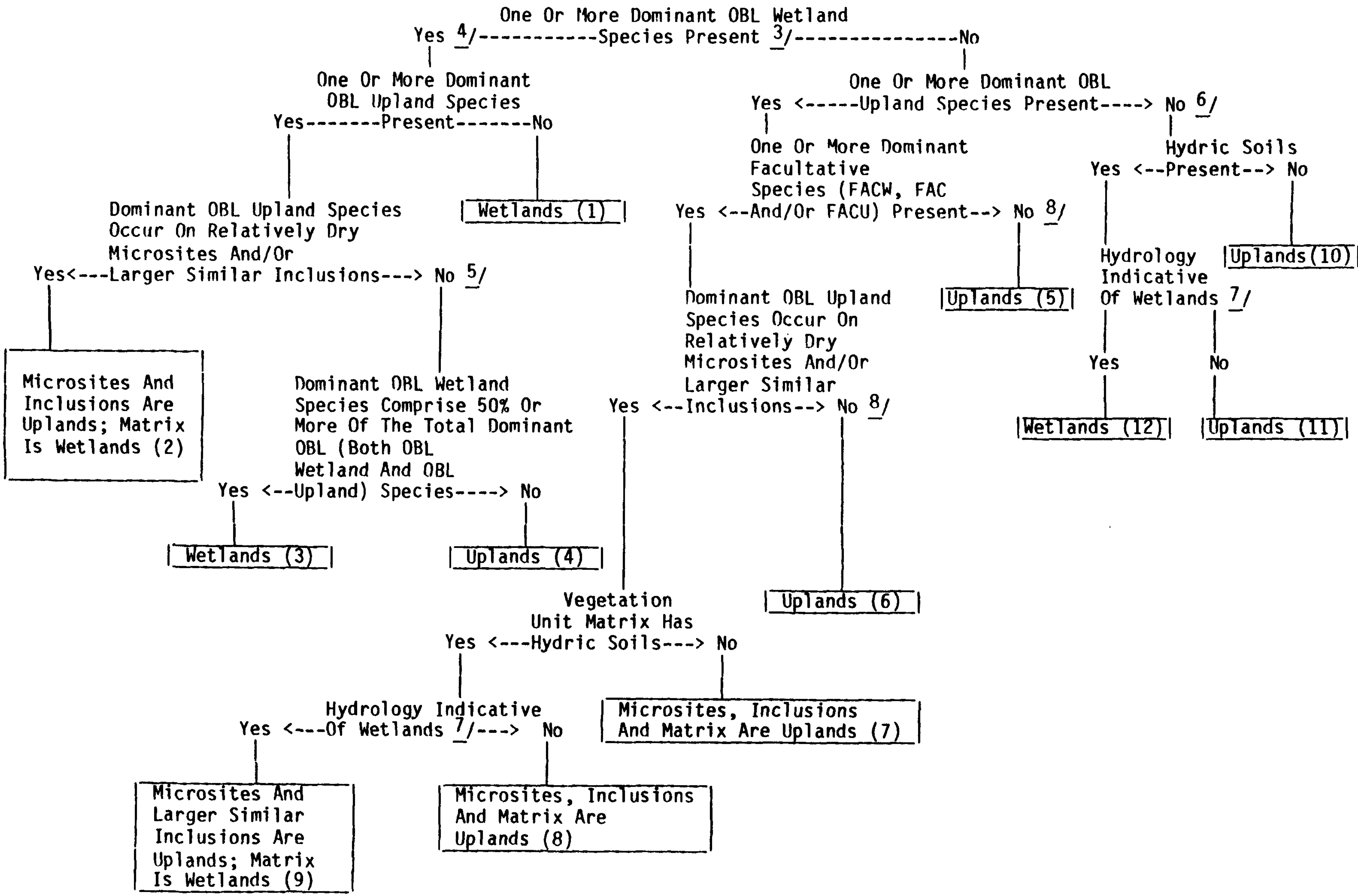
Dominant Species	Indicator Status
1. ____________________	________
2. ____________________	________
3. ____________________	________
4. ____________________	________
5. ____________________	________
6. ____________________	________
7. ____________________	________
8. ____________________	________
9. ____________________	________
10. ____________________	________
11. ____________________	________
12. ____________________	________
13. ____________________	________
14. ____________________	________
15. ____________________	________

****

1. Is hydrophytic vegetation present? Yes _____ No _____ Inconclusive _____
2. Are hydric soils present? Yes _____ No _____ Inconclusive _____
3. Are hydrology indicators present? Yes _____ No _____ Inconclusive _____
4. Overall, is the vegetation unit wetland? Yes _____ No _____ Inconclusive _____
5. Comments: ____
____
____

APPENDIX A: JURISDICTIONAL DECISION FLOW CHART

PART A: DETERMINATIONS IN WHICH ONE OR MORE DOMINANT PLANT SPECIES OCCUR 1/2/



Footnotes For Part A

1/ The methodology presented in this flow diagram relies hierarchically on vegetation, soils and hydrology. As pointed out by the Corps of Engineers (Environmental Laboratory, 1987), there are certain wetland types and/or conditions that may make application of indicators of one or more of the parameters difficult, at least at certain times of the year. This should not be considered atypical. Rather, it is due to normal seasonal or annual variations in environmental conditions that result from causes other than human activities or catastrophic natural events. The Corps gives four examples of this situation (wetlands in drumlins, seasonal wetlands, prairie potholes, and vegetated flats). For example, vegetated flats dominated by annual plants may appear only as unvegetated mudflats during the nongrowing season. Under such circumstances, an indicator of hydrophytic vegetation would not be evident. Likewise, a prairie pothole may not have inundated or saturated soils during most of the growing season in years of below normal precipitation. Thus, a hydrology indicator would be absent. Under these circumstances, a field investigator making a jurisdictional determination must decide whether or not wetland indicators are normally present during a portion of the growing season.

The Corps further points out that atypical situations may also exist in which one or more indicators of hydrophytic vegetation, hydric soils and/or wetland hydrology cannot be found due to the effects of recent human activities or natural events. For example, unauthorized activities such as (1) the alteration or removal of vegetation, (2) the placement of dredged or fill material over a wetland, and (3) the construction of levees, drainage systems, or dams that significantly alter hydrology. Under such circumstances, an investigation of the pre-existing conditions is necessary to determine whether or not a wetland existed prior to the disturbance. Recent natural events (e.g., impoundment of water by beaver) and man-induced conditions (e.g., inadvertent impoundment due to highway construction) may also result in atypical situations that effect wetland vegetation and hydrology in an area which was uplands prior to flooding. However, the area may not yet have developed hydric soil indicators. It is important in the latter two circumstances (i.e., natural events and man-induced conditions) to determine whether or not the alterations to the area have resulted in changes that are now the "normal circumstances." The relative permanence of the change and whether or not the area is now functioning as a wetland must be considered. A site with wetland vegetation and hydrology (other than from irrigation) that has not yet developed hydric soil characteristics due to recent flooding should be considered to have soils that are functioning as hydric soils.

2/ Non-dominant plants may be present as well.

3/ Dominant facultative species (FACW, FAC and/or FACU) may be present as well.

4/ In the presence of one or more dominant obligate wetland species, assume wetland hydrology is present (except for upland microsites and/or larger similar inclusions) unless evidence of disturbance suggests otherwise.

Footnotes for Part A (continued)

5/ This situation (both dominant obligate wetland species and dominant obligate upland species in the same vegetation unit under non-microsite/inclusion circumstances) should only occur in disturbed units, either naturally (e.g., a saltmarsh invading a pine forest due to sea level rise) or unnaturally (e.g., a ditched wetland with wetland obligates dying out and upland obligates invading). When it does occur, a 50% rule should be applied. An alternative to the 50% rule for forested sites would be to examine tree vigor and reproduction (e.g., seedlings and saplings), which may give a good indication of the direction of vegetation change at the unit or site. This alternative may apply to herbaceous sites as well.

6/ Under these circumstances, dominant FACW, FAC, and/or FACU species must be present.

7/ At this point, a field investigator must decide whether or not wetland hydrologic indicators are naturally present. If one or more are present, the vegetation unit is wetlands; if not, the unit is uplands. If the site has been hydrologically disturbed, the significance of the disturbance must be considered in deciding whether or not the unit is still wetlands hydrologically.

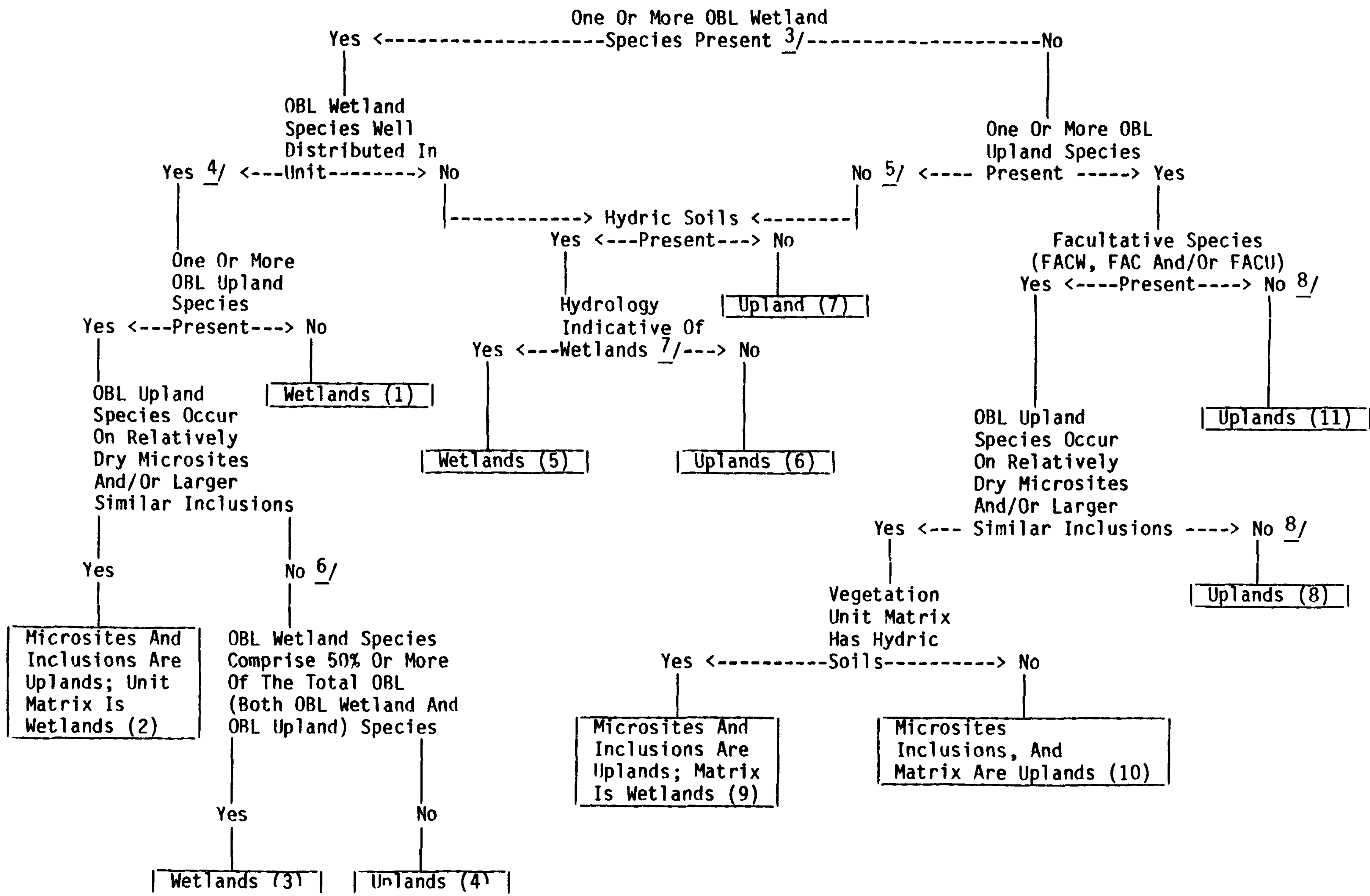
8/ In the presence of one or more dominant obligate upland species, assume upland hydrology is present (except for wetland microsites and/or similar larger inclusions) unless evidence of disturbance suggest otherwise.

Note: (1) - (12) are wetland determination points.

OBL = obligate
FACW = facultative wetland
FAC = straight facultative
FACU = facultative upland

APPENDIX A: JURISDICTIONAL DECISION FLOW CHART

PART B: DETERMINATION IN WHICH ONLY NON-DOMINANT PLANT SPECIES OCCUR 1/2/



Footnotes For Part B

1/ A situation in which no species is dominant will seldom occur. Consequently, this flow chart will not be utilized often.

2/ The methodology presented in this flow diagram relies hierarchically on vegetation, soils and hydrology. As pointed out by the Corps of Engineers (Environmental Laboratory, 1987), there are certain wetland types and/or conditions that may make application of indicators of one or more of the parameters difficult, at least at certain times of the year. This should not be considered atypical. Rather it is due to normal seasonal or annual variations in environmental conditions that result from causes other than human activities or catastrophic natural events. The Corps gives four examples of this situation (wetlands in drumlins, seasonal wetlands, prairie potholes, and vegetated fats). For example, vegetated flats dominated by annual plants may appear only as unvegetated mudflats during the nongrowing season. Under such circumstances, an indicator of hydrophytic vegetation would not be evident. Likewise, a prairie pothole may not have inundated or saturated soils during most of the growing season in years of below normal precipitation. Thus, a hydrology indicator would be absent. Under these circumstances, a field investigator making a jurisdiction determina-ation must decide whether or not wetland indicators are normally present during a portion of the growing season.

The Corps further points out that atypical situations may also exist in which one or more indicators of hydrophytic vegetation, hydric soils and/or wetland hydrology cannot be found due to the effects of recent human activities or natural events. For example, unauthorized activities such as (1) the alteration or removal of vegetation, (2) the placement of dredged or fill material over a wetland, and (3) the construction of levees, drainage systems, or dams that significantly alter hydrology. Under such circumstances, an investigation of the pre-existing conditions is necessary to determine whether or not a wetland existed prior to the disturbance. Recent natural events (e.g., impoundment of water by beaver) and man-induced conditions (e.g., inadvertent impoundment due to highway construction) may also result in atypical situations that effect wetland vegetation and hydrology in an area which was uplands prior to flooding. However, the area may not yet have developed hydric soil indicators. It is important in the latter two circumstances (i.e., natural events and man-induced conditions) to determine whether or not the alterations to the area have resulted in changes that are now the "normal circumstances." The relative permanence of the change and whether or not the area is now functioning as a wetland must be considered. A site with wetland vegetation and hydrology (other than from irrigation) that has not yet developed hydric soil characteristics due to recent flooding should be considered to have soils that are functioning as hydric soils.

3/ Non-dominant OBL upland species and/or non-dominant facultative species (FACW, FAC and/or FACU) may be present as well.

4/ In the presence of one or more non-dominant obligate wetland species that are well-distributed in the unit, assume wetland hydrology is present (except for upland microsites and/or larger similar inclusions) unless evidence of disturbance suggests otherwise.

5/ Under these circumstances, non-dominant FACW, FAC, and/or FACU species must be present.

Footnotes for Part B (continued)

6/ This situation (both obligate wetland species and obligate upland species in the same vegetation unit under non-microsite/inclusion circumstances) should occur rather infrequently and only in disturbed units, either naturally (e.g., a saltmarsh invading a pine forest due to sea level rise) or unnaturally (e.g., a ditched wetland with wetland obligates dying out and upland obligates invading). When it does occur, a 50% rule should be applied. An alternative to the 50% rule for forested sites would be to examine tree vigor or reproduction (e.g., seedlings and saplings), which may give a good indication of the direction of vegetation change at the unit or site. This alternative may apply to herbaceous sites as well.

7/ At this point, a field investigator must decide whether or not wetland hydrologic indicators are naturally present. If one or more are present, the vegetation unit is wetlands; if not, the unit is uplands. If the site has been hydrologically disturbed, the significance of the disturbance must be considered in deciding whether or not the unit is still wetlands hydrologically.

8/ In the presence of one or more non-dominant obligate upland species that are well-distributed in the unit, assume upland hydrology is present (except for wetland microsites and/or similar larger inclusions) unless evidence of disturbance suggests otherwise.

Note: (1) - (11) are wetland determination points.

OBL = obligate
FACW = facultative wetland
FAC = straight facultative
FACU = facultative upland

APPENDIX B: JURISDICTIONAL

DECISION DIAGNOSTIC KEY 1/

1a. Vegetation units are dominated by one or more plant species. Non-dominant species may also be present.

2a. One or more dominant obligate wetland plant species are present in the vegetation unit (or site if it is a monotypic site). Facultative species (facultative wetland, straight facultative and/or facultative upland) may occur as dominants as well.2/

3a. Obligate upland dominants (one or more) are present.

4a. Dominant obligate upland species occur on relatively dry microsites (e.g., live tree bases, decaying tree stumps, mosquito ditch spoil piles, small earth hummocks) and/or on larger similar inclusions occurring in an otherwise topographically uniform unit containing dominant obligate wetland species. Under such circumstances, you should check to see if you correctly horizontally stratified the site and adjust accordingly by either: (a) showing these microsites and inclusions as local UPLANDS in a WETLANDS matrix or by (b) considering the unit to be all WETLANDS, but acknowledging the presence of the local UPLANDS in a written description of the site.(1)3/

4b. Dominant obligate upland species do not occur on relatively dry microsites and/or larger similar inclusions; they occur rather uniformly intermixed with the dominant obligate wetland species. Under such circumstances, the unit and/or site is probably significantly hydrologically disturbed (naturally or by man) and successional vegetation changes are occurring.4/

5a. 50% or more of the total dominant obligate species (both obligate wetland species and obligate upland species) are obligate wetland species....................WETLANDS (2)

5b. Less than 50% of the total dominant obligate species are obligate wetland species.....................UPLANDS (3)

3b. Obligate upland dominants are not present.............WETLANDS (4)

2b. One or more dominant obligate wetland plant species are not present in the vegetation unit (or site if it is a monotypic site). Facultative species (facultative wetland, straight facultative and/or facultative upland) may occur as dominants as well.

6a. Obligate upland dominants (one or more) are present.

7a. One or more dominant facultative species (facultative wetland, straight facultative and/or facultative upland) are present.

8a. Dominant obligate upland species occur on relatively dry microsites and/or larger similar inclusions. Under such circumstances, you should check to see if you correctly horizontally stratified the site and determine whether the vegetation unit matrix (the area dominated by the facultative species in this instance) is wetlands by examining soils.7/

9a. Vegetation unit matrix has hydric soils.

10a. Hydrology of vegetation unit matrix is indicative of wetlands.........Microsites and inclusions are UPLANDS; matrix is WETLANDS (5).5/

10b. Hydrology of vegetation unit matrix is not indicative of wetlands....Microsites, inclusions and matrix are UPLANDS (6).

9b. Vegetation unit matrix does not have hydric soils...Microsites, inclusions, and matrix are UPLANDS (7).

8b. Dominant obligate upland species do not occur on relatively dry microsites and/or larger similar inclusions.....UPLANDS (8).6/

7b. One or more facultative species are not present......UPLANDS (9).6/

6b. Obligate upland dominants are not present; one or more dominant facultative species (facultative wetland, straight facultative and/or facultative upland) are present.7/

11a. Hydric soils are present

8a. Hydrology is indicative of wetlands......WETLANDS (10).5/

8b. Hydrology is not indicative of wetlands...UPLANDS (11).

11b. Hydric soils are not present......UPLANDS (12).

1b. Vegetation units are not dominated by one or more plant species.8/

12a. One or more obligate wetland species are present.

13a. Obligate wetland species are well-distributed in unit.9/

14a. One or more obligate upland species are present.

15a. Obligate upland species occur on relatively dry microsites and/or larger similar inclusions. Under these circumstances, the microsites and inclusions are UPLANDS and the vegetation unit matrix is WETLANDS (13).

15b. Obligate upland species do not occur on relatively dry microsites and/or larger similar inclusions; they occur rather uniformly intermixed with the obligate wetland species. Under such circumstances, the unit and/or entire site is probably significantly hydrologically disturbed (naturally or by man) and successional changes are occurring.4/

16a. 50% or more of the total obligate species (both obligate upland and obligate wetland) are obligate wetland species.....WETLANDS (14).

16b. Less than 50% of the total obligate species are obligate wetland species...UPLANDS (15).

14b. One or more obligate upland species are not present...WETLANDS (16).

13b. Obligate wetland species are not well-distributed in unit.

17a. Hydric soils are present.

18a. Hydrology is indicative of wetlands......WETLANDS (17).5/

18b. Hydrology is not indicative of wetlands...UPLANDS (18).

17b. Hydric soils are not present...UPLANDS (19).

12b. One or more obligate wetland species are not present.

19a. One or more obligate upland species are present.

20a. Facultative species (facultative wetland, straight facultative and/or facultative upland) are present.

21a. Obligate upland species occur on relatively dry microsites and/or larger similar inclusions.

22a. Vegetation unit matrix has hydric soils...Microsites and inclusions are UPLANDS; matrix is WETLANDS (20).

22b. Vegetation unit matrix does not have hydric soils... ...Microsites, inclusions and matrix are UPLANDS (21).

21b. Obligate upland species do not occur on relatively dry microsites and/or larger similar inclusions......UPLANDS (22).10/

20b. Facultative species are not present.............UPLANDS (23).10/

19b. One or more obligate upland species are not present; one or more facultative species (facultative wetland, straight facultative and/or facultative upland) are present.7/

23a. Hydric soils are present.

24a. Hydrology is indicative of wetlands......WETLANDS (24).5/

24b. Hydrology is not indicative of wetlands...UPLANDS (25).

23b. Hydric soils are not present.....UPLANDS (26).

Footnotes for Key

1/ The methodology presented in this diagnostic key relies hierarchically on vegetation, soils and hydrology. As pointed out by the Corps of Engineers (Environmental Laboratory, 1987), there are certain wetland types and/or conditions that may make application of indicators of one or more of the parameters difficult, at least at certain times of the year. This should not be considered atypical. Rather, it is due to normal seasonal or annual variations in environmental conditions that result from causes other than human activities or catastrophic natural events. The Corps gives four examples of this situation (wetlands in drumlins, seasonal wetlands, prairie potholes, and vegetated flats). For example, vegetated flats dominated by annual plants may appear only as unvegetated mudflats during the nongrowing season. Under such circumstances, an indicator of hydrophytic vegetation would not be evident. Likewise, a prairie pothole may not have inundated or saturated soils during most of the growing season in years of below normal precipitation. Thus, a hydrology indicator would be absent. Under these circumstances, a field investigator making a jurisdictional determination must decide whether or not wetland indicators are normally present during a portion of the growing season.

The Corps further points out that atypical situations may also exist in which one or more indicators of hydrophytic vegetation, hydric soils and/or wetland hydrology cannot be found due to the effects of recent human activities or natural events. For example, unauthorized activities such as (1) the alteration or removal of vegetation, (2) the placement of dredged or fill material over a wetland, and (3) the construction of levees, drainage systems, or dams that significantly alter hydrology. Under such circumstances, an investigation of the preexisting conditions is necessary to determine whether or not a wetland existed prior to the disturbance. Recent natural events (e.g., impoundment of water by beaver) and man-induced conditions (e.g., inadvertent impoundment due to highway construction) may also result in atypical situations that effect wetland vegetation and hydrology in an area which was uplands prior to flooding. However, the area may not yet have developed hydric soil indicators. It is important in the latter two circumstances (i.e., natural events and man-induced conditions) to determine whether or not the alterations to the area have resulted in changes that are now the "normal circumstances." The relative permanence of the change and whether or not the area is now functioning as a wetland must be considered. A site with wetland vegetation and hydrology (other than from irrigation) that has not yet developed hydric soil characteristics due to recent flooding should be considered to have soils that are functioning as hydric soils.

Footnotes for Key (continued)

2/ In the presence of one or more dominant obligate wetland species, assume wetland hydrology is present (except for upland microsites and/or larger similar inclusions) unless evidence of disturbance suggests otherwise.

3/ Numbers in parentheses represent jurisdictional decision points in the key.

4/ Where significant drainage has occurred, soils usually will not be diagnostic either since soil wetness characteristics (e.g., gleying and mottling) generally take many years to respond to hydrologic changes. Therefore, a 50% rule should be applied to the vegetation. An alternative to this 50% rule for forested sites would be to examine tree vigor and reproduction (e.g., seedlings and saplings), which may give a good indication of the direction of vegetation change at the unit or site. This alternative may apply to herbaceous sites as well.

5/ At this point, a field investigator must decide whether or not wetland hydrologic indicators are naturally present. If one or more are present, the vegetation unit is wetlands; if not, the unit is uplands. If the site has been hydrologically disturbed, the significance of the disturbance must be considered in deciding whether or not the unit is still wetlands hydrologically.

6/ In the presence of one or more dominant obligate upland species, assume upland hydrology is present (except for wetland microsites and/or larger, similar inclusions) unless evidence of disturbance suggests otherwise.

7/ Because facultative species are not diagnostic of wetlands or uplands, an examination of soil and hydrologic parameters is necessary to help determine whether the vegetation unit is a wetland.

8/ A situation without one or more dominants will seldom occur. Consequently, this part of the key should seldom be used.

9/ In the presence of one or more non-dominant obligate wetland species that are well-distributed in the vegetation unit, assume wetland hydrology is present (except for upland microsites and/or larger similar inclusions) unless evidence of disturbance suggests otherwise.

10/ In the presence of one or more non-dominant obligate upland species that are well-distributed in the vegetation unit, assume upland hydrology is present (except for wetland microsites and/or larger similar inclusions) unless evidence of disturbance suggests otherwise.

Attachment 6

Major Differences Between

EPA's and the Corps' Wetland

Jurisdictional Manuals

1. Situation involving the depth of the root zone and hydrologic modifications.

   a. Because of information in the Corps' manual on page 38 (visual observation of soil saturation), page 27 (paragraph 38), and page A11 (root zone definition), the Corps seems to be saying that if the water table drops greater than 12 inches below the ground surface, a site does not meet the hydrology criterion. EPA's manual acknowledges that in some instances certain wetland plants (particularly trees) may have significant roots deeper than 12 inches. The EPA manual (page 19, Volume I) reads "For most plant species occurring in wetlands, particularly herbaceous plants, the majority of the roots and rhizomes generally occur within the upper 30 centimeters (12 inches) of soil." The underlined words allow flexibility, acknowledging that some wetland plants have significant roots/rhizomes below 12 inches.

   b. EPA's manual considers secondary plant succession, where feasible, in determining the significance of hydrologic disturbance as opposed to picking an arbitrary depth to water table cutoff (threshold). Actually, the Corps' manual on page 27 would tend to support this to a large extent, but the impression Headquarters has gotten when dealing with the Corps generically and for a specific wetland type more recently is that the 12-inch threshold is fixed in concrete and very inflexible.

2. Determining what constitutes hydrophytic vegetation.

   a. In determining whether hydrophytic vegetation is present, the Corps' manual says that more than 50% of the dominant species must be OBL, FACW or FAC. EPA's manual, on the other hand, acknowledges that on a site-by-site basis a combination of species drier than this (other than having OBL upland dominants) could, in fact, be occurring under wetland hydrologic/soil conditions (i.e., even FACU species can have a relatively high, 1-33%, probability occurrence in wetlands). In other words, EPA's manual allows for soils/hydrology to indicate whether the plants in question (i.e., any combination of facultative dominants) are occurring under inundated or saturated soil conditions rather than arbitrarily ruling out certain combinations via the 50% cutoff (threshold). How often the two approaches will result in different conclusions for the same site remains to be seen. From limited field data, Headquarters has found some differences.

b. As explained on page 23 and elsewhere in their manual, the Corps has a FAC neutral option (disregard all straight facultative species) for deciding whether hydrophytic vegetation is present. EPA's manual does not have this option.

3. Sample protocols.

EPA's vegetation sampling protocol (i.e., sample plot details, etc.) is different from the Corps. This may not necessarily be a problem, however, since there are a number of ways to effectively sample vegetation.

4. Hydrologic indicators.

EPA's manual (page 20, Volume I) considers plant morphological adaptations (e.g., tree buttressing) to be hydrologic indicators in the absence of significant hydrological modifications. The Corps' manual does not.

5. Overall format.

EPA's manual is in two volumes; The Corps' is in one. EPA's intent here is to develop a field tool (the methodology itself) that stands alone in terms of field application with back-up information, rationale, etc. being in a separate volume. However, the Corps' back-up information is much more comprehensive than EPAs. The Corps' manual has two basic jurisdictional approaches: Routine, which has three different levels, and comprehensive. EPA's manual has an analogous simple approach and detailed approach. The Corps' manual also has specific sections on atypical situations and problem areas. These situations are covered in less detail in EPA's manual. EPA's manual has two additional tools (a diagnostic key and a flow chart), both of which were produced to expedite and conceptually guide decisions about jurisdictional decisions for sample plots and vegetation units once the field data have been collected. Either can be used with the same results.

Attachment 7

Site Specific Evaluation Form for

EPA's Wetland Identification and Delineation Manual

(Interim Draft-April 1987) 1/

A. Background Information

1. Site/Project Description

a. Name: ______

b. Location (County & State): ______

c. Date of Site Visit: ______

d Physiographic Setting: ______

e. Wetland Type(s): ______

f. Extent of Disturbance: ______

2. Jurisdictional Approach Utilized (Simple or Detailed): ______

3. Jurisdictional Decision (wetland or upland) ______

4. Duration (time necessary to make determination)

a. Field Time: ______

b. Office Time: ______

B. Overall Effectiveness of the Field Methodology at the Site

1. Was the method effective at the site? If it was not, please explain. ______

C. Specific Items to Evaluate for Each Site

1. Was the sequence of steps in the field methodology appropriate and logical? If not, why wasn't it? ____________________

2. Was the vegetation sampling protocol effective? If not, why wasn't it? ____________________

3. Was the soil sampling protocol effective? If not, why wasn't it? ____________________

4. Was the hydrology sampling protocol effective? If not, why wasn't it? ____________________

5. Were the flow chart and diagnostic key helpful in making the jurisdictional decision? If not why weren't they? Where they problematic in any way? Please explain. ____________________

6. Were there any problems with any of the data forms? Please explain. ____________________

7. Any additional comments: ____________________

1/ Fill out this form for each official or unofficial jurisdictional determination made. Each completed form, along with the appropriate data sheets and any additional comments or recommendations should be sent to Headquarters (Bill Sipple, Office of Wetlands Protection, FTS 382-5066) preferably as soon as possible after a determination has been made and at least no later than February 28, 1988.

Attachment 8

Overall Evaluation Form

for EPA's Wetland Identification

and Delineation Manual

(Interim Draft-April 1987) 1/2/

1. Was the field methodology effective overall? (Please explain the conditions under which it was and/or was not effective).

2. Were there geographical or hydrological settings in which the field methodology did not work well? If so, indicate the circumstances involved.

3. Were there certain wetland types in which the field methodology did not work well? If so, indicate the wetland types and describe the circumstances involved.

4. Did the field methodology work for disturbed sites? If not, please explain why.

5. Were the sequences of steps in the two jurisdictional approaches (simple and detailed) appropriate and logical? If not, please explain.

6. Was the vegetation sampling protocol a problem in specific geographic areas, hydrologic settings or wetland types? If so, please explain. ______

7. Were there any problems with the soil or hydrology protocols in specific geographic areas, hydrologic settings or wetland types? If so, please explain. ______

8. Were the flow chart and diagnostic key helpful in making jurisdictional decisions? If not, please explain. ______

9. Did you encounter any problems with the various data forms? Please explain. ______

10. Other comments on EPA's manual: ______

1/ The purpose of this evaluation form is to obtain an overall evaluation of the manual. Thus, only one form should be filled out by each Region.

2/ If you review or field test the Corps manual, please submit a similar overall evaluation. Pay particular attention to how it differs from EPA's manual (see comparison between the two that was developed by EPA Headquarters). If you have evaluated any of the differences between EPA's and the Corps' manuals, please elaborate on any preferences you may have and why.

WETLAND IDENTIFICATION

AND DELINEATION MANUAL

VOLUME I

RATIONALE, WETLAND PARAMETERS,

[illegible] OVERVIEW OF JURISDICTIONAL APPROACH

UNITED STATES · ENVIRONMENTAL PROTECTION AGENCY

April, 1987

Interim Final

WETLAND IDENTIFICATION
AND DELINEATION MANUAL

VOLUME I

RATIONALE, WETLAND PARAMETERS,
AND OVERVIEW OF JURISDICTIONAL APPROACH

by

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Washington, D.C. 20460

April, 1987
Interim Final

PREFACE

According to Corps of Engineers and Environmental Protection Agency (EPA) regulations (33 CFR Section 328.3 and 40 CFR Section 230.3, respectively), wetlands are ". . . areas that are inundated or saturated with 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." Although this definition has been in effect since 1977, the development of formal guidance for implementing it has been slow, despite the fact that such guidance could help assure regional and national consistency in making wetland jurisdictional determinations. Moreover, a consistent, repeatable operational methodology for determining the presence and boundaries of wetlands as defined under the federal regulations cited above would alleviate some concerns of the regulated public and various private interest groups; it would also substantially reduce interagency disputes over wetland jurisdictional determinations. Therefore, this Wetland Identification and Delineation Manual was developed to address the need for operational jurisdictional guidance.

The basic rationale behind EPA's wetland jurisdictional approach was initially conceived in 1980 with the issuance of interim guidance for identifying wetlands under the 404 program (Environmental Protection Agency, 1980). In 1983 the rationale was expanded and a draft jurisdictional approach was developed consistent with the revised rationale. EPA distributed the 1983 draft rationale and approach to about forty potential peer reviewers. Because the responses were, for the most part, favorable, further revisions were made and a second draft was circulated to about sixty potential peer reviewers in 1984. Individuals receiving the drafts for review were associated with federal, state, and regional governmental agencies, academic institutions, consulting firms, and private environmental organizations; they represented a wide range of wetland technical expertise. The 1984 draft also went through EPA regional review, as well as formal interagency review by the U.S. Fish and Wildlife Service, Corps of Engineers, National Marine Fisheries Service, and Soil Conservation Service. Based upon the 1984 peer review comments, the comments from the federal agencies, and EPA field testing over the last few years in bottomland hardwoods, pocosins, and East Coast marshes and swamps, the document was further developed into this 2-volume Wetland Identification and Delineation Manual. Volume I presents EPA's rationale on wetland jurisdiction, elaborates on the three wetland parameters generally considered when making wetland jurisdictional determinations, and presents an overview of the jurisdictional approaches developed by EPA in Volume II, the Field Methodology. Thus, it lays the foundation for the "simple" and "detailed" jurisdictional approaches presented in Volume II.

This Wetland Identification and Delineation Manual has been approved by EPA as an interim final document to be field tested by EPA regional and headquarters' personnel for a one year period. During this same review period, the Corps of Engineers has agreed to conduct field review of its wetland delineation manual (Environmental Laboratory, 1987). After the respective reviews, both agencies have agreed to meet, consider the comments received, and attempt to merge the two documents into one 404 wetland jurisdictional methodology for use by both agencies.

The author truly appreciates the efforts of the many peer reviewers who commented on one or both of the drafts that preceded this interim final document, including Greg Auble, Barbara Bedford, Virginia Carter, Harold Cassell, Lew Cowardin, Bill Davis, Dave Davis, Doug Davis, Frank Dawson, Mike Gantt, Mike Gilbert, Frank Golet, Dave Hardin, Robin Hart, John Hefner, Wayne Klockner, Bill Kruczynski, Lyndon Lee, Dick Macomber, Ken Metsler, John Organ, Greg Peck, Don Reed, Charlie Rhodes, Charlie Roman, Dana Sanders, Bill Sanville, Hank Sather, Jim Schmid, Joe Shisler, Pat Stuber, Carl Thomas, Doug Thompson, Ralph Tiner, Fred Weinmann, and Bill Wilen. Their many constructive comments and recommendations have been very helpful in refining this document. The author also appreciates the help of EPA's Regional Bottomland Hardwood Wetland Delineation Review Team (Tom Glatzel, Lyndon Lee, Randy Pomponio, Susan Ray, Charlie Rhodes, Bill Sipple, Norm Thomas, and Tom Welborn) in field testing the basic rationale underlying the Field Methodology at a number of bottomland hardwood sites in 1986. The vegetation sampling protocol in the Field Methodology is to a large extent an outgrowth of that effort. Helpful review and administrative guidance was provided by Suzanne Schwartz, John Meagher, and Dave Davis of EPA's Office of Wetlands Protection. Comments and suggestions received during the federal interagency review were also instrumental in further refining the manual. In fact, in addressing the soil and hydrology parameters in this manual, the author relied heavily upon materials already developed by the Corps of Engineers in their wetland delineation manual cited above. Stan Franczak ably handled the huge typing load associated with the interim final, as well as the earlier drafts.

TABLE OF CONTENTS

SECTION I: INTRODUCTION

This volume of the Wetland Identification and Delineation Manual was developed as a companion document to Volume II, the Field Methodology. It presents EPA's rationale on wetland jurisdiction (Section II), elaborates on the three parameters generally considered in making wetland jurisdictional determinations (Section III), and presents an overview of the jurisdictional approaches developed by EPA in Volume II, the Field Methodology (Section IV).

Anyone using the Field Methodology, should first become familiar with Volume I, since it lays the foundation for the jurisdictional approaches presented in Volume II. Thus, Volume I should be thought of, in part, as a prerequisite training document on the use of the Field Methodology. It is particularly important to thoroughly review the glossary in Appendix A, since a good understanding of the terms used in the methodology is imperative.

In utilizing this Field Identification and Delineation Manual, keep in mind that wetland jurisdictional determinations frequently have both technical and administrative components. Sometimes the latter component will play an important role in jurisdictional determinations. For example, because of cyclic hydrologic changes, some isolated wetlands (e.g., prairie potholes) do not have "fixed" boundaries. What vegetation boundary to choose (e.g., that established under high water conditions, low water conditions or average water conditions) is an agency administrative decision beyond the scope of this document. A second administrative decision beyond the scope of this document is a determination as to whether or not an isolated wetland meets the commerce test and is thus a "water of the United States." Therefore, to the extent practicable, this Wetland Identification and Delineation Manual emphasizes the technical aspects of jurisdiction.

SECTION II: RATIONALE

Although the three parameters mentioned in the Corps-EPA regulatory definition of wetlands (vegetation, soils and hydrology) are determinative factors in terms of whether or not a site is a wetland, it does not follow that all three parameters have to be evaluated or measured in every instance in order to determine the presence and boundaries of a wetland. Frequently, vegetation alone, which is a reflection of hydrologic and soil conditions, will suffice. Specifically, in the presence of one or more dominant obligate wetland species and in the absence of significant hydrologic modifications, it can be assumed that soils would, with some exceptions (e.g., where obligate wetland plants have recently become established, but hydric soils have not yet developed), be hydric. In other words, there is generally no need to collect data on soils and hydrology in a vegetation unit dominated by one or more obligate wetland plant species. Likewise, there is generally no need to collect soils and hydrology data for a vegetation unit dominated by one or more obligate upland species. However, if vegetation alone is not diagnostic, such as when only facultative species occur, soils and hydrology must be considered in determining the extent of wetlands and/or uplands at a site.

SECTION III: THE THREE WETLAND PARAMETERS: HYDROPHYTIC VEGETATION, HYDRIC SOILS, AND WETLAND HYDROLOGY

A. Hydrophytic Vegetation

1. Characteristics of Hydrophytic Vegetation

As used in this manual, hydrophyte is a broad term that includes both aquatic plants and wetland plants. Therefore, hydrophytic vegetation includes any macroscopic plant life growing in water or on a substrate that is a least periodically deficient of oxygen as a result of excessive water content. Aquatic habitats are areas, other than wetlands, that generally have shallow or deep water; the shallow water areas sometimes support non-emergent macroscopic hydrophytes (e.g., submerged aquatic, unattached-floating, and attached-floating plant species). "Swamps, marshes, bogs and similar areas" were mentioned in the Corps-EPA wetland regulatory definition (33 CFR Section 328.3 and 40 CFR Section 230.3) as examples of areas commonly considered wetlands and to distinguish them from other waters of the United States, such as aquatic habitats, and uplands. The hydrophytes that usually dominate wetlands as defined in this document are emergent plant species (erect, rooted non-woody species such as the common cattail, Typha latifolia) or woody species, such as the bald cypress (Taxodium distichum). As opposed to submerged species such as water milfoil (Myriophyllum spicatum), unattached-floating species such as duckweed (Lemna minor), and attached-floating species such as water lily (Nymphaea odorata), emergent species may be permanently or temporarily flooded at their bases, but do not tolerate prolonged inundation of the entire plants (or if tolerant, do not flower when submerged). Wetland hydrophytes are usually also vascular plants. Thus, most wetlands are dominated by emergent vascular plant species, which may or may not occur in association with vascular or non-vascular submergent, unattached-floating, and/or attached-floating plant species. When these non-emergent macroscopic hydrophytes do occur interspersed with emergent plants in a vegetation unit, the unit should be considered wetlands if 50% or more of the total percent areal cover is comprised of emergent species. Small areas of bare ground or open water may occur interspersed with wetland vegetation. Under such circumstances, the bare ground (unless it is an upland inclusion) and open water should be considered part of the wetland system.

2. <u>Prevalent Vegetation</u>

The Corps-EPA regulatory definition of wetlands includes the phrase "a prevalence of vegetation." As used in this manual, the term prevalence is considered equivalent to dominance. Thus, the prevalent vegetation is the dominant vegetation. In an ecological sense, a dominant plant species is one that by virtue of its size, number, production, or other activities, exerts a controlling influence on its environment and therefore determines to a large extent what other kinds of organisms are present in the ecosystem (Odum, 1971). In this document, however, dominance strictly refers to the spatial extent of a species because the extent is directly discernible or measurable in the field. Spatially dominant plant species are characteristically the most common species (i.e., those having numerous individuals or a large biomass in comparison to uncommon or rare species). In this sense, a dominant species is either the predominant species (the only species dominating a unit) or a codominant species (when two or more species dominate a unit). In the jurisdictional approaches presented in this <u>Manual</u>, percent areal cover is the standard measure of spatial extent, except for trees in which case basal area is used. <u>Note: Because this Manual relies heavily on vegetation, in its absence (e.g., during the non-growing season, particularly when dealing with annual species, or after clearing or filling) historical data (e.g., aerial photographs) will have to be utilized.</u>

3. <u>Typically Adapted Plants</u>

The words "typically adapted" are also present in the Corps-EPA wetland definition. Something that is typical is normal, usual or common in occurrence (Environmental Laboratory, 1987). An adaptation is a condition of showing fitness for a particular environment, as applied to characteristics of a structure, function, or entire organism (Mayr, 1970). These characteristics make the organism more fit (adapted) for reproduction and/or existence under conditions of its environment. For example, plant species that gain a competitive advantage in saturated soil conditions are typically adapted for such conditions. Various morphological, physiological, and reproductive adaptations for inundation or saturated soil conditions are given in A4b (page 11).

4. Indicators of Hydrophytic Vegetation

There are a number of indicators of the presence of hydrophytic vegetation. Some indicators are diagnostic under natural conditions (i.e., obligate wetland species); others are, for the most part, diagnostic (i.e., morphological, physiological, and reproductive adaptations); still others (i.e., facultative species) are indicative of hydrophytic vegetation in the presence of hydric soils and hydrologic indicators. These indicators of hydrophytic vegetation are elaborated below.

a. Obligate wetland species. The U.S. Fish and Wildlife Service (1986) has prepared a national list and a series of regional lists of plants that occur in wetlands. Some of the species on these lists are obligate wetland species which, under natural conditions, always occur in wetlands. The presence of obligate wetland species, particularly as dominants, in a vegetation unit should be considered diagnostic of wetlands as long as the unit has not been significantly modified hydrologically. Facultative species may be present as well, but obligate upland species can not be present.

The U.S. Fish and Wildlife Service plant lists were developed in cooperation with a national panel and regional panels comprised of personnel from the U.S. Fish and Wildlife Service, Environmental Protection Agency, Corps of Engineers, and Soil Conservation Service. There are three points that should be kept in mind when utilizing the lists.

(1) Because the plant lists were developed for use with the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin, et al, 1979), they include plant species that occur in a number of habitat types that are not considered wetlands under the Corps-EPA regulatory program. However, most of these areas are at least potentially other waters of the United States (e.g., shallow open water, mud flats, and submerged

aquatic beds), which are frequently dominated by macroscopic, non-emergent species (e.g., the various submerged, unattached-floating, and rooted-floating plants) and/or microscopic algae.

(2) Because the plant lists include only vascular plants, alternate taxonomic or ecological reference sources will have to be utilized for determining the indicator status of non-vascular plants (e.g., bryophytes). This will be particularly applicable to bogs and swamps in the Northeast, Pacific Northwest, Alaska, and Hawaii.

(3) It has been suggested by some users of the plant lists that they are too awkward (i.e., they contain too many species, too many uncommon species, too many unfamiliar species). This apparently reflects a misunderstanding of how the lists will likely be used in a jurisdictional sense. The fact that a field investigator may not know all the species on a regional list is irrelevant, since not all the species on a list will occur in a generic wetland type (e.g., a bog) let alone at a given site. Thus, at any one time, the field investigator will be dealing with a small subset of the plants on the list -- a subset determined by the investigator at the site, not the list. The field investigator will then check the dominants found against their indicator status on the list and make the jurisdictional decision. If field investigators find that their level of unfamiliarity with the plants at a given site precludes a scientifically sound and defensible determination, additional expertise should be sought. Furthermore, because there are many wetland types in each region and a determination of all of the dominants for each type has not been made, potential dominants should not be eliminated by rule (i.e., a complete list of species that occur in wetlands will allow for all possibilities).

b. Plants with adaptations for soil saturation and/or inundation.

(1) Plants with morphological adaptations. Plants manifest a number of morphological adaptations to inundation and/or saturated soil conditions such as pneumatophores, buttressed tree trunks, adventitious roots, shallow root systems, floating stems, floating leaves, polymorphic leaves, multiple trunks, hypertrophied lenticels, and inflated leaves, stems or roots. Note: Although a given wetland plant species may have one or more morphological adaptations, in other wetland species they may not be as evident or may even be non-existent.

(2) Plants with physiological adaptations. Although they are not as useful because they cannot be observed in the field, known physiological adaptations, such as the accumulation of malate in the swamp tupelo (*Nyssa sylvatica* var. *biflora*) and increased levels of nitrate reductase in the eastern larch (*Larix laricina*), are associated with inundation and/or soil saturation.

(3) Plants with reproductive adaptations. Many wetland plants have reproductive strategies that allow them to exist and reproduce under inundated or saturated soil conditions. Some can germinate under low oxygen concentrations; other have flood-tolerant seedlings. Many species also manifest prolonged seed viability, remaining dormant until soil moisture conditions are right for germination.

c. Facultative species. Any combination of the three categories of facultative species (i.e., facultative wetland, straight facultative, and/or facultative upland) should be considered indicative of hydrophytic vegetation if the vegetation unit in which they occur has hydric soils and one or more hydrologic indicators are at least periodically present during the growing season. In addition, obligate upland species must either be absent or present only on microsites and/or larger similar inclusions. In other words, facultative species, even as dominants, are not in themselves diagnostic of wetlands or uplands. However, an examination of the soils and hydrology should give an indication as to whether the facultative species are, in fact, occurring under conditions that would require them to be adapted for life in saturated soils. Note: This latter statement may not be applicable to existing wetlands that have been hydrologically disturbed (e.g., ditched). Because of the inherent difficulty in establishing how much the water table in the disturbed wetland would have to drop to no longer be a wetland hydrologically, it may be more appropriate to judge the significance of the hydrologic impact on the vegetation by evaluating the nature and direction of secondary plant succession to determine whether the site still functions, or has the potential to function, as a wetland.

B. Hydric Soils

1. Definition

A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part (Soil Conservation Service, 1987). Such soils usually support hydrophytic plants.

2. Criteria for Hydric Soils

Consistent with the above definition, the Soil Conservation Service (1987) in cooperation with the National Technical Committee for Hydric Soils developed the following hydric soil criteria.

a. All Histosols except Folists, or
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 15 centimeters (0.5 foot) 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) water table at less than 30 centimeters (1.0 foot) from the surface for a significant period (usually a week or more) during the growing season if permeability is equal to or greater than 15 centimeters/hour (6.0 inches/hour) in all layers within 50 centimeters (20 inches), or

      (b) water table at less than 45 centimeters (1.5 feet) from the surface for a significant period (usually a week or more) during the growing season if permeability is less than 15 centimeters/hour (6.0 inches/hour) in any layer within 50 centimeters (20 inches), or

c. Soils that are ponded for long duration 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.

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* For an elaboration of these terms, see Soil Taxonomy (Soil Survey Staff, 1975) or Keys to Soil Taxonomy (Department of Agriculture, 1985).

3. Classification of Hydric Soils

Under the current soil classification system published in Soil Taxonomy (Soil Survey Staff, 1975), there are two broad categories of hydric soils: Organic soils (Histosols) and mineral soils. All organic soils are hydric except for the Folists, which occur mostly in very humid climates from the Tropics to high latitudes. In the United States, Folists are found mainly in Hawaii and Alaska (Soil Survey Staff, 1975). Folists are more or less freely drained Histosols that consist primarily of plant litter that has accumulated over bedrock. Those Histosols that are hydric are commonly known as peats and mucks. Mineral soils, on the other hand, consist predominantly of mineral matter, and contain less than 20% organic matter by weight (Buckman and Brady, 1969). Mineral soils that are hydric are saturated long enough to significantly affect various physical and chemical soil properties. They are usually either gray, mottled immediately below the surface horizon, or have thick, dark-colored surface layers overlying gray or mottled subsurface horizons (Environmental Laboratory, 1987).

4. Indicators of Hydric Soils

Indicators of hydric soils can be placed into two categories: Soil series and phases on the national and state hydric soils lists and field indicators of hydric soils. These indicators are elaborated below.

a. Soil series and phases considered hydric. The Soil Conservation Service (1987) has developed national and state lists of hydric soils in conjunction with the National Technical Committee for Hydric Soils. In practice, it is always best to verify in the field that the soil series or phase listed as hydric has been correctly mapped and that the area in question is not an inclusion of another series or phase that is not hydric. Note: Some mapping units (e.g., tidal marsh) may be hydric but will not be on the list of hydric soils because they do not yet have series names for the area in question. In addition, a hydric soil that has been drained to the extent that it no longer meets the hydric soil criteria in B2 (page 13) is no longer considered hydric.

b. Field evidence of hydric soils.

(1) Organic soils (Histosols). Histosols are organic soils (mostly peats and mucks) that have organic materials in more than half (by volume) the upper 80 centimeters (32 inches), unless the depth to rock or to fragmental materials in less than 80 centimeters, or the bulk density is very low (Soil Survey Staff, 1975). A more detailed definition can be found in Soil Taxonomy (Soil Survey Staff, 1975). Except for Folists, all organic soils are hydric.

(2) Histic epipedons. A histic epipedon is an 8-16 inch (20-40 centimeter) 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% organic matter when no clay is present or a minimum of 30% organic matter when 60% or greater clay is present (Environmental Laboratory, 1987). In general, a histic epipedon is a thin horizon of peat or muck if the sod has not been plowed (Soil Survey Staff, 1975).

(3) Mineral soils with mottling and/or gleying. Soil colors can be very useful indicators of hydric mineral soils. Because of the anaerobic conditions associated with waterlogging, soils generally become chemically reduced and gleyed. With chemical reduction, elements such as iron and manganese change from the oxidized (ferric and manganic) state to the reduced (ferrous and manganous) state. Such changes are manifested in bluish, greenish or grayish colors characteristic of gleying. Gleyed soil conditions can be determined by comparing a soil sample with the gley chart in Munsel Soil Color Charts (Kollmorgen Corporation, 1975). Gleying can occur in both mottled and unmottled soils.

Mineral soils that are periodically saturated for long periods during the growing season also are usually hydric. Under such alternating saturated and unsaturated conditions, mottles commonly develop. Mottles are spots or blotches of different color or shades of color interspersed with the dominant color (Buckman and Brady, 1969). The dominant color is called the soil matrix. Although the soil matrix is usually greater than 50% of a given soil layer, the term soil matrix can refer to a soil layer that has no mottles at all. When the soil matrix in a mottled soil is gleyed, it is considered a hydric soil. When the matrix is not gleyed, it is still considered hydric if it has a chroma of ≤ 2. Likewise, an unmottled gleyed soil is considered hydric, as are unmottled soils that are not gleyed, but have a chroma of ≤ 1. Soil chroma should be determined using the Munsel Soil Color Charts (Kollmorgen Corporation, 1975). Note: Because soil color is generally not a good indicator in sandy soils (e.g., barrier islands), other indicators of hydric soils may have to be used.

(4) Aquic or peraquic moisture regime. The aquic moisture regime is a reducing regime that is virtually free of dissolved oxygen because the soil is saturated by ground water or by water of the capillary fringe (Soil Survey Staff, 1975). The soil is considered saturated if water stands in an unlined borehole at shallow enough depths that the capillary fringe reaches the soil surface except in non-capillary pores. Because dissolved oxygen is removed from ground water by microorganism, root, and soil faunal respiration, it is implicit in the concept of aquic moisture regime that the soil temperature is above biologic zero (5 degrees centigrade) at some time while the soil or soil horizon is saturated (Soil Survey Staff, 1975).

There are also soils (e.g., saltmarsh soils) in which the ground water is always at or very close to the surface. The moisture regimes for these soils is termed peraquic (Soil Survey Staff, 1975). Although soils with peraquic moisture regimes would always be hydric under natural conditions, those with aquic moisture regimes would be hydric only if they meet the hydric soil criteria specified B2 (page 13).

(5) Sulfidic materials. Sulfidic materials accumulate in soils that are permanently saturated, generally with brackish water. Under saturated conditions, the sulfates in water are biologically reduced to sulfides as the soil materials accumulate (Soil Survey Staff, 1975). The presence of sulfidic materials is generally evidenced by the smell of hydrogen sulfide, which has a rotten egg odor.

(6) Iron and manganese concretions. Concretions are local concentrations of chemical compounds (e.g., iron oxide) in the form of a grain or nodule of varying size, shape, hardness, and color (Buckman and Brady, 1969). Iron and manganese concretions are usually black or dark brown and occur as small aggregates near the soil surface. Iron and manganese concretions greater than 2 millimeters (0.08 inches) in diameter that occur within 7.5 centimeters (3.0 inches) of the soil surface are evidence that the soil is saturated for long periods near the surface (Environmental Laboratory, 1987).

(7) Anaerobic soil conditions. Most wetlands manifest at least periodic soil saturation (waterlogging). When saturation is long enough, an anaerobic environment develops, which can result in a highly reduced soil. Under these conditions, ferric iron, the oxidized form of oxygen, is converted to the reduced form, ferrous iron. The presence of reduced iron in the soil can be detected by the use of a colorimetric field test kit.

(8) Other organic materials. In sandy soils (e.g., on barrier islands), organic materials in the soil profile under the conditions described below are considered evidence of hydric soils (Environmental Laboratory, 1987).

(a) High organic matter in the surface horizon. Because prolonged inundation and soil saturation result in anaerobic conditions, organic matter tends to accumulate above or in the surface horizon of sandy soils. The mineral surface layer generally appears darker than the mineral material immediately below it due to organic matter interspersed among or adhearing to sand particles particles. Note: Because organic matter also accumulates on upland soils, in some instances it may be difficult to distinguish a surface organic layer associated with a wetland site from litter and duff associated with an upland site unless the species composition of the organic materials is determined.

(b) Organic pans. As organic matter moves downward through sandy soils, it tends to accumulate and become slightly cemented with aluminum at a point in the soil profile representing the most commonly occurring depth to the water table. This thin layer of hardened organic matter is called an organic pan or spodic horizon.

(c) Dark vertical streaking in subsurface horizons. This is the result of the downward movement of organic materials from the soil surface. When the soil from a vertical streak is rubbed between the fingers, a dark stain will result.

C. Wetland Hydrology

1. Characteristics of Wetland Hydrology

Wetland hydrology is the sum total of wetness characteristics in areas that are inundated or have saturated soils for a sufficient duration to support hydrophytic vegetation (Environmental Laboratory, 1987). This inundation or saturation can come from many sources, such as direct precipitation, surface runoff, ground water, tidal influence, and overland flooding. Thus, if there is anything that all wetlands have in common, they are at least periodically wet (Cowardin, et al, 1979).

2. Hydrologic Indicators

Although the hydrology parameter may at times be quite evident and dramatic in the field (e.g., overbank flooding), more often than not this parameter and its various indicators are usually very difficult to observe. Furthermore, as opposed to the vegetation and soil parameters, which are relatively stable, the hydrology parameter exhibits substantial spatial and temporal variation, making it generally impracticable for delineating wetland boundaries. Rather, hydrologic indicators are most useful in confirming that a site with hydrophytic vegetation and hydric soils still exhibits hydrologic conditions typically associated with such vegetation and soils (i.e., that the vegetation unit has not been significantly hydrologically modified to the extent that it supports only remnant, generally stressed and/or dying, hydrophytic vegetation and drained hydric soils). In other words, whereas hydrologic indicators can sometimes be diagnostic of the presence of wetlands, they are generally either operationally impracticable (in the case of recorded data) or technically inaccurate (in the case of field indicators) for delineating wetland boundaries. In the former case, surveying the wetland boundary is generally too time consuming (even if a given elevation corresponds with the "wetland hydrologic boundary," which is unlikely); in the latter case, it should be obvious that indicators of flooding frequently extend well beyond the wetland boundary. Consequently, in the jurisdictional approaches presented in this Manual, hydrophytic plants and hydric soils are used to spatially bound wetlands. Note: In some instances, however, the successional responses of the vegetation at a known wetland site that has been hydrologically modified (e.g., ditched) may be more useful than a documented hydrologic change, such as an arbitrarily established drop in water table, in determining whether the site is still a wetland.

Hydrologic indicators associated with wetlands fall under two categories: recorded data and field data. These indicators are elaborated below.

a. Recorded data. Recorded data can be obtained from tide gauges, stream gauges, flood predictions, historical data (e.g., aerial photographs and soil surveys), etc. The U.S. Geological Survey and the Corps of Engineers are two good sources of recorded hydrologic data.

b. Field data.

(1) Visual observation of inundation. An obvious hydrologic indicator is inundation (flooding or ponding). Although visual evidence of inundation is most commonly obtained for wetlands along estuaries, rivers, streams, and lakes, inundation can sometimes be observed in wetlands occurring at other geomorphological settings as well, including isolated depressional wetlands.

(2) Visual observation of soil saturation. Evidence of soil saturation can be obtained from examining a soil pit after sufficient time has passed to allow water to drain into the hole. The amount of time required will depend upon the texture of the soil. For example, water will drain more slowly into a soil pit dug in a clayey soil as opposed to a sandy one. In some heavy clay soils, however, water may not rapidly move into the hole even when the soil is saturated. Under these circumstances, it may be necessary to examine the sides of the soil pit for seepage. Note: The depth to saturated soil will always be somewhat higher in the soil profile than the standing water due to the upward movement of water in the capillary zone.

For soil saturation to have a significant impact on the plants in a vegetation unit, it must occur within the major portion of the root zone (Environmental Laboratory, 1987). For most species occurring in wetlands, particularly herbaceous plants, the majority of the roots and rhizomes generally occur within the upper 30 centimeters (12 inches) of soil. Note: When examining for this indicator in the field, both antecedent weather conditions (e.g., the significance recent storms and long-term droughts) and the time of the year should be taken into consideration.

(3) Sediment deposits. Tidal flooding in estuaries and flooding along non-tidal rivers, streams, and lakes frequently results in the deposition of inorganic or organic sediments on live vegetation, debris, and stationary man-made structures. This is frequently manifested as a fine layer of silt. Silt is also sometimes evident at the soil surface on small debris.

(4) Drift lines. Like watermarks and sediment deposits, drift lines are commonly found along rivers, streams and lakes. Debris (e.g., plant parts, sediment, and assorted litter) is frequently left stranded in plants, on man-made structures, and at other obstructions as the flood-waters recede.

(5) Surface scouring. Surface scouring occurs along floodplains where overbank flooding erodes sediments (e.g., at the bases of trees). The absence of leaf litter from the soil surface is also sometimes an indication of surface scouring.

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

(7) Morphological plant adaptations. Many plants have developed morphological adaptations in response to inundation and/or soil saturation (see A4b, page 11). As long as there is no evidence of significant hydrological modifications, these adaptations can be used as hydrologic indicators.

SECTION IV: OVERVIEW OF JURISDICTIONAL APPROACHES

A. General

Prior to making a jurisdictional determination, it is generally necessary to gather preliminary data and scope out the delineation effort. This will allow the field investigator to decide whether the simple or detailed jurisdictional approach presented in Volume II is applicable to the project or site in question. The simple jurisdictional approach is for routine situations wherein a field investigator needs only to traverse the majority of the site and record data from ocular inspection. The detailed jurisdictional approach is generally for large and/or controversial sites or projects; it entails establishing transects and sample plots. In addition to traversing the majority of the site (simple approach) and establishing transects and sample plots (detailed approach), both of these jurisdictional approaches involve a number of specific steps. Four of these steps, which are basic to both approaches, are elaborated below. The entire sequence of steps, including the sampling protocols, are presented in Volume II.

There are a number of ways to effectively sample vegetation. Many procedures will produce essentially the same results and some procedures may be appropriate for certain vegetation types but not for others. The procedure presented in Volume II has been effective in the field, but may have to be adjusted in some instances because of site conditions and the nature of the vegetation. Other information on vegetation sampling is included in books by Barbour, Burk and Pitts (1987), Cain and Castro (1959), Curtis (1971), Daubenmire (1968), Greig-Smith (1983), Mueller-Dombois and Ellenberg (1974), Oosting (1956), and Smith (1974).

B. Basic Steps for Jurisdictional Approaches

1. Horizontal stratification of the site into vegetation units.

Vegetation units (i.e., patches, groupings, or zones of plants that are evident in overall plant cover and which appear distinct from other such units) should be distinguished in the field based upon an examination of vegetation structure and floristic composition. Vegetation units can also be determined through analysis of "vegetation signatures" on aerial photographs as long as a representative number of units are verified by field checking. Once this step is complete, a field investigator should have, either in his/her mind or on a vegetation map, topographic map, or annotated aerial photograph, a good indication of the various vegetation units at the site.

2. Determination of the dominant plant species.

This Manual relies heavily on the presence of dominant plant species. The spatially dominant species in a vegetation unit are characteristically the most common species (i.e., those having numerous individuals or a large biomass in comparison to uncommon or rare species). Percent areal cover is the standard measure of spatial extent and dominance used in this Manual, except for trees in which basal area is assessed. Percent areal cover is an estimate of the area covered by the foliage of a plant species projected onto the ground. Because of species overlap, each species should be treated separately in sampling, and the total areal cover of all species will frequently exceed 100%. Basal area is a measure of dominance in forests expressed as the area of a trunk of a tree at diameter breast height or as the total of such areas for all trees in a given space (Curtis, 1971).

Whether a species is dominant or not in a vegetation unit will depend upon the nature of the vegetation. In a monotypic vegetation type, the species present is clearly predominant and thus the dominant species in this instance. More frequently, however, two or more species will codominate a vegetation unit in which case all of the codominants should be considered dominant species. It is not uncommon to have a number of species dominating a vegetation unit, especially at forested sites where a few species may dominate each vertical stratum. Thus, the percent areal cover or the basal area necessary for a species to be a dominant should be flexible because of the naturally occurring spatial heterogeneity of some vegetation.

The approach taken in this Manual for determining the dominant species in a vegetation unit is an inductive one in which the dominant plants are determined after the data are collected, as opposed to collecting data on only what are considered the dominant plants based upon some a priori threshold. Although vegetation sampling protocols for the simple and detailed approaches vary somewhat, the basic procedure for determining the dominant plants in a vertical stratum can best be explained using the herbaceous stratum of a forested site as an example. Under the detailed approach, this first entails quantifying the average percent areal cover of each herbaceous species. Next, the herbaceous species are ranked according to their average percent areal cover; then the average percent areal cover values for all the herbaceous species are summed. Lastly, the average percent areal cover values of the ranked herbaceous species are cumulatively summed until 50% of the total average percent areal cover values for all herbaceous species is reached or initially exceeded. Any herbaceous species contributing to this 50% threshold are considered dominants. An essentially similar procedure is applied to any shrubs, woody vines, saplings and trees at the forested site. A more detailed explanation of this procedure is given in Volume II. Note: The 50% rule used in this Manual is for determining the dominant species in a vegetation unit. It should not be confused with two other 50% rules that have been suggested for determining what constitutes a "prevalence of vegetation typically adapted for life in saturated soil conditions" and "hydrophytic vegetation." Under the 50% rule for determining a "prevalence of vegetation typically adapted for life in saturated soil conditions," wetland plants must comprise at least 50% of the dominant species within the "plant community" at the site in question. Under the 50% rule for determining "hydrophytic vegetation," greater than 50% of the dominant plant species in a vegetation unit must be obligate wetland species, facultative wetland species, or straight facultative species.

3. Determination of the indicator status of the dominant species in the vegetation unit using the U.S. Fish and Wildlife Service's national or appropriate regional list of plants that occur in wetlands.

Species on the lists are classified either as obligate wetland species or one of the three categories of facultative species (facultative wetland, straight facultative, and facultative upland). Unless there is a good technical reason to believe otherwise for a given species, any vascular plant species not on the lists should be considered an obligate upland species. However, because the national and regional lists are based upon the National List of Scientific Plant Names (Soil Conservation Service, 1982), the scientific names of some species listed may not be readily recognized by a field investigator (i.e., the investigator may be more familiar with a more commonly used taxonomic synonym). It is particularly important for the field investigator to be aware of this since a species may appear to be not on the list and therefore be considered an obligate upland species by the investigator, whereas it may really be on the list under its currently accepted scientific name. A brief check of the synonyms listed in Volume II of the National List of Scientific Plant Names should prevent this problem.

4. Decision on which vegetation units at the site are wetlands and delineation of the wetland boundaries.

The geographical extent of wetlands at a site will coincide with the spatial distribution of the wetland vegetation units. Two tools (a Jurisdictional Decision Flow Chart and a Jurisdictional Decision Diagnostic Key) presented in Volume II will expedite and conceptually guide decisions about jurisdiction for sample plots and vegetation units once the field data have been collected. Two approaches were developed to allow user flexibility, since some field investigators may feel more comfortable using one over the the other; however, they closely track each other and will lead to the same jurisdictional decisions. For example, the flow chart and key both indicate that the presence of dominant obligate plant species, whether obligate wetland or obligate upland, is generally diagnostic in itself. Specifically, if one or more dominant plant species in a vegetation unit is an obligate wetland species, the vegetation unit (and the site if it is a monotypic site) is a wetland and there is no need to consider soils and hydrology, other than to verify that there have been no significant hydrologic modifications. Likewise, the presence of one or more dominant obligate upland plant species is conclusive evidence of the presence of uplands. On the other hand, by definition, the presence of one or more dominant facultative species in a vegetation unit, even the presence of all facultative wetland dominants, is not truly diagnostic despite the fact the latter situation in particular would strongly suggest that the unit is a wetland. Therefore, if only facultative species dominate a vegetation unit, the flow chart and key direct investigators to the soil and hydrologic parameters to help determine whether the vegetation unit is wetland.

In some instances a mix of dominant obligate wetland species and dominant obligate upland species will occur in the same vegetation unit. These exceptions are reflected in the flow chart and key. They are either a consequence of (1) relatively dry microsites and/or larger similar inclusions (which support the upland species), (2) relative wet microsites and/or larger similar inclusions (which support the wetland species), or (3) plant succession resulting from natural or man-induced disturbances (e.g., the landward edge of a tidal marsh that is encroaching on an adjacent upland forest due to sea level and a site that has been drained but at which wetland plant species still persist but upland species are invading, respectively). When a mix of dominant obligate wetland species and dominant obligate upland species occurs, it is necessary to check to see if the site has been appropriately horizonally stratified and to adjust accordingly. If the obligate upland plants occur on dry microsites or similar larger inclusions, it is necessary to either show these local areas as individual upland units or consider the site to be wetlands but acknowledge the presence of local upland areas in a written description of the site. (A comparable procedure should be used for local low areas in an otherwise upland site.) As long as there are definable vegetation units, however, they should be handled individually. The minimum size treatable (i.e., the minimal mapping unit) will depend upon site conditions (e.g., size and access), plant physiognomy, and the tools available (e.g., type and quality of aerial photographs). Nevertheless, every attempt should be made to separately treat small units (i.e., to finely horizontally stratify) in order to segregate any discrete upland units in a wetland matrix (or vice versa) that could otherwise bias a jurisdictional determination.

If there is a rather uniform intermixed distribution of dominant obligate wetland species and dominant obligate upland species (the various subcategories of facultative species may be present too), then the unit is probably a naturally or unnaturally disturbed one where successional changes are occurring. Under these circumstances, either a 50% rule will have to be applied to the obligate species, or as an alternative for forested sites, tree vigor and reproduction (e.g., seedlings and saplings) may give a good indication of the direction of vegetation change at the unit or site. In some instances, the vegetation may be so heterogeneous that nothing appears to dominate. A situation in which no species is dominant will seldom occur, however, if the site has been appropriately horizontally stratified. Nevertheless, this situation is addressed in both the flow chart and the key.

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APPENDIX A

GLOSSARY

APPENDIX A

GLOSSARY

Adaptation--The condition of showing fitness for a particular environment, as applied to characteristics of a structure, function, or entire organism (Mayr, 1970). These characteristics make the organism more fit (adapted) for reproduction and/or existence under the conditions of its environment. Plant species that gain a competitive advantage in saturated soil conditions are typically adapted for such conditions.

Aerobic--A condition in which molecular oxygen is present in the environment.

Anaerobic--A condition in which molecular oxygen is absent from the environment (Soil Conservation Service, 1987). This commonly occurs in wetlands when soils are saturated by water.

Aquatic habitats--Habitats, other than wetlands, that generally have shallow or deep water. The water can be intermittently or permanently present. Shallow water areas sometimes support non-emergent hydrophytes.

Aquic moisture regime--A reducing regime in which the soil is virtually free of dissolved oxygen because it is saturated by ground water or by water of the capillary fringe. Some soils (e.g., salt marshes) are so wet that the ground water is always at or very close to the soil surface and they are considered to have a peraquic moisture regime (Soil Survey Staff, 1975).

Basal area--A measure of dominance in forests expressed as the area of a trunk of a tree at diameter breast height (dbh) or as the total of such areas for all trees in a given space (Curtis, 1971).

Baseline--A line, generally a highway, unimprove road, or some other evident feature, from which transects extend into a site for which a wetland jurisdictional determination is to be made.

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

Capillary zone--The zone of soil essentially saturated with water, in which pores become filled as a result of surface tension (American Society of Agricultural Engineering, 1967).

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 (Environmental Laboratory, 1987).

Cover class--As used in this Manual, a category into which plant species would fit based upon their percent areal cover. The cover classes used (midpoints in parenthesis) are T=<1%(none), 1=1-5%(3.0), 2=6-15%(10.5), 3=16-25%(20.5), 4-26-50%(38.0), 5=51-75%(63.0), 6=76-95%(85.5), and 7=96-100%(98.0).

Diameter breast height (dbh)--The diameter of a tree trunk at 1.37 meters (4.5 feet) above the ground.

Dominant--In a ecological sense, a dominant plant species is one that by virtue of its size, number, production, or other activities, exerts a controlling influence on its environment and therefore determines to a large extent what other kinds of organisms are present in the ecosystem (Odum, 1971). In this document, however, dominance strictly refers to the spatial extent of a species because spatial extent is directly discernible or measurable in the field. In this sense, a dominant species is either the predominant species (i.e., the only species dominating a unit) or a codominant species (i.e., when two or more species dominant a unit). The measures of spatial extent utilized in this Manual (percent areal cover and basal area) are defined elsewhere in the glossary.

Facultative species--Species that can occur both in wetlands and uplands. There are three subcategories of facultative species (facultative wetland, straight facultative, and facultative upland). Under natural conditions, a facultative wetland species is usually (estimated probability of 67-99%) found in wetlands, but is occasionally found in uplands; a straight facultative species has basically a similar likelihood (estimated probability of 34-66%) of occurring in both wetlands and uplands; a facultative upland species is usually (estimated probability of 67-99%) found in uplands, but is occasionally found in wetlands.

Fern allies--A group of non-flowering vascular plants comprised of clubmosses (Lycopodiaceae), small clubmosses (Selaginellaceae), horsetails (Equisetaceae), and quillworts (Isoetaceae).

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 (Soil Conservation Service, 1987).

Flora--A list of plant taxa in a geographic area of any size. This could be a simple list or a more detailed one that includes taxonomic descriptions, diagnostic keys, distribution data, etc. Compare this term with the term "vegetation."

Folist--A more or less freely drained Histosol that consists primarily of plant litter that has accumulated over bedrock (Soil Survey Staff, 1975).

Forbs--Broadleaf herbaceous plants, in contrast to bryophytes, ferns, fern allies, and graminoids.

Frequently flooded--A class of flooding in which flooding is likely to occur often under usual weather conditions (more than 50% change of flooding in any year, or more than 50 times in 100 years) (Soil Conservation Service, 1987).

Graminoids--Grasses (Gramineae) and grasslike plants, such as sedges (Cyperaceae) and rushes (Juncaceae).

Growing season--The portion of the year when soil temperatures are above biologic zero (5 degrees C), as defined in Soil Taxonomy (Soil Survey Staff, 1975). The following growing season months are assumed by the Soil Conservation Service (1987) for each of the soil temperature regimes:

Isohyperthermic:	January-December
Hyperthermic:	February-December
Isothermic:	January-December
Thermic:	February-October
Isomesic:	January-December
Mesic:	March-October
Frigid:	May-September
Cryic:	June-August
Pergelic:	July-August

Habitat--An environment occupied by plants and animals.

Herbaceous plants--Plants without persistent woody stems above the ground. Herbaceous plants are commonly called herbs.

Histic epipedon--An 8-16 inch (20-40 centimeter) 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% organic matter when no clay is present or a minimum of 30% organic matter when 60% or greater clay is present (Environmental Laboratory, 1987). In general, a thin horizon of peat or muck if the soil has not been plowed (Soil Survey Staff, 1975).

Histosol--An order in Soil Taxonomy composed of organic soils (mostly peats and mucks) that have organic materials in well over half the upper 80 centimeters (32 inches) unless the depth to rock or to fragmental materials is less than 80 centimeters (a rare condition), or the bulk density is very low (Soil Survey Staff, 1975).

Horizontal stratification--The division of the vegetation at a site into vegetation units (i.e., various patches, groupings, or zones).

Hydric soil--A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part (Soil Conservation Service, 1987).

Hydrophytes--Large plants (macrophytes), such as aquatic mosses, liverworts, non-microscopic algae and vascular plants, that grow in permanent water or on a substrate that is at least periodically inundated and/or saturated with water.

Hydrophytic vegetation--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.

Inundated--A condition in which a soil is periodically or permanently flooded or ponded by water.

Long duration--A duration class in which inundation for a single event ranges from 7 days to 1 month (Soil Conservation Service, 1987).

Mineral soil--A soil consisting predominantly of, and having its properties determined predominantly by, mineral matter. Mineral soils usually contain less than 20% organic matter by weight (Buckman and Brady, 1969).

Monotypic vegetation--Vegetation that is dominated by only one plant species.

Mottling--Spots or blotches of different color or shades of color interspersed with the dominant color (Buckman and Brady, 1969). The dominant color is called the soil matrix.

Muck--Highly decomposed organic material in which the original plant parts are not recognizable (Buckman and Brady, 1969).

Obligate upland species--Species that, under natural conditions, always occur in uplands (i.e., greater than 99% of the time). The less than 1% is to allow for anomalous wetland occurrences (i.e., occurrences that are the result of man-induced disturbances and transplants).

Obligate wetland species--Species that, under natural conditions, always occur in wetlands (i.e., greater than 99% of time). The less than 1% is to allow for anomalous upland occurrences (i.e., occurrences that are the result of man-induced disturbances and transplants).

Organic pan--A layer (i.e., spodic horizon), usually occurring at 30-75 centimeters (12-30 inches) below the soil surface in coarse-textured soils, in which organic matter and aluminum (with or without iron) accumulated at the point where the top of the water table most often occurs (Environmental Laboratory, 1987).

Peat--The sod layer at and near the surface of a wetland, as well as the deeper, partially decomposed, vegetation into which the sod eventually grades (Sipple, 1985).

Percent areal cover--An estimate of the area covered by the foliage of a plant species projected onto the ground. It is determined independent of other species, and because of species overlap, the total areal cover for all species will frequently exceed 100%, particularly for forested sites.

Periodic--Occurring or recurring at intervals which need not be regular or predictable. Used here in reference to inundation or saturation of a wetland soil.

Permeability--The quality of the soil that enables water to move downward through the profile, measured as the number of inches per hour that water moves downward through the saturated soil (Soil Conservation Service, 1987).

Physiognomy--A term referring to the overall appearance of the vegetation, as opposed to its floristic composition. This is the result of the various life forms (e.g., trees, shrubs, and herbs) and their distribution in each stratum (Kuchler, 1967).

Ponded--A condition in which water stands in a closed depression. The water is removed only by percolation, evaporation, or transpiration (Soil Conservation Service, 1987).

Poorly drained--A condition in which water is removed from the soil so slowly that the soil is saturated periodically during the growing season or remains wet for long periods (Soil Conservation Service, 1987).

Prevalence--This term is equivalent to dominance. Thus, the prevalent vegetation is the dominant vegetation.

Quadrats--Sampling units or plots that may vary in size, shape, number, and arrangement, depending upon the nature of the vegetation and the objectives of the study (Smith, 1974).

Root zone--That part of the soil profile that is or can be occupied by plant roots and rhizomes. For most plant species occurring in wetlands, particularly herbaceous plants, the majority of the roots and rhizomes generally occur within the upper 30 centimeters (12 inches) of soil.

Sapling--A young tree between 1 and 10 centimeters (0.4 and 4 inches) in diameter 1.37 meters (4.5 feet) above the ground surface.

Saturated--A condition in which all voids (pores) between soil particles in the root zone are filled with water to a level at or near the soil surface (maximum water retention capacity). Saturation may be periodic or permanent.

Seedling--A young tree that is smaller than a sapling and generally less than 1 meter (3.28 feet) high.

Shrub--A woody plant that at maturity is usually less than 6.1 meters (20 feet) tall and generally exhibits several erect, spreading or prostrate stems and has a bushy appearance (e.g., smooth alder, Alnus serrulata) (Cowardin, et al, 1979).

Soil--A dynamic natural body on the surface of the earth in which plants grow, composed of mineral and organic materials and living forms. Also the collection of natural bodies occupying parts of the earth's surface that support plants and that have properties due to the integrated effect of climate and living matter acting upon parent material, as conditioned by relief, over periods of time (Buckman and Brady, 1969).

Soil color--A characteristic of soil that has three variables: chroma, hue, and value. The hue notation of a color indicates its relationship to red, yellow, green, blue, and purple; the value notation indicates its lightness; and the chroma notation indicates its strength or departure from a neutral of the same lightness (Kollmorgen Corporation, 1975).

Soil horizon--A layer of soil, approximately parallel to the soil surface, with distinct characteristics produced by soil-forming processes (Buckman and Brady, 1969). For example, the A horizon is the upper-most mineral horizon. It lies at or near the soil surface and is where maximum soil leaching occurs.

Soil matrix--The portion (usually greater than 50%) of a given soil layer that has the dominant color (Environmental Laboratory, 1987).

Soil phase--A subdivision of a soil series based on features such as slope, surface texture, stoniness, and thickness (Soil Conservation Service, 1987).

Soil profile--A verticle section of the soil through all the horizons and extending into the parent material (Buckman and Brady, 1969).

Soil series--A group of soils having horizons similar in differentiating characteristics and arrangements in the soil profile, except for texture of the surface layer (Soil Conservation Service, 1987).

Somewhat poorly drained--A condition in which water is removed slowly enough that the soil is wet for significant periods during the growing season (Soil Conservation Service, 1987).

Species area curve--As used in this Manual, the curve on a graph produced when plotting the cumulative number of plant species found in a series of quadrats against the cumulative number or area of those quadrats. It is used here in the detailed jurisdictional approach to determine the number of quadrats sufficient to adequately survey the herbaceous understory.

Topographic contour--An imaginery line of constant elevation along the ground (Environmental Laboratory, 1987). A contour line is the corresponding line on a topographic map.

Transect--As used in this Manual, a line along which sample plots are established for collecting vegetation, soil, and hydrology data.

Tree--A woody plant that at maturity is usually 6.1 meters (20 feet) or more in height and generally has a single trunk, unbranched to about three feet above the ground, and more or less definite crown (e.g., red maple, Acer rubrum) (Cowardin, et al, 1979). As distinguished from a sapling, a tree is greater than 10 centimeters (4 inches) diameter breast height.

Typical--That which normally, usually or commonly occurs (Environmental Laboratory, 1987).

Under natural conditions--This phrase refers to situations in which plant species occur in the native state at sites "undisturbed" by man as opposed to those species occurring as transplants or on sites significantly disturbed by man's activities (e.g., dredging, filling, draining, and impounding).

Under normal circumstances--This phrase was placed in the regulatory definition of wetlands to respond, for example, to those situations in which an individual has attempted to eliminate permit requirements by destroying the wetland vegetation (e.g., a de-vegetated wetland could normally support wetland vegetation) and those areas that are not wetlands but experience the abnormal presence of wetland vegetation (e.g., marsh spoil piles placed under upland conditions, but temporarily supporting marsh plants due to remnant plant propagules). Under the former situation, an area would still remain a part of the overall wetland system protected by the Section 404 program. Conversely, the abnormal presence of wetland vegetation in a non-wetland area would not be sufficient to include that area within the jurisdiction of the Section 404 program. Legal alterations to the hydrologic regime, as opposed to mere removal of vegetation, may alter "normal circumstances" if they in fact change the nature of a wetland area so that it no longer functions as part of waters of the United States.

Uplands--Areas that, under normal circumstances, support a prevalence of plants that are not typically adapted for life in saturated soil conditions. Uplands include all areas, other than aquatic habitats, that are not wetlands.

Upland-wetland boundary--The line established in jurisdictional determinations that separate wetland areas from adjacent upland areas.

Vegetation--The plant life as it exists on the ground (i.e., the mosaic of plant communities on a landscape) (Kuchler, 1967).

Vegetation signature--A unique spectral reflectance or emission response transmitted or received by a sensor (e.g., the photographic appearance of vegetation units on color film).

Vegetation structure--The division of a plant community into strata and the distribution of the various life forms in each of these strata (Kuchler, 1967).

Vegetation unit--A patch, grouping, or zone of plants evident in overall plant cover which appears distinct from other such units because of the vegetation's structure and floristic composition. A given unit is typically topographically distinct and typically has a rather uniform soil, except possibly for relatively dry microsites in an otherwise wet area (e.g., tree bases, old tree stumps, mosquito ditch spoil piles, and small earth hummocks) or relatively wet microsites in an otherwise dry area (e.g., small depressions).

Very long duration--A duration class in which inundation for a single event is greater than 1 month (Soil Conservation Service, 1987).

Very poorly drained--A condition in which water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season (Soil Conservation Service, 1987).

Water table--The zone of saturation at the highest average depth during the wettest season. It is at least 15 centimeters (6 inches) thick and persists in the soil for more than a few weeks (Soil Conservation Service, 1987).

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 (Environmental Laboratory, 1987).

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

Wetlands--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 (33 CFR Section 328.3 and 40 CFR Section 230.3).

WETLAND IDENTIFICATION AND DELINEATION MANUAL

VOLUME II

FIELD METHODOLOGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

April, 1987

Interim Final

WETLAND IDENTIFICATION

AND DELINEATION MANUAL

VOLUME II

FIELD METHODOLOGY

by

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PREFACE

According to Corps of Engineers and Environmental Protection Agency (EPA) regulations (33 CFR Section 328.3 and 40 CFR Section 230.3, respectively), wetlands are ". . . areas that are inundated or saturated with 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." Although this definition has been in effect since 1977, the development of formal guidance for implementing it has been slow, despite the fact that such guidance could help assure regional and national consistency in making wetland jurisdictional determinations. Moreover, a consistent, repeatable operational methodology for determining the presence and boundaries of wetlands as defined under the federal regulations cited above would alleviate some concerns of the regulated public and various private interest groups; it would also substantially reduce interagency disputes over wetland jurisdictional determinations. Therefore, this Wetland Identification and Delineation Manual was developed to address the need for operational jurisdictional guidance.

The basic rationale behind EPA's wetland jurisdictional approach was initially conceived in 1980 with the issuance of interim guidance for identifying wetlands under the 404 program (Environmental Protection Agency, 1980). In 1983 the rationale was expanded and a draft jurisdictional approach was developed consistent with the revised rationale. EPA distributed the 1983 draft rationale and approach to about forty potential peer reviewers. Because the responses were, for the most part, favorable, further revisions were made and a second draft was circulated to about sixty potential peer reviewers in 1984. Individuals receiving the drafts for review were associated with federal, state, and regional governmental agencies, academic institutions, consulting firms, and private environmental organizations; they represented a wide range of wetland technical expertise. The 1984 draft also went through EPA regional review, as well as formal interagency review by the U.S. Fish and Wildlife Service, Corps of Engineers, National Marine Fisheries Service, and Soil Conservation Service. Based upon the 1984 peer review comments, the comments from the federal agencies, and EPA field testing over the last few years in bottomland hardwoods, pocosins, and East Coast marshes and swamps, the document was further developed into this 2-volume Wetland Identification and Delineation Manual. Volume I presents EPA's rationale on wetland jurisdiction, elaborates on the three wetland parameters generally considered when making wetland jurisdictional determinations, and presents an overview of the jurisdictional approaches developed by EPA in Volume II, the Field Methodology. Thus, it lays the foundation for the "simple" and "detailed" jurisdictional approaches presented in Volume II.

This Wetland Identification and Delineation Manual has been approved by EPA as an interim final document to be field tested by EPA regional and headquarters' personnel for a one year period. During this same review period, the Corps of Engineers has agreed to conduct field review of its wetland delineation manual (Environmental Laboratory, 1987). After the respective reviews, both agencies have agreed to meet, consider the comments received, and attempt to merge the two documents into one 404 wetland jurisdictional methodology for use by both agencies.

The author truly appreciates the efforts of the many peer reviewers who commented on one or both of the drafts that preceded this interim final document, including Greg Auble, Barbara Bedford, Virginia Carter, Harold Cassell, Lew Cowardin, Bill Davis, Dave Davis, Doug Davis, Frank Dawson, Mike Gantt, Mike Gilbert, Frank Golet, Dave Hardin, Robin Hart, John Hefner, Wayne Klockner, Bill Kruczynski, Lyndon Lee, Dick Macomber, Ken Metsler, John Organ, Greg Peck, Don Reed, Charlie Rhodes, Charlie Roman, Dana Sanders, Bill Sanville, Hank Sather, Jim Schmid, Joe Shisler, Pat Stuber, Carl Thomas, Doug Thompson, Ralph Tiner, Fred Weinmann, and Bill Wilen. Their many constructive comments and recommendations have been very helpful in refining this document. The author also appreciates the help of EPA's Regional Bottomland Hardwood Wetland Delineation Review Team (Tom Glatzel, Lyndon Lee, Randy Pomponio, Susan Ray, Charlie Rhodes, Bill Sipple, Norm Thomas, and Tom Welborn) in field testing the basic rationale underlying the Field Methodology at a number of bottomland hardwood sites in 1986. The vegetation sampling protocol in the Field Methodology is to a large extent an outgrowth of that effort. Helpful review and administrative guidance was provided by Suzanne Schwartz, John Meagher, and Dave Davis of EPA's Office of Wetlands Protection. Comments and suggestions received during the federal interagency review were also instrumental in further refining the manual. In fact, in addressing the soil and hydrology parameters in this manual, the author relied heavily upon materials already developed by the Corps of Engineers in their wetland delineation manual cited above. Stan Franczak ably handled the huge typing load associated with the interim final, as well as the earlier drafts.

TABLE OF CONTENTS

SECTION I: INTRODUCTION

This Field Methodology is intended for use by Environmental Protection Agency field personnel in making wetland jurisdictional determinations. It was developed as a separate volume to facilitate its use in the field. The Field Methodology includes four sections and five appendices. Section I is an introduction which indicates the purpose of the document, outlines its contents, and explains its relationship to Volume I (Rationale, Wetland Parameters, and Overview of Jurisdictional Approaches). Section II addresses scoping and preliminary data gathering, two steps that are generally necessary prior to making jurisdictional determinations. A simple approach for making more or less routine jurisdictional determinations is outlined in Section III. A detailed approach for making jurisdictional determinations for large and/or controversial sites or projects is presented in Section IV. Appendix A is a Jurisdictional Decision Flow Chart; Appendix B is a Jurisdictional Decision Diagnostic Key. Both of these appendices are tools that will expedite and conceptually guide decisions about jurisdiction for vegetation units and sample plots once the field data have been collected. They closely track each other and will lead to the same conclusions; one's preference for use will be solely a matter of choice. Some field investigators may find the flow chart easier to use than the key, especially if they have had limited experience using diagnostic keys. Appendices C and D include field data forms for the simple and detailed approaches, respectively. Lists of necessary and optional equipment for both approaches are included in Appendix E.

Volume II should not be utilized in isolation from Volume I. Users should first become very familiar with the rationale, wetland parameters, and overview of the jurisdictional approaches presented in Volume I. It is also very important to thoroughly review the glossary in Volume I, since a good understanding of the terms used in the methodology is imperative. Thus, Volume I should be thought of, in part, as a prerequisite training document on the use of Volume II, in that an understanding of the former will help assure the proper use of the jurisdictional approaches presented in the latter.

SECTION II: SCOPING AND PRELIMINARY DATA GATHERING

A. General

Prior to making a wetland jurisdictional determination, it is generally necessary to gather preliminary data on the site or project and scope out the task. This will allow the field investigator to determine whether the simple or detailed jurisdictional approach is appropriate.

B. Steps for Preliminary Data Gathering and Scoping

1. Obtain and review any aerial photographs, vegetation maps, wetland maps, topographic maps, soil surveys, technical reports, or other pertinent information depicting and/or describing the site.

2. Estimate the size of the site.

3. Determine the site's geomorphological setting (e.g., floodplain, isolated depression, ridge and swale complex) and its habitat or vegetative complexity (i.e., the range of habitat or vegetation types).

4. Determine whether a permit situation or an enforcement situation is involved.

5. If necessary, do a field reconnaissance to complete Steps 2-4.

6. Based upon Steps 1-5, determine whether the simple jurisdictional approach (Section III) or the detailed jurisdictional approach (Section IV) is appropriate. This step assumes that a field investigator is already familiar with the simple and detailed jurisdictional approaches and the types of projects or sites that would generally be applicable to them as described in Sections III A and IV A of this *Field Methodology*.

SECTION III: SIMPLE JURISDICTIONAL APPROACH

A. General

The simple jurisdictional approach is generally applicable to sites or projects that are small in extent (e.g., a narrow fringe marsh along a shoreline or a small depressional wetland) and/or non-controversial in terms of public or private interests, ecological significance, potential jurisdictional challenges, enforcement status, etc. Discretion must be exercised in deciding whether a project is simple, however, since even small sites may be so vegetatively complex to require detailed examination; larger sites may be so uniform to allow for a simple examination. Significantly altered sites and controversial sites, particularly enforcement situations, will generally entail conducting a detailed field examination regardless of size.

The simple jurisdictional approach involves inspecting the majority of the site and making ocular vegetation estimates for the vegetation units as a whole (as opposed to detailed sampling along transects), and when appropriate, examining soil and hydrologic conditions as well. Because fourteen steps are potentially involved in the simple jurisdictional approach, on the surface it appears more complex than it really is. Actually, many jurisdictional determinations can be made without going through all fourteen steps. The simple jurisdictional approach will generally be applied only to smaller sites, which probably will have only one or at most, a few vegetation units. Furthermore, a field investigator will only have to proceed through Step 6 for any vegetation units dominated by one or more obligate plant species, assuming there is no evidence of significant hydrologic modifications. And if a vegetation unit is comprised of only herbaceous plants, which is the situation with most marshes, dominants will have to be determined just for those species. Thus, jurisdictional determinations for small herbaceous wetlands, especially those with dominant obligate wetland species, should be rather easy to conduct.

All sites or projects for which the simple jurisdictional approach is not appropriate, should be examined using the detailed jurisdictional approach (Section IV). Field data forms are included in Appendix C. A list of necessary and optional equipment is given in Appendix E.

B. Steps for Implementing Simple Jurisdictional Approach

1. Decide how the jurisdictional determination will be presented (e.g., ground delineation, delineation on aerial photographs or topographic maps, or written description in a technical report). Proceed to Step 2.

2. Inspect the entire site and horizontally stratify it into different vegetation units either mentally, or on an aerial photograph or a topographic map. Proceed to Step 3.

3. Determine the dominant plant species for each vegetation unit.

   a. Visually estimate the percent areal cover (by species) of the graminoids, forbs, ferns, fern allies, bryophytes, woody seedlings, and non-woody vines in the herbaceous understory and record it on Data Form C-1. This should be done by estimating the area of the vegetation unit covered by the foliage of a given plant species projected onto the ground.

   b. Indicate the cover class into which each herbaceous species falls and its corresponding midpoint. The cover classes (and midpoints) are: T=<1% (none); 1=1-5% (3.0); 2=6-15% (10.5); 3=16-25% (20.5); 4=26-50% (38.0); 5=51-75% (63.0); 6=76-95% (85.5); 7=96-100% (98.0).

   c. Rank the herbaceous species according to midpoints. If two or more species have the same midpoints, use the actual recorded percent areal cover as a tie-breaker. If two or more species have the same midpoints and actual recorded percent areal cover, equally rank them.

   d. Sum the midpoint values of all herbaceous species.

   e. Multiply the total midpoint values by 50%.

   f. Compile the cumulative total of the ranked species in the herbaceous understory until 50% of the sum of the midpoints for all herbaceous species is reached or initially exceeded. All species contributing cover to the cumulative 50% threshold should be considered dominants. If two or more of these species have the same midpoints and actual recorded areal cover, consider them all dominants.

g. Visually estimate the percent areal cover of the shrub species and record it on Data Form C-2. Follow the same procedure used for herbaceous species in Step 3a-f (page 9).

h. Visually estimate the percent areal cover of the woody vines (other than seedlings) independent of the strata in which they occur and record it on Data Form C-2. Follow the same procedure used for herbaceous species in Step 3a-f (page 9).

i. Visually estimate the percent areal cover of the saplings and record it on Data Form C-3. Follow the same procedure used for herbacecous species in Step 3a-f (page 9).

j. Visually estimate the relative basal area of the tree species (exclusive of saplings) and record it on Data Form C-3. This should be done by considering both the size and number of individuals of a tree species and comparing that species to other tree species in the vegetation unit. Note: The total relative basal area for all the species in a vegetation unit will always equal 100%.

k. Rank the trees species by relative basal area.

l. Compile the cumulative sum of the ranked tree species until 50% of the total relative basal area for all tree species is reached or initially exceeded. All species contributing relative basal area to the cumulative 50% threshold should be considered dominants. If the threshold is reached by two or more species with equal relative basal area values, consider them all dominants, along with any higher ranking species. If all the species have equal relative basal area values, consider them all dominants. Proceed to Step 4.

4. Determine the indicator status of the dominant plant species in each vegetation unit using the appropriate regional list of plants that occur in wetlands. Proceed to Step 5.

5. Determine whether the vegetation units have been hydrologically modified (e.g., whether a vegetation unit with dominant obligate wetland species has been ditched or a vegetation unit with dominant obligate upland species has been impounded).

a. In the presence of one or more dominant obligate wetland species or one or more dominant obligate upland species in a vegetation unit, and in the absence of hydrological modifications, a jurisdictional determination can be made without further consideration of hydrology. If hydrological modifications are evident, however, the significance of these modifications must be determined before making the jurisdictional determination. Proceed to Step 6.

b. In the presence of only dominant facultative species (i.e., facultative wetland, straight facultative, and/or facultative upland) in a vegetation unit, proceed to step 7.

c. If both situations exist at a site, steps 6 and 7 must be completed.

6. Using the data summary sheets (Data Form C-5) and either the Jurisdictional Decision Flow Chart (Appendix A) or the Jurisdictional Decision Diagnostic Key (Appendix B), decide whether the vegetation units supporting one or more dominant obligate wetland species or one or more dominant obligate upland species, are wetland units. Note: In a situation involving multiple vertical strata in which the only dominants in a given stratum occur sparsely because the total percent areal cover for that stratum is low, more weight should be given to the dominants in any strata that have substantially greater overall percent areal cover. For example, if a vegetation unit in a herbaceous wetland (e.g., a marsh) has one shrub species represented by a few scattered individuals, the shrub species would be considered the dominant shrub species present and thus a dominant under this methodology. However, that shrub species should be given relatively little weight in comparison with the dominant herbaceous species, which are obviously more abundant overall. This can be particularly significant if the shrub species is either an obligate wetland species or an obligate upland species and its indicator status is inconsistent with the indicator status of the herbaceous species that are more abundant overall (i.e., both obligate wetland species and obligate upland species occur as dominants in the same vegetation unit). This situation would usually result from anomalous conditions (e.g., man-induced disturbance), natural disturbance, or the presence of microsites. Proceed to Step 14.

7. If the dominant plant species in any vegetation units are all facultative (i.e., facultative wetland, straight facultative, and/or facultative upland), examine the soils and hydrology as indicated in Steps 8-13.

8. Check the appropriate county soil survey to determine the soil series or phases for the vegetation units containing only facultative species. Proceed to Step 9.

9. Check the national list of hydric soils or the pertinent state hydric soils list to determine whether the soil series or phases for the vegetation units are considered hydric. Proceed to Step 10.

10. Dig soil pits in the vegetation units and examine the soil profiles to confirm whether they fit the soil series or phase descriptions in the soil survey. This is necessary due to the possibility of inclusions of other soil series or phases and to check for possible mapping errors. Also some mapping units may be hydric (e.g., tidal marsh) but will not be on the list of hydric soils because they do not yet have series names for the area in question. Proceed to Step 11.

11. Determine whether field indicators of hydric soil conditions exist in the vegetation units and record them on Data Form C-4. The presence of one or more of the following indicators is indicative of the presence of hydric soils. Note: The soil examination can be terminated when a hydric soil indicator is encountered.

    a. Organic soils (Histosols) or mineral soils with a histic epipedon.

    b. Gleying or mottling with a soil matrix chroma of ≤ 2 in mineral soils. Using Munsel Soil Color Charts, record the soil matrix color and mottle color (i.e., the hue, value, and chroma) of a soil sample by matching the sample with the appropriate color chips. Note: The soil should be moistened if it is dry when examined. For example, a soil sample with a hue of 10YR, a value of 6, and a chroma of 2 would be recorded as 10YR6/2. Also determine whether the soil is gleyed by matching the soil sample with the color chips on the gley page of Munsel Soil Color Charts. These samples should be taken at approximately a 25 centimeter (10 inch) depth, or immediately below the A horizon, whichever is higher in the soil profile. Apply the following diagnostic soil key to confirm whether the colors in the soil matrix are indicative of hydric soil conditions:

<u>1a</u>. Soil is mottled:

<u>2a</u>. Matrix is gleyed............................hydric.

<u>2b</u>. Matrix is <u>not</u> gleyed:

<u>3a</u>. Chroma of matrix is $\leq$ 2................hydric.

<u>3b</u>. Chroma of matrix is > 2............<u>not</u> hydric.

<u>1b</u>. Soil is not mottled:

<u>4a</u>. Matrix is gleyed............................hydric.

<u>4b</u>. Matrix is <u>not</u> gleyed and chroma is $\leq$ 1.......hydric.

<u>4c</u>. Matrix is <u>not</u> gleyed and chroma is > 1...<u>not</u> hydric.

Because of their high organic content, some mineral soils (e.g., Mollisols) may not meet these hydric criteria. However, in such dark (black) soils, the presence of gray mottles within 25 centimeters (10 inches) of soil surface is considered indicative of hydric conditions. For the most part in the United States, Mollisols are mainly the dark colored, base-rich soils of the Prairie Region. Because of the color of the parent material (e.g. the red soils of the Red River Valley) some soils will not meet any of these color characteristics. Soil color is also generally not a good indicator in sandy soils (e.g., barrier islands). When problematic parent materials or sandy soils are encountered, hydric soil indicators other than color may have to be relied on in the field.

c. <u>Sulfidic materials</u>. The smell of hydrogen sulfide (rotten egg odor) is indicative of the presence of sulfidic materials. Hydrogen sulfide forms under extreme reducing conditions associated with prolonged soil saturation or inundation.

d. <u>Iron or manganese concretions</u>. These are usually black or dark brown and occur as small aggregates near the soil surface.

e. <u>Ferrous iron</u>. This is chemically reduced iron, the presence of which can be determined using a colorimetric field test kit.

f. <u>Other organic materials</u>. In sandy soils (e.g., on barrier islands) look for any of the indicators listed below.

(1) A layer of organic matter above the mineral surface or high organic matter content in the surface horizon. The mineral surface layer generally appears darker than the mineral

material immediately below it due to organic matter interspersed among or adhering to sand particles. Note: Because organic matter also accumulates in upland soils, in some instances it may be difficult to distinguish a surface organic layer associated with a wetland site from litter and duff associated with an upland site unless the plant species composition of the organic material is determined.

(2) A thin organic layer of hardened soil (i.e., an organic pan or spodic horizon) at 30-75 centimeter (12-30 inch) depths.

(3) Dark vertical streaking in subsurface horizons due to the downward movement of organic materials from the surface. When the soil from a vertical streak is rubbed between the fingers, a dark stain will result.

Proceed to Step 12.

12. Make hydrologic observations in the vegetation units and record them on Data Form C-4.

a. Record any evidence of surface inundation, such as drift lines, water marks, sediment deposition, standing water, surface scouring, drainage patterns, etc.

b. After sufficient time has passed to allow water to drain into the soil pit dug in Step 10, examine the pit for evidence of standing water. Note: Because of the capillary zone, the soil will be saturated higher in the soil profile than the depth of standing water in the soil pit.

c. Record any plant species that have morphological adaptations (e.g., buttressed tree bases and adventitious roots) to saturated soil conditions or surface inundation.

d. When necessary, additional information on hydrology should be obtained from recorded sources, such as stream gauge data, tide gauge data, flood predictions, soil surveys, and the national or state lists of hydric soils.

Note: It is not necessary to directly demonstrate that wetland hydrology is present. It is only necessary to show that the soil or its surface are at least periodically saturated or inundated, respectively. Specifically, with a vegetation unit dominated by one or more dominant obligate wetland plant species, it is necessary to show either (1) that there have been no significant hydrologic modifications or (2) that there is one or more hydrologic indicators at least periodically present during the growing season. With a vegetation unit dominated by only facultative species (i.e., facultative wetland, straight facultative, and/or facultative upland) occurring on a hydric soil, it is necessary to demonstrate that there is one or more hydrologic indicators at least periodically present during the growing season. Indicators of surface inundation and the presence of saturated soils in the major portion of the root zone are considered hydrology indicators. Plant morphological adaptations are also considered hydrology indicators, unless the vegetation unit has been significantly altered hydrologically. Other hydrology indicators include the various recorded sources listed in Step 12d (page 14). Proceed to Step 13.

13. Using the data summary sheets (Data Form C-5) and either the Jurisdictional Decision Flow Chart (Appendix A) or the Jurisdictional Decision Diagnostic Key (Appendix B), decide whether the vegetation units dominated by facultative species (i.e., facultative wetland, straight facultative and/or facultative upland) are wetland units. See the note in Step 6 (page 11) and proceed to Step 14.

14. Indicate the extent of wetlands at the site either on a topographic map or aerial photograph, in a written description, or by a ground delineation (or any combination of the above). The geographic extent of wetlands at the site will coincide with the distribution of the various wetland vegetation units determined in Steps 6 and/or 13, as applicable. Therefore, any upland-wetland boundaries at the site will coincide with the boundaries between the upland vegetation units and the wetland vegetation units that are present.

SECTION IV: DETAILED JURISDICTIONAL APPROACH

A. General

The detailed jurisdictional approach is generally applicable to sites or projects that are large (e.g., an extensive riverine bottomland hardwood tract or a large depressional wetland) and/or controversial in terms of public or private interests, ecological significance, potential jurisdictional challenges, enforcement status, etc. In some instances, the detailed jurisdictional approach might also be appropriate for smaller sites or projects, especially those with complex vegetation. Likewise, significantly altered sites, as well as enforcement situations, will generally entail conducting a detailed field examination regardless of size. Under some circumstances, such as enforcement cases involving filled wetlands, it may be necessary to rely on alternative approaches. One option is photointerpretation of vegetation units on pre-project aerial photographs; another is peat analysis (Sipple, 1985; see Section V of Volume I for full citation).

The detailed jurisdictional approach involves standard quantitative vegetation sampling along transects and frequently an examination of the soils and hydrology as well. Field data forms are included in Appendix D. A list of necessary and optional equipment is given in Appendix E.

B. Steps for Implementing Detailed Jurisdictional Approach

1. Decide how the jurisdictional determination will be presented (e.g., ground delineation, delineation on aerial photographs or topographic maps, written description in a technical report). Proceed to Step 2.

2. If a reconnaissance survey was not done in the preliminary data gathering and scoping effort, it generally should be done here. Proceed to Step 3.

3. Horizontally stratify the site into different vegetation units. The approach used to stratify the site will be contingent upon how the jurisdictional determination will be presented. If the determination is to be presented using aerial photographs, then vegetation units should be tentatively delineated directly on the photographs or on photographic overlays prior to going into the field. These vegetation units should then be refined as appropriate in the field. If a ground delineation is planned, vegetation units can also be shown on aerial photographs or topographic maps, but the upland-wetland boundary will also have to be delineated on the ground using stakes or flagging tape. Proceed to Step 4.

4. Establish a baseline or baselines from which transects will extend into the site. A baseline might be the boundary of the site, a highway or unimproved road, or some other evident lineal feature. It should extend more or less parallel to any major watercourse at the site and/or perpendicular to the topographic gradient. Delineate the baseline on an aerial photograph or a topographic map and record its length and compass heading. Proceed to Step 5.

5. Establish transect locations. The number of transects necessary to adequately characterize a site will vary with the size of the site and the complexity of the vegetation. It is generally best to divide the baseline into segments (e.g., 100 foot, 500 foot, or 1000 foot intervals depending on the size of the site) and randomly select a point within each segment to begin a transect. Be sure, however, that each vegetation unit is included within at least one transect. Proceed to Step 6.

6. Establish each transect along a compass heading perpendicular to the baseline. Transects should extend far enough into the site to adequately characterize all of the vegetation units along the heading.

7. Following the compass heading, walk each transect to a point at which all of the vegetation units along the transect have been encountered. Frequently, this will be to the river or stream if the site is a floodplain. In the process, make any necessary adjustments to the tentatively delineated vegetation units or establish such units if they were not delineated in Step 3. Also record the length of the transects by either pacing or measuring. If aerial photographs or topographic maps are used, delineate the transects on them. Proceed to Step 8.

8. After a transect has been established and walked to its terminus, it should be traversed again in the opposite direction to do the quantitative sampling. The number of sample plots necessary will depend upon the length of the transect and the complexity of the vegetation. At least one 0.1 acre (0.04 hectare) circular sample plot should be established in each vegetation unit along a transect. Additional sample plots should be established within the unit at 91.5 meters (300 foot) intervals or sooner if a different vegetation unit is encountered. With exceptionally large vegetation units, however, a sampling interval larger than 91.5 meters may be more appropriate. Thus, a field investigator should exercise discretion in establishing sampling intervals. Sample plots should be shown on either the aerial photographs or topographic maps, or their distances from the baseline should be recorded in the absence of photographs or maps. Proceed to Step 9.

9. Select a point along the transect in the ultimate vegetation unit to center the first 0.1 acre sample plot. Flag the center of the plot and the four cardinal compass points of the perimeter of the circular plot. This will divide the plot into four quadrants, and the plot will have a 10.9 meter (35.8 foot) radius. Proceed to Step 10.

10. Determine the dominant plant species for the sample plot. There are a number of ways to effectively sample vegetation. Many procedures will produce essentially the same results and some procedures may be appropriate for certain vegetation types but not for others. The following procedure has proven effective in the field, but may have to be adjusted as appropriate depending upon site conditions and the nature of the vegetation.

    a. Randomly toss two $0.1m^2$ quadrat frames into the herbaceous understory of each quadrant of the 0.1 acre plot. On Data Form D-1, record the percent areal cover of each plant species (graminoids, forbs, ferns, fern allies, bryophytes, woody seedlings, and herbaceous vines) occurring soley within or extending into each quadrat frame when viewed from directly above it.

    b. Construct a species area curve to determine whether the eight $0.1m^2$ quadrats are sufficient to adequately survey the herbaceous understory. The number of quadrats necessary will correspond to the point on the curve where it first levels off (and remains essentially level), indicating that the quadrats after that point added few if any additional species. If eight $0.1m^2$ quadrats are not sufficient, do additional quadrats in increments of four (one in each quadrant) until the necessary number of quadrats is reached.

    c. For each species, sum the percent areal cover for all $0.1m^2$ quadrats and divide the total by the total number of quadrats sampled, which will give an average percent areal cover by species.

    d. Rank the species in the herbaceous understory by average percent areal cover. If two or more species have the same average percent areal cover, equally rank them.

    e. Sum the average percent areal cover for all the species in the herbaceous understory.

    f. Multiply the total average percent areal cover by 50%.

    g. Compile the cumulative sum of the ranked species in the herbaceous understory until 50% of the total average percent areal cover for all species is reached or initially exceeded. All species contributing cover to the cumulative 50% threshold should be considered dominants. If the threshold is reached by two or more species with equal average percent areal cover values, consider them all dominants, along with any higher ranking species. If all species have equal average percent areal cover values, consider them all dominants.

h. Determine the percent areal cover of the shrubs within the entire 0.1 acre sample plot and record the data on Data Form D-2. This should be done by traversing the plot a number of times, listing the shrub species present, and estimating the percent areal cover by shrub species for the entire plot.

i. Indicate the cover class into which each shrub species falls and its corresponding midpoint.

j. Rank the shrub species according to midpoints. If two or more species have the same midpoints, use the actual recorded percent areal cover as the tie-breaker. If two or more species have the same midpoints and actual recorded percent areal cover, equally rank them.

k. Sum the midpoint values of all shrub species.

l. Multiply the total midpoint values by 50%.

m. Compile the cumulative total of the ranked shrub species until 50% of the sum of the midpoints for all shrub species is reached or initially exceeded. All species contributing cover to the cumulative 50% threshold should be considered dominants. If two or more of these species have the same midpoints and actual recorded areal cover, consider them all dominants.

n. Determine the percent areal cover of the woody vine species (other than seedlings) within the entire 0.1 acre sample plot and record the data on Data Form D-2. This should be done by traversing the plot a number of times, listing the woody vine species present, and estimating the percent areal cover by species for the entire plot independent of the strata in which they occur. Follow the same procedure used for shrubs in Step 10i-m (page 19).

o. Determine the percent areal cover of the saplings with the entire 0.1 acre sample plot and record the data on Data Form D-3. This should be done by traversing the plot a number of times, listing the sapling species present, and estimating the percent areal cover by species for the entire plot. Follow the same procedure used for shrubs in Step 10i-m (page 19).

p. Determine the basal area of the trees (exclusive of saplings) using the point sampling (Bitterlich) system (Avery, 1967; Dillworth & Bell, 1978) and record the data on Data Form D-3. Since the Bitterlich system is a plotless method, both trees within and beyond the 0.1 acre plot should be tallied. This should be done using either a prism or an angle gauge. Note: An alternative plotless method for sampling trees is the point quarter method.

(1) Hold the prism or angle gauge directly over the center of the 0.1 acre plot and record all individual trees by species "sighted in" according to the prism or angle gauge while rotating 360 degrees in one direction. In the process, also measure the basal area of each individual tree using a basal area tape. If a basal area tape is not available, determine the diameter of each individual tree with a diameter tape and compute its basal area by the formula $A = \frac{\pi d^2}{4}$.

(2) Sum the individual tree basal areas by species.

(3) Rank the tree species by their basal areas.

(4) Sum the basal areas of all tree species.

(5) Multiply the summed (total) basal area by 50%.

(6) Compile the cumulative sum of the ranked tree species until 50% of the total basal area for all tree species is reached or initially exceeded. All species contributing cover to the cumulative 50% threshold should be considered dominants. If the threshold is reached by two or more species with equal basal area values, consider them all dominants, along with any higher ranking species. If all species have equal basal area values, consider them all dominants. If it is felt that a representative sample of the trees has not been obtained by the one Bitterlich tally, additional tallies should be obtained by offsetting perpendicularly from the center point of the plot in alternate directions and taking additional tallies. Otherwise, proceed to step 11.

11. Determine the indicator status of the dominant plant species in the vegetation unit using the appropriate regional list of plants that occur in wetlands. Proceed to Step 12.

12. Determine whether the vegetation unit has been hydrologically modified (e.g., whether a vegetation unit with dominant obligate wetland plants has been ditched or a vegetation unit with dominant obligate upland plants has been impounded).

    a. In the presence of one or more dominant obligate wetland species or one or more dominant obligate upland species in a vegetation unit and in the absence of hydrological modifications, a jurisdictional determination can be made without further consideration of hydrology. If hydrological modifications are evident, the significance of these modifications must be determined before making the jurisdictional determination. Proceed to Step 13.

    b. In the presence of only dominant facultative species (i.e., facultative wetland, straight facultative, and/or facultative upland) in a vegetation unit, proceed to step 14.

    c. If both situations exist at the site, steps 13 <u>and</u> 14 must be completed.

13. Using the sample plot data summary sheet (Data Form D-5) and either the Jurisdictional Decision Flow Chart (Appendix A) or the Jurisdictional Decision Diagnostic Key (Appendix B), decide whether the vegetation unit supporting one or more dominant obligate wetland or one or more dominant obligate upland species, is a wetland unit. <u>Note</u>: <u>In a multiple-strata setting in which the only dominants in a given stratum occur sparsely in the sample plot because the total percent area cover for that stratum in that plot is low, more weight should be given to the dominants in any strata that have substantially greater overall percent areal cover in the sample plot.</u> For example, if a sample plot in a herbaceous wetland (e.g., a marsh) has one shrub species represented by a few scattered individuals, the shrub species would be considered the dominant shrub species present and thus a dominant under this methodology. However, it should be given relatively little weight in comparison with the dominant herbaceous species, which are obviously more abundant overall. This can be particularly significant if the shrub species is either an obligate wetland species or an obligate upland species and its indicator status is inconsistent with the indicator status of the herbaceous species that are more abundant overall (i.e., both obligate wetland

species and obligate upland species occur as dominants in the same plot). This situation would usually result from anomalous conditions (e.g., man-induced disturbance) or the presence of microsites. A second potential sampling problem may also occur. If a single large tree is recorded in a sample plot, it may be determined to be dominant for that plot under this methodology. Similarly to the example above, this species may have an indicator status that is inconsistent with the dominants in the other strata. Thus, when this situation is encountered, it is important to determine whether the individual tree is occurring under either anomalous conditions or on a microsite; in either case, it should be given relatively little weight in comparison with any overall more abundant species in the vegetation unit. Proceed to Step 21.

14. If the dominant plant species in the vegetation unit are all facultative (i.e., facultative wetland, straight facultative, and/or facultative upland), examine the soils and hydrology as indicated in Steps 15-19.

15. Check the appropriate county soil survey to determine the soil series or phases for the vegetation unit containing only facultative species. Proceed to Step 16.

16. Check the national list of hydric soils or the pertinent state hydric soils list to determine whether the soil series or phases for the vegetation unit are considered hydric. Proceed to Step 17.

17. Dig a soil pit near the center of the 0.1 acre sample plot and examine the soil profile in the vegetation unit to confirm whether it fits the soil series or phase descriptions in the soil survey. This is necessary due to the possibility of inclusions of other soil series or phases and to check for possible mapping errors. Also, some mapping units may be hydric (e.g., tidal marsh) but will not be on the list of hydric soils because they do not yet have series names for the area in question. If it is felt that

supplemental soil sampling should be done to adequately characterize the soils at the plot, additional samples can be readily obtained by randomly sampling in each quadrant with an Oakfield soil probe or similar device. Proceed to Step 18.

18. Determine whether field indicators of hydric soil conditions exist in the soil pits and record the data on Data Form D-4. The presence of one or more of the following indicators is indicative of the presence of hydric soils. Note: The soil examination can be terminated when a hydric soil indicator is encountered.

a. Organic soils (Histosols) or mineral soils with a histic epipedon.

b. Gleying or mottling with a soil matrix chroma of < 2 in mineral soils. Using Munsel Soil Color Charts, record the soil matrix color and mottle color (i.e., the hue, value, and chroma) of a soil sample by matching the sample with the appropriate color chips. Note: The soil should be moistened if it is dry when examined. For example, a soil sample with a hue of 10YR, a value of 6, and a chroma of 2 would be recorded as 10YR6/2. Also determine whether the soil is gleyed by matching the soil sample with the color chips on the gley page of Munsel Soil Color Charts. These samples should be taken at approximately a 25 centimeter (10 inch) depth or immediately below the A horizon, whichever is higher in the soil profile. Apply the following diagnostic soil key to confirm whether the colors in the soil matrix are indicative of hydric soil conditions:

1a. Soil is mottled:

2a. Matrix is gleyed............................hydric.

2b. Matrix is not gleyed

3a. Chroma of matrix is ≤ 2................hydric.

3b. Chroma of matrix is > 2............not hydric.

1b. Soil is not mottled:

4a. Matrix is gleyed............................hydric.

4b. Matrix is not gleyed and chroma is ≤ 1.......hydric.

4c. Matrix is not gleyed and chroma is > 1...not hydric.

Because of their high organic content, some mineral soils (e.g., Mollisols) may not meet these hydric criteria. However, in such dark (black) soils, the presence of gray mottles within 25 centimeters (10 inches) of the soil surface is considered indicative of hydric conditions. For the most part, in the United States, Mollisols are mainly the dark colored, base-rich soils of the Prairie Region. Because of the color of the parent material (e.g., the red soil of the Red River Valley) some soils will not meet any of these color characteristics. Soil color is also generally not a good indicator in sandy soils (e.g., barrier islands). When problematic parent materials or sandy soils are encountered, hydric soil indicators other than color may have to be relied on in the field.

c. <u>Sulfidic materials</u>. The smell of hydrogen sulfide (rotten egg odor) is indicative of the presence of sulfidic materials. Hydrogen sulfide forms under extreme reducing conditions associated with prolonged soil saturation or inundation.

d. <u>Iron or manganese concretions</u>. These are usually black or dark brown and occur as small aggregates near the soil surface.

e. <u>Ferrous iron</u>. This is a chemically reduced iron, the presence of which can be determined by using a calorimetric field test kit.

f. <u>Other organic materials</u>. In sandy soils, look for any of the indicators listed below.

(1) A layer of organic matter above the mineral surface or high organic matter in the surface horizon. The mineral surface layer generally appears darker than the mineral material immediately below it due to organic matter interspersed among or adhering to sand particles. <u>Note</u>: <u>Because organic matter also accumulates in upland soils, in some instances it may be difficult to distinguish a surface organic layer associated with a wetland site from litter and duff associated with an upland site unless the plant species composition of the organic material is determined</u>.

(2) A thin organic layer of hardened soil (i.e., an organic pan or spodic horizon) at 30-75 centimeter (12-30 inch) depths.

(3) Dark vertical streaking in subsurface horizons due to the downward movement of organic materials from the surface. When the soil from a vertical streak is rubbed between the fingers, a dark stain will result.

Proceed to Step 19.

19. Make hydrologic observations in the vegetation unit and record the data on Data Form D-4.

a. Traverse the 0.1 acre sample plot a number of times and record any evidence of surface inundation, such as drift lines, water marks, sediment deposition, standing water, surface scouring, drainage patterns, etc.

b. After sufficient time has passed to allow water to drain into the soil pit dug in Step 17, examine the pit for evidence of soil saturation. Note: Because of the capillary zone, the soil will be saturated higher in the profile than the standing water in the soil pit.

c. Record any plant species found that have morphological adaptations to saturated soil conditions or surface inundation.

d. When necessary, additional information on hydrology should be obtained from recorded sources, such as stream gauge data, tide gauge data, flood predictions, soil surveys, the national or state lists of hydric soils.

Note: It is not necessary to directly demonstrate that wetland hydrology is present. It is only necessary to show that the soil or its surface are at least periodically saturated or inundated, respectively. Specifically, with a vegetation unit dominated by one or more dominant obligate wetland plant species, it is necessary to show either (1) that there have been no significant hydrologic modifications or (2) that there is one or more hydrologic indicators at least periodically present during the growing season. With a vegetation unit dominated by only facultative species (i.e., facultative wetland, straight facultative, and/or facultative upland) occurring on a hydric soil, it is necessary to demonstrate that there is one or more hydrologic indicators at least periodically present during the growing season. Indicators of surface inundation and the presence of saturated soils in the major portion of the root zone are considered hydrology indicators. Plant morphological adaptations are also considered hydrology indicators, unless the vegetation unit has been significantly altered hydrologically. Other hydrology indicators include the various recorded sources listed in Step 19d (page 26). Proceed to Step 20.

20. Using the sample plot data summary sheet (Data Form D-5) and either the Jurisdictional Decision Flow Chart or the Jurisdictional Decision Diagnostic Key, decide whether the vegetation unit dominated by facultative species (i.e., facultative wetland, straight facultative and/or facultative upland) is a wetland unit. See the note in Step 13 (page 22) and proceed to step 21.

21. Proceed along the transect towards the baseline until another vegetation unit is encountered or 91.5 meters (300 feet), whichever comes first. Establish a second 0.1 acre sampling plot (plot two) at least 15.2 meters (50 feet) beyond the boundary of the new vegetation unit or at a distance 91.5 meters from the first plot if the same vegetation unit is encountered. Repeat the same procedures given in Steps 10-20. If the vegetation unit (including soils and topography) at the second plot is the same as the first, or if the second is different but they are either both wetlands or both uplands, proceed to Step 23. If the vegetation unit at the second plot is different and one of the units is upland and the other is wetland, then an upland-wetland boundary has been traversed. Proceed to Step 22.

22. Determine the upland-wetland boundary between the two plots.

    a. Move back along the transect at least 15.2 meters (50 feet) into what is obviously the vegetation unit encountered in the first sample plot. Repeat the same procedures given in Steps 10-20 for this sample plot (plot three).

    b. Look for a change in vegetation or topography between sample plots two and three. Information from the data forms for plots two and three will provide cues as to which parameters have changed. In a forested area, this will frequently involve changes in the shrubs or herbaceous plants. If there is a vegetation or topographic change or break, sample the soil at that point along the transect to see if it is hydric. If it is hydric, proceed towards the upland plot until a more evident change or break in the vegetation or topography is noted, and examine the soil again to see if it is hydric. If no evident change or break in vegetation or topography is initially noted, the soil should be examined half way between plots two and three. If the soil is hydric at this point on the transect, sample the soil again half way between this point and plot two. By repeating either of these procedures, make as many additional soil samples as necessary to determine the location of the upland-wetland boundary (actually a point) along the transect. A soil probe (e.g., an Oakfield soil probe) is very helpful to do this intensified soil sampling. Note: At this point in the overall procedure, soils generally become more useful than vegetation in establishing the upland-wetland boundary, particularly if there is no evident vegetation change or break or when facultative species dominate two adjacent vegetation units. Therefore, a Data Form D-4 should be filled out for each additional soil sample taken between sample plots two and three. On the Data Form D-4's, also include any hydrology observations made in the immediate vicinity of the soil samples. Because quantitative vegetation data have already been obtained for 0.1 acre plots (sample plots two and three) centered approximately 15.2 meters (50 feet) to each side of the upland-wetland boundary, further detailed quantitative analysis of the vegetation is generally not necessary. Any vegetation breaks or changes in species composition in the immediate vicinity of the soil samples should be recorded, however, on a Data Form D-5. Data Form D-5's (including vegetation, soils and hydrology observations) must be completed at least for the areas immediately to each side of the upland-wetland boundary point (i.e., one form should be completed for an upland unit and one form should be completed for a wetland unit).

c. Once the upland-wetland boundary point is determined, indicate its location on the aerial photograph or topographic map with the letters "BP" and record its distance from one of the two 0.1 acre sample plots or the baseline. Proceed to step 23.

23. Make additional wetland determinations along the transect in accordance with Step 21. The procedure described in Step 22 should be applied at every place along the transect where a wetland boundary occurs between successive 0.1 acre sampling plots. Proceed to Step 24.

24. Establish all other necessary transects and repeat the procedures in Steps 7-23. Proceed to Step 25.

25. Synthesize the sample data for all of the transects to determine the portion of the site that is wetlands.

a. Examine the sample plot data summary sheets (Data Form D-5) and indicate on the aerial photograph or topographic map all plots that are wetlands and all plots that are uplands.

b. If the sampling plots are all wetlands or all uplands, the entire site is either entirely wetlands or entirely uplands, respectively.

c. If some sampling plots are uplands and some are wetlands, then an upland-wetland boundary is present. Connect the upland-wetland boundary points ("BP's") on the aerial photograph or topographic map by following either the vegetation break or the topographic contour that corresponds with the upland-wetland boundary points. This interpolated line passing through the "BP's" is the upland-wetland boundary.

d. If the distances between transects are large or the vegetation breaks or the topographic contours do not consistently correspond with the upland-wetland boundary, it may be necessary to do additional soil sampling across the boundary in the areas between transects. The latter should done by walking the approximate upland-wetland boundary and periodically sampling across it. For each soil sample across the boundary, record soil data (and hydrology observations from the immediate vicinity) on a Data Form D-4. Data Form D-5's (including vegetation, soils and hydrology observations) must be completed at least for the areas immediately to each side of the upland-wetland boundary point (i.e., one form should be completed for an upland unit and one form should be completed for a wetland unit).

e. If the upland-wetland boundary is to be delineated on the ground, place stakes or flagging tape at all transect boundary points, as well as at any boundary points established by inter-transect sampling.

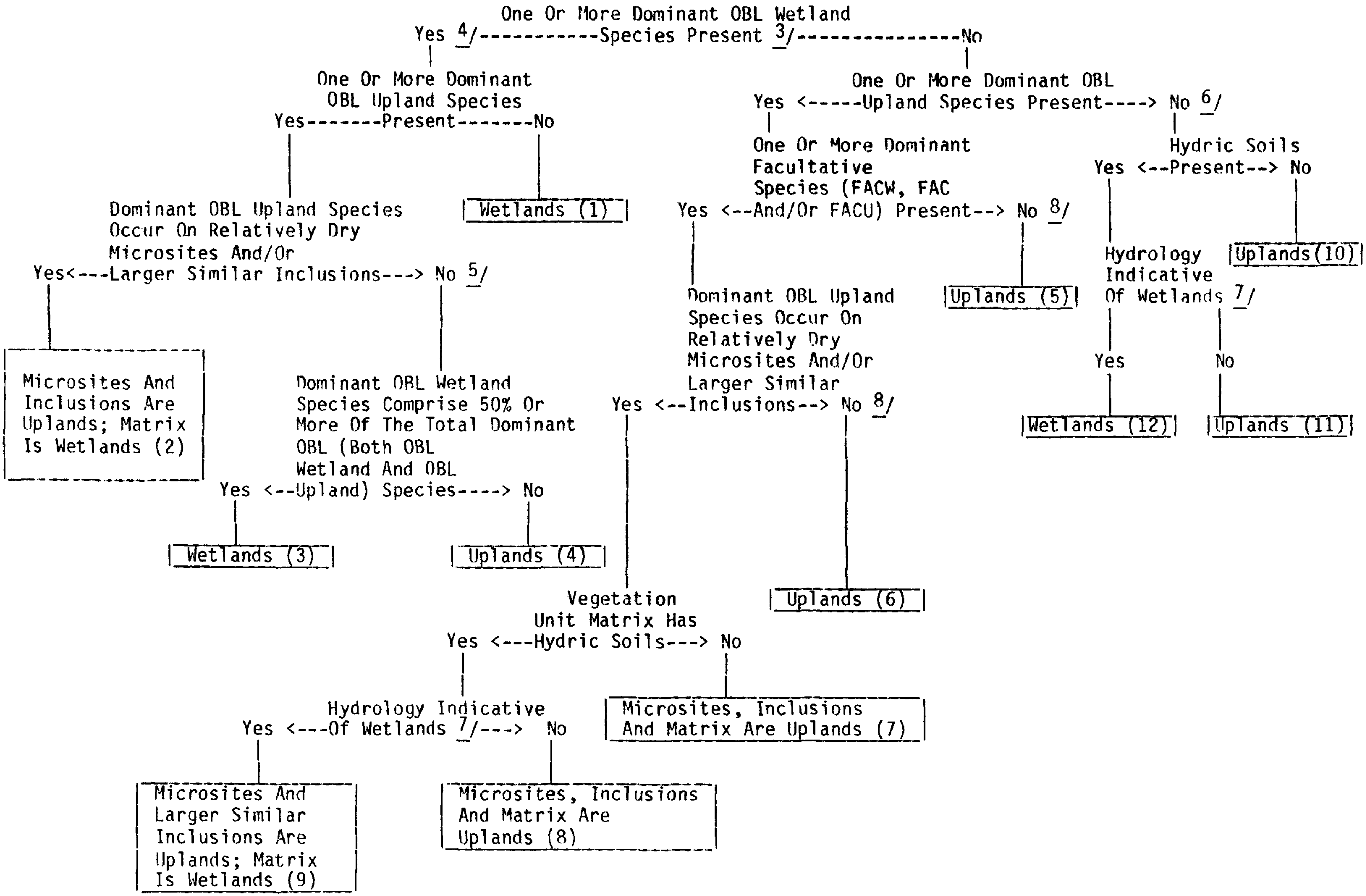
APPENDIX A

JURISDICTIONAL DECISION

FLOW CHART

APPENDIX A: JURISDICTIONAL DECISION FLOW CHART

PART A: DETERMINATIONS IN WHICH ONE OR MORE DOMINANT PLANT SPECIES OCCUR 1/2/



Footnotes For Part A

1/ The methodology presented in this flow diagram relies hierarchically on vegetation, soils and hydrology. As pointed out by the Corps of Engineers (Environmental Laboratory, 1987), there are certain wetland types and/or conditions that may make application of indicators of one or more of the parameters difficult, at least at certain times of the year. This should not be considered atypical. Rather, it is due to normal seasonal or annual variations in environmental conditions that result from causes other than human activities or catastrophic natural events. The Corps gives four examples of this situation (wetlands in drumlins, seasonal wetlands, prairie potholes, and vegetated flats). For example, vegetated flats dominated by annual plants may appear only as unvegetated mudflats during the nongrowing season. Under such circumstances, an indicator of hydrophytic vegetation would not be evident. Likewise, a prairie pothole may not have inundated or saturated soils during most of the growing season in years of below normal precipitation. Thus, a hydrology indicator would be absent. Under these circumstances, a field investigator making a jurisdictional determination must decide whether or not wetland indicators are normally present during a portion of the growing season.

The Corps further points out that atypical situations may also exist in which one or more indicators of hydrophytic vegetation, hydric soils and/or wetland hydrology cannot be found due to the effects of recent human activities or natural events. For example, unauthorized activities such as (1) the alteration or removal of vegetation, (2) the placement of dredged or fill material over a wetland, and (3) the construction of levees, drainage systems, or dams that significantly alter hydrology. Under such circumstances, an investigation of the pre-existing conditions is necessary to determine whether or not a wetland existed prior to the disturbance. Recent natural events (e.g., impoundment of water by beaver) and man-induced conditions (e.g., inadvertent impoundment due to highway construction) may also result in atypical situations that effect wetland vegetation and hydrology in an area which was uplands prior to flooding. However, the area may not yet have developed hydric soil indicators. It is important in the latter two circumstances (i.e., natural events and man-induced conditions) to determine whether or not the alterations to the area have resulted in changes that are now the "normal circumstances." The relative permanence of the change and whether or not the area is now functioning as a wetland must be considered. A site with wetland vegetation and hydrology (other than from irrigation) that has not yet developed hydric soil characteristics due to recent flooding should be considered to have soils that are functioning as hydric soils.

2/ Non-dominant plants may be present as well.

3/ Dominant facultative species (FACW, FAC and/or FACU) may be present as well.

4/ In the presence of one or more dominant obligate wetland species, assume wetland hydrology is present (except for upland microsites and/or larger similar inclusions) unless evidence of disturbance suggests otherwise.

Footnotes for Part A (continued)

5/ This situation (both dominant obligate wetland species and dominant obligate upland species in the same vegetation unit under non-microsite/inclusion circumstances) should only occur in disturbed units, either naturally (e.g., a saltmarsh invading a pine forest due to sea level rise) or unnaturally (e.g., a ditched wetland with wetland obligates dying out and upland obligates invading). When it does occur, a 50% rule should be applied. An alternative to the 50% rule for forested sites would be to examine tree vigor and reproduction (e.g., seedlings and saplings), which may give a good indication of the direction of vegetation change at the unit or site. This alternative may apply to herbaceous sites as well.

6/ Under these circumstances, dominant FACW, FAC, and/or FACU species must be present.

7/ At this point, a field investigator must decide whether or not wetland hydrologic indicators are naturally present. If one or more are present, the vegetation unit is wetlands; if not, the unit is uplands. If the site has been hydrologically disturbed, the significance of the disturbance must be considered in deciding whether or not the unit is still wetlands hydrologically.

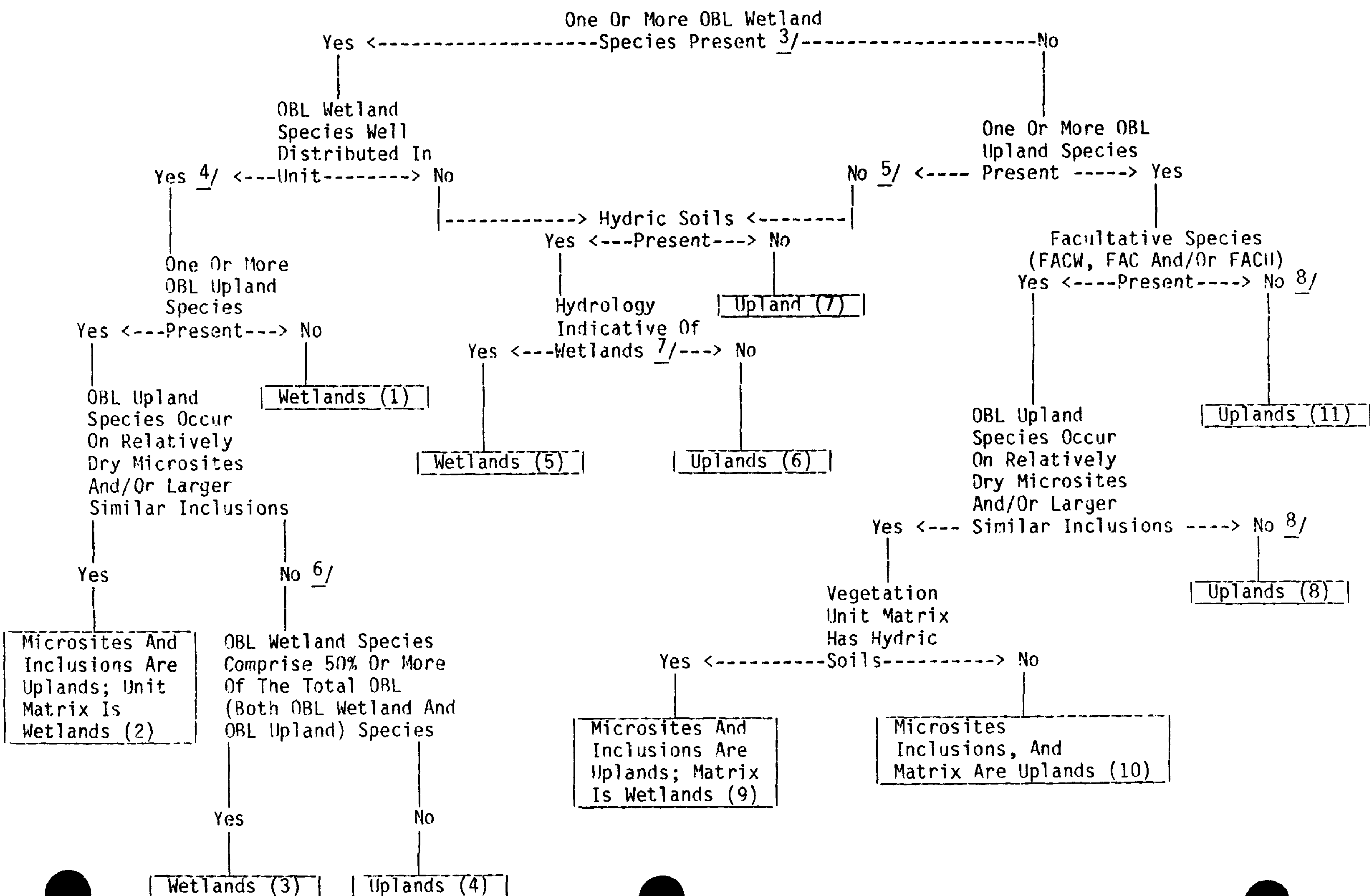
8/ In the presence of one or more dominant obligate upland species, assume upland hydrology is present (except for wetland microsites and/or similar larger inclusions) unless evidence of disturbance suggest otherwise.

Note: (1) - (12) are wetland determination points.

OBL = obligate
FACW = facultative wetland
FAC = straight facultative
FACU = facultative upland

APPENDIX A: JURISDICTIONAL DECISION FLOW CHART

PART B: DETERMINATION IN WHICH ONLY NON-DOMINANT PLANT SPECIES OCCUR 1/2/



Footnotes For Part B

1/ A situation in which no species is dominant will seldom occur. Consequently, this flow chart will not be utilized often.

2/ The methodology presented in this flow diagram relies hierarchically on vegetation, soils and hydrology. As pointed out by the Corps of Engineers (Environmental Laboratory, 1987), there are certain wetland types and/or conditions that may make application of indicators of one or more of the parameters difficult, at least at certain times of the year. This should not be considered atypical. Rather it is due to normal seasonal or annual variations in environmental conditions that result from causes other than human activities or catastrophic natural events. The Corps gives four examples of this situation (wetlands in drumlins, seasonal wetlands, prairie potholes, and vegetated fats). For example, vegetated flats dominated by annual plants may appear only as unvegetated mudflats during the nongrowing season. Under such circumstances, an indicator of hydrophytic vegetation would not be evident. Likewise, a prairie pothole may not have inundated or saturated soils during most of the growing season in years of below normal precipitation. Thus, a hydrology indicator would be absent. Under these circumstances, a field investigator making a jurisdiction determina-ation must decide whether or not wetland indicators are normally present during a portion of the growing season.

The Corps further points out that atypical situations may also exist in which one or more indicators of hydrophytic vegetation, hydric soils and/or wetland hydrology cannot be found due to the effects of recent human activities or natural events. For example, unauthorized activities such as (1) the alteration or removal of vegetation, (2) the placement of dredged or fill material over a wetland, and (3) the construction of levees, drainage systems, or dams that significantly alter hydrology. Under such circumstances, an investigation of the pre-existing conditions is necessary to determine whether or not a wetland existed prior to the disturbance. Recent natural events (e.g., impoundment of water by beaver) and man-induced conditions (e.g., inadvertent impoundment due to highway construction) may also result in atypical situations that effect wetland vegetation and hydrology in an area which was uplands prior to flooding. However, the area may not yet have developed hydric soil indicators. It is important in the latter two circumstances (i.e., natural events and man-induced conditions) to determine whether or not the alterations to the area have resulted in changes that are now the "normal circumstances." The relative permanence of the change and whether or not the area is now functioning as a wetland must be considered. A site with wetland vegetation and hydrology (other than from irrigation) that has not yet developed hydric soil characteristics due to recent flooding should be considered to have soils that are functioning as hydric soils.

3/ Non-dominant OBL upland species and/or non-dominant facultative species (FACW, FAC and/or FACU) may be present as well.

4/ In the presence of one or more non-dominant obligate wetland species that are well-distributed in the unit, assume wetland hydrology is present (except for upland microsites and/or larger similar inclusions) unless evidence of disturbance suggests otherwise.

5/ Under these circumstances, non-dominant FACW, FAC, and/or FACU species must be present.

Footnotes for Part B (continued)

6/ This situation (both obligate wetland species and obligate upland species in the same vegetation unit under non-microsite/inclusion circumstances) should occur rather infrequently and only in disturbed units, either naturally (e.g., a saltmarsh invading a pine forest due to sea level rise) or unnaturally (e.g., a ditched wetland with wetland obligates dying out and upland obligates invading). When it does occur, a 50% rule should be applied. An alternative to the 50% rule for forested sites would be to examine tree vigor or reproduction (e.g., seedlings and saplings), which may give a good indication of the direction of vegetation change at the unit or site. This alternative may apply to herbaceous sites as well.

7/ At this point, a field investigator must decide whether or not wetland hydrologic indicators are naturally present. If one or more are present, the vegetation unit is wetlands; if not, the unit is uplands. If the site has been hydrologically disturbed, the significance of the disturbance must be considered in deciding whether or not the unit is still wetlands hydrologically.

8/ In the presence of one or more non-dominant obligate upland species that are well-distributed in the unit, assume upland hydrology is present (except for wetland microsites and/or similar larger inclusions) unless evidence of disturbance suggests otherwise.

Note: (1) - (11) are wetland determination points.

OBL = obligate
FACW = facultative wetland
FAC = straight facultative
FACU = facultative upland

APPENDIX B

JURISDICTIONAL DECISION

DIAGNOSTIC KEY

APPENDIX B: JURISDICTIONAL

DECISION DIAGNOSTIC KEY 1/

1a. Vegetation units are dominated by one or more plant species. Non-dominant species may also be present.

2a. One or more dominant obligate wetland plant species are present in the vegetation unit (or site if it is a monotypic site). Facultative species (facultative wetland, straight facultative and/or facultative upland) may occur as dominants as well.2/

3a. Obligate upland dominants (one or more) are present.

4a. Dominant obligate upland species occur on relatively dry microsites (e.g., live tree bases, decaying tree stumps, mosquito ditch spoil piles, small earth hummocks) and/or on larger similar inclusions occurring in an otherwise topographically uniform unit containing dominant obligate wetland species. Under such circumstances, you should check to see if you correctly horizontally stratified the site and adjust accordingly by either: (a) showing these microsites and inclusions as local UPLANDS in a WETLANDS matrix or by (b) considering the unit to be all WETLANDS, but acknowledging the presence of the local UPLANDS in a written description of the site.(1)3/

4b. Dominant obligate upland species do not occur on relatively dry microsites and/or larger similar inclusions; they occur rather uniformly intermixed with the dominant obligate wetland species. Under such circumstances, the unit and/or site is probably significantly hydrologically disturbed (naturally or by man) and successional vegetation changes are occurring.4/

5a. 50% or more of the total dominant obligate species (both obligate wetland species and obligate upland species) are obligate wetland species....................WETLANDS (2)

5b. Less than 50% of the total dominant obligate species are obligate wetland species.....................UPLANDS (3)

3b. Obligate upland dominants are not present.............WETLANDS (4)

2b. One or more dominant obligate wetland plant species are not present in the vegetation unit (or site if it is a monotypic site). Facultative species (facultative wetland, straight facultative and/or facultative upland) may occur as dominants as well.

6a. Obligate upland dominants (one or more) are present.

7a. One or more dominant facultative species (facultative wetland, straight facultative and/or facultative upland) are present.

8a. Dominant obligate upland species occur on relatively dry microsites and/or larger similar inclusions. Under such circumstances, you should check to see if you correctly horizontally stratified the site and determine whether the vegetation unit matrix (the area dominated by the facultative species in this instance) is wetlands by examining soils.7/

9a. Vegetation unit matrix has hydric soils.

10a. Hydrology of vegetation unit matrix is indicative of wetlands........Microsites and inclusions are UPLANDS; matrix is WETLANDS (5).5/

10b. Hydrology of vegetation unit matrix is not indicative of wetlands....Microsites, inclusions and matrix are UPLANDS (6).

9b. Vegetation unit matrix does not have hydric soils...Microsites, inclusions, and matrix are UPLANDS (7).

8b. Dominant obligate upland species do not occur on relatively dry microsites and/or larger similar inclusions.....UPLANDS (8).6/

7b. One or more facultative species are not present......UPLANDS (9).6/

6b. Obligate upland dominants are not present; one or more dominant facultative species (facultative wetland, straight facultative and/or facultative upland) are present.7/

11a. Hydric soils are present

8a. Hydrology is indicative of wetlands......WETLANDS (10).5/

8b. Hydrology is not indicative of wetlands...UPLANDS (11).

11b. Hydric soils are not present......UPLANDS (12).

1b. Vegetation units are not dominated by one or more plant species.8/

12a. One or more obligate wetland species are present.

13a. Obligate wetland species are well-distributed in unit.9/

14a. One or more obligate upland species are present.

15a. Obligate upland species occur on relatively dry microsites and/or larger similar inclusions. Under these circumstances, the microsites and inclusions are UPLANDS and the vegetation unit matrix is WETLANDS (13).

15b. Obligate upland species do not occur on relatively dry microsites and/or larger similar inclusions; they occur rather uniformly intermixed with the obligate wetland species. Under such circumstances, the unit and/or entire site is probably significantly hydrologically disturbed (naturally or by man) and successional changes are occurring.[4]

16a. 50% or more of the total obligate species (both obligate upland and obligate wetland) are obligate wetland species.....WETLANDS (14).

16b. Less than 50% of the total obligate species are obligate wetland species...UPLANDS (15).

14b. One or more obligate upland species are not present...WETLANDS (16).

13b. Obligate wetland species are not well-distributed in unit.

17a. Hydric soils are present.

18a. Hydrology is indicative of wetlands......WETLANDS (17).[5]

18b. Hydrology is not indicative of wetlands...UPLANDS (18).

17b. Hydric soils are not present...UPLANDS (19).

12b. One or more obligate wetland species are not present.

19a. One or more obligate upland species are present.

20a. Facultative species (facultative wetland, straight facultative and/or facultative upland) are present.

21a. Obligate upland species occur on relatively dry microsites and/or larger similar inclusions.

22a. Vegetation unit matrix has hydric soils...Microsites and inclusions are UPLANDS; matrix is WETLANDS (20).

22b. Vegetation unit matrix does not have hydric soils... ...Microsites, inclusions and matrix are UPLANDS (21).

21b. Obligate upland species do not occur on relatively dry microsites and/or larger similar inclusions......UPLANDS (22).[10]

20b. Facultative species are not present.............UPLANDS (23).[10]

19b. One or more obligate upland species are not present; one or more facultative species (facultative wetland, straight facultative and/or facultative upland) are present.[7]

23a. Hydric soils are present.

24a. Hydrology is indicative of wetlands......WETLANDS (24).5/

24b. Hydrology is not indicative of wetlands...UPLANDS (25).

23b. Hydric soils are not present.....UPLANDS (26).

Footnotes for Key

1/ The methodology presented in this diagnostic key relies hierarchically on vegetation, soils and hydrology. As pointed out by the Corps of Engineers (Environmental Laboratory, 1987), there are certain wetland types and/or conditions that may make application of indicators of one or more of the parameters difficult, at least at certain times of the year. This should not be considered atypical. Rather, it is due to normal seasonal or annual variations in environmental conditions that result from causes other than human activities or catastrophic natural events. The Corps gives four examples of this situation (wetlands in drumlins, seasonal wetlands, prairie potholes, and vegetated flats). For example, vegetated flats dominated by annual plants may appear only as unvegetated mudflats during the nongrowing season. Under such circumstances, an indicator of hydrophytic vegetation would not be evident. Likewise, a prairie pothole may not have inundated or saturated soils during most of the growing season in years of below normal precipitation. Thus, a hydrology indicator would be absent. Under these circumstances, a field investigator making a jurisdictional determination must decide whether or not wetland indicators are normally present during a portion of the growing season.

The Corps further points out that atypical situations may also exist in which one or more indicators of hydrophytic vegetation, hydric soils and/or wetland hydrology cannot be found due to the effects of recent human activities or natural events. For example, unauthorized activities such as (1) the alteration or removal of vegetation, (2) the placement of dredged or fill material over a wetland, and (3) the construction of levees, drainage systems, or dams that significantly alter hydrology. Under such circumstances, an investigation of the preexisting conditions is necessary to determine whether or not a wetland existed prior to the disturbance. Recent natural events (e.g., impoundment of water by beaver) and man-induced conditions (e.g., inadvertent impoundment due to highway construction) may also result in atypical situations that effect wetland vegetation and hydrology in an area which was uplands prior to flooding. However, the area may not yet have developed hydric soil indicators. It is important in the latter two circumstances (i.e., natural events and man-induced conditions) to determine whether or not the alterations to the area have resulted in changes that are now the "normal circumstances." The relative permanence of the change and whether or not the area is now functioning as a wetland must be considered. A site with wetland vegetation and hydrology (other than from irrigation) that has not yet developed hydric soil characteristics due to recent flooding should be considered to have soils that are functioning as hydric soils.

Footnotes for Key (continued)

2/ In the presence of one or more dominant obligate wetland species, assume wetland hydrology is present (except for upland microsites and/or larger similar inclusions) unless evidence of disturbance suggests otherwise.

3/ Numbers in parentheses represent jurisdictional decision points in the key.

4/ Where significant drainage has occurred, soils usually will not be diagnostic either since soil wetness characteristics (e.g., gleying and mottling) generally take many years to respond to hydrologic changes. Therefore, a 50% rule should be applied to the vegetation. An alternative to this 50% rule for forested sites would be to examine tree vigor and reproduction (e.g., seedlings and saplings), which may give a good indication of the direction of vegetation change at the unit or site. This alternative may apply to herbaceous sites as well.

5/ At this point, a field investigator must decide whether or not wetland hydrologic indicators are naturally present. If one or more are present, the vegetation unit is wetlands; if not, the unit is uplands. If the site has been hydrologically disturbed, the significance of the disturbance must be considered in deciding whether or not the unit is still wetlands hydrologically.

6/ In the presence of one or more dominant obligate upland species, assume upland hydrology is present (except for wetland microsites and/or larger, similar inclusions) unless evidence of disturbance suggests otherwise.

7/ Because facultative species are not diagnostic of wetlands or uplands, an examination of soil and hydrologic parameters is necessary to help determine whether the vegetation unit is a wetland.

8/ A situation without one or more dominants will seldom occur. Consequently, this part of the key should seldom be used.

9/ In the presence of one or more non-dominant obligate wetland species that are well-distributed in the vegetation unit, assume wetland hydrology is present (except for upland microsites and/or larger similar inclusions) unless evidence of disturbance suggests otherwise.

10/ In the presence of one or more non-dominant obligate upland species that are well-distributed in the vegetation unit, assume upland hydrology is present (except for wetland microsites and/or larger similar inclusions) unless evidence of disturbance suggests otherwise.

APPENDIX C

DATA FORMS FOR

SIMPLE JURISDICTIONAL DETERMINATIONS

DATA FORM C-1: HERBACEOUS SPECIES DATA
FOR SIMPLE JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ________________________________ Date: ______________
Project/Site: ______________________ State: ______________ County: _________________
Applicant/Owner: ___________________________ Vegetation Unit #/Name: _________________
****

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					

Sum of Midpoints ________
50% X Sum of Midpoints ________
****

1. Note: Herbaceous species include all graminoids, forbs, ferns, fern allies, bryophytes, woody seedings, and herbaceous vines.
2. Cover classes (midpoints): T<1% (none); 1=1-5% (3.0); 2=6-15% (10.5); 3=16-25% (20.5); 4=26-50% (38.0); 5=51-75% (63.0); 6=76-95% (85.5); 7=96-100% (98.0).
3. To determine the dominants, first rank the species by their midpoints. Then cumulatively sum the midpoints of the ranked species until 50% of the total for all species midpoints is reached or initially exceeded. All species contributing to that cumulative total should be considered dominants and indicated with an asterisk above.
4. Do the dominant herbaceous species indicate that the vegetation unit supports hydrophytic vegetation? Yes ______ No ______ Inconlusive ______.
5. Note: Inconclusive should be checked when only facultative (i.e., facultative wetland, straight facultative, and/or facultative upland) species dominate.
6. Comments: ____

DATA FORM C-2: SHRUB AND WOODY VINE DATA
FOR SIMPLE JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ______________________ Date: __________
Project/Site: ______________ State: __________ County: __________
Applicant/Owner: ________________ Vegetation Unit #/Name: __________

****

SHRUBS

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					
6.					
7.					

Sum of Midpoints ______
50% X Sum of Midpoints ______

****

WOODY VINES

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					
6.					
7.					

Sum of Midpoints ______
50% X Sum of Midpoints ______

****

1. Note: A shrub is usually less than 6.1 meters (20 feet) tall and generally exhibits several erect, spreading or prostrate stems and has a bushy appearance. Percent cover of woody vines should be estimated independent of strata and exclusive of seedlings.
2. Cover classes (midpoints): T<1% (none); 1=1-5% (3.0); 2=6-15% (10.5); 3=16-25% (20.5); 4=26-50% (38.0); 5=51-75% (63.0); 6=76-95% (85.5); 7=96-100% (98.0).
3. To determine the dominants, first rank the shrub species by their midpoints. Then cumulatively sum the midpoints of the ranked shrub species until 50% of the total for all shrub species midpoints is reached or initially exceeded. Do the same for woody vines. All species contributing to these cumulative totals should be considered dominants and marked with an asterisk above.
4. Do the dominant shrub species indicate that the vegetation unit supports hydrophytic vegetation? Yes ______ No ______ Inconlusive ______.
5. Do the dominant woody vine species indicate that the vegetation unit supports hydrophytic vegetation? Yes ______ No ______ Inconclusive ______.
6. Note: Inconclusive should be checked when only facultative (i.e., facultative wetland, straight facultative, and/or facultative upland) species dominate.
7. Comments: ____

DATA FORM C-3: TREE AND SAPLING DATA
FOR SIMPLE JURISDICTIONAL DETERMINATION

EPA Region: _______ Recorder: ________________________ Date: ____________
Project/Site: __________________ State: __________ County: ____________
Applicant/Owner: ____________________ Vegetation Unit #/Name: __________

****

TREES

Species	Indicator Status	Relative Basal Area (%)	Rank
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

Total Relative Basal Area Equals 100%

****

SAPLINGS

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					

Sum of Midpoints ______
50% X Sum of Midpoints ______

****

1. Note: A tree is greater than 10 centimeters (4 inches) diameter breast height (dbh). A sapling is from 1-10 centimeters (0.4-4 inches) dbh.
2. Cover classes (midpoints): T<1% (none); 1=1-5% (3.0); 2=6-15% (10.5); 3=16-25% (20.5) 4=26-50% (38.0); 5=51-75% (63.0); 6=76-95% (85.5); 7=96-100% (98.0).
3. To determine the dominants, first rank the tree species by relative basal area. Then cumulatively sum the relative basal area of the ranked tree species until 50% of the total relative basal area for all tree species is reached or initially exceeded Do the same for saplings using the sum of midpoints. All species contributing to thes cumulative totals should be considered dominants and marked with an asterisk above.
4. Do the dominant trees indicate that the vegetation unit supports hydrophytic vegetatic Yes _____ No _____ Inconlusive _____.
5. Do the dominant saplings indicate that the vegetation unit supports hydrophytic vegetation? Yes _____ No _____ Inconclusive _____.
6. Note: Inconclusive should be checked when only facultative (i.e., facultative wetland straight facultative, and/or facultative upland) species dominate.
7. Comments: ____

DATA FORM C-4: SOIL/HYDROLOGY DATA
FOR SIMPLE JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ________________________________ Date: ______________
Project/Site: _______________________ State: _____________ County: ______________
Applicant/Owner: __________________________ Vegetation Unit #/Name: ______________

****

SOILS

Is the soil on the national or state hydric soils list? Yes ______ No ______
Series/phase: _____________________________ Subgroup: ____________________
Is the soil a Histosol or is a histic epipedon present? Yes ______ No ______
Is the soil:
Mottled? Yes ______ No ______ Matrix Color: __________ Mottle Color: ______________
Gleyed? Yes ______ No ______
Other Indicators ____
____

1. Note: Soils should be sample at about 25 centimeters (10 inches) or immediately below the A horizon, whichever comes first. If desired, use the back of the form to diagram or describe the soil profile.
2. Does the sampling indicate that the vegetation unit has hydric soils?
   Yes ______ No ______ Inconclusive ______.
   Rationale: ____
   ____
   ____
   ____
   Comments: ____
   ____
   ____

****

HYDROLOGY

1. Is the ground surface inundated? Yes ______ No ______ Depth of water: ___________
2. Is the soil saturated? Yes ______ No ______ Depth to free-standing water: _______
3. List other field evidence of surface inundation or soil saturation ____________
   ____
   ____
4. Are hydrology indicators present in the vegetation unit?
   Yes _____ No _____ Inconclusive _____.
   Note: It may be necessary to rely on supplemental historical data (e.g., soil surveys) during a dry season or drought year as long as a site has not been significantly modified hydrologically since data collection.
   Rationale: ____
   ____
   ____
5. Comments: ____
   ____
   ____

DATA FORM C-5: SUMMARY OF DATA
FOR SIMPLE JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ________________________________ Date: ______________
Project/Site: _______________________ State: _____________ County: ________________
Applicant/Owner: ___________________________ Vegetation Unit #/Name: ________________

****

Dominant Species	Indicator Status
1. ________________	________
2. ________________	________
3. ________________	________
4. ________________	________
5. ________________	________
6. ________________	________
7. ________________	________
8. ________________	________
9. ________________	________
10. ________________	________
11. ________________	________
12. ________________	________
13. ________________	________
14. ________________	________
15. ________________	________
16. ________________	________
17. ________________	________
18. ________________	________
19. ________________	________
20. ________________	________

****

1. Is hydrophytic vegetation present? Yes ______ No ______ Inconclusive ______
2. Are hydric soils present? Yes ______ No ______ Inconclusive ______
3. Are hydrology indicators present? Yes ______ No ______ Inconclusive ______
4. Overall, is the vegetation unit wetland? Yes ______ No ______ Inconclusive ______
5. Comments: ____
____
____

APPENDIX D

DATA FORMS FOR

DETAILED JURISDICTIONAL DETERMINATIONS

DATA FORM D-1: HERBACEOUS SPECIES DATA
FOR DETAILED JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ______________________________ Date: __________
Project/Site: ______________________ State: ____________ County: ____________
Applicant/Owner: __________________________ Transect #: __________ Plot #: __________

****

PERCENT AREAL COVER

Species	Status	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	$\overline{X}$	Rank
1.											
2.											
3.											
4.											
5.											
6.											
7.											
8.											
9.											
10.											
11.											
12.											
13.											
14.											
15.											
16.											
17.											
18.											
19.											
20.											

Total of Averages (X's) of Percent Areal Cover __
50% X Total of Averages (X's) of Percent Areal Cover __

****

1. Note: Herbaceous species include all graminoids, forbs, ferns, fern allies, bryophytes, woody seedlings, and herbaceous vines.
2. To determine the dominants, first rank the species by their average percent areal cover. Then cumulatively sum the percent areal cover averages (X's) of the ranked species until 50% of the total of all the species averages is reached or initially exceeded. All species contributing to that cumulative total should be considered dominants and indicated with an asterisk above.
3. Do the dominant herbaceous species indicate that the vegetation unit supports hydrophytic vegetation? Yes _____ No _____ Inconclusive _____.
4. Note: Inconclusive should be checked when only facultative (facultative wetland, straight facultative, and/or facultative upland) species dominate.
5. Comments: ____
____
____
____
____

DATA FORM D-2: SHRUB AND WOODY VINE
DATA FOR DETAILED JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ______________________________ Date: ____________
Project/Site: ______________________ State: _____________ County: ______________
Applicant/Owner: ___________________________ Transects #: _________ Plot #: ________

****

SHRUBS

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					

Sum of Midpoints ____________
50% X Sum of Midpoints ____________

****

WOODY VINES

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					

Sum of Midpoints ____________
50% X Sum of Midpoints ____________

****

1. Note: A shrub usually is less than 6.1 meters (20 feet) tall and generally exhibits several erect, spreading or prostrate stems and has a bushy appearance. Percent cover of woody vines should be estimated independent of strata and exclusive of seedlings.
2. Cover classes (midpoints): T=<1% (none); 1=1-5% (3.0); 2=6-15% (10.5); 3=16-25% (20.5); 4=26-50% (38.0); 5=51-75% (63.0); 6=76-95% (85.5); 7=96-100% (98.0).
3. To determine dominants, first rank the shrub species by their midpoints. Then cumulatively sum the midpoints of the ranked shrub species until 50% of the total for all shrub species midpoints is reached or initially exceeded. Do the same for woody vines. All species contributing to these cumulative totals should be considered dominants and marked with an asterisk above.
4. Do the dominant shrubs indicate that the vegetation unit supports hydrophytic vegetation? Yes ______ No ______ Inconclusive ______.
5. Do the dominant woody vine species indicate that the vegetation unit supports hydrophytic vegetation? Yes ______ No ______ Inconclusive ______.
6. Note: Inconclusive should be checked when only facultative (i.e., facultative wetland, straight facultative, and/or facultative upland) species dominate.
7. Comments: ____

____

DATA FORM D-3: TREE AND SAPLING DATA
FOR DETAILED JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ______________________________ Date: ____________
Project/Site: ______________________ State: ____________ County: ______________
Applicant/Owner: ____________________ Transect #: __________ Plot #: __________

****

TREES (Bitterlich Method)

Individual Tree (Species Name)	Indicator Status	DBH (cm/ft)	Basal Area Per Tree (sq ft)	Basal Area Per Species (sq ft)	Rank
1.		/			
2.		/			
3.		/			
4.		/			
5.		/			
6.		/			
7.		/			
8.		/			
9.		/			
10.		/			

Total Basal Area of All Species Combined __________
50% X Total Basal Area of All Species Combined __________

****

SAPLINGS

Species	Indicator Status	Percent Areal Cover	Cover Class	Midpoint of Cover Class	Rank
1.					
2.					
3.					
4.					
5.					

Sum of Midpoints __________
50% X Sum of Midpoints __________

****

1. Note: A tree is greater than 10 centimeters (4 inches) diameter breast height (dbh). A sapling is from 1-10 centimeters (0.4-4 inches) dbh.
2. Cover classes (midpoints): T<1% (none); 1=1-5% (3.0); 2=6-15% (10.5); 3=16-25% (20.5); 4=26-50% (38.0); 5=51-75% (63.0); 6=76-95 (85.5); 7=96-100% (98.0).
3. To determine the dominants, first rank the tree species by their basal areas. Then cumulatively sum the basal areas of the ranked tree species until 50% of the total basal area for all tree species is reached or initially exceeded. Do the same for saplings using the sum of midpoints. All species contributing to these cumulative totals should be considered dominants and marked with an asterisk above.
4. Do the dominant trees indicate that the vegetation unit supports hydrophytic vegetation? Yes _____ No _____ Inconlusive _____.
5. Do the dominant samplings indicate that the vegetation unit supports hydrophytic vegetation? Yes _____ No _____ Inconclusive _____.
6. Note: Inconclusive should be checked when only facultative (i.e., facultative wetland, straight facultative, and/or facultative upland) species dominate.
7. Comments: ____

DATA FORM D-4: SOIL/HYDROLOGY DATA FOR DETAILED JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ________________________________ Date: ______________
Project/Site: _______________________ State: ______________ County: ______________
Applicant/Owner: ___________________________ Transect #: __________ Plot #: ________

****

SOILS

Is the soil on the national or state hydric soils list? Yes _____ No _____
Series/phase: ____________________________ Subgroup: ______________________________
Is the soil a Histosol or is a histic epipedon present? Yes _____ No _____
Is the soil:
Mottled? Yes _____ No _____ Matrix Color: __________ Mottle Color: __________
Gleyed? Yes _____ No _____
Other Indicators ____

1. Note: Soils should be sampled at about 25 centimeters (10 inches) or immediately below the A horizon, whichever comes first. If desired, use the back of the form to diagram or describe the soil profile.
2. Does the sampling indicate that the vegetation unit has hydric soils?
   Yes _____ No _____ Inconclusive ______
3. Rationale: ____
4. Comments: ____

****

HYDROLOGY

1. Is the ground surface inundated? Yes _____ No _____ Depth of water: __________
2. Is the soil saturated? Yes _____ No _____ Depth of free-standing water: ________
3. List other field evidence of surface inundation of soil saturation ______________
4. Are hydrology indicators present in the vegetation unit?
   Yes _____ No _____ Inconclusive _____
   Note: It may be necessary to rely on supplemental historical data (e.g., soil surveys) during a dry season or drought year as long as a site has not been significantly modified hydrologically since data collection.
   Rationale: ____
5. Comments: ____

DATA FORM D-5: SUMMARY OF DATA
FOR DETAILED JURISDICTIONAL DETERMINATION

EPA Region: ________ Recorder: ________________________________ Date: ______________
Project/Site: ________________________ State: ______________ County: ______________
Applicant/Owner: ____________________________ Transect #: ____________ Plot #: ________

****

Dominant Species	Indicator Status
1. ________________________________	________
2. ________________________________	________
3. ________________________________	________
4. ________________________________	________
5. ________________________________	________
6. ________________________________	________
7. ________________________________	________
8. ________________________________	________
9. ________________________________	________
10. ________________________________	________
11. ________________________________	________
12. ________________________________	________
13. ________________________________	________
14. ________________________________	________
15. ________________________________	________

****

1. Is hydrophytic vegetation present? Yes _____ No _____ Inconclusive _____
2. Are hydric soils present? Yes _____ No _____ Inconclusive _____
3. Are hydrology indicators present? Yes _____ No _____ Inconclusive _____
4. Overall, is the vegetation unit wetland? Yes _____ No _____ Inconclusive _____
5. Comments: ____
____
____

APPENDIX E

EQUIPMENT NECESSARY FOR

MAKING WETLAND JURISDICTIONAL

DETERMINATIONS

APPENDIX E

EQUIPMENT NECESSARY FOR MAKING WETLAND JURISDICTIONAL DETERMINATIONS

Item	Jurisdictional Approach [1]
National or regional list of plants that occur in wetlands	1,2
National or state hydric soils list	1,2
Key to Soil Taxonomy (optional)[2]	2
National List of Scientific Plant Names (optional)	1,2
State or regional plant identification manuals	1,2
Plant field guides	1,2
Spencer tape	2
Diameter tape or basal area tape	2
Two 0.1m^2 quadrat frames	2
Prism or angle gauge	2
Vasculum or plastic bags	1,2
Sighting compass	2
Pens or pencils	1,2
Clip board and data sheets	1,2
Notebook	1,2
Flagging tape	1,2
Wooden stakes or wire flagging stakes (optional)	1,2
Increment borer (optional)	2
10X hand lens	1,2
Dissecting kit	1,2
Calculator	2
Aerial photographs or topographic map	1,2
Shovel	1,2
Bucket auger and/or soil probe	1,2
Munsel Color Soil Charts	1,2
Colorimetric field test kit (optional)	1,2

1/ 1 refers to equipment needed for simple jurisdictional approach.
2 refers to equipment needed for detailed jurisdictional approach.

2/ Optional items are not necessary, but may be useful in certain situations.

WETLANDS RESEARCH PROGRAM

TECHNICAL REPORT Y-87-1

CORPS OF ENGINEERS WETLANDS DELINEATION MANUAL

by

Environmental Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
PO Box 631, Vicksburg, Mississippi 39180-0631

January 1987
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Prepared for DEPARTMENT OF THE ARMY
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Washington, DC 20314-1000

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Delineation	Manual	Plant communities	Vegetation
Hydrology	Methods	Soil	Wetlands

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

This document presents approaches and methods for identifying and delineating wetlands for purposes of Section 404 of the Clean Water Act. It is designed to assist users in making wetland determinations using a multiparameter approach. Except where noted in the manual, this approach requires positive evidence of hydrophytic vegetation, hydric soils, and wetland hydrology for a determination that an area is a wetland. The multiparameter approach provides a logical, easily defensible, and technical basis for wetland determinations. Technical guidelines are presented for wetlands, deepwater aquatic habitats, and nonwetlands (uplands).

Hydrophytic vegetation, hydric soils, and wetland hydrology are also characterized, and wetland indicators of each parameter are listed.

(Continued)

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19. ABSTRACT (Continued).

Methods for applying the multiparameter approach are described. Separate sections are devoted to preliminary data gathering and analysis, method selection, routine determinations, comprehensive determinations, atypical situations, and problem areas. Three levels of routine determinations are described, thereby affording significant flexibility in method selection.

Four appendices provide supporting information. Appendix A is a glossary of technical terms used in the manual. Appendix B contains data forms for use with the various methods. Appendix C, developed by a Federal interagency panel, contains a list of all plant species known to occur in wetlands of the region. Each species has been assigned an indicator status that describes its estimated probability of occurring in wetlands. A second list contains plant species that commonly occur in wetlands of the region. Morphological, physiological, and reproductive adaptations that enable a plant species to occur in wetlands are also described, along with a listing of some species having such adaptations. Appendix D describes the procedure for examining the soil for indicators of hydric soil conditions, and includes a national list of hydric soils developed by the National Technical Committee for Hydric Soils.

PREFACE

This manual is a product of the Wetlands Research Program (WRP) of the US Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss. The work was sponsored by the Office, Chief of Engineers (OCE), US 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.

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 US Department of Agriculture (USDA), Soil Conservation Service (SCS)) and Mr. Stephen W. Forsythe (formerly detailed to WES by the US 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.

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CONTENTS

CONVERSION FACTORS, NON-SI TO SI (METRIC)
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*
feet	0.3048	metres
inches	2.54	centimetres
miles (US statute)	1.6093	kilometres
square inches	6.4516	square centimetres

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

CORPS OF ENGINEERS WETLANDS DELINEATION MANUAL

PART I: INTRODUCTION

Background

1. Recognizing the potential for continued or accelerated degradation of the Nation's waters, the US 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.*

b. Provide methods for applying the technical guidelines.

c. Provide supporting information useful in applying the technical guidelines.

---

* 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 (see paragraph 26a), 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), US 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 position 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:

<u>a</u>. The definition of wetlands (paragraph 26<u>a</u>) 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.

<u>b</u>. 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. 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.

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

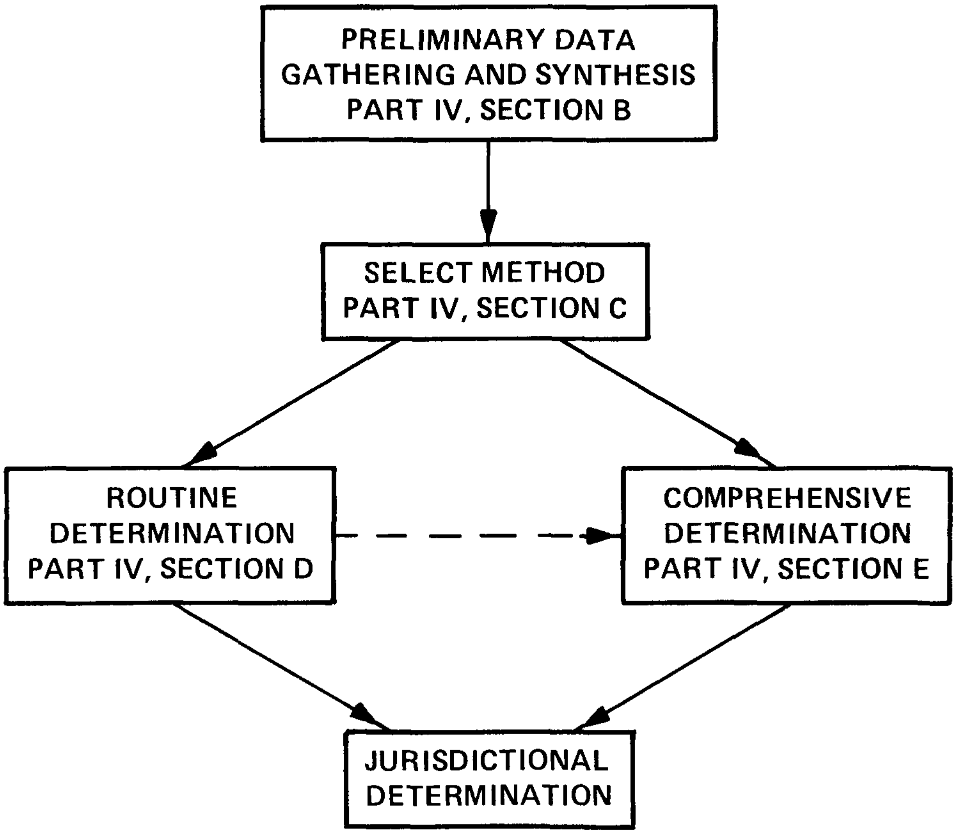

Figure 1. General schematic diagram of activities leading to a wetland/nonwetland determination

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 (see paragraph 26a) 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.

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 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.* Indicators of vegetation associated with wetlands are listed in paragraph 35.

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* Species (e.g. *Acer rubrum*) having broad ecological tolerances occur in both wetlands and nonwetlands.

(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.* 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.**

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.

(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.

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

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

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.*

   (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.

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* 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 (paragraph 26a) 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.

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 FAC* (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.

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.)

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

Table 1

Plant Indicator Status Categories*

Indicator Category	Indicator Symbol	Definition
OBLIGATE WETLAND PLANTS	OBL	Plants that occur almost always (estimated probability >99%) in wetlands under natural conditions, but which may also occur rarely (estimated probability <1%) in nonwetlands. Examples: *Spartina alterniflora*, *Taxodium distichum*.
FACULTATIVE WETLAND PLANTS	FACW	Plants that occur usually (estimated probability >67% to 99%) in wetlands, but also occur (estimated probability 1% to 33% in nonwetlands). Examples: *Fraxinus pennsylvanica*, *Cornus stolonifera*.
FACULTATIVE PLANTS	FAC	Plants with a similar likelihood (estimated probability 33% to 67%) of occurring in both wetlands and nonwetlands. Examples: *Gleditsia triacanthos*, *Smilax rotundifolia*.
FACULTATIVE UPLAND PLANTS	FACU	Plants that occur sometimes (estimated probability 1% to <33%) in wetlands, but occur more often (estimated probability >67% to 99%) in nonwetlands. Examples: *Quercus rubra*, *Potentilla arguta*.
OBLIGATE UPLAND PLANTS	UPL	Plants that occur rarely (estimated probability <1%) in wetlands, but occur almost always (estimated probability >99%) in nonwetlands under natural conditions. Examples: *Pinus echinata*, *Bromus mollis*.

* 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).

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).

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:*

a. More than 50 percent of the dominant species are OBL, FACW, or FAC** (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

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* 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.

** 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.

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	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.

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

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* 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

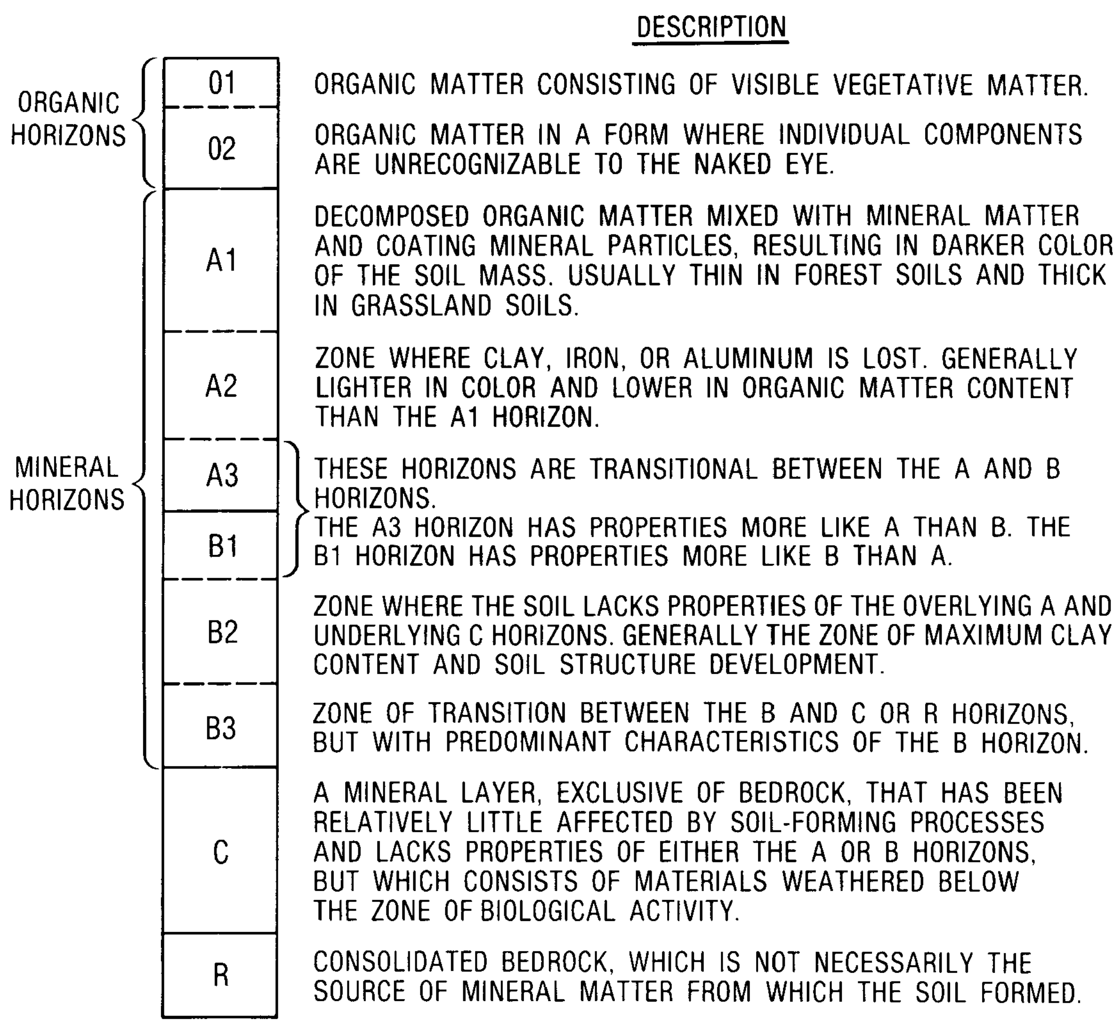

Figure 2. Generalized soil profile

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

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* 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

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

Figure 3. Organic soil

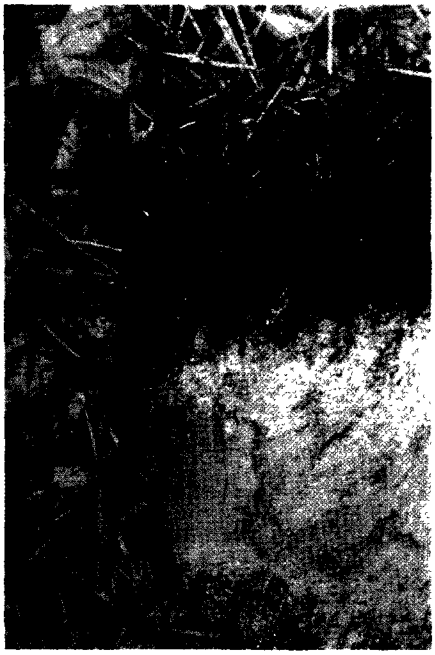

Figure 4. Gleyed soil

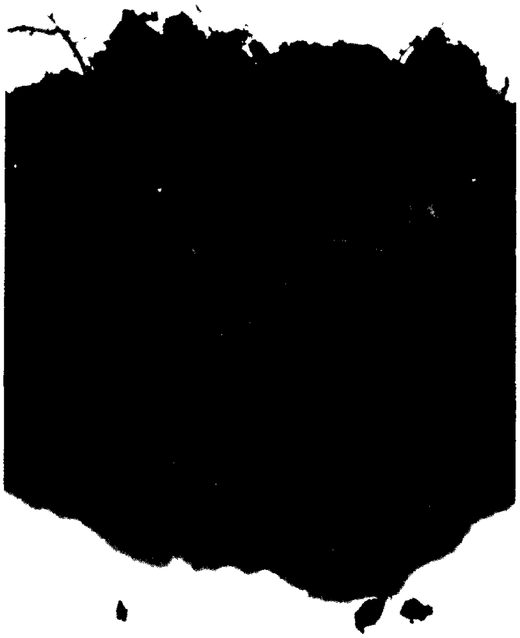

Figure 5. Soil showing matrix (brown) and mottles (reddish-brown)

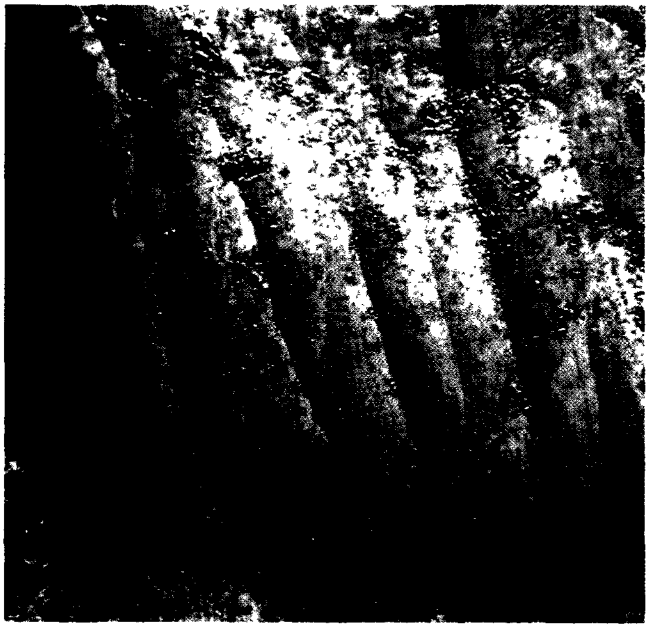

Figure 6. Iron and manganese concretions

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.

Classification

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

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* 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

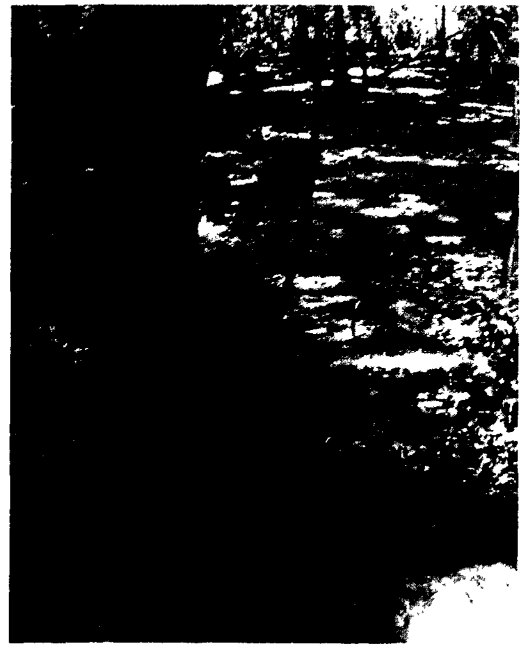

Figure 8. Absence of leaf litter and drift line (extreme left)

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

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* 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:

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* 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

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* 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.

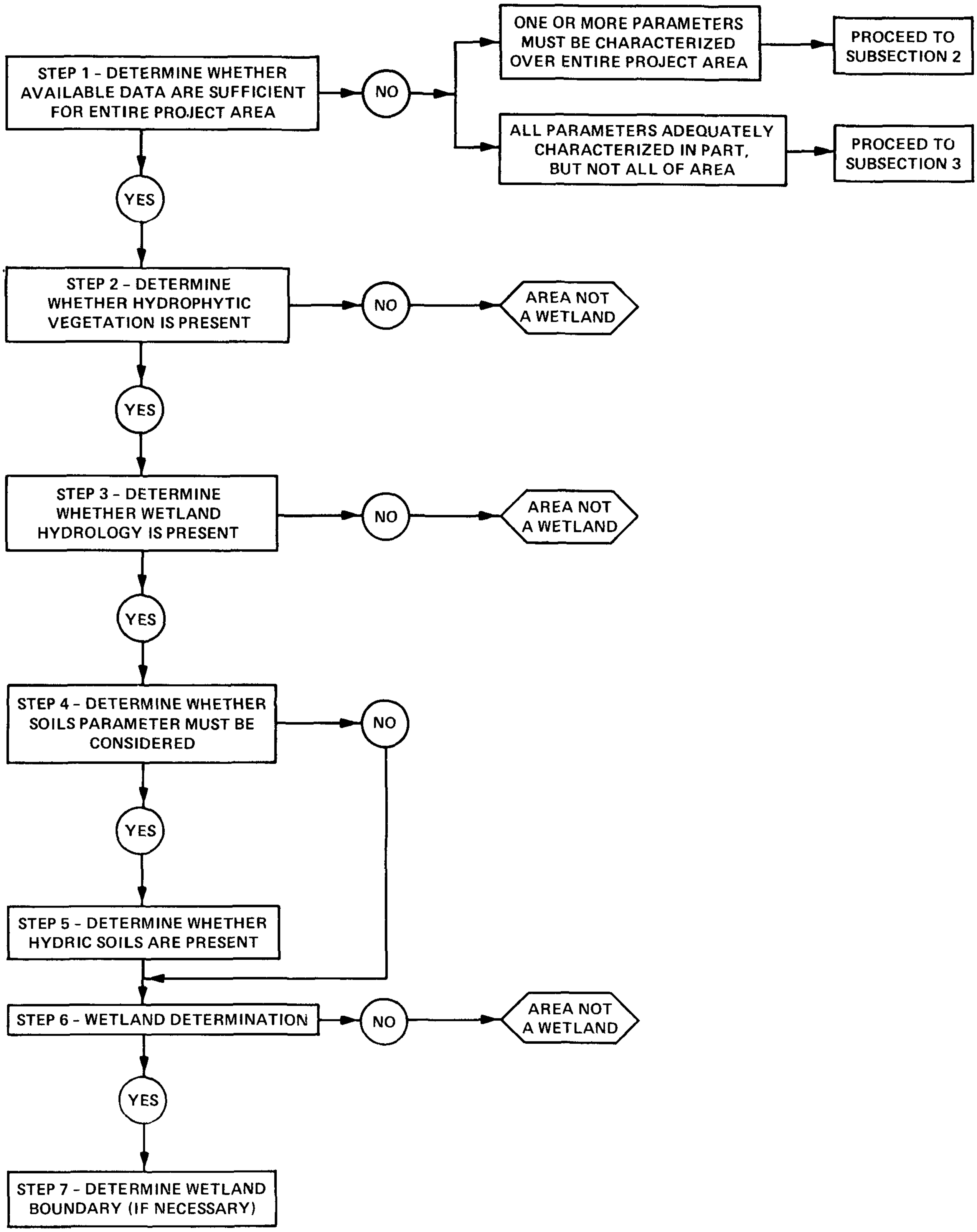

Figure 13. Flowchart of steps involved in making a wetland determination when an onsite inspection is unnecessary

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

• STEP 2 - Determine Whether Hydrophytic Vegetation Is Present. 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.

• STEP 3 - Determine Whether Wetland Hydrology Is Present. 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:

a. 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).

b. 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 a or b 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

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

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

a. Has plant communities dominated by one or more FAC species;
b. Has vegetation dominated by FACW species but no adjacent community dominated by OBL species;
c. Has a gradual, nondistinct boundary between wetlands and nonwetlands; and/or
d. 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.

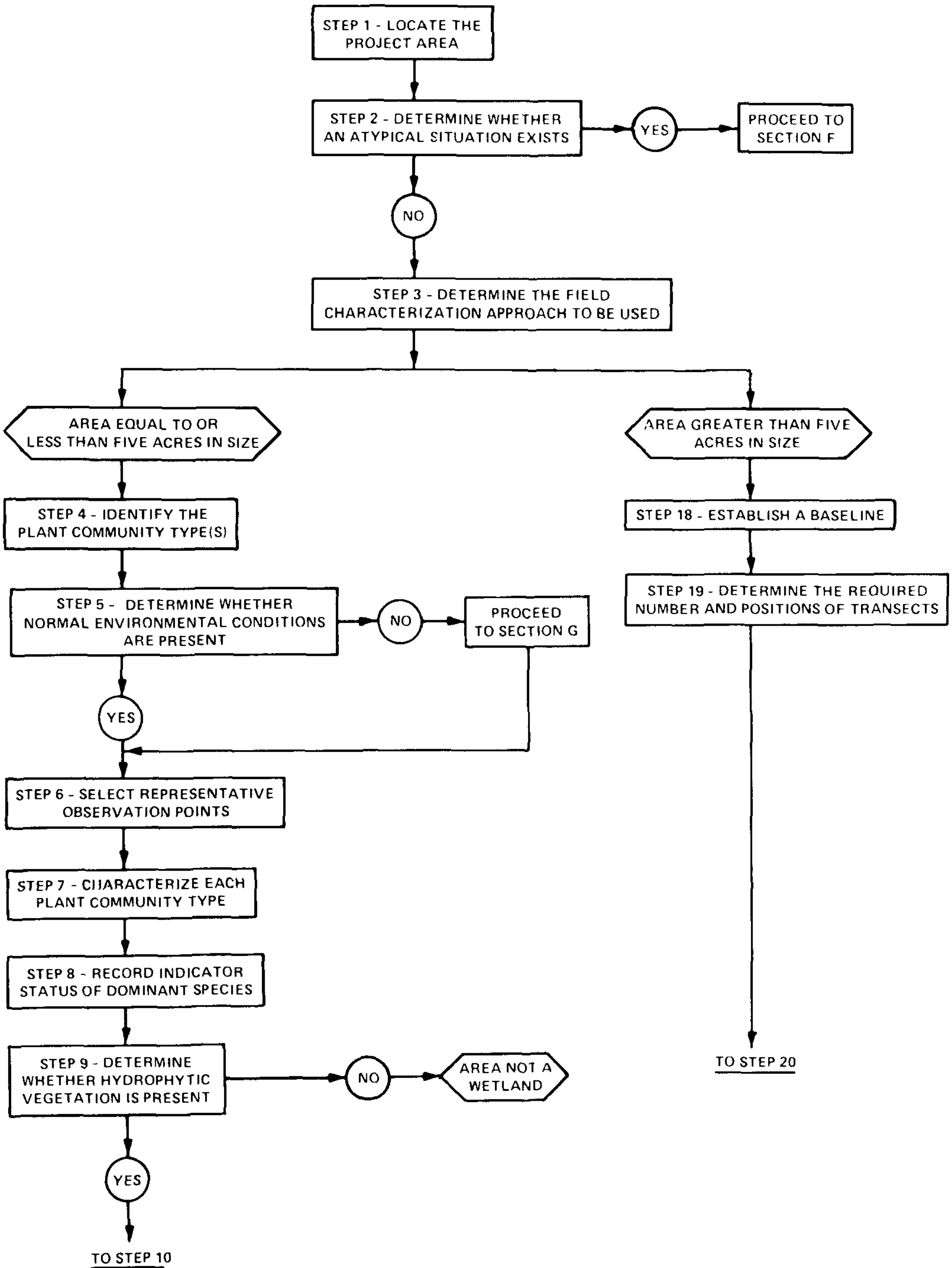

Figure 14. Flowchart of steps involved in making a routine wetland determination when an onsite visit is necessary (Continued)

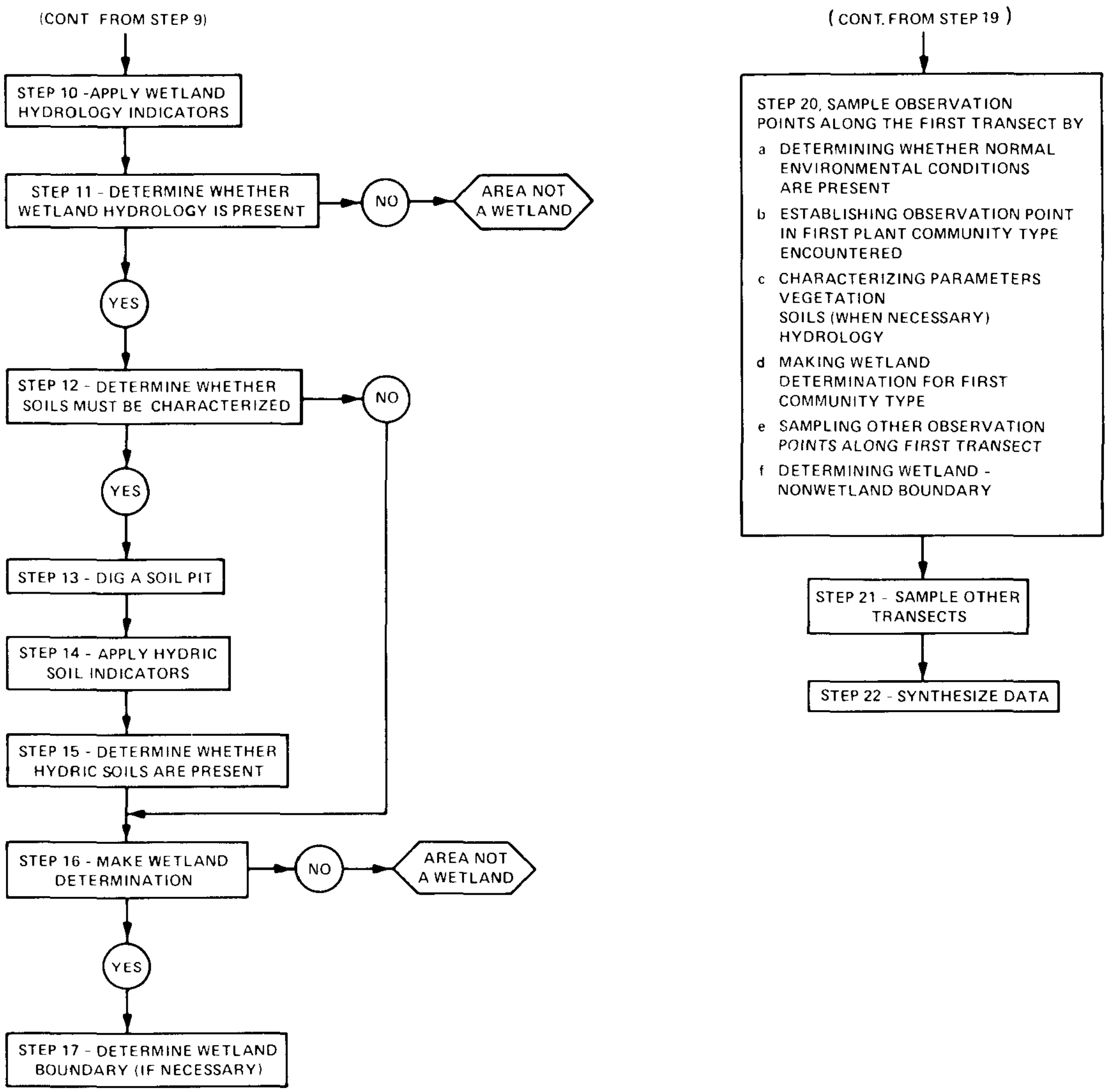

Figure 14. (Concluded)

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.

- STEP 7 - Characterize Each Plant Community Type. 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.
- STEP 8 - Record Indicator Status of Dominant Species. 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.
- STEP 9 - Determine Whether Hydrophytic Vegetation Is Present. 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.
- STEP 10 - Apply Wetland Hydrologic Indicators. 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.
- STEP 11 - Determine Whether Wetland Hydrology Is Present. 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.

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* 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

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* 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

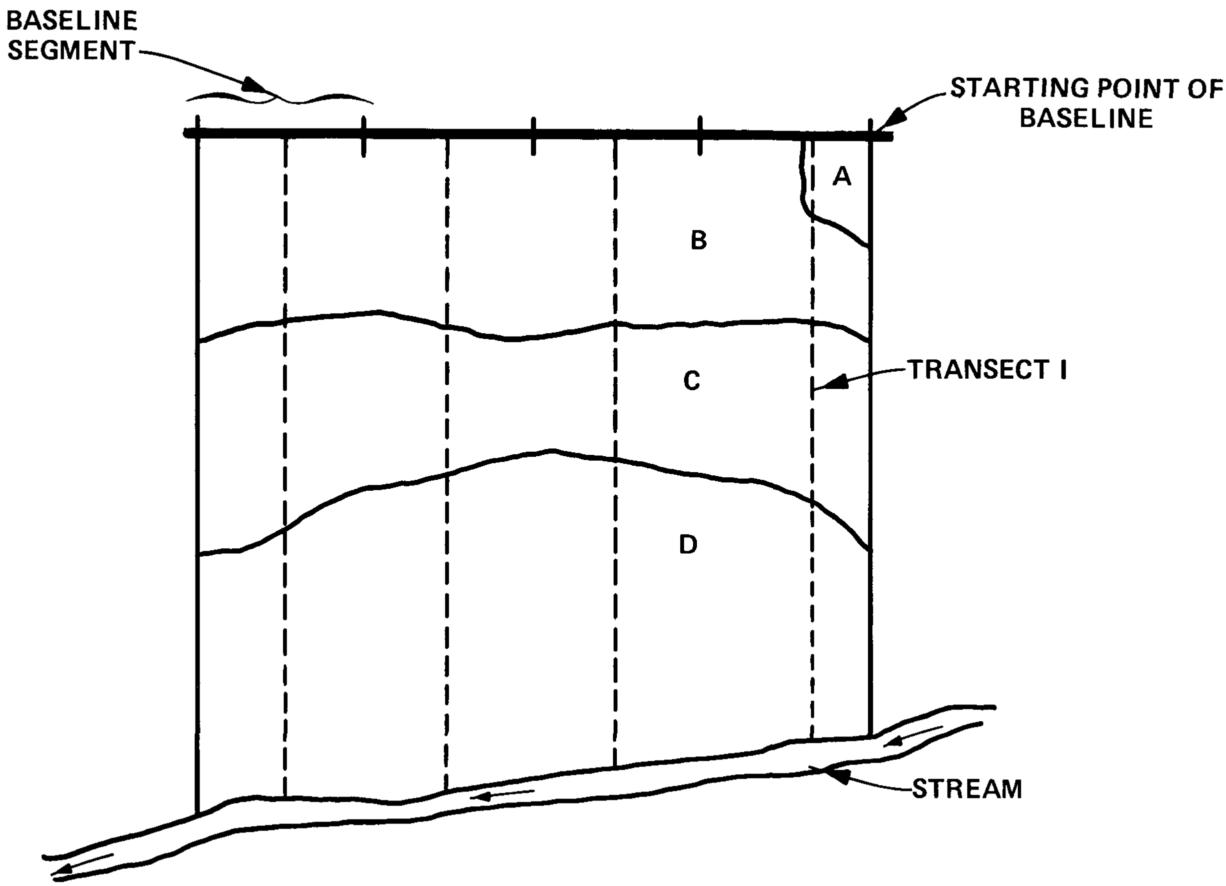

Figure 15. General orientation of baseline and transects (dotted lines) in a hypothetical project area. Alpha characters represent different plant communities. All transects start at the midpoint of a baseline segment except the first, which was repositioned to include community type A

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

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* 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.

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* 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).

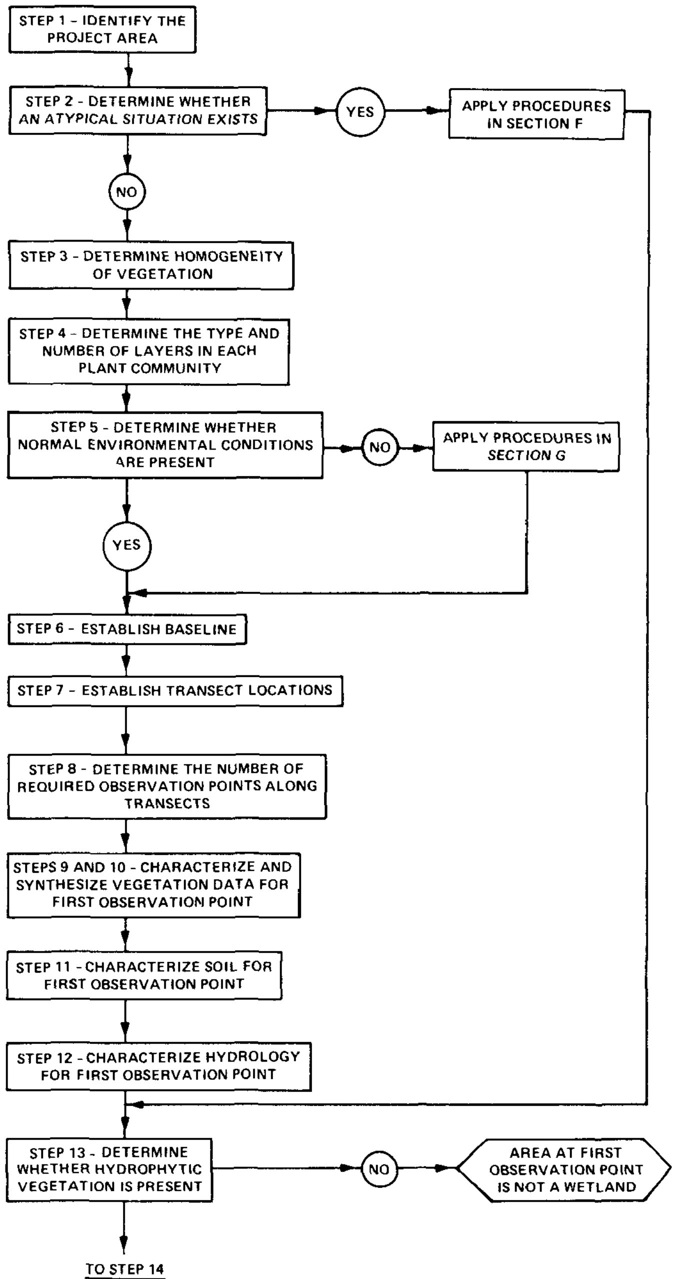

Figure 16. Flowchart of steps involved in making a comprehensive wetland determination (Section E) (Continued)

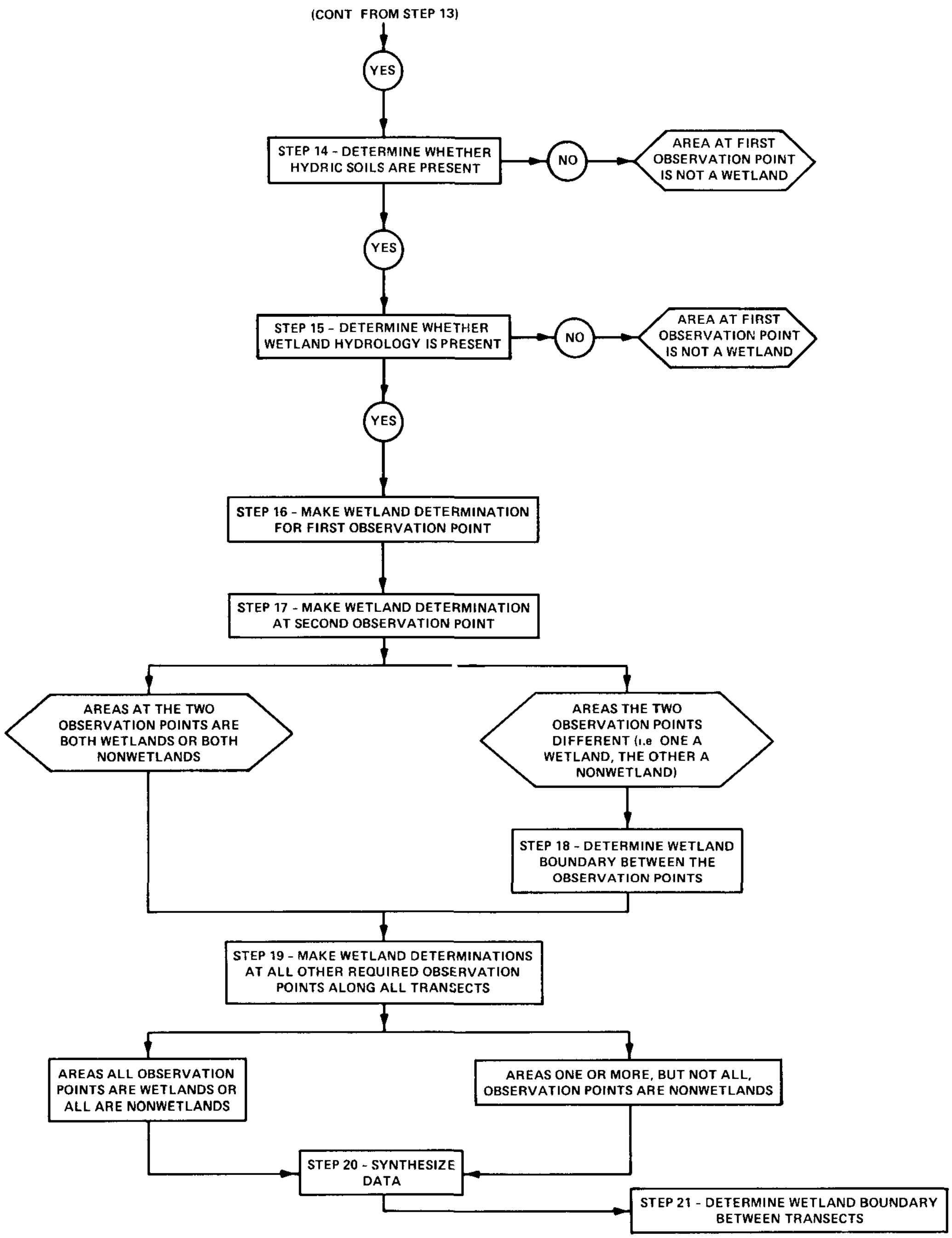

Figure 16. (Concluded)

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 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 - 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

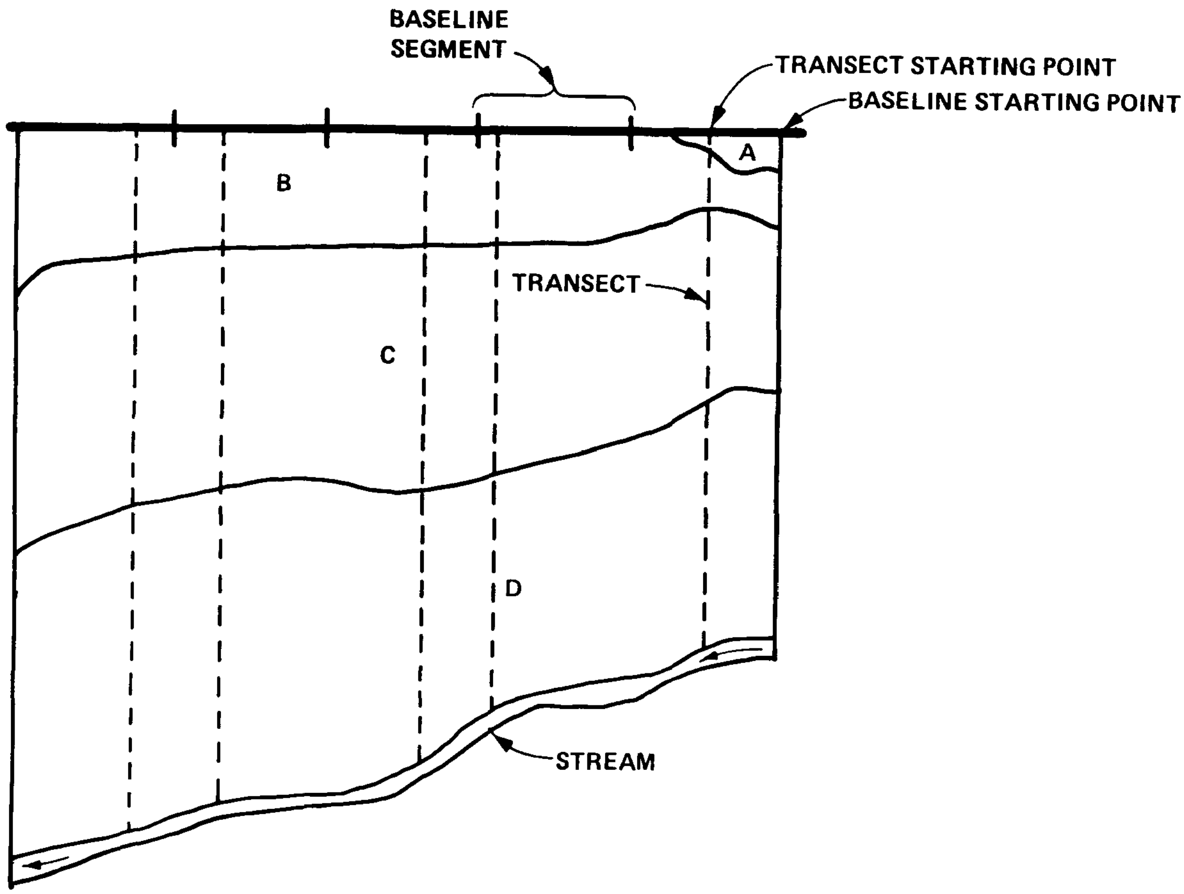

Figure 17. General orientation of baseline and transects in a hypothetical project area. Alpha characters represent different plant communities. Transect positions were determined using a random numbers table

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

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* 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 only 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?

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

PROCEED TO STEP 3.

• STEP 3 - Determine the Type of Vegetation That Previously Occurred.

Obtain all possible evidence of the type of plant communities that occurred in the area prior to alteration. Potential sources of such evidence include:

a. Aerial photography. Recent (within 5 years) aerial photography can often be used to document the type of previous vegetation. The general type of plant communities formerly present can usually be determined, and species identification is sometimes possible.

b. Onsite inspection. Many types of activities result in only partial removal of the previous plant communities, and remaining species may be indicative of hydrophytic vegetation. In other cases, plant fragments (e.g. stumps, roots) may be used to reconstruct the plant community types that occurred prior to site alteration. Sometimes, this can be determined by examining piles of debris resulting from land-clearing operations or excavation to uncover identifiable remains of the previous plant community.

c. Previous site inspections. Documented evidence from previous inspections of the area may describe the previous plant communities, particularly in cases where the area was altered after a permit application was denied.

d. Adjacent vegetation. Circumstantial evidence of the type of plant communities that previously occurred may sometimes be obtained by examining the vegetation in adjacent areas. If adjacent areas have the same topographic position, soils, and hydrology as the altered area, the plant community types on the altered area were probably similar to those of the adjacent areas.

e. SCS records. Most SCS soil surveys include a description of the plant community types associated with each soil type. If the soil type on the altered area can be determined, it may be possible to generally determine the type of plant communities that previously occurred.

f. Permit applicant. In some cases, the permit applicant may provide important information about the type of plant communities that occurred prior to alteration.

g. Public. Individuals familiar with the area may provide a good general description of the previously occurring plant communities.

h. NWI wetland maps. The NWI has developed wetland type maps for many areas. These may be useful in determining the type of plant communities that occurred prior to alteration.

To develop the strongest possible record, all of the above sources should be considered. If the plant community types that occurred prior 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

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* 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.

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* 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

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* 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?

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* 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.

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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 aboveground 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.

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* 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

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

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* 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
1	*Quercus lyrata*	465	1,145	1
2	*Quercus lyrata*	680		
3	*Carya aquatica*	85	243	3
4	*Carya aquatica*	120		
5	*Carya aquatica*	38		
6	*Gleditsia aquatica*	235	253	2
7	*Gleditsia aquatica*	18		
8	*Diospyros virginiana*	46	46	
9				
10				

HERBS		MIDPOINT OF % COVER CLASS	RANK
1	*Boehmeria cylindrica*	37.5	2
2	*Polygonum hydropiperoides*	62.5	1
3	*Brunnichia ovata*	37.5	3
4	*Gleditsia aquatica* (seedling)	2.5	
5	*Eclipta alba*	2.5	
6			
7			
8			
9			
10			

SAPLINGS/SHRUBS		MIDPOINT OF HEIGHT CLASS	TOTAL HEIGHT CLASS	RANK
1	*Forestiera acuminata*	4.5	13.0	1
2	*Forestiera acuminata*	4.5		
3	*Forestiera acuminata*	1.5		
4	*Forestiera acuminata*	2.5		
5	*Planera aquatica*	4.5	8.0	2
6	*Planera aquatica*	3.5		
7	*Carya aquatica*	1.5	1.5	
8				
9				
10				

WOODY VINES		NUMBER OF STEMS	RANK
1	*Toxicodendron radicans*	35	1
2	(only woody vine present)		
3			
4			
5			
6			
7			
8			
9			
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; multitrunk; 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 α-α-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.

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* 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.

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* 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)

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)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
HOLLY SPRINGS	Cumulic Haplaquolls	INSAK	Typic Tropaquents
HOLOPAW	Grossarenic Ochraqualfs	IPSWICH	Typic Sulfihemists
HOMOSASSA	Typic Sulfaquents	IRIM	Typic Haplaquolls
HONTOON (DR)	Typic Medisaprists	IROQUOIS (DR)	Typic Argiaquolls
HOODOO	Mollic Andaquepts	ISAN (DR)	Typic Haplaquolls
HOOSIERVILLE	Typic Ochraqualfs	ISANTI (DR)	Typic Haplaquolls
HOUGHTON (DR)	Typic Medisaprists	ISLES	Arenic Ochraqualfs
HOUK	Argiaquic Xeric Argialbolls	ISTOKPOGA	Typic Medihemists
HOULKA (FF)	Vertic Haplaquepts	IVIE	Torriorthentic Haploxerolls
HOVDE	Typic Psammaquents	JACKPORT	Vertic Ochraqualfs
HOVEN	Typic Natraquolls	JACOB	Vertic Haplaquepts
HOVERT	Aquic Natrargids	JACOBSEN	Histic Cryaquepts
HOYTVILLE	Mollic Ochraqualfs	JAMES	Cumulic Haplaquolls
HUEY	Typic Natraqualfs	JAMESTON	Typic Argiaquolls
HUICHICA (P)	Abruptic Haplic Durixeralfs	JAREALES	Thapto-Histic Tropic Fluvaquents
HUMBOLDT	Fluvaquentic Haplaquolls	JAROLA	Typic Argialbolls
HUMESTON	Argiaquic Argialbolls	JARRON	Typic Natraqualfs
HUNCHBACK	Cumulic Cryaquolls	JASCO	Typic Fragiaqualfs
HUSSA	Fluvaquentic Haplaquolls	JEDDO (DR)	Aeric Ochraqualfs
HYDABURG	Lithic Cryohemists	JEFFERS	Typic Haplaquolls
HYDE (DR)	Typic Umbraquults	JENA (FF)	Fluventic Dystrochrepts
IBERIA	Vertic Haplaquolls	JOENEY	Typic Sideraquods
ICARIA (DR)	Typic Umbraquults	JOHNSTON (DR)	Cumulic Humaquepts
ICENE	Aquic Camborthids	JOICE	Typic Medisaprists
ICESLEW	Typic Haplaquepts	JOLIET	Lithic Haplaquolls
IGUALDAD	Typic Tropaquepts	JOSEPH	Aquic Xerofluvents
IJAM	Vertic Fluvaquents	JUBILEE	Typic Haplaquolls
ILACHETOMEL	Typic Sulfihemists	JUDICE	Vertic Haplaquolls
ILION	Mollic Ochraqualfs	JUNTURA	Cumulic Haplaquolls
IMMOKALEE	Arenic Haplaquods	JUPITER	Lithic Haplaquolls
INCELL	Cumulic Haplaquolls	JURVANNAH	Typic Cryaquents
INEZ	Typic Albaqualfs	KADE	Typic Cryaquents
INKOM	Cumulic Haplaquolls	KAIKLI	Lithic Cryosaprists
INKOSR	Typic Tropaquepts	KALIFONSKY	Typic Cryaquepts
INMACHUK	Pergelic Cryofibrists	KALIGA	Terric Medisaprists

(Continued)

Soil Phase	Classification	Soil Phase	Classification
KALMARVILLE	Mollic Fluvaquents	KIMMERLING	Cumulic Haplaquolls
KALOKO	Typic Calciaquolls	KINA	Typic Cryohemists
KALONA	Typic Haplaquolls	KINDER	Typic Glossaqualfs
KAMAN	Typic Pelluderts	KINGILE	Terric Medisaprists
KANAPAHA	Grossarenic Paleaquults	KINGMAN	Fluvaquentic Haplaquolls
KANEBREAK	Cumulic Haplaquolls	KINGS (DR)	Vertic Haplaquolls
KANONA	Aeric Haplaquepts	KINGSLAND	Typic Medihemists
KANTISHNA	Hydric Borofibrists	KINGSVILLE (DR)	Mollic Psammaquents
KANUTCHAN	Typic Pelloxererts	KINKORA	Typic Ochraquults
KANZA	Mollic Psammaquents	KINROSS (DR)	Typic Haplaquods
KARANKAWA	Typic Haplaquents	KINSMAN (DR)	Aeric Haplaquods
KARHEEN	Typic Cryosaprists	KINSTON (DR)	Typic Fluvaquents
KARLUK	Typic Cryaquepts	KIRK	Andic Cryaquepts
KARNAK	Vertic Haplaquepts	KIZHUYAK	Andaqueptic Cryaquents
KARSHNER	Pergelic Cryaquepts	KJAR	Histic Humaquepts
KATO (DR)	Typic Haplaquolls	KLABER	Typic Glossaqualfs
KAUFMAN	Typic Pelluderts	KLAMATH	Cumulic Cryaquolls
KEALIA	Typic Salorthids	KLANELNEECHENA	Histic Pergelic Cryaquepts
KEANSBURG	Typic Umbraquults	KLAWASI	Histic Pergelic Cryaquepts
KEECHI	Typic Fluvaquents	KNIGHT	Argiaquic Argialbolls
KENNER	Fluvaquentic Medisaprists	KNOKE (DR)	Cumulic Haplaquolls
KENUSKY	Umbric Paleaquults	KOBEL	Vertic Haplaquepts
KEOWNS (DR)	Mollic Haplaquepts	KOGISH	Typic Sphagnofibrists
KERSTON (DR)	Fluvaquentic Medisaprists	KOKOMO	Typic Argiaquolls
KESSON	Typic Pasammaquents	KOLLS	Vertic Haplaquolls
KESTERSON	Glossic Natraqualfs	KOLLUTUK	Pergelic Ruptic-Histic Cryaquepts
KETONA	Vertic Ochraqualfs	KOOLAU	Plinthic Tropaquepts
KEYESPOINT (FF)	Vertic Haplaquepts	KOSMOS	Typic Humaquepts
KEZAN	Mollic Fluvaquents	KOSSUTH	Typic Haplaquolls
KIAN	Aeric Fluvaquents	KOTO	Typic Natraquolls
KILGORE	Cumulic Cryaquolls	KOURY (FF)	Fluvaquentic Dystrochrepts
KILLBUCK	Typic Fluvaquents	KOVICH	Cumulic Haplaquolls
KILLEY	Typic Cryaquents	KRATKA (DR)	Typic Haplaquolls
KILMANAGH (DR)	Aeric Haplaquepts	KUSKOKWIM	Histic Pergelic Cryaquepts
KILWINNING	Vertic Ochraqualfs	KUSLINA	Histic Pergelic Cryaquepts

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
KYDAKA	Typic Humaquepts	LAWET	Typic Calciaquolls
LABISH	Cumulic Humaquepts	LAWNWOOD	Aeric Haplaquods
LABOUNTY	Typic Humaquepts	LAWSON (FF)	Cumulic Hapludolls
LACAMAS	Typic Glossaqualfs	LEAF	Typic Albaquults
LACERDA	Aquentic Chromuderts	LEAGUEVILLE	Arenic Paleaquults
LACHAPELLA	Typic Cryaquepts	LEAKSVILLE	Typic Albaqualfs
LACOOCHEE	Spodic Psammaquents	LEBEAU	Aquentic Chromuderts
LACOTA (DR)	Mollic Haplaquepts	LEDWITH	Mollic Albaqualfs
LAFITTE	Typic Medisaprists	LEE	Typic Fluvaquents
LAGRANGE	Typic Ochraqualfs	LEICESTER	Aeric Haplaquepts
LAHRITY	Mollic Haplaquepts	LEMETA	Pergelic Cryofibrists
LAJARA	Typic Haplaquolls	LEMOLO	Typic Humaquepts
LAKE CHARLES	Typic Pelluderts	LEMOND (DR)	Typic Haplaquolls
LAKEMONT	Udollic Ochraqualfs	LENA (DR)	Typic Medisaprists
LAKESHORE	Typic Salorthids	LENAWEE (DR)	Mollic Haplaquepts
LALLIE (DR)	Typic Fluvaquents	LENOIR (FF)	Aeric Paleaquults
LAM	Fluvaquentic Haplaquolls	LEON	Aeric Haplaquods
LAMINGTON	Typic Fragiaquults	LEONARD	Vertic Ochraqualfs
LAMO	Cumulic Haplaquolls	LEONARDTOWN	Typic Fragiaquults
LAMOOSE	Typic Haplaquolls	LETON	Typic Glossaqualfs
LAMOURE (DR)	Cumulic Haplaquolls	LETRI	Typic Haplaquolls
LAMSON (DR)	Aeric Haplaquepts	LEVASY	Fluvaquentic Haplaquolls
LANEXA	Terric Medisaprists	LEVELTON	Typic Haplaquepts
LANG (FF)	Typic Psammaquents	LEVY	Typic Hydraquents
LANGLOIS	Tropic Fluvaquents	LICKDALE	Humic Haplaquepts
LANTON (DR)	Cumulic Haplaquolls	LIDDELL (DR)	Typic Haplaquepts
LANTZ	Typic Umbraqualfs	LIGHTNING	Typic Ochraqualfs
LANYON	Typic Haplaquolls	LILBOURN	Aeric Fluvaquents
LAROSE	Typic Hydraquents	LIM (DR)	Aeric Fluvaquents
LARRY	Typic Haplaquolls	LIMERICK	Typic Fluvaquents
LATAHCO	Argiaquic Xeric Argialbolls	LINDAAS (DR)	Typic Argiaquolls
LATHER	Limnic Borohemists	LINWOOD (DR)	Terric Medisaprists
LATTY	Typic Haplaquepts	LIPAN	Entic Pellusterts
LAUDERHILL (DR)	Lithic Medisaprists	LIPPINCOTT	Typic Argiaquolls
LAUGENOUR (FF)	Aeric Fluvaquents	LISCO	Typic Halaquepts

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
LITRO	Vertic Haplaquepts	MACKEN	Vertic Haplaquolls
LIVIA	Typic Natraqualfs	MADALIN	Mollic Ochraqualfs
LIVINGSTON (DR)	Mollic Haplaquepts	MADELIA	Typic Haplaquolls
LOBO	Hemic Sphagnofibrists	MAGNA	Typic Calciaquolls
LOCODA	Typic Fluvaquents	MAGOTHA	Typic Natraqualfs
LOGAN	Typic Calciaquolls	MAHALASVILLE (DR)	Typic Argiaquolls
LOGY (FF)	Torrifluventic Haploxerolls	MAHTOWA (DR)	Typic Haplaquolls
LOKOSEE	Grossarenic Ochraqualfs	MALABAR	Grossarenic Ochraqualfs
LOLAK	Typic Halaquepts	MANAHAWKIN	Terric Medisaprists
LOMALTA	Udorthentic Pellusterts	MANATEE	Typic Argiaquolls
LORAIN (DR)	Mollic Ochraqualfs	MANFRED (DR)	Typic Natraquolls
LOTUS	Aquic Quartzipsamments	MANN (DR)	Typic Haplaquolls
LOUGHBORO	Aeric Glossaqualfs	MANSFIELD	Typic Fragiaquepts
LOUIN	Aquentic Chromuderts	MARCUS	Typic Haplaquolls
LOUP	Typic Haplaquolls	MARCUSE	Vertic Haplaquepts
LOVELAND	Fluvaquentic Haplaquolls	MARCY	Typic Fraqiaquepts
LOVELOCK	Fluvaquentic Haplaquolls	MARENGO	Typic Argiaquolls
LOWS (DR)	Mollic Haplaquepts	MARGATE	Mollic Psammaquents
LOXLEY (DR)	Typic Borosaprists	MARIA (FF)	Typic Haplaquepts
LOYSVILLE	Typic Fragiaqualfs	MARKES	Typic Ochraqualfs
LUDDEN (DR)	Vertic Haplaquolls	MARKEY (DR)	Terric Borosaprists
LUFKIN	Vertic Albaqualfs	MARLA	Aquic Cryumbrepts
LUMBEE (DR)	Typic Ochraquults	MARLAKE	Mollic Fluvaquents
LUMMI	Fluvaquentic Haplaquolls	MARNA	Typic Haplaquolls
LUNCH	Terric Cryohemists	MARSHAN (DR)	Typic Haplaquolls
LUPTON (DR)	Typic Borosaprists	MARSHBROOK	Cumulic Haplaquolls
LURA (DR)	Cumulic Haplaquolls	MARSHDALE	Cumulic Haplaquolls
LURAY	Typic Argiaquolls	MARSHFIELD (DR)	Typic Ochraqualfs
LUTE (P)	Typic Natraquolls	MARTEL	Typic Umbraqualfs
LUTON	Vertic Haplaquolls	MARTIN PENA	Tropic Fluvaquents
LYLES	Typic Haplaquolls	MARTISCO	Histic Humaquepts
LYME (DR)	Aeric Haplaquepts	MARYSLAND (DR)	Typic Calciaquolls
LYNN HAVEN	Typic Haplaquods	MASCOTTE	Ultic Haplaquods
LYNNE	Ultic Haplaquods	MASHULAVILLE	Typic Fragiaquults
LYONS (DR)	Mollic Haplaquepts	MASONTOWN	Cumulic Humaquepts

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
MASSENA	Aeric Haplaquepts	MEIKLE	Typic Albaqualfs
MASSIE	Typic Argialbolls	MELHOMES	Humaqueptic Psammaquents
MATAGORDA	Typic Natraqualfs	MELTON	Humic Cryaquepts
MATHISTON	Aeric Fluvaquents	MELVIN	Typic Fluvaquents
MATTAMUSKEET (DR)	Terric Medisaprists	MENASHA (DR)	Typic Haplaquolls
MATTAN	Terric Medisaprists	MENDELTNA	Histic Pergelic Cryaquepts
MATUNUCK	Typic Sulfaquents	MENDENHALL	Cumulic Cryaquolls
MAUMEE (DR)	Typic Haplaquolls	MENLO	Histic Humaquepts
MAUREPAS	Typic Medisaprists	MERCEDES (F)	Udorthentic Pellusterts
MAURERTOWN	Typic Ochraqualfs	MERDEN	Fluvaquentic Haplaquolls
MAVIE	Typic Calciaquolls	MERMENTAU	Aeric Haplaquepts
MAXCREEK	Typic Haplaquolls	MERMILL (DR)	Mollic Ochraqualfs
MAXFIELD	Typic Haplaquolls	MERWIN (DR)	Terric Borohemists
MAYBESO	Terric Cryosaprists	MESEI	Terric Troposaprists
MAYBID	Typic Humaquepts	MHOON	Typic Fluvaquents
MAYER (DR)	Typic Haplaquolls	MICCO	Terric Medifibrists
MAYHEW	Vertic Ochraqualfs	MIDLAND	Typic Ochraqualfs
MAZASKA	Typic Argiaquolls	MILFORD (DR)	Typic Haplaquolls
MCCLEARY	Aeric Fluvaquents	MILLERVILLE (DR)	Limnic Borohemists
MCCOLL (DR)	Typic Fragiaquults	MILLGROVE	Typic Argiaquolls
MCCRORY	Albic Glossic Natraqualfs	MILLINGTON (DR)	Cumulic Haplaquolls
MCCUNE	Aeric Glossaqualfs	MILLSDALE	Typic Argiaquolls
MCDONALDSVILLE	Typic Haplaquolls	MINER	Mollic Ochraqualfs
MCFAIN (DR)	Fluvaquentic Haplaquolls	MINNETONKA (DR)	Typic Argiaquolls
MCGEHEE	Aeric Ochraqualfs	MINNEWAUKAN	Typic Psammaquents
MCGIRK	Typic Ochraqualfs	MINNIECE	Typic Umbraqualfs
MCGUFFEY	Histic Humaquepts	MINOCQUA (DR)	Mollic Haplaquepts
MCKEE	Typic Hydraquents	MINTER (FF)	Typic Ochraqualfs
MCKENNA	Mollic Haplaquepts	MITCH (F)	Cumulic Haploborolls
MCKENSIE	Typic Haplaquepts	MOAG	Typic Fluvaquents
MCMURRAY	Typic Medihemists	MOLAS	Typic Argialbolls
MEDANO	Typic Haplaquolls	MOLLVILLE	Typic Glossaqualfs
MEDFRA	Histic Pergelic Cryaquepts	MONARDA (DR)	Aeric Fragiaquepts
MEDOMAK	Fluvaquentic Humaquepts	MONEE	Mollic Ochraqualfs
MEGGETT (DR)	Typic Albaqualfs	MONITEAU	Typic Ochraqualfs

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
MONROEVILLE (DR)	Typic Argiaquolls	NACLINA	Aquentic Chromuderts
MONTEOCHA	Ultic Haplaquods	NADA	Typic Albaqualfs
MONTGOMERY (DR)	Typic Haplaquolls	NAHATCHE	Aeric Fluvaquents
MONTVERDE	Typic Medifibrists	NAHMA (DR)	Histic Humaquepts
MOOREVILLE (FF)	Fluvaquentic Dystrochrepts	NAKINA (DR)	Typic Umbraqualfs
MOOSE RIVER	Typic Cryaquents	NAKNEK	Histic Pergelic Cryaquepts
MOOSELAKE (DR)	Typic Borohemists	NANIAK	Typic Sulfaquents
MOOSILAUKE (DR)	Aeric Haplaquepts	NAPA	Typic Natraquolls
MORALES	Aeric Glossaqualfs	NAPOLEON	Typic Medihemists
MORELAND (FF)	Vertic Hapludolls	NARROWS	Calcic Cryaquolls
MOREY	Typic Argiaquolls	NARTA	Typic Natraqualfs
MORPH (DR)	Typic Glossaqualfs	NASKEAG	Aeric Haplaquods
MOSLANDER	Typic Cryaquolls	NASS	Typic Haplaquents
MOULTRIE	Spodic Psammaquents	NATAL	Umbric Ochraqualfs
MOUNDPRAIRIE	Mollic Fluvaquents	NATROY	Aquic Chromoxererts
MOUNTAINVIEW	Fluvaquentic Medisaprists	NAVAJO	Vertic Torrifluvents
MOUNTMED		NAVAN (DR)	Typic Argiaquolls
MOWATA	Typic Glossaqualfs	NAWNEY	Typic Fluvaquents
MOYINA	Andic Cryaquepts	NELSE (FF)	
MUCKALEE	Typic Fluvaquents	NEMAH	Humic Haplaquepts
MUDSOCK	Mollic Haplaquepts	NESS	Udic Pellusterts
MUKILTEO	Typic Medihemists	NETTLES	Alfic Arenic Haplaquods
MULAT	Arenic Ochraquults	NEVERSINK	Aeric Haplaquepts
MULDROW	Typic Argiaquolls	NEWALBIN	Typic Fluvaquents
MULLICA	Typic Humaquepts	NEWARK (P)	Aeric Fluvaquents
MULLINS	Typic Fragiaquults	NEWBERG	Fluventic Haploxerolls
MUNSET	Ultic Haploxeralfs	NEWBERRY	Mollic Ochraqualfs
MURVILLE	Typic Haplaquods	NEWELLTON (FF)	Aeric Fluvaquents
MUSKEGO (DR)	Limnic Medisaprists	NEWSON (DR)	Humaqueptic Psammaquents
MUSSEY (DR)	Typic Argiaquolls	NEWTON (DR)	Typic Humaquepts
MUSTANG	Typic Psammaquents	NGERUNGOR	Typic Sulfihemists
MYAKKA	Aeric Haplaquods	NIKFUL	Aquultic Hapludalfs
MYATT (DR)	Typic Ochraquults	NIKOLAI (DR)	Terric Borosaprists
MYRICK (DR)	Fluvaquentic Haplaquolls	NIMMO (DR)	Typic Ochraquults
NABESNA	Histic Pergelic Cryaquepts	NIOTA	Mollic Albaqualfs

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
NISHNA	Cumulic Haplaquolls	OKOBOJI	Cumulic Haplaquolls
NISHON (DR)	Typic Albaqualfs	OLASHES (FF)	Mollic Haploxeralfs
NITTAW	Typic Argiaquolls	OLBUT	Abruptic Argiaquolls
NOKASIPPI	Typic Haplaquolls	OLDHAM (DR)	Cumulic Haplaquolls
NOLIN (FF)	Dystric Fluventic Eutrochrepts	OLDS	Andic Cryaquepts
NOLO	Typic Fragiaquults	OLDSMAR	Alfic Arenic Haplaquods
NOME	Pergelic Cryaquepts	OLENO	Vertic Haplaquepts
NOOKACHAMPS	Typic Fluvaquents	OLENTANGY (DR)	Histic Humaquepts
NORMA	Mollic Haplaquepts	OLMSTED	Mollic Ochraqualfs
NORTHCOTE (DR)	Vertic Haplaquolls	OLUSTEE	Ultic Haplaquods
NORTHWOOD (DR)	Histic Humaquepts	OMNI	Fluvaquentic Haplaquolls
NORWELL (DR)	Typic Fragiaquepts	ONA	Typic Haplaquods
NORWICH	Typic Fragiaquepts	ONTKO	Andic Cryaquepts
NOTI	Typic Humaquepts	OPELIKA	Mollic Albaqualfs
NOVARY	Cumulic Cryaquolls	OPENLAKE (FF)	Vertic Haplaquepts
NOVATO	Typic Hydraquents	ORCAS	Typic Sphagnofibrists
NUBY	Typic Fluvaquents	ORELIA (P)	Typic Ochraqualfs
NUGENT (FF)	Typic Udifluvents	ORIDIA	Aeric Fluvaquents
NUTALL	Mollic Albaqualfs	ORIO (DR)	Mollic Ochraqualfs
OAKHURST	Vertic Albaqualfs	ORWET (DR)	Typic Calciaquolls
OAKLIMETER (FF)	Fluvaquentic Dystrochrepts	OSAGE	Vertic Haplaquolls
OBANION	Aeric Halaquepts	OSHAWA	Cumulic Haplaquolls
OCHO	Haplic Nadurargids	OSIER (DR)	Typic Psammaquents
OCOEE	Terric Medifibrists	OSSIAN (DR)	Typic Haplaquolls
OCOSTA	Typic Fluvaquents	OSSIPEE (DR)	Terric Borohemists
ODENSON	Andaqueptic Haplaquolls	OSWALD (FF)	Aquic Chromoxererts
ODNE	Typic Ochraqualfs	OTHELLO	Typic Ochraquults
OGEECHEE (DR)	Typic Ochraquults	OTTER (DR)	Cumulic Haplaquolls
OGEMAW (DR)	Aquic Haplorthids	OUACHITA (FF)	Fluventic Dystrochrepts
OJATA	Typic Calciaquolls	OVERTON	Aeric Haplaquepts
OKANOGAN (FF)	Fluventic Haploxerolls	OWEGO	Mollic Fluvaquents
OKAW	Typic Albaqualfs	OZAMIS	Fluvaquentic Haplaquolls
OKEECHOBEE (DR)	Hemic Medisaprists	OZAN	Typic Glossaqualfs
OKEELANTA (DR)	Terric Medisaprists	OZIAS	Aeric Fluvaquents
OKLAWAHA	Terric Medifibrists	PAHOKEE	Lithic Medisaprists

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
PAHRANAGAT	Fluvaquentic Haplaquolls	PELHAM (DR)	Arenic Paleaquults
PAISLEY	Typic Albaqualfs	PELIC	Typic Fluvaquents
PALMAR	Typic Tropohemists	PELLA (DR)	Typic Haplaquolls
PALMETTO	Grossarenic Paleaquults	PELLICER	Typic Sulfaquents
PALMS (DR)	Terric Medisaprists	PEMI (DR)	Typic Haplaquepts
PAMLICO (DR)	Terric Medisaprists	PENGILLY	Typic Fluvaquents
PANASOFFKEE	Arenic Ochraqualfs	PENNSUCO	Typic Fluvaquents
PANDORA	Typic Ochraqualfs	PEOGA	Typic Ochraqualfs
PANGBORN	Typic Medisaprists	PEOH	Cumulic Haplaquolls
PANSEY	Plinthic Paleaquults	PEONE	Andaqueptic Fluvaquents
PANTEGO (DR)	Umbric Paleaquults	PEORIA	Albic Glossic Natraqualfs
PANTHER	Typic Haplaquolls	PEOTONE (DR)	Cumulic Haplaquolls
PAPAGUA	Typic Albaqualfs	PEPPER	Alfic Haplaquods
PARANAT	Fluvaquentic Haplaquolls	PERCILLA	Aeric ochraqualfs
PAREHAT	Fluvaquentic Haploxerolls	PERCY (DR)	Typic Calciaquolls
PARENT (DR)	Typic Haplaquolls	PERELLA (DR)	Typic Haplaquolls
PARKHILL (DR)	Mollic Haplaquepts	PERQUIMANS (DR)	Typic Ochraquults
PARKWOOD	Mollic Ochraqualfs	PERRINE	Typic Fluvaquents
PARNELL (DR)	Typic Argiaquolls	PERRY	Vertic Haplaquepts
PARSIPPANY	Aeric Ochraqualfs	PESCADERO (FF)	Aquic Natrixeralfs
PARTLOW	Typic Ochraquults	PETEETNEET	Typic Medisaprists
PASCO	Cumulic Haplaquolls	PETROLIA (DR)	Typic Fluvaquents
PASQUETTI	Andaqueptic Haplaquolls	PETTIGREW (DR)	Histic Humaquepts
PASQUOTANK (DR)	Typic Haplaquepts	PEWAMO (DR)	Typic Argiaquolls
PATCHIN	Aeric Haplaquepts	PHILBON	Terric Medisaprists
PATTERSON	Aeric Ochraqualfs	PHOENIX	Entic Pelloxererts
PATTON (DR)	Typic Haplaquolls	PIASA	Mollic Natraqualfs
PAULDING	Typic Haplaquepts	PICKFORD	Aeric Haplaquepts
PAULINA	Fluvaquentic Haplaquolls	PICKNEY (DR)	Cumulic Humaquepts
PAWCATUCK	Typic Sulfihemists	PILINE	Aquic Chromoxererts
PAXICO	Aeric Fluvaquents	PILLSBURY (DR)	Aeric Haplaquepts
PAXVILLE (DR)	Typic Umbraquults	PINCONNING (DR)	Mollic Haplaquents
PEACHAM (DR)	Humic Fragiaquepts	PINEDA	Arenic Glossaqualfs
PECKISH	Typic Sulfaquents	PINELLAS	Arenic Ochraqualfs
PEDIGO (FF)	Cumulic Haploxerolls	PINHOOK (DR)	Mollic Ochraqualfs

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
PINNEBOG (DR)	Hemic Medisaprists	POUNCEY	Typic Albaquults
PINONES	Thapto-Histic Tropic Fluvaquents	POVERTY	Typic Haplaquepts
PIOPOLIS (DR)	Typic Fluvaquents	POY (DR)	Typic Haplaquolls
PIT (FF)	Chromic Pelloxererts	POYGAN (DR)	Typic Haplaquolls
PLACEDO	Typic Fluvaquents	PREAKNESS	Typic Humaquepts
PLACID	Typic Humaquepts	PREBISH (DR)	Typic Haplaquolls
PLANK	Typic Glossaqualfs	PROCHASKA (DR)	Fluvaquentic Haplaquolls
PLANKINTON (DR)	Typic Argialbolls	PROVO BAY	Typic Calciaquolls
PLANTATION	Histic Humaquepts	PUERCO	Typic Torrerts
PLATTE	Mollic Fluvaquents	PUGET	Aeric Fluvaquents
PLAYMOOR	Cumulic Haplaquolls	PUNGO (DR)	Typic Medisaprists
PLEASANT (P)	Torrertic Argiustolls	PUNTA	Grossarenic Haplaquods
PLEINE	Histic Humaquepts	PURDY	Typic Ochraquults
PLEVNA	Fluvaquentic Haplaquolls	PUSHMATAHA	Aquic Udifluvents
PLUCK	Typic Fluvaquents	PUTNAM	Mollic Albaqualfs
PLUMMER (DR)	Grossarenic Paleaquults	PYBURN	Typic Umbraquults
POCATY	Typic Sulfihemists	PYWELL	Typic Borosaprists
POCOMOKE	Typic Umbraquults	QUAM (DR)	Cumulic Haplaquolls
POGANEAB	Typic Fluvaquents	QUARLES	Mollic Ochraqualfs
POLAWANA (DR)	Cumulic Humaquepts	QUINN	Typic Ochraqualfs
POMONA	Ultic Haplaquods	QUOSATANA	Fluvaquentic Humaquepts
POMPANO	Typic Psammaquents	RACOMBES	Pachic Argiustolls
PONZER (DR)	Terric Medisaprists	RACOON (DR)	Typic Ochraqualfs
POOLER (DR)	Typic Ochraquults	RAFAEL	Typic Haplaquepts
POPASH	Typic Umbraqualfs	RAFTON	Typic Fluvaquents
POPHERS	Aeric Fluvaquents	RAGSDALE (DR)	Typic Argiaquolls
POPLE	Arenic Glossaqualfs	RAHAL	Arenic Albaqualfs
PORFIRIO	Aquic Calciustolls	RAINS	Typic Paleaquults
PORRETT	Andaqueptic Ochraqualfs	RALSEN	Fluvaquentic Haplaquolls
PORTAGE	Vertic Haplaquolls	RAMELLI (FF)	Typic Haplaquolls
PORTAGEVILLE (DR)	Vertic Haplaquolls	RAMSDELL	Typic Haplaquepts
PORTLAND	Vertic Haplaquepts	RANDALL (DR)	Udic Pellusterts
PORTSMOUTH (DR)	Typic Umbraquults	RANDMAN	Argic Cryaquolls
POTTSBURG	Grossarenic Haplaquods	RANTOUL (DR)	Vertic Haplaquolls
POUJADE	Durixerollic Haplargids	RAPPAHANNOCK	Terric Sulfihemists

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
RAUVILLE	Cumulic Haplaquolls	ROANOKE (DR)	Typic Ochraquults
RAVENDALE	Entic Chromoxererts	ROBERTSVILLE	Typic Fragiaqualfs
RAYLAKE	Aquentic Chromuderts	ROBINSONVILLE (FF)	Typic Udifluvents
RAYNHAM (DR)	Aeric Haplaquepts	ROCKWELL	Typic Calciaquolls
RAYPOL	Aeric Haplaquepts	ROEBUCK (FF)	Vertic Hapludolls
REDCO	Aquentic Chromuderts	ROELLEN	Vertic Haplaquolls
REDDICK (DR)	Typic Haplaquolls	ROEMER	Arenic Ochraqualfs
REDLODGE	Cumulic Cryaquolls	ROETEX	Udertic Haplustolls
REED	Vertic Argiaquolls	ROLFE	Typic Argialbolls
REESVILLE	Aeric Ochraqualfs	ROLISS (DR)	Typic Haplaquolls
REGAL	Typic Haplaquolls	ROMEO	Lithic Haplaquolls
REGAN (DR)	Typic Calciaquolls	ROMNELL	Cumulic Haplaquolls
REMBERT (DR)	Typic Ochraquults	ROMULUS	Udollic Ochraqualfs
RENNIE	Mollic Fluvaquents	RONDEAU (DR)	Limnic Borosaprists
RENSSELAER (DR)	Typic Argiaquolls	ROOT	Mollic Fluvaquents
RENTON	Mollic Fluvaquents	ROPER (DR)	Histic Humaquepts
REPARADA	Tropic Fluvaquents	ROSANE	Typic Cryaquolls
RETROP	Aquic Udifluvents	ROSCOE	Typic Pellusterts
REVERE	Typic Calciaquolls	ROSCOMMON (DR)	Mollic Psammaquents
REXFORD	Aeric Fragiaquepts	ROSE CREEK	Fluvaquentic Haploxerolls
REYES (F)	Sulfic Fluvaquents	ROSEBLOOM	Typic Fluvaquents
RIB (DR)	Mollic Haplaquepts	ROSEDHU (DR)	Typic Haplaquods
RICCO	Fluvaquentic Haplaquolls	ROSELLA	Albic Glossic Natraqualfs
RICEBORO (DR)	Arenic Paleaquults	ROSEWOOD (DR)	Typic Calciaquolls
RIDOTT	Mollic Ochraqualfs	ROSHE SPRINGS	Typic Calciaquolls
RIFLE (DR)	Typic Borohemists	ROUNDABOUT (DR)	Aeric Haplaquepts
RIGOLETTE	Typic Ochraqualfs	ROUNDHEAD (DR)	Histic Humaquepts
RINDGE	Typic Medisaprists	ROUTON	Typic Ochraqualfs
RIO	Typic Argiaquolls	ROWE	Typic Argiaquolls
RIPPOWAM (DR)	Aeric Fluvaquents	ROXANA (FF)	Typic Udifluents
RITA	Typic Fluvaquents	ROXTON	Vertic Haplaquolls
RITZ	Typic Fluvaquents	RUARK	Typic Ochraqualfs
RIVIERA	Arenic Glossaqualfs	RUBIO	Mollic Albaqualfs
RIVRA (FF)	Ustic Torrifluvents	RUMNEY	Aeric Fluvaquents
RIZ	Typic Natrixeralfs	RUNEBERG (DR)	Typic Haplaquolls

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
RUSCO (P)	Aquic Argiustolls	SARPY	Typic Udipsamments
RUSE	Lithic Haplaquepts	SATILLA	Thapto-Histic Fluvaquents
RUSHMORE (DR)	Typic Haplaquolls	SAUCEL	Typic Salorthids
RUSHVILLE	Typic Albaqualfs	SAUGATUCK (DR)	Aeric Haplaquods
RUTLEGE (DR)	Typic Humaquepts	SAULICH	Histic Pergelic Cryaquepts
RYAN	Typic Natraquolls	SAUNDERS	Aeric Calciaquolls
SABLE (DR)	Typic Haplaquolls	SAUVIE	Fluvaquentic Haplaquolls
SACO	Fluvaquentic Haplaquolls	SAWATCH	Histic Haplaquolls
SACRAMENTO (FF)	Vertic Haplaquolls	SAWMILL (DR)	Cumulic Haplaquolls
SAGANING (DR)	Aeric Haplaquepts	SAWTELPEAK	Typic Cryaquolls
SAGE	Typic Fluvaquents	SAYERS (FF)	Typic Ustifluvents
SAGO (DR)	Histic Humaquepts	SCANTIC (DR)	Typic Haplaquepts
SALADAR	Fluvaquentic Troposaprists	SCARBORO	Histic Humaquepts
SALADON	Typic Cryaquolls	SCATLAKE	Typic Hydraquents
SALAMATOF	Spagnic Borofibrists	SCHERRARD	Natric Duraquolls
SALERNO	Grossarenic Haplaquods	SCHOOLEY	Andaqueptic Fluvaquents
SALINAS (FF)	Pachic Haploxerolls	SCHRADER	Cumulic Haplaquolls
SALMO	Cumulic Haplaquolls	SCITICO	Typic Haplaquepts
SALT LAKE	Typic Calciaquolls	SCOGGIN	Typic Ochraquults
SALTAIR	Typic Salorthids	SCOTT (DR)	Typic Argialbolls
SALTERY	Fluvaquentic Cryofibrists	SCUPPERNONG (DR)	Terric Medisaprists
SALTESE	Typic Medisaprists	SEARSPORT	Typic Psammaquents
SALZER	Vertic Haplaquepts	SEASTRAND	Terric Medihemists
SAMBA	Typic Umbraqualfs	SEATTLE	Typic Medihemists
SAMISH	Typic Fluvaquents	SEBAGO	Fibric Borohemists
SAMMAMISH	Fluvaquentic Humaquepts	SEBEWA (DR)	Typic Argiaquolls
SAMPSEL	Typic Argiaquolls	SEBRING	Typic Ochraqualfs
SAMSULA (DR)	Terric Medisaprists	SEELYEVILLE (DR)	Typic Borosaprists
SANDUSKY	Fluvaquentic Haplaquolls	SEGIDAL	Typic Sideraquods
SANIBEL (DR)	Typic Psammaquents	SEJITA	Typic Salorthids
SANTANELA	Typic Natraqualfs	SEKIU	Humic Haplaquepts
SANTAROSA (F)	Typic Haplaquolls	SELLERS	Cumulic Humaquepts
SANTEE (DR)	Typic Argiaquolls	SELMA (DR)	Typic Haplaquolls
SAPELO	Ultic Haplaquods	SEMIAHMOO	Typic Medisaprists
SARANAC (DR)	Fluvaquentic Haplaquolls	SESSUM	Vertic Ochraqualfs

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
SETTLEMENT	Aeric Halaquepts	SNIDER	Aquic Hapludolls
SETTLEMEYER	Fluvaquentic Haplaquolls	SNOHOMISH	Thapto-Histic Fluvaquents
SEVERN (FF)	Typic Udifluvents	SOLIER	Aeric Haplaquepts
SEXTON	Typic Ochraqualfs	SOLOMON	Vertic Haplaquolls
SHAKER	Aeric Haplaquepts	SONOMA	Aeric Fluvaquents
SHAKOPEE	Typic Calciaquolls	SORTER	Typic Ochraqualfs
SHALBA	Typic Albaqualfs	SOSTIEN	Vertic Fluvaquents
SHALCAR	Terric Medisaprists	SOUTHAM	Cumulic Haplaquolls
SHANDEP (DR)	Cumulic Haplaquolls	SPALDING	Typic Borohemists
SHANGHAI (FF)	Aquic Xerofluvents	SPENARD (DR)	Sideric Cryaquods
SHARKEY	Vertic Haplaquepts	SPERRY	Typic Argialbolls
SHEFFIELD	Typic Fragiaqualfs	SPICER (DR)	Typic Haplaquolls
SHELMADINE	Typic Fragiaquults	SPOONER (DR)	Typic Ochraqualfs
SHENKS	Terric Medisaprists	SPRINGFIELD	Aeric Albaqualfs
SHERRY (DR)	Udollic Ochraqualfs	ST. JOHNS	Typic Haplaquods
SHILOH (DR)	Cumulic Haplaquolls	ST. NICHOLAS	Lithic Cryaquods
SHIMA	Terric Medisaprists	STAMP	Typic Cryochrepts
SHINKEE	Terric Medisaprists	STANEY	Fluvaquentic Cryofibrists
SHONKIN	Typic Haplustalfs	STAPLES	Arenic Ochraqualfs
SHOOKER (DR)	Typic Ochraqualfs	STARICHKOF	Fluvaquentic Borohemists
SHREWSBURY (DR)	Typic Ochraquults	STATELINE	Mollic Ochraqualfs
SHUMWAY	Vertic Haplaquepts	STAVE	Typic Cryaquents
SICKLES (DR)	Mollic Haplaquents	STEED	Entic Haploxerolls
SIKESTON	Cumulic Haplaquolls	STENDAL	Aeric Fluvaquents
SILVIES	Cumulic Cryaquolls	STERRETT	Aeric Ochraqualfs
SIMS (DR)	Mollic Haplaquepts	STIMSON	Typic Humaquepts
SKAGIT	Typic Fluvaquents	STIRUM (DR)	Typic Natraquolls
SKAGWAY	Typic Cryopsamments	STOCKADE	Typic Umbraqualfs
SKOKOMISH	Mollic Fluvaquents	STONO (DR)	Typic Argiaquolls
SLIKOK	Histic Cryaquepts	STRANDQUIST	Typic Haplaquolls
SLOAN	Fluvaquentic Haplaquolls	STREATOR (DR)	Typic Haplaquolls
SMILEY (DR)	Typic Argiaquolls	STROM	Pachic Argixerolls
SMILEYVILLE	Mollic Albaqualfs	STUMPP	Natric Cryoborolls
SMITHTON	Typic Paleaquults	STURGILL	Fluvaquentic Haplaquolls
SMYRNA	Aeric Haplaquods	SUCARNOOCHEE (FF)	Aquentic Chromuderts

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
SUISUN	Typic Medihemists	TAWCAW (FF)	Fluvaquentic Dystrochrepts
SUMAN (DR)	Fluvaquentic Haplaquolls	TEALWHIT	Aeric Haplaquepts
SUMAS	Typic Fluvaquents	TEETERS	Mollic Halaquepts
SUMPF (DR)	Cumulic Haplaquolls	TELA (FF)	Typic Argiustolls
SUN	Aeric Haplaquepts	TELFERNER	Typic Albaqualfs
SUNNYHAY	Lithic Cryosaprists	TEMPLE (FF)	Aeric Haplaquepts
SURFSIDE	Vertic Haplaquolls	TENDOY	Typic Borosaprists
SURRENCY	Arenic Umbric Paleaquults	TENSAS (FF)	Aeric Ochraqualfs
SUSANNA	Ultic Haplaquods	TEPETE	Terric Borohemists
SWALER	Xerollic Paleargids	TEQUESTA	Arenic Glossaqualfs
SWAN	Typic Haplaquolls	TERMO	Xerollic Paleargids
SWANSEA	Terric Medisaprists	TEROUGE	Aquic Chromuderts
SWANTON (DR)	Aeric Haplaquepts	TERRA CEIA (DR)	Typic Medisaprists
SWANVILLE (DR)	Aeric Haplaquepts	TETONKA (DR)	Argiaquic Argialbolls
SWARTZ	Typic Palexeralfs	TETONVIEW (DR)	Typic Calciaquolls
SWEETWATER	Fluvaquentic Haplaquolls	TETONVILLE	Mollic Cryofluvents
SYCAMORE (FF)	Aeric Haplaquepts	TEXARK	Typic Pelluderts
SYRENE	Typic Calciaquolls	THIEFRIVER (DR)	Typic Calciaquolls
TACOMA	Andaqueptic Fluvaquents	THOMAS (DR)	Histic Humaquepts
TACOOSH (DR)	Terric Borohemists	THORNDALE	Typic Fragiaqualfs
TAINTOR	Typic Argiaquolls	THORNTON	Aquic Xerorthents
TALCO	Aeric Glossaqualfs	THORP (DR)	Argiaquic Argialbolls
TALCOT (DR)	Typic Haplaquolls	TIBURONES	Typic Troposaprists
TALMOON (DR)	Mollic Ochraqualfs	TICE (FF)	Fluvaquentic Hapludolls
TALQUIN	Entic Haplaquods	TICHNOR	Typic Ochraqualfs
TAMBA	Typic Haplaquepts	TIFFANY (DR)	Typic Haplaquolls
TANAK		TILFER	Typic Haplaquolls
TANANA	Pergelic Cryaquepts	TIMBALIER	Typic Medisaprists
TANDY	Aquic Udifluvents	TINN	Vertic Haplaquolls
TANTILE	Ultic Haplaquods	TIOCANO (DR)	Udic Pellusterts
TANWAX	Mollic Fluvaquents	TISCH	Mollic Andaquepts
TAPPAN (DR)	Typic Haplaquolls	TISONIA	Typic Sulfihemists
TATLUM	Typic Hydraquents	TITUS	Fluvaquentic Haplaquolls
TATTON	Typic Psammaquents	TOBICO (DR)	Mollic Psammaquents
TAWAS (DR)	Terric Borosaprists	TOCOI	Ultic Haplaquods

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
TODDSTAV	Typic Ochraquults	TUCKER (FF)	Cumulic Haploxerolls
TOGUS	Terric Borofibrists	TUCKERMAN	Typic Ochraqualfs
TOINE (FF)	Ultic Hapludalfs	TUGHILL	Histic Humaquepts
TOISNOT (DR)	Typic Fragiaquults	TUKWILA	Limnic Medisaprists
TOLEDO	Mollic Haplaquepts	TULELAKE (F)	Aeric Fluvaquents
TOLSONA	Histic Pergelic Cryaquepts	TULLAHASSEE (FF)	Aquic Udifluvents
TOMAST	Aeric Paleaquults	TUNICA (FF)	Vertic Haplaquepts
TOMOKA	Terric Medisaprists	TUPUKNUK	Pergelic Cryaquepts
TOMOTLEY (DR)	Typic Ochraquults	TURLOCK	Albic Natraqualfs
TONKA (DR)	Argiaquic Argialbolls	TURNBULL	Typic Hydraquents
TONKEY (DR)	Mollic Haplaquepts	TUSCAWILLA	Typic Ochraqualfs
TOOLES	Arenic Albaqualfs	TUSCUMBIA	Vertic Haplaquepts
TOOLESBORO	Typic Haplaquolls	TUSKEEGO	Mollic Ochraqualfs
TOPPENISH	Fluvaquentic Haplaquolls	TWEBA	Aeric Fluvaquents
TOR	Lithic Haplaquepts	TWIG (DR)	Histic Humaquepts
TORHUNTA (DR)	Typic Humaquepts	TWOMILE	Typic Albaqualfs
TORPEDO LAKE	Histic Cryaquepts	TYNDALL (FF)	Aeric Haplaquepts
TORRY	Typic Medisaprists	TYONEK	Fluvaquentic Borosaprists
TORSIDO	Typic Argiaquolls	UDOLPHO (DR)	Mollic Ochraqualfs
TOTO (DR)	Limnic Medisaprists	UGAK	Andic Cryaquepts
TOTTEN (DR)	Typic Natraquolls	UMBERLAND (F,P)	Aeric Halaquepts
TOWHEE	Typic Fragiaqualfs	UMIAT	Pergelic Cryaquepts
TOXAWAY (DR)	Cumulic Humaquepts	UNA	Typic Haplaquepts
TRACK	Fluvaquentic Haplaquolls	UNAKWIK	Terric Cryohemists
TRACOSA	Typic Haplaquents	UNCAS	Mollic Andaquepts
TRAER	Typic Ochraqualfs	URBO (FF)	Aeric Haplaquepts
TREATY (DR)	Typic Argiaquolls	URICH	Typic Argiaquolls
TREBLOC	Typic Paleaquults	URNESS (DR)	Mollic Fluvaquents
TRIANGLE	Aquic Chromoxererts	UTABA	Cumulic Haploxerolls
TRINITY	Typic Pelluderts	UTE	Argic Cryaquolls
TROSKY (DR)	Typic Haplaquolls	VACHERIE (FF)	Aeric Fluvaquents
TRUMBULL	Typic Ochraqualfs	VALDEZ (FF)	Aeric Haplaquepts
TRUSSEL	Aeric Fragiaquepts	VALKARIA	Spodic Psammaquents
TRYON	Typic Psammaquents	VALLERS (DR)	Typic Calciaquolls
TSIRKU	Typic Cryofluvents	VAMONT	Aquentic Chromuderts

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
VARICK	Mollic Ochraqualfs	WADMALAW (DR)	Umbric Ochraqualfs
VASSALBORO	Typic Borofibrists	WAGNER (DR)	Mollic Albaqualfs
VASTINE	Typic Haplaquolls	WAKELAND (FF)	Aeric Fluvaquents
VAUGHAN	Typic Albaqualfs	WALDEN (FF)	Typic Cryaquolls
VEAZIE	Cumulic Haploxerolls	WALDO	Fluvaquentic Haplaquolls
VEEDUM (DR)	Typic Humaquepts	WALDORF	Typic Haplaquolls
VELASCO	Cumulic Haplaquolls	WALFORD	Mollic Ochraqualfs
VENABLE	Cumulic Cryaquolls	WALLER	Typic Glossaqualfs
VENAPASS	Cumulic Cryaquolls	WALLKILL (DR)	Thapto Histic Fluvaquents
VENICE	Typic Medihemists	WALPOLE	Aeric Haplaquepts
VENLO (DR)	Typic Haplaquolls	WAMBA	Typic Haplaquolls
VERBOORT	Typic Argialbolls	WANSER	Typic Psammaquents
VERENDRYE	Typic Haplaquolls	WAPATO	Fluvaquentic Haplaquolls
VERHALEN	Mollic Torrerts	WARDELL (DR)	Mollic Ochraqualfs
VERO	Alfic Haplaquods	WAREHAM	Humaqueptic Psammaquents
VESPER (DR)	Humic Haplaquepts	WARM SPRINGS	Aeric Calciaquolls
VESTABURG (DR)	Mollic Psammaquents	WARMAN (DR)	Histic Humaquepts
VESTON	Typic Fluvaquents	WARNERS (DR)	Fluvaquentic Haplaquolls
VICTORIA (P)	Udic Pellusterts	WARRENTON	Typic Tropaquepts
VIDAURI	Vertic Albaqualfs	WASDA (DR)	Histic Humaquepts
VIGIA	Histic Tropaquepts	WASHBURN (P)	
VIKING	Typic Haplaquolls	WASHTENAW (DR)	Aeric Fluvaquents
VILLY	Typic Fluvaquents	WASILLA	Humic Cryaquepts
VIMVILLE	Typic Glossaqualfs	WASKISH	Typic Sphagnofibrists
VINCENNES	Typic Haplaquepts	WATCHUNG	Typic Ochraqualfs
VIRDEN (DR)	Typic Argiaquolls	WAUBERG	Arenic Albaqualfs
VOATS (FF)	Fluventic Haploxerolls	WAUCEDAH	Histic Humaquepts
VOLTA	Typic Natraqualfs	WAUCHULA	Ultic Haplaquods
VOLTAIRE	Fluvaquentic Haplaquolls	WAUPACA (DR)	Mollic Fluvaquents
WABASH	Vertic Haplaquolls	WAUSEON (DR)	Typic Haplaquolls
WABASHA	Mollic Fluvaquents	WAUTOMA (DR)	Mollic Haplaquents
WABASSO	Alfic Haplaquods	WAVELAND	Arenic Haplaquods
WACAHOOTA	Arenic Paleaquults	WAVERLY	Typic Fluvaquents
WACOUSTA (DR)	Typic Haplaquolls	WAXPOOL	Albaquic Hapludalfs
WADLEIGH	Typic Cryaquods	WAYLAND (DR)	Mollic Fluvaquents

(Continued)

Table D1 (Continued)

Soil Phase	Classification	Soil Phase	Classification
WEBILE	Terric Medisaprists	WILLETTE (DR)	Terric Medisaprists
WEBSTER	Typic Haplaquolls	WILLIMAN	Arenic Ochraquults
WEEKIWACHEE	Typic Sulfihemists	WILLOWS	Typic Pelloxererts
WEEKSVILLE (DR)	Typic Humaquepts	WILLWOOD	Typic Torriorthents
WEHADKEE (DR)	Typic Fluvaquents	WILMINGTON	Typic Haplaquods
WEIMER	Typic Pelloxererts	WILSON	Vertic Ochraqualfs
WEIR (DR)	Typic Ochraqualfs	WINDER	Typic Glossaqualfs
WEIRMAN (FF)	Torrifluventic Haploxerolls	WINGER	Typic Calciaquolls
WELCH	Cumulic Haplaquolls	WINGINAW (DR)	Terric Borofibrists
WELSUM	Cumulic Haplaquolls	WINLO	Typic Duraquolls
WENAS	Cumulic Haplaquolls	WINTERSET	Typic Argiaquolls
WENDANE	Aeric Halaquepts	WISNER (DR)	Typic Haplaquolls
WESCONNETT	Typic Haplaquods	WITBECK	Mollic Haplaquepts
WESTBROOK	Typic Sulfihemists	WOCKLEY	Plinthaquic Paleudalfs
WESTLAND (DR)	Typic Argiaquolls	WOLCOTT	Typic Haplaquolls
WESTON	Typic Ochraquults	WOLDALE	Typic Haplaquolls
WESTWEGO	Thapto-Histic Fluvaquents	WOLFESON	Aquic Xerochrepts
WETZEL	Typic Ochraqualfs	WOLLENT	Typic Humaquepts
WEYERS	Fluvaquentic Haplaquolls	WOODINGTON (DR)	Typic Paleaquults
WHATELY	Mollic Haplaquepts	WOODINVILLE	Typic Fluvaquents
WHEATLEY (DR)	Mollic Psammaquents	WOODLYN	Typic Ochraqualfs
WHITEHORN	Typic Humaquepts	WOODS CROSS	Cumulic Haplaquolls
WHITESON	Fluvaquentic Haplaquolls	WOOFUS	Fluvaquentic Haplaquolls
WHITEWOOD (DR)	Cumulic Haplaquolls	WORSHAM	Typic Ochraquults
WHITMAN	Typic Humaquepts	WORTHING (DR)	Typic Argiaquolls
WHITSON	Typic Ochraqualfs	WRANGELL	Pergelic Cryohemists
WICHUP (FF)	Histic Cryaquolls	WRENCOE	Typic Haplaquolls
WIERGATE	Typic Pelluderts	WRIGHTSVILLE	Typic Glossaqualfs
WILBANKS (DR)	Cumulic Humaquepts	WULFERT	Terric Sulfihemists
WILBRAHAM	Aquic Dystrochrepts	WYALUSING	Typic Fluvaquents
WILDWOOD (DR)	Histic Humaquepts	WYANDOTTE (DR)	Typic Calciaquolls
WILHITE	Typic Fluvaquents	WYARD	Typic Haplaquolls
WILL (DR)	Typic Haplaquolls	WYICK	Typic Albaqualfs
WILLAMAR	Typic Natraqualfs	WYNONA	Cumulic Haplaquolls
WILLANCH	Aeric Tropaquepts	WYNOOSE	Typic Albaqualfs

(Continued)

Table D1 (Concluded)

Soil Phase	Classification	Soil Phase	Classification
WYSOCKING (DR)	Thapto-Histic Fluvaquents	ZADOG (DR)	Typic Haplaquolls
XIPE	Fluvaquentic Haplaquolls	ZEPHYR	Typic Ochraquults
YAKIMA	Cumulic Haploxerolls	ZIEGENFUSS (DR)	Mollic Haplaquepts
YAMSAY	Limnic Borosaprists	ZILABOY	Aquic Chromuderts
YAQUINA	Aquic Haplorthids	ZILLAH	Fluvaquentic Haplaquolls
YOBE	Aeric Halaquepts	ZIPP	Typic Halaquepts
YONGES (DR)	Typic Ochraqualfs	ZOE	Cumulic Haplaquolls
YORKTOWN	Typic Fluvaquents	ZOHNER	Calcic Cryaquolls
YOST	Typic Pelloxererts	ZOLA (FF)	Cumulic Haploxerolls
YUKON	Histic Pergelic Cryaquepts	ZOOK	Cumulic Haplaquolls
YULEE	Typic Haplaquolls	ZUMAN	Typic Haplaquents
YUVAS	Abruptic Durixeralfs	ZWINGLE	Typic Albaqualfs
ZACHARY	Typic Albaqualfs	ZYZZUG	Typic Humaquepts