U.S. Department of Transportation
Federal Highway Administration

Memorandum

Subject **INFORMATION:** National Academy of Science Wetland Characterization Committee Report

Date JUL 25 1995

From Chief, Environmental Analysis Division

Reply to Attn. of HEP-42

To Regional Administrators
Federal Lands Highway Program Administrator

The National Academy of Science (NAS) recently published the report of the Congressionally-directed Wetland Characterization Committee, titled *Wetlands: Characteristics and Boundaries*. The report discusses the ecological characteristics of wetlands relative to identification, delineation, and functions, and makes recommendations for a more sound approach to their regulation and management.

The report is substantial, more than 250 pages long. Attached is the executive summary, which presents many of the major findings and conclusions, and a summary of the conclusions and recommendations that are at the end of each chapter. The report is expected to have a role in changes to the Federal wetland regulatory program currently being discussed in the reauthorization of the Clean Water Act.

The entire report is available from the National Academy of Science Press, 2101 Constitution Avenue NW., Washington, D.C. 20418. Field offices that would like to obtain a copy can order directly from the NAS, or contact Paul Garrett of my staff at (202) 366-9173.

James M. Shrouds

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2 Attachments

FHWA:HEP-42:PGarrett:nb:x62067:7/21/95
Revised:7/24/95
Disk:Paul's, File name:NAS_RPT.MEM
cc: HEP-40, HEP-41, HEP-30, HEP-31, HEP-32, HCC-30, HEP-42(FBank), HEP-42(PGarrett), HEP-42(2Files)

FEDERAL HIGHWAY ADMINISTRATION 1893 1993

Executive Summary

Until very recently, policies of the United States federal government were intended to encourage or subsidize the conversion of wetlands to filled or drained lands that could be used for agriculture or other purposes not compatible with the existence of wetlands. These federal policies, in addition to extensive private efforts of a similar nature, reduced the total wetland acreage in the contiguous United States by approximately 117 million acres, or half of the original total, by the mid-1980s. While this conversion of wetland produced extensive amounts of new cropland that bolstered the agricultural potential of the United States, and eliminated some of the socioeconomic nuisances associated with wetlands, it also reduced many of the valuable attributes of wetlands, including support of waterfowl and maintenance of water quality. An increasingly broad concern for these losses created political support for comprehensive protection of wetlands. Federal regulation of wetlands began to take effect on a broad scale in the 1970s, and now encompasses virtually all wetlands. Wetlands are the only ecosystem type to be comprehensively regulated across all public and private lands within the United States.

The 1972 amendments to the Federal Water Pollution Control Act gave the U.S. Army Corps of Engineers (USACE) and the Environmental Protection Agency (EPA) authority to regulate pollution of waters in the United States. The coverage of the 1972 act extended to wetlands, but was narrowly construed at first and extended to only approximately 15% of the total wetland acreage in the United States. Between 1972 and 1977, judicial decisions greatly broadened the coverage of the statute and created for the first time a need for a regulatory definition of wetlands and for federal conventions by which a definition could be applied. The USACE finalized a regulatory definition in 1977, but delegated to its district offices the development of procedures for identifying and delineating wetlands. Section 404 of the 1977 Federal Water Pollution Control Act amendments (Clean Water Act) confirmed the national commitment to regulation of wetlands, and broad federal application of the 1977 act to wetlands was upheld judicially in 1985. In the same year, the Food Security Act established a separate regulatory definition of wetlands for application to agricultural lands.

Foreseeing the need for greater national uniformity in the identification and delineation of wetlands, the USACE issued in 1987 a national delineation manual ("1987 Corps manual"). Subsequently, USACE collaborated with the U.S. Fish and Wildlife Service (FWS), EPA, and

the U.S. Department of Agriculture (USDA) in the preparation of a revised manual, which was released in 1989 ("1989 interagency manual"). The 1989 manual was strongly criticized, however, by individuals and groups who perceived it as being excessively inclined toward the regulation of lands that might not be properly classified as wetlands. A second attempt at the creation of a revised manual was initiated by the Bush administration in 1991 ("1991 proposed revisions"). The 1991 proposed revisions were criticized for excluding many wetlands from regulatory coverage, and were not implemented. Thus USACE and EPA have continued to use the 1987 Corps manual. In the meantime, the Soil Conservation Service (now the National Resources Conservation Service [NRCS]) had implemented the 1985 Food Security Act through the preparation of a separate delineation manual ("1985 Food Security Act manual") for use on agricultural lands.

