WETLAND DELINEATION 1991

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Introduction

Wetland delineation is the process of identifying the presence of a wetland and then defining its upper limit or the wetland-dryland boundary. It is a vitally important process because it establishes areas subject to various land-use laws and implementing regulations. Numerous States have passed wetland protection laws that limit and control the types of activities that can be conducted in wetlands. The Federal government regulates the dredging and filling of wetlands in navigable waters through Section 10 of the Rivers and Harbors Act and the deposition of fill in all waters (including wetlands) through Section 404 of the Clean Water Act. Since a permit may be required for such activities, it is essential for landowners and others to know or be able to determine where wetlands are. The method of wetland delineation, therefore, becomes an issue of critical concern to the landowner as well as to the society that receives the benefits of wetland functions. This article provides an overview of the evolution of wetland delineation at the Federal level, focusing on the 1989 Federal interagency manual, clarifies some common misunderstandings about this manual, offers technical recommendations for improvement, discusses the practicality of using wetland hydrology for wetland recognition, outlines some of the more significant of the proposed revisions to the manual, and offers an alternative approach to wetland identification.

The Evolving Process of Wetland Delineation

Before the existence of wetland laws and regulations at Federal, State, and local levels, wetlands were simply viewed in a general way as marshes, swamps, and bogs, for example. These areas were obviously wet and there was little need for concern about the boundaries of these areas. Scientists studying wetlands in the past focused on these clearly defined habitats and tended to avoid the transitional gradient between wetland and dryland. Wetlands provide many functions that are highly valued by society, such as flood water storage, water quality renovation, shoreline stabilization, and fish and wildlife habitat. In response to accelerating losses of wetlands across the country, the deteriorating quality of remaining wetlands, and widespread recognition of wetland values, various laws were passed to control the use of these valuable natural resources (Burke, et al. 1988; Kusler 1983). With these laws came the need to determine the wetland-dryland boundary on the landscape.

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[1] Opinions expressed in this paper are those of the author and do not necessarily reflect those of any agency of past or present employment.

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To define the limits of wetlands for regulatory purposes and for conducting a national inventory of wetlands, standard methods for identifying and delineating wetlands were needed to insure consistent and reproducible results. Due in part to varied needs, regional environmental differences, and the expertise of the proponents of wetland regulations, the definition of wetlands and delineation methods vary somewhat across the country. Table 1 presents examples of different definitions of wetlands.

Until the 1980s, wetland delineation followed one of two approaches: (1) characterizing wetlands by their vegetation (a predominance of wetland plants) or (2) identifying wetlands by their soils, with the former approach being the typical one. Although all wetland definitions mention hydrology to some extent, there are significant problems with using hydrology alone to identify all wetlands and their boundaries, since: (1) most wetlands are not continuously wet, but are alternately wet and dry, at least in the upper part of the soil, (2) hydrology is a dynamic force varying daily, seasonally, and annually, and (3) sufficient long-term hydrologic data are not available to adequately define wetlands and their boundaries. Consequently, wetland definitions make only generalized reference to hydrologic conditions, usually in terms of being sufficient to support hydrophytes and/or create hydric soils. It is generally accepted by wetland scientists and others that wetlands are best identified by the visible and enduring expressions of their hydrology, that is, by their vegetation and/or soils.

In the late 1970s, the U.S. Fish and Wildlife Service (FWS) developed a technically based wetland definition and classification system for the primary purpose of conducting a nationwide inventory of wetlands. The classification system received extensive and unprecedented review by Federal, State, and local agencies, the academic community, private industry, and others. The classification system went through three major drafts and extensive field testing prior to its final publication in December 1979 as Classification of Wetlands and Deepwater Habitats of the United States (Cowardin, et al. 1979). This document maintains that certain plants or soil types indicate wetlands (see definition in Table 1). Subsequently with the help of other Federal agencies, the FWS published a list of wetland plant species - National List of Plant Species that Occur in Wetlands (Reed 1988) and obtained support from the U.S.D.A. Soil Conservation Service to produce a list of hydric soils - Hydric Soils of the United States. (Note: The FWS definition coined the term "hydric soil.") The FWS also realized the difficulty of precisely defining wetland hydrology and simply acknowledged that "the water table is usually at or near the surface or the land is covered by shallow water." While not defined, "near the surface" presumably recognized that environmental conditions in the majority of the root zone profoundly affect a plant's ability to survive, grow, and reproduce, thus saturation in the root zone is fundamental to defining wetland hydrology.

In the 1980s, the Corps of Engineers (COE) and Environmental Protection Agency (EPA) each developed a three-parameter method for identifying vegetated wetlands for regulatory purposes, although the methods were not mandated for agency use nationwide. The three-parameter test required examination of vegetation, soils, and hydrology and identification of indicators of hydrophytic vegetation, hydric soils, and wetland hydrology to define an area

as wetland. Conceivably, the three-parameter method would produce a wetland determination that could be reasonably defended in court. The Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987) included the following as indicators of wetland hydrology: (1) recorded data on flooding and seasonal high water tables, (2) visual observation of inundation, (3) visual observation of soil saturation (usually must be within 12 inches of the surface - the "major portion of the root zone")[2], (4) water marks, (5) drift lines, (6) sediment deposits, and (7) drainage patterns that show evidence of surface water flow. These indicators are mostly indicative of surface water flooding or ponding and do not include a valid indirect indicator of saturated soils. This latter issue is of vital importance, since there are many wetlands with saturated soils that exist due to the presence of a seasonal high water table with no surface water flooding or ponding. The Federal regulatory definition of wetland emphasizes saturated soils as do other definitions (see Table 1). The EPA wetland manual (Sipple 1988) expanded this list of hydrologic indicators to include: (1) surface scouring (e.g., absence of leaf litter), (2) moss lines on trees and shrubs, (3) bare areas (e.g., evidence of long-standing water), and (4) morphological adaptations of plants in response to inundation and/or soil saturation (in the absence of significant hydrologic modification). Both manuals had difficulty finding indicators of soil saturation (except direct evidence) that were not "hydric soil properties." This difficulty has been a major problem in developing a three-parameter method to identify "saturated only" wetlands. However, using evidence of long-term hydrology left in the soil should be viewed no differently than evidence of recent inundation on top of the soil or plant morphological adaptations for assessing hydrology. It is the consideration of wetland hydrology that is important in the three-parameter test. A more detailed comparison between the COE and EPA manuals can be found in Tiner (1989).

In 1988, the U.S.D.A. Soil Conservation Service (SCS) published a procedure for identifying wetlands subject to the "Swampbuster" provision of the Food Security Act of 1985. Wetlands were determined by a predominance of hydric soils and a prevalence of hydrophytic vegetation. This procedure did not require looking for indicators of wetland hydrology.

Given the differences in the Federal wetland delineation techniques, the boundary of a "designated wetland" varied with the delineation method used, especially in relatively flat areas. Differences between the COE and EPA manuals caused considerable problems since they were used for the same purpose - identifying wetlands subject to regulation under the Clean Water Act. Consequently, after field testing their manuals, the COE and EPA agreed to meet and attempt to resolve inconsistencies. The FWS and SCS (the other Federal agencies with other approaches to wetland delineation) were invited to participate in the discussion. The first interagency meeting held on May 19-

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[2] The COE manual accepted observations of soil saturation within 12 inches as an indication of wetland hydrology because "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" (p. 38, Environmental Laboratory 1987).

20, 1988 concluded that the agencies essentially had the same basic concept of vegetated wetland and that it should be possible to develop a single technically-based interagency wetland delineation manual to serve the needs of all four agencies. Such a manual would produce consistent, reproducible, technically-grounded wetland delineation and thereby avoid (or at least, minimize) interagency disputes over the location and boundaries of wetlands. The Federal Interagency Committee for Wetland Delineation (Committee) was established to develop this technical manual. The procedure for developing the manual was agreed upon by the Committee at the outset: all parties must agree on all elements of the Manual, therefore if any agency had a problem or concern about any aspect of or specific language in the manual, this difference of opinion had to be resolved. This process established an atmosphere of requisite cooperation, and at times created considerable debate over seemingly minor details. After several committee meetings and review of drafts entitled Federal Manual for Identifying and Delineating Vegetated Wetlands, the final manual was prepared. The title was changed to accommodate one of the agencies. The new title replaced the word "Vegetated" with "Jurisdictional," since the document would eventually be used in some way to identify wetlands potentially regulated by the 404 Program or subject to the provisions of other Federal programs (e.g., Food Security Act). The Federal Manual for Identifying and Delineating Jurisdictional Wetlands (Federal Interagency Committee for Wetland Delineation 1989) was formally adopted on January 10, 1989 by the four cooperating agencies (COE, EPA, FWS, and SCS) as the "technical basis for identifying and delineating jurisdictional wetlands in the United States" (emphasis added). The Manual could be used to identify wetlands potentially subject to Section 404 of the Clean Water Act and the "Swampbuster" provision of the Food Security Act, or vegetated wetlands in general for the FWS's National Wetlands Inventory.

Despite its final title, the Manual purposely did not include policy considerations, since policy issues are a matter of agency discretion and are subject to frequent revision to meet the changing needs of society. Also, the Manual did not change agency definitions of wetlands, but merely recognized that despite varied language, the concept of these definitions was essentially the same for vegetated wetlands. The technical focus of the Manual allowed the Committee to avoid discussions of differing opinions on how wetlands should be regulated during the development of the Manual and more importantly produced a document that set the limits of wetland on a technical basis, thereby allowing other agencies (including States) to adopt it and structure policy around it to meet their own needs.

On January 19, 1989, EPA and the COE signed a memorandum of agreement (MOA) for determining the geographic jurisdiction of the Section 404 program which specified the use of the Manual. This established for the first time a national standard for wetland delineation for this program. This MOA further stated that "all future programmatic guidance, interpretations, and regulations on geographic jurisdiction and exemptions shall be developed by EPA with input from the Corps." The SCS never officially adopted the Manual for use in identifying wetlands subject to the Swampbuster provision of the Food Security Act. Clearly, the use of the Manual is a matter of agency policy and may vary between agencies.

The 1989 Manual - A Technical Solution to the Wetland Delineation Problem

The Manual by design is a technical solution to the issue of wetland delineation among the cooperating agencies. It attempts to identify all vegetated wetlands, whether or not they are subject to Federal laws or regulations. By adopting the Manual as the technical basis for identifying and delineating wetlands, the agencies agreed for the first time to establish a national standard for wetland delineation.

"Jurisdictional wetlands" in the context of the Manual are simply vegetated wetlands potentially subject to some form of Federal jurisdiction (regulation or policy) that meet three technical criteria: (1) hydrophytic vegetation, (2) hydric soils, and (3) wetland hydrology. The Manual is essentially the three-parameter test used by the COE and EPA, but differs mainly in its expanded list of acceptable indicators of wetland hydrology. A brief overview of the technical criteria and their technical rationale follows.

Hydrophytic Vegetation

The hydrophytic vegetation criterion recognizes that most wetlands are dominated by OBL, FACW, and/or FAC plant species, but that some wetlands are dominated by FACU species (Table 2). The latter plant communities can only be identified as hydrophytic vegetation upon verification of hydric soils and wetland hydrology. In these cases, the dominant FACU species are clearly hydrophytes and should meet the hydrophytic vegetation criterion. Moreover, the Manual acknowledges that any macrophyte growing "in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content" is a "hydrophyte" (p.69). It is clear that this concept of a hydrophyte is based on the individual plant's ability to adapt to these wetness conditions and is not simply based on where other individuals of that species occur (see Tiner 1991 for details). "Normal circumstances" in the criterion simply means that if the vegetation is removed, the criterion is still met provided the soils and hydrology would otherwise support such vegetation. This interpretation of normal circumstances underlies the Manual's intent of identifying all vegetated wetlands. It recognizes that a wetland still exists even if its vegetation is removed, as long as the existing hydrologic conditions would support such vegetation. (Note: This interpretation of "normal circumstances" was different than the COE had for implementing Section 404 of the Clean Water Act, which essentially emphasized existing land-use, e.g. most "farmed" wetlands were considered nonwetlands since they did not support nor would likely support hydrophytic vegetation due to continued farming practices.)

Hydric Soil

The hydric soil criterion contains verbatim the NTCHS national hydric soil criteria (Table 3). The Committee saw no need to modify it or take only a portion of it for the Manual. A hydric soil by definition is "a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part" (p. 69). The phrase "long enough" is addressed in the criterion as seven days of flooding or ponding on

a frequent basis or soil saturation within 0.5 feet, 1.0 feet, or 1.5 feet depending on soil drainage characteristics and permeability which affects the capillary fringe (zone of effective saturation) above the water table. It is obvious that the hydric soil criterion embodies wetland hydrology elements, which has incidentally been a major source of criticism of the Manual. The seven day period during the growing season was generally considered to be sufficient to create anaerobic conditions in soils based on laboratory studies by Dr. William Patrick of Louisiana State University. Many soils undoubtedly become anaerobic shortly after flooding, so seven days is probably conservative. Anaerobic or simply low-oxygen conditions should stress plants intolerant of low oxygen and thereby favor the growth of hydrophytes. It is unlikely, however, that seven days is long enough to create the soil morphology equated with most hydric soils, since significant reduction (not just anaerobic conditions) must occur before iron is mobilized. The process of iron reduction is responsible for the "gleyed" colors characteristic of most hydric mineral soils. A minimal period of 10-21 days of saturation at some frequency may be required for hydric soil properties to begin to form. In many hydric soils, microbial activity responsible for iron reduction takes place year-round provided the soil does not freeze and sufficient organic material is available. These soils typically support hydrophytic vegetation across the country as documented by numerous recent Fish and Wildlife Service studies (Scott, et al. 1989, Segelquist, et al. 1990). Thus, hydric soil properties may be formed, in part, during conditions colder than "biological zero" (41 degrees F), although at much slower rates.

Besides using the national list of hydric soils and county soil surveys as guides to identifying "potential" areas of hydric soil, certain field indicators must be observed to verify the presence of hydric soils under this criterion: (1) organic soils (peats and mucks), (2) histic epipedon (8-16 inch organic surface layer on top of mineral subsoil), (3) sulfidic material (rotten egg odor), (4) aquic or peraquic moisture regime (reducing environment), (5) direct observations of reducing soil conditions, (6) gleyed (grayish, greenish, or bluish) subsoil layers below the surface layer, (7) low chroma subsoils (matrix chroma of 2 or less with brighter mottles or matrix chroma of 1 or less without mottles), (8) iron and manganese concretions, and (9) sandy hydric soils (high organic content in surface layers, organic streaking of subsoil, or wet Spodosols). Therefore, to properly apply this criterion specific observable properties must be used to help recognize hydric soils in the field. These properties typically result from long-term wetness.

Wetland Hydrology

Admittedly, the wetland hydrology criterion is almost a repeat of the hydrologic elements of the hydric soil criterion (Table 4). The reason for this was the belief that the hydric soil criterion adequately reflected wetland hydrology conditions, except the requirement for organic soils (Histosols) which did not specify any water table levels. These conditions favor the establishment of hydrophytic vegetation. Besides adding the qualification for organic soils, the wetland hydrology criterion also made reference to "saturation to the surface ... at some point in time during an average rainfall year." The growing season was not specified, since it was felt that the areas meeting this criterion would most likely be saturated to

the surface, at least instantaneously, during a rainfall in the nongrowing season, thereby establishing a surface connection which was an important concern for one of the agencies. Other hydrologic conditions were specified for the growing season since oxygen deficiency in the root zone (the upper part of the soil and not simply "at the surface") at this time affects plant growth and survival.

Besides consulting hydrologic records or aerial photographs, wetland hydrology may be detected in the field by a number of indicators: (1) visual observation of inundation, (2) visual observation of soil saturation (required depth of saturation varies due to soil permeability and resultant capillary fringe above the water table), (3) oxidized channels (rhizospheres) along living roots (an expression of a plant growing in an oxygen-deficient environment), (4) water marks, (5) drift lines, (6) water-borne sediment deposits, (7) water-stained leaves, (8) surface-scoured areas, (9) wetland drainage patterns, (10) morphological plant adaptations to inundation or saturation (e.g., buttressed trunks, multiple trunks, pneumatophores, adventitious roots, shallow root systems, hypertrophied lenticels, aerenchyma, polymorphic leaves, and floating leaves), or (11) hydric soil characteristics. Use of diagnostic hydric soil properties is valid only where "there is no indication of significant hydrologic modifications," so it could be reasonably assumed that the observed soil properties were reflecting the long-term hydrology. In an area subject to significant ditching or other drainage, hydric soil properties should not be used, but instead further assessment of hydrology is required to determine the effectiveness of the drainage measures.

Common Misunderstandings

Once the Manual was accepted by the four agencies as the technical basis for identifying and delineating jurisdictional (vegetated) wetlands in the U.S., it became the standard technique for wetland delineation, thereby eliminating or reducing the need for pre-existing approaches, which in many cases failed to identify and underestimated the extent of wetlands. With the subsequent implementation of this technical standard for the 404 Program (U.S. Dept. of Army and EPA Memorandum of Agreement, January 19, 1989), wetland identification and delineation became, for the first time, consistent across the country for this program. This created significant controversy in areas where former delineation approaches had excluded areas which the new standard included.

For example, the interpretation of "under normal circumstances" regarding the hydrophytic vegetation criterion now meant that removal of vegetation did not disqualify an area from being identified as wetland. Hydric soil and hydrology would continue to support hydrophytic vegetation, if allowed to grow. This represented a significant change from the way the COE had been interpreting "normal circumstances" for identifying Section 404 wetlands. COE regulatory guidance letters (82-2 and 86-9; now expired) defined "normal circumstances" in terms of current land use: If a wetland was farmed and planted with corn, for example, the area did not qualify as wetland since hydrophytic vegetation was not present and would not likely be in the future due to continued farming. Since the Manual was conceived as a technical document, COE representatives on the Committee agreed to a technical

definition of "normal circumstances" that was different from their policy interpretation.

The wetland hydrology criterion specified certain depths (based on soil drainage classes) to look for evidence of the water. In order to properly assess an area's hydrology, the drainage class and permeability of the soil had to be known. "Drainage class" as applied locally by SCS is not a national standard, and may vary from State to State and even from county to county. Consequently, the use of "drainage classes" in the wetland hydrology criterion created much confusion and controversy with this criterion as well as the hydric soil criterion. Despite efforts to clarify these classes, it is clear that a more practical standard is needed. One possibility might be a hydrology criterion emphasizing saturation in the upper part of the soil where the majority of roots of wetland plants are located. This possible change would remove the elements of the wetland hydrology criterion derived from the hydric soil criterion and eliminate the impression that the method is a less than three criteria approach for wetland identification.

Probably due to the relationship between the hydric soil criterion and the wetland hydrology criterion, a misunderstanding has developed - that any area mapped as a hydric soil on a county soil survey map was a wetland. The Committee clearly intended that specific soil properties resulting from wetland hydrology be used to separate soils actually meeting the hydric soil criterion in the field from those that do not. Many soils listed on the national list of hydric soils do not always exhibit hydric properties, although most typically do in their natural, undrained state. Therefore, it is vital that these soils be examined in the field to determine if they are truly hydric. Also, hydric soil map units may include significant acreages of nonhydric soils (soils that were never wetland), drained hydric soils that no longer meet the criterion, and dry phases of hydric soil series that were never wetland. By considering any mapped hydric soil area as wetland, millions of acres of former wetlands (now drained) as well as nonhydric soil inclusions could be misrepresented as wetlands. Various sources reporting on wetland acreage figures regarding the scope of areas covered by the Manual have, in fact, used this approach and thus erroneously inflated the extent of "jurisdictional wetlands" in the country.

Recommendations to Improve the Manual

The 1989 Manual was designed as a technical standard to identify and delineate areas that are wet enough to be considered vegetated "wetland." The Manual embodied the state-of-the-art in wetland delineation. At the outset, the Committee recognized that refinements in the Manual would undoubtedly be required after extensive field use. However, the revisions currently being considered are not limited to technical changes that improve or clarify the delineation process, but incorporate policy considerations driven by the Federal regulatory program. If such revisions are implemented, the document will have been changed from a descriptive yardstick for identifying wetlands to a policy document that defines the limits of designated wetlands for implementing Federal policy. Such a document would have limited utility beyond the Federal regulatory arena. A technical document would have far greater utility because it would enable government agencies at all levels

(Federal, State, and local) to use a technically-based standard to identify and delineate the universe of wetlands and then structure regulatory policy around this to meet their administrative needs and functional policy objectives. Wetland policy might vary from agency to agency or from Federal to State levels, but the geographic areas to which the term "wetland" applies would remain constant and provide a common reference for discussion. This recommended approach would involve making technically-driven changes to the 1989 Manual, while leaving policy considerations to individual agencies.

By limiting changes in the Manual to technical matters, the 1989 Manual could be improved technically by applying current knowledge of wetland delineation and minimizing misunderstandings. The technical changes outlined below would have the merit of keeping policy differences within agencies and making the Manual more universally useful. All of these changes had been approved by the Committee, except the wetland hydrology criterion (see 3. below) which is a fresh approach to this issue.

1. Hydrophytic Vegetation Criterion - no change, same as 1989 Manual.

2. Hydric Soil Criterion - change as follows:

"An area has hydric soil when it has either:

1. Soils listed by series in "Hydric Soils of the United States" (1987 and amendments), or

2. Organic soils (Histosols, except Folists), or

3. Mineral soils classified as Sulfaquents, Hydraquents, or Histic and Typic subgroups of Aquic suborders, or

4. Other soils that meet the National Technical Committee for Hydric Soils' criteria for hydric soil."

Rationale. This makes use of extensive State lists of hydric soil series and county lists of hydric soil map units. It is similar to the use of regional wetland plant lists for assessing the hydrophytic vegetation criterion. Separation of wet phases from dry phases of hydric soil series could be done at the "map unit" level or through the use of regional indicators of significant saturation in assessing the wetland hydrology criterion. While this criterion attempts to minimize concern about drainage classes of soils, it ultimately uses them in #4 above and still keeps open an area of local interpretation and potential misapplication. (Note: The proposed 1991 revisions are very similar to this criterion, except that it does not include "Typic subgroups" in #3 above.) An alternative to #4 that would eliminate indirect reference to drainage classes would be the following:

"4. Other soils, not effectively drained, that possess regional indicators of significant soil saturation and a seasonal high water table."

3. Wetland Hydrology Criterion - this is a new approach examining hydrologic conditions over the entire year, since the year-round hydrology is important for many wetland plants, hydric soil formation, and the functions and values of wetlands (see Rationale below) - change as follows:

"An area has wetland hydrology when it is either:

1. Flooded by flowing water for more than 7 consecutive days during the year in most years; or

2. Saturated near the surface by surface water or ground water usually for more than 28 to 42 consecutive days during the year in most years; or

3. Periodically flooded by tidal water in most years.

'Flowing water' is water derived from flooding by rivers and streams, for example, as opposed to 'standing water' in an isolated depression. 'Near the surface' means within the majority of the root zone of wetland plants, that is, within 6 inches in sandy soils and within 12 inches in other soils. 'In most years' generally means more than 50 years out of 100 years in geographic areas where evapotranspiration does not exceed precipitation and therefore represents the prevailing hydrologic regime. However in arid and semiarid regions of the country where evapotranspiration exceeds precipitation (creating moisture deficits), 25 years out of 100 years may be sufficient to create wetlands, since averages are meaningless in these highly variable climates."

Rationale. Hydrologic conditions during the entire year should be considered for the following reasons:

(1) evergreen plants and persistent grasses and other grasslike plants (e.g., sedges) continue to grow during the "dormant period" for nonevergreens, and saturation at this time should affect these plants and competing species;

(2) root growth for perennial plants, such as trees and shrubs, usually extends into autumn and winter (in temperate regions) and has been reported to occur when soil temperatures are above 0.5 degrees C (Lopushinsky and Max 1990; Lyr and Hoffman 1967);

(3) most wetland soils in the lower 48 states are not frozen for extended periods in winter, therefore permitting biological activity by soil microbes as well as plant activity;

(4) water conditions during the dormant period (winter) have a profound influence on the hydrologic conditions during the early part of the "growing season;"

(5) winter wetness conditions also probably help prevent winter

dessication of some wetland plants, especially those having overwintering flower buds that may be particularly vulnerable to winter drying and may affect subsequent plant growth as observed in loblolly and slash pines (Haywood, et al. 1990);

(6) hydric soil properties have developed under conditions that extend beyond the "growing season;".

(7) the functions of wetlands do not cease with the "growing season" (e.g., flood water storage and water quality renovation are important year-round);

(8) wetness during the "dormant period" limits potential uses of the land. This approach would eliminate the need to arbitrarily define the "growing season" across the country. The hydrology in arid and semi-arid regions is more variable and less predictable than in humid regions, so "averages" are meaningless. Consequently, wetland hydrology conditions in 25 of 100 years may be sufficient to create wetland plant communities and hydric soils. This criterion should be reviewed by the Committee and regional experts prior to its adoption.

4. Specify the hydric soil properties that can be used to indicate wetland hydrology in areas with no significant hydrologic modification.

   Rationale. These should be regionally valid properties that directly result from long-term wetness and indicate a seasonal high water of sufficient duration and frequency to favor the establishment of wetland plants, in most cases (e.g., organic surface layer 8 inches or thicker and gleyed subsoils immediately below the surface layer). This would eliminate the need for "special" procedures to identify wetlands that are dry in summer and fall. (Note: The proposed 1991 revisions mention these indicators, but do not enumerate them nor tell one how to use them.)

5. Expand the list of hydrology indicators to include regionally specific features (e.g., crusted algal mats and lichen lines) that are reliable indicators of inundation or saturation.

6. Link criteria to indicators in the mandatory part of the Manual.

   Rationale. To be practical, emphasis in wetland delineation should be placed upon reliable indicators. Measurement of hydrology, for example, should only be appropriate for areas subject to significant hydrologic modification or where indicators send such conflicting signals that can only be resolved by making hydrologic observations or measurements. (Note: The proposed 1991 revisions do this.)

7. Add a wetland identification key to the Manual that would facilitate wetland recognition in areas not significantly disturbed.

8. Establish a minimum threshold for a valid vegetative stratum (e.g., 5-

10% areal cover of a plot).

Rationale. Currently as long as a vegetative life form (e.g., herb, shrub, tree, woody vine) is present, it should be considered a stratum for determining dominants. Setting a minimum cover for a "valid" stratum helps improve this standard approach and reduces the impact of less abundant species on the hydrophytic vegetation assessment. (Note: The proposed 1991 revisions do this.)

9. Change title back to its original title Federal Manual for Identifying and Delineating Vegetated Wetlands.

Rationale. This title best reflects the technical scope of the Manual. The term "jurisdictional" in the current title suggests emphasis on legal or regulatory concerns, which are matters of agency policy and were not the purpose of the Manual.

The above changes reflect technical considerations only, to clarify misconceptions and minimize the potential for misuse, and to improve consistency and accuracy of wetland delineation nationwide. Agency officials at all levels of government could then decide how to use the Manual for specific programs to meet their statutory responsibilities and formulate policies to deal with the variety of wetlands that occur throughout the country.

Practicality of Using Hydrology for Wetland Recognition

For practical purposes when identifying wetlands and their boundaries, it is best to rely on the visible and enduring expressions of their hydrology, that is, by their vegetation and/or soils. Recent U.S. Fish and Wildlife Service studies have further confirmed traditional scientific opinion and observations that there is an excellent correlation between "hydrophytic vegetation" and "hydric soils" for determining the presence of wetlands (Scott, et al. 1989, Segelquist, et al. 1990). Consequently, these features should be used to identify wetlands, in the absence of significant hydrologic modification. Requiring that areas having such vegetation and soils must be demonstrably wet for a specific period makes wetland identification unnecessarily burdensome and puts too much emphasis on a condition that is not documented in the scientific literature. Existing wetland definitions reflect this realization (Table 1). If the presence of water must be required to identify wetlands, then investigators must limit their work to the "wet season." This has been and is still done in many areas of the country for performing "perk" tests to determine site suitability for septic systems. Local water tables could be monitored annually to determine the appropriate length of the "wet season" for each year, since conditions will vary from year to year. This, too, is already in practice in some areas for validating the "perk" tests. Such monitoring and limiting field work to the "wet season" may, however, be too costly, restrictive, and place heavy seasonal workloads on consultants and regulators alike.

At the present time, emphasis in wetland recognition should be placed on what we know best - vegetation and soils - and only use specific hydrologic

conditions when an area has been significantly hydrologically modified or when vegetation and soil characteristics provide conflicting evidence. In the former case, the altered hydrology often negates the interpretative value of vegetation and soil properties. Consequently, it is necessary to define hydrologic conditions that can be measured to evaluate whether the area is effectively drained or not. The wetland hydrology criterion proposed above could be used to determine whether such areas are still wetland or not.

Proposed Revisions to the 1989 Manual

On August 14, 1991, proposed revisions to the 1989 manual were published in the Federal Register (Vol. 56, No. 157, pp. 40446-40480). Written comments must be submitted on or before October 15, 1991. The following are among the more salient changes:

1. Wetland Hydrology Criterion - changed from 7 consecutive days of inundation or a seasonal high water table during the "growing season" to 15 consecutive days of inundation or 21 consecutive days of soil saturation at the surface.

2. Growing Season - changed from one based on soil temperature of 41 degrees F at 20 inches below the surface ("biological zero") to one based on a period 3 weeks before the average last killing frost in spring to 3 weeks after the first killing frost in the fall.

3. Wetland Hydrology Indicators - now requires saturation at the surface; deleted "water-stained leaves caused by inundation" as a valid indicator, but asks for public comment on this. Although many indicators are retained, they may not actually coincide with the criterion that requires saturation at the surface for 21 consecutive days.

4. Hydrophytic Vegetation Criterion - Revisions contain only prevalence index approach; still considering how to use dominants, specifically FAC for identifying hydrophytic vegetation and asks for public comments. FACU-dominated plant communities growing on undrained hydric soils subject to wetland hydrology are deleted from the criterion and instead treated as an exception that fails to meet the criterion.

5. Wetland Boundary Delineation - now requires indicator of all three criteria at the boundary, versus relying on evidence of seasonal high water table found by examining soil properties within 18 inches of the surface in most poorly and very poorly drained soils.

6. Wetland Identification - requires documentation of indicators of all three criteria and eliminates short-cuts for "obvious wetlands" like where all dominants are OBL and wetland hydrology indicators are materially present, the area was previously classified as wetland without examining the soils (i.e., assume hydric soil criterion is met).

7. Indicators vs. Criteria - criteria remain mandatory, but indicators are now a part of the criteria, taking much of the individual interpretation out of the process.

8. Problem area wetlands section - question whether this section is mandatory or optional; also any exceptions to meeting all three criteria must be described and five types are specified (pocosins, playas, prairie potholes, vernal pools, and other wetlands that fail to meet the hydrophytic vegetation criterion). Lists other types of wetlands in Appendix 6 (problem area wetlands), but fails to specify how they should be considered: jurisdictional wetland or not?

The Primary Indicator Approach to Wetland Identification

An alternative to revising the 1989 manual and continuing to fine tune the "three criteria" approach (or 3-parameter approach) to wetland identification is an approach based on using a series of single highly reliable characteristics. The "primary indicator" approach is founded on the premise that nearly every wetland in its natural undrained condition possesses at least one distinctive feature that can be used to separate it from nonwetland. This approach is an outgrowth of conventional practices in wetland identification including the Fish and Wildlife Service's wetland classification system (Cowardin, et al. 1979) which is widely recognized and accepted as the national standard for wetland classification (Mader 1991). Traditionally, many wetlands have been recognized by a single feature, such as a plant community dominated by OBL species (e.g., cattail marsh, buttonbush swamp, leatherleaf bog, or bald cypress swamp) or by organic soils (peats and mucks, not Folists), for example. As long as the area's hydrology has not been significantly drained, these and other distinctive features, considered individually, indicate the presence of wetland. A list of these primary wetland indicators is presented in Table 5. The upper limit of wetlands be determined by the point at which none of these indicators are present. Delineating the wetland-nonwetland boundary in areas of low relief usually requires finding evidence of a seasonal high water table as typically expressed in the soil (e.g., gleyed matrix immediately below the A-horizon or low chroma mottles within 12 inches of the surface and a low chroma matrix within 18 inches). This approach streamlines and simplifies the process of wetland identification and focuses on documenting the determining factor rather than preparing a detailed description of the site's vegetation, soils, and hydrology characteristics. Consequently, it allows identification of many wetlands without requiring strong technical skills in both botany and soil sciences, although individuals making wetland determinations and delineations must have some basic knowledge or training in these disciplines to fully utilize this approach or any other meaningful approach. Hydrologically disturbed sites would require an assessment as to whether the present hydrology is sufficient to consider the area as wetland, applying technically sound procedures established by the regulatory agencies.

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Table 1. Definitions of "wetland" according to selected Federal agencies and State statutes. Most coastal states have definitions of coastal or tidal wetlands that emphasize the presence of plant species occurring in these saline habitats. While useful in these salt-stressed situations, listing of common freshwater wetland plants is too lengthy to include in a wetland definition for nationwide application.

Organization (Reference)	Wetland Definition
U.S. Fish and Wildlife Service (Cowardin, et al. 1979)	"Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year." Most coastal states have definitions of coastal or tidal wetlands that emphasize the presence of plant species occurring in these saline habitats. While of general use in these situations, the list of plants found in inland or freshwater wetlands is too enormous to include in the definition.
U.S. Army Corps of Engineers (Federal Register, July 19, 1977) and U.S. Environmental Protection Agency (Federal Register, December 24, 1980)	Wetlands are "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."
U.S.D.A. Soil Conservation Service (National Food Security Act Manual, 1988)	"Wetlands are defined as areas that have a predominance of hydric soils and that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions, except lands in Alaska identified as having a high potential for agricultural development and a predominance of permafrost soils."

Organization (Reference)	Wetland Definition
State of New Jersey (N.J. Pinelands Comprehensive Management Plan, 1980; Pinelands Protection Act - N.J. STAT. ANN. Section 13:18-1 to 13:29).	"Wetlands are those lands which are inundated or saturated by water at a magnitude, duration and frequency sufficient to support the growth of hydrophytes. Wetlands include lands with poorly drained or very poorly drained soils as designated by the National Cooperative Soils Survey of the Soil Conservation Service of the United States Department of Agriculture. Wetlands include coastal wetlands and inland wetlands, including submerged lands." These types are characterized by lists of representative plants.
State of Connecticut (Conn. Gen. Stat. Ann., Section 22a-36 to 22a-45.	"Wetlands means land, including submerged land... which consists of any of the soil types designated as poorly drained, very poorly drained, alluvial, and flood plain by the National Cooperative Soil Survey, as may be amended from time to time, of the Soil Conservation Service of the United States Department of Agriculture."
State of Illinois (Interagency Wetland Policy Act of 1989)	"Wetland means land that has a predominance of hydric soils (soils which are usually wet and where there is little or no free oxygen) and that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of hydrophytic vegetation (plants typically found in wet habitats) typically adapted for life in saturated soil conditions. Areas which are restored or created or planned construction projects and which function as a wetland are included within this definition even when all three wetland parameters are not present."

Table 2. Hydrophytic vegetation criterion in the 1989 Manual.

"An area has hydrophytic vegetation when, under normal circumstances: (1) more than 50 percent of the composition of the dominant species from all strata are obligate wetland (OBL), facultative wetland (FACW), and/or facultative (FAC) species, or (2) a frequency analysis of all species within the community yields a prevalence index value of less than 3.0 (where OBL = 1.0, FACW = 2.0, FAC = 3.0, FACU = 4.0, and UPL = 5.0). CAUTION: When a plant community has less than or equal to 50 percent of the dominant species from all strata represented by OBL, FACW, and/or FAC species, or a frequency analysis of all species within the community yields a prevalence index value of greater than or equal to 3.0, and hydric soils and wetland hydrology are present, the area also has hydrophytic vegetation. (Note: These areas are considered problem area wetlands.)"

Table 3. Hydric soil criterion in the 1989 Manual.

"An area has hydric soils when the National Technical Committee for Hydric Soils (NTCHS) criteria for hydric soils are met.

NTCHS Criteria for Hydric Soils (U.S.D.A. Soil Conservation Service 1987):

1. All Histosols except Folists; or

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

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

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

      (1) water table at less than 1.0 feet 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 inches/hour in all layers within 20 inches, or

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

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

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

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

Table 4. Wetland hydrology criterion in the 1989 Manual.

"An area has wetland hydrology when saturated to the surface or inundated at some point in time during an average rainfall year, as defined below:

1. Saturation to the surface normally occurs when soils in the following natural drainage classes meet the following conditions:

   A. In somewhat poorly drained mineral soils, the water table is less than 0.5 feet from the surface for usually one week or more during the growing season; or

   B. In low permeability (<6.0 inches/hour), poorly drained or very poorly drained mineral soils, the water table is less than 1.5 feet from the surface for usually one week or more during the growing season; or

   C. In more permeable (≥6.0 inches/hour), poorly drained or very poorly drained mineral soils, the water table is less than 1.0 feet from the surface for usually one week or more during the growing season; or.

   D. In poorly drained or very poorly drained organic soils, the water table is usually at a depth where saturation to the surface occurs more than rarely. (Note: Organic soils that are cropped are often drained, yet the water table is closely managed to minimize oxidation of organic matter; these soils often retain their hydric characteristics and if so, meet the wetland hydrology criterion.)

2. An area is inundated at some time if ponded or frequently flooded with surface water for one week or more during the growing season.

(Note: An area saturated for a week during the growing season, especially early in the growing season, is not necessarily a wetland. However, in the vast majority of cases, an area that meets the NTCHS criteria for hydric soil is a wetland.)"

Table 5. Recommended list of primary indicators of wetlands. The presence of any of these characteristics in an area that has not been significantly drained, typically indicates wetland. The upper limit of wetland is determined by the point at which none of these indicators are observed. (Note: Exceptions may occur as they do with any method and they must be specified.)

Vegetation Indicators of Wetland

1. OBL species predominate the plant community.

2. OBL and FACW species predominate the plant community.

3. Prevalence index of the plant community is less than 2.0.

4. OBL species present throughout the plant community and areal cover of OBL and FACW species exceeds the areal cover of FACU and UPL species.

5. Plants with the following morphological adaptations are materially present: pneumatophores (knees), prop roots, hypertrophied lenticels, buttressed stems or trunks, and floating leaves. (Note: Some of these features may not be applicable in tropical U.S., e.g., Hawaii.)

Soil Indicators of Wetlands

1. Organic soils (except Folists) present.

2. Histic epipedon (e.g., organic surface layer 8-16 inches thick) present.

3. Sulfidic material (H_2S, odor of "rotten eggs") present within 18 inches of the soil surface.

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

5. Nonsandy soils with a low chroma matrix within 18 inches of the soil surface and one of the following within 12 inches of the surface:

    a. low chroma mottles; or

    b. iron and manganese concretions or nodules; or

    c. distinct or prominent oxidized rhizospheres along living roots.

6. Sandy soils with one of the following:

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

   b. surface layer of peat or muck of any thickness where a leaf litter surface mat is absent; or

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

   d. vertical organic streaking or blotchiness within 12 inches of the surface; or

   e. distinct or prominent high chroma mottles within 12 inches of the surface; or

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

   g. oxidized rhizospheres along living roots within 12 inches of the surface.

7. Soils identified in the field as Typic subgroups of Aquic suborders.