The preparation and withdrawal of the 1989 interagency manual and the 1991 proposed revisions, and the adoption of a separate manual designated specifically for agricultural lands, created confusion and uncertainty about the scientific and technical validity of federal regulatory practice in the identification and delineation of wetlands. As a result, Congress requested in 1993 that the National Academy of Sciences provide, through a committee formed by the National Research Council, an assessment of the adequacy and validity of wetland definitions, the basis for applying definitions through delineation manuals, present knowledge of the structure and function of wetlands, and regional variation among wetlands.

The regulatory definition of wetlands and the procedures by which wetlands are identified and delineated are of great practical concern because of the nationwide regulation of wetlands. If flawed definitions or flawed procedures lead to the identification of wetlands where wetlands do not exist, landowners will unjustifiably lose the flexibility to develop land for agriculture or other purposes. On the other hand, definitional or procedural flaws that lead to the exclusion of true wetlands will not reflect the intent of legislation and judicial decisions that have established federal regulatory authority over wetlands. The work of the NRC committee has been to analyze the scientific and technical basis for identification and delineation of wetlands, but not to analyze economic or social issues connected with wetlands.

In comparing the 1987 Corps manual with the 1989 interagency manual and the 1991 proposed revisions, the NRC committee concludes that the 1989 interagency manual would typically provide the most expansive interpretation of wetland boundaries. The 1987 manual would produce delineations essentially the same as the 1989 manual in some instances, but would be somewhat more restrictive than the 1989 manual in most instances. Delineation by use of the 1991 proposed revisions would be considerably more restrictive than by use of either the 1987 or 1989 manuals, and would lead to outright exclusion of numerous true wetlands through impractical documentation requirements.

Improvements in the scientific understanding of wetlands since 1987 and refinement of regulatory practice through experience over almost a decade of intensive wetland regulation suggest that a new federal delineation manual should be prepared for common use by all federal agencies involved in the regulation of wetlands. This new manual should draw freely from the strengths of each of the existing manuals, but would not be identical to any of the present manuals. The new manual should incorporate some changes in present practice and some solutions to past problems of regulatory practice, as well as an increased emphasis on regionalization within a framework of national standards. In some instances, the unavailability of critical information

also demonstrates an urgent need for study of selected wetland characteristics for which lack of information hampers the identification and delineation of wetlands.

DEFINITIONS, FACTORS, CRITERIA, AND INDICATORS

It is useful to maintain a reference definition of wetland that stands outside the context of any particular agency, policy, or regulation. This places a broad framework around regulatory practice and puts into perspective regulatory definitions and the selection of criteria and indicators for regulatory purposes. A regulatory definition, in contrast, might reflect in varying degrees regulatory policy or legislation that restricts or extends regulatory jurisdiction in ways that differ from the reference definition.

A reference definition of wetlands is as follows: *A wetland is an ecosystem that depends on constant or recurrent, shallow inundation or saturation at or near the surface of the substrate. The minimum essential characteristics of a wetland are recurrent, sustained inundation or saturation at or near the surface and the presence of physical, chemical, and biological features reflective of recurrent, sustained inundation or saturation. Common diagnostic features of wetlands are hydric soils and hydrophytic vegetation. These features will be present except where specific physicochemical, biotic, or anthropogenic factors have removed them or prevented their development.*

As shown by the reference definition, three major factors characterize a wetland: water, substrate (physicochemical features), and biota. Customary reference to these as "parameters" is not correct and should be avoided. Although wetlands depend for their existence on all three factors, it is often scientifically defensible, in the absence of alterations or ambivalent indications, to infer information about one factor from another. The states of the three factors that characterize wetlands are the criteria for identification of wetlands: recurrent, sustained saturation (the hydrologic criterion), physical and chemical conditions in the substrate that reflect recurrent, sustained saturation (the substrate criterion), and the presence of organisms that are specifically adapted to recurrent and sustained saturation of the substrate (the biological criterion).

Of the three factors that characterize wetlands, water has special status because neither the characteristic substrates nor the characteristic biota of wetlands can develop in the absence of specific hydrologic conditions. Disturbance of the biota or substrate can produce a wetland in which the characteristic substrates or organisms are absent, at least temporarily. In contrast, elimination of the characteristic hydrology of a wetland eliminates the wetland, even though the characteristic substrate and organisms can persist for some time after the hydrologic change. Thus, when hydrology has been altered, the presence of organisms and substrates that are characteristic of wetlands is not necessarily indicative of a wetland.

Although hydrologic conditions are paramount to the maintenance of a wetland, it is often more difficult to evaluate hydrology than it is to assess substrate or biota. Therefore, even though water is in a sense more important than any other factor, substrate and biota will typically provide the most easily obtained and reliable evidence for the presence of wetlands, except where hydrology has been altered.

A criterion is a standard of judgment or principle for testing. As shown by the reference definition, wetlands are associated with specific conditions of water, substrate, and biota. These

specific conditions correspond to thresholds or criteria that are used to judge whether a particular ecosystem is a wetland.

Each of the three criteria (hydrology, substrate, and biota) must be interpreted in terms of indicators that can be documented under field conditions. Each criterion can be interpreted with reference to multiple indicators. Some indicators are general; others are more specific and can be used only as secondary evidence or to support a more general indicator. The two most broadly significant indicators of wetlands are hydrophytic vegetation and hydric soils. Because these indicators are so often associated with wetlands, they are sometimes mistaken for criteria. This is incorrect, however. Some wetlands develop where hydric soils are absent or where vascular plants cannot grow, and the wetland supports instead other kinds of organisms that are reflective of recurrent, sustained saturation. Wetlands that lack hydric soils or hydrophytic vascular plants, although unusual, should not be excluded from regulation simply because they lack the most common indicators.

WATER

Although specific hydrologic conditions are an absolute requirement for the formation and maintenance of wetlands, the direct assessment of these conditions in the field by use of information on water table depth or inundation is often infeasible and should not be held as a strict requirement for the identification and delineation of all wetlands. In some cases, however, a direct evaluation of hydrology is essential or extremely useful in supporting the reliability of delineation. In particular, hydrologic alterations could invalidate most or all indicators except direct indicators of hydrologic conditions, and in this case direct hydrologic evaluation is mandatory. In addition, neutral or mixed indications from substrate and biotic factors should be taken as a requirement for hydrologic analysis.

Direct hydrologic analysis requires, at a minimum, information on three related elements: the duration of saturation and its relation to the growing season, the critical depth for saturation, and the frequency of saturation. In the absence of specific regional information to the contrary, the threshold for duration of saturation can be approximated as 14 days during the growing season in most years (long-term mean exceeding 50% of years). The depth over which saturation should be evaluated is the upper plant rooting zone, which can be estimated as 1 ft (30 cm). The depth of the water table should be taken as a direct indicator of the depth of the saturated zone below the surface, except where the capillary fringe makes a significant extension of the saturated zone above the water table.

The 14-day duration threshold should be viewed as provisional because it does not account for factors that can cause variation in the threshold. Because of the strong influence of temperature on the rate at which anaerobic conditions develop in saturated soils, a more sophisticated approach should be developed from a concept, such as degree-days, that accounts simultaneously for time and temperature. The current growing-season concept cannot be applied reliably to subarctic, arctic, and alpine regions, or to the southwestern and tropical parts of the United States. These regions should be evaluated separately while a more credible system for defining saturation thresholds is developed for the nation as a whole. In particular, perennially cold soils can develop the anaerobic conditions necessary for the formation of hydric soils and for the es-

tablishment of wetland vegetation even when soil temperatures seldom or never exceed the temperature that is presently used in defining the growing season (41°F, or 5°C).

Visual indicators of hydrologic events such as drift lines or blackened leaves are not reliable without support from other hydrologic data. In some instances, small amounts of direct hydrologic information on water-table level or depth of inundation can be expanded through the use of modeling.

SUBSTRATE

Most wetlands are characterized by hydric soils, which carry physical and chemical indications of repeated and prolonged saturation at or near the surface. These indications derive from blockage of oxygen transport by water in the substrate. Steady depletion of oxygen in saturated soils is caused by roots as well as microbes and other soil organisms. Often this leads to complete loss of oxygen and in some cases to substantial accumulation of reduced substances. Manifestations of hydric soils include lack of oxygen or low redox (reduction-oxidation) potential during the period of saturation, characteristic irregularities in the color of the soil, and other so-called redoximorphic features. These features are directly significant as indicators of hydric soils; they are also significant in showing the recurrent development of conditions that exclude many upland plant species, which are intolerant of conditions that accompany the loss of oxygen.

The national Hydric Soils List (Hydric Soils of the United States) has been developed under the sponsorship of the NRCS through the National Technical Committee for Hydric Soils (NTCHS). This list represents sound application of the principles of soil science to the identification of hydric soils, and it should be maintained, revised, and reviewed under federal sponsorship. The primary data, however, as well as procedures for identification of hydric soils and changes in the designation of hydric soils, should be more thoroughly documented and reviewed and should be made more widely available than in the past. In addition, a wetlands fidelity system should be considered for use with hydric soils as it is for hydrophytic vegetation, and more studies should be done of soils that are difficult to classify in the field, and particularly those that require the use of water table data, which typically are not available from field surveys. More emphasis should be placed on the development of field indicators for hydric soils.

In some instances, substrates other than hydric soils (such as unconsolidated floodplain substrates) and biotic communities other than hydrophytic vascular plants (such as algae) are associated with wetlands. There is no scientific basis for excluding these environments from designation as wetlands, and delineation manuals should acknowledge the admissibility of their indicators, unless laws or regulations dictate explicitly that they be excluded. Identification of these wetlands can be facilitated by the broadening of biotic indicators to include aquatic invertebrates, algae, and mosses.

VEGETATION

Hydrophytic vegetation is assessed through use of the National List of Plant Species that Occur in Wetlands (Hydrophyte List). This list is a valid tool for identifying hydrophytic vegeta-

tion. It is important that refinement of the list continue under federal support. The fidelity rating (obligate, facultative, etc.) assigned to plants through the Hydrophyte List is a useful foundation for the evaluation of predominance of hydrophytic vegetation and is scientifically credible. For some species, however, the existence of genetically distinctive populations that have differing affinities for wetland conditions complicates the use of the list. More extensive study of these species, and appropriate identification of the regions in which the differing genetic types are present, will enhance the usefulness of the list.

Either a dominance measure (the 50% rule) or a prevalence index can be used in quantifying the predominance of hydrophytic vegetation. The dominance measure classifies plant communities as indicative of wetland if more than 50% of the dominant taxa are hydrophytic. The prevalence index is calculated from wetland fidelity indicator values for each species, weighted by abundance, and is indicative of wetland above a threshold value indicating predominance of hydrophytes. Correct application of either method requires extensive botanical background as well as field experience. All strata of vegetation should be considered for either method. The prevalence index has withstood extensive scientific scrutiny.

A prevalence index value that is near neutrality (3.0) or a dominance estimate near 50% is not a reliable indicator for assessment of vegetation in the absence of independent information on soils, hydrology, or both. Very high or very low values for dominance or for the prevalence index reliably distinguish wetland from upland, if hydrology has not been altered, but should be supplemented with information on soils. An array of simple but definitive indicators based on vegetation can and should be constructed for use in the field as a means of conserving time, effort, and expense in vegetation analysis.

Vegetation indexes are sometimes computed without the inclusion of facultative species ("FAC-neutral" tests). Present evidence indicates, however, that such procedures do not resolve the ambiguities of communities that cannot be easily classified. A better alternative under such circumstances is to place heavier weight on other indicators. Information on soils is critical in marginal cases or where transition from wetland to upland is gradual, particularly because soil is less responsive than is vegetation to short-term change.

COMBINATIONS OF INDICATORS FOR WATER, SOIL, AND VEGETATION

Federal support is needed for more extensive, regionalized studies of the relationships between hydric soils, hydrophytic vegetation, and specific hydrologic thresholds associated with the development of wetlands. In the past, field studies have tended to focus separately on soils, vegetation, or hydrology, rather than on the coincidence of the three, which is a critical matter for identification and delineation of wetlands. The research should have a long-term component that is based in part on the establishment of regionally dispersed reference wetlands from which information can be collected routinely.

Evaluation of the three factors that define wetlands should account for the causal relationships among water, substrate, and biota. Although wetlands are defined by all three factors, it is often scientifically defensible to infer information about one factor from another in the absence of alterations or mixed evidence. This is especially true for hydrology, which is adequately charac-

terized by hydric soils or hydrophytic vegetation if there is no evidence for alteration of hydrologic conditions. If hydrologic information is unavailable, wetlands should be identified by rigorous joint consideration of substrate (typically soil), and biota (typically vegetation).

A modified approach to the assessment of wetlands could reduce the collection of unnecessary information and thus save considerable public and private money without sacrificing the accuracy of delineation, and should be considered for use by regulatory agencies. The approach would involve either the use of primary indicators or the use of a hierarchical method for the evaluation of evidence. Either method would reduce the collection of unneeded evidence for sites that are easily classified as upland or as wetland, thus allowing more resources to be used for cases with mixed evidence, uncertain indications, or complications that result from alteration.

ESPECIALLY CONTROVERSIAL WETLANDS

Classification of some kinds of wetlands has been particularly controversial, typically because of special legislative or regulatory treatment or because of special difficulties associated with identification or delineation. These especially controversial wetlands include permafrost wetlands, wetlands in riparian zones, isolated and shallow wetlands, agricultural wetlands, altered wetlands, transitional or marginal wetlands, and especially shallow or intermittently flooded wetlands.

Many proposals have been made to regulate permafrost wetlands separately from nonpermafrost wetlands. Extensive permafrost wetlands are now excluded from the regulatory definition of wetlands by the Food Security Act. The regulatory treatment of permafrost wetlands is significant because of their abundance in Alaska, which has a high proportion of the nation's remaining wetlands. Although regulatory exclusions of wetlands can occur for political or administrative reasons without a scientific basis, it should be clearly recognized that permafrost wetlands of Alaska or at any other location fall well within the NRC committee's reference definition of wetlands, and would be regulated as wetlands by any system that purports to protect or regulate all wetlands.

Riparian zones, which are the lands immediately adjacent to rivers and streams, also have posed some difficult problems, particularly in the western United States. Riparian zones share some of the characteristics of wetlands and often include wetlands but cannot be defined wholly as wetlands by any widely used definition because they are often saturated at much lower frequencies than wetlands. Riparian zones suppress the undesirable effects of flooding, maintain water quality, and serve as centers of biological diversity, especially in the western United States, and in this way share some of the functions and values of wetlands. If national policy calls for protection of riparian zones pursuant to the goals of the Clean Water Act, regulation must be achieved through legislation that recognizes the special attributes of riparian zones, and not by attempts to define them as wetlands.

Isolated wetlands and headwater wetlands also have been a subject of controversy because of their differential protection under Section 404 of the Clean Water Act. Wetlands that are isolated from other surface waters or that occupy headwaters are not necessarily less valuable or less functional than other wetlands are, and they may even perform some unique or particularly valuable functions, including maintenance of water quality and the support of waterfowl. Even

though such wetlands qualify for protection under Section 404, Nationwide Permit 26 allows them to be filled in amounts up to 1 acre (0.4 ha) with no review and 10 acres (4 ha) with minimal review, except where Nationwide Permit 26 is overridden by the USACE district engineer or state regulations. Nationwide Permit 26 has been controversial because of the cumulative wetland losses that can result through its application and is the cause of more litigation than any other nationwide permit. The rationale for extensive use of Nationwide Permit 26 for isolated and headwater wetlands should be reviewed.

Especially shallow wetlands that might be dry much of the year, but that are maintained by repeated seasonal saturation or inundation, require protection even at times when they are completely dry if they are to retain their functions.

Agricultural wetlands, which for present purposes include both farmed wetlands and nonfarmed wetlands within farmed areas, are extensive within the United States. They often perform functions that are similar in nature to those of nonagricultural wetlands. Use of special definitions or criteria for the identification of agricultural wetlands is not justified because it leads to differential delineation of wetlands on agricultural and nonagricultural lands.

Wetlands that have been altered through activities other than agriculture present special problems in delineation. Any federal manual applicable to such lands should instruct delineators on the valid use of inference for the purpose of assessing altered lands. Natural transitional zones, especially if they are very broad, also present special problems in delineation. Transition zones should be the subject of more extensive study for the purpose of strengthening the efficiency and accuracy of delineation.

REGIONALIZATION

Regionalization, which is the adaptation of wetland indicators to regional variation in wetland characteristics, is the best approach for establishing the relationship between growing season, duration of saturation, and the development of substrate and biota. The current federal regulatory system is regionalized to some extent through the delegated authority of the regional offices of federal agencies and through the use of the Hydrophyte List and Hydric Soils List. The administrative system for regionalization of wetland assessment is haphazard, however. Regions for wetland regulation need to be redefined around environmental factors such as physiography and climate and should be used in common by all agencies. More extensive development of regional analysis and regional protocols should be encouraged administratively and through research, provided that the outcome of federal regulatory practice is reasonably uniform across the nation. A uniform process should be used to develop regional standards, and the four federal agencies that assess wetlands (USACE, EPA, NRCS, FWS) should cooperate in the development of regional protocols.

MAPS, IMAGES, AND MODELING

Use of aerial photography and satellite images for identifying and delineating wetlands can be acceptable, but it requires extensive field validation and should be designed and timed for as-

sessment of wetlands rather than assessment of crops. Conventions for interpretation should be standardized across agencies that are involved in the delineation of wetlands. The National Wetlands Inventory provides an important overview of wetlands for the United States, and should be completed. Mathematical and computer models, if verified in the field, are useful and reliable methods for evaluating the hydrology of certain types of wetlands and the effects of alterations on wetland hydrology and will in some cases make the delineation of wetlands more effective and expeditious.

REGULATORY PRACTICE

Training and certification of delineators should be facilitated by federal agencies involved in the regulation of wetlands. The expertise necessary for delineation of wetlands should be clarified by the federal agencies that establish delineation protocols. Because identifying and delineating wetlands is a complex task a delineator would be required to have a scientific education at the college level combined with specialized training in delineation methods and practices. All wetland assessment programs of regulatory significance should incorporate procedures for quality control and quality assurance.

A federal system should be created for maintaining computerized records of regulatory wetland assessments, and this information should be made available to federal agencies, states, and private parties. It should form the basis for periodic nationwide synthesis and reporting of information on the numbers, kinds, and outcomes of regulatory actions related to wetlands.

Consolidation of all wetland regulatory functions into a single federal agency would improve the consistency of wetland delineations. Even if several agencies continue to share responsibility for wetland delineation, they should use a single definition and one delineation manual for all regulatory purposes.

FUNCTIONAL ASSESSMENT

Many wetland functions are considered useful or important by society. For example, inundation of wetlands can prevent flood damage elsewhere, denitrification can improve water quality, wetland habitat can help maintain waterfowl populations, and anoxic conditions in the substrate can influence the development of unique plant communities that contribute to the conservation of biodiversity.

The value of a wetland is a measure of its importance to society. Wetland functions are valued to various degrees by society, but there is no precise, general relationship between wetland functions and the value of wetlands to society, and values can be difficult to determine objectively. A wetland's value can be weighed directly or relative to other uses that could be made of the site. For this reason, the location of a wetland may affect its value to society. For example, wetlands in urban settings might have higher value for recreation and education or for alternative uses than wetlands in undeveloped lands or far from population centers. Assessing the value of wetlands requires the use of methods from economics and other related fields, and is not yet well developed.

The societal priorities for protection of wetlands and for investment in wetland protection are matters of policy that must reflect in part the value that society places on wetlands. Assessment of value requires comprehensive scientific knowledge of wetland functions. Indeed, some groups have suggested the creation of a national scheme that would designate wetlands of high, medium, and low value based on some general guidelines involving size, location, or some other factor that does not require field evaluation. It is not possible, however, to relate such categories in a reliable way to objective measures of wetland functions, in part because the relationships between categories and functions are variable and in part because we still have insufficient knowledge of wetland functions. In general, the identification and delineation of wetlands must be kept separate from the functional analysis of wetlands.

Functional analysis of wetlands should be extended and refined; it should take into account the interactions between wetlands and their surroundings. The regulation of wetlands is an integral part of watershed management, which in turn is central to the objectives of the Clean Water Act.

GENERAL CONCLUSIONS

Federal laws, such as the Commerce Clause, or policies, such as those developed by federal agencies implementing the Clean Water Act, could intentionally exclude some wetlands from regulation. Therefore, it is important to maintain the distinction between a reference definition, which ignores the matter of jurisdiction, and a regulatory one, which takes into account the intent of laws or policies that do not necessarily encompass all wetlands.

The federal regulatory system for protection of wetlands is scientifically sound and effective in most respects, but it can be more efficient, more uniform, more credible with regulated entities, and more accurate in a technical or scientific sense through constructive reforms of the type suggested in this report.

Detailed recommendations can be found at the end of Chapters 2, 3, 5, 6, 7, 8, 9, and 10.

SUMMARY OF RECOMMENDATIONS AND CONCLUSIONS

1. More intensive and regionally diverse studies of basic wetland phenomena should be undertaken in support of stronger foundations for identification, delineation, and functional protection of wetlands.

2. Three factors must be assessed in the identification or delineation of wetlands: water, substrate, and biota. It is not useful or correct to refer to these factors as parameters. The status of these three factors is the criteria for identification and delineation of wetlands. Wetland indicators are measurements or observations by which criteria are evaluated, and should accommodate regional variation.

3. A new delineation manual should be developed, to be used by all Federal Agencies. Thirty-five specific recommendations are made relative to criteria, methods, and procedures for delineation of wetlands. Criteria for wetland status are prioritized into strong and weak evidence of wetland hydrology. Strong indicators of wetland hydrology include clearly hydric soils and obligate or facultative wet vegetation in the absence of facultative-upland or upland plants. Strong indicators can be considered sufficient evidence for wetland status in the absence of hydrologic modification, if contrary evidence is not present. Regional variations must be considered in establishing specific criteria. Indirect hydrologic indicators (water marks, etc.) should not be used to determine the long term hydrologic status of a site. The duration of saturation required for development of hydric conditions for most areas of the continental United States can be estimated as 14 days during the growing season, in the absence of other evidence. Alteration of hydrology requires supplemental hydrologic analysis to determine wetland status. Further research is needed if a more accurate description of the relationship between soils, hydrology, and vegetation is desired.

4. Permafrost wetlands and isolated or intermittent wetlands have structure and functions similar to other wetlands, and should be identified, delineated and regulated by the same principles.

5. Riparian zones, although they do not meet criteria for delineation as wetlands, perform many of the same functions as wetlands, including water quality enhancement and flood water storage. In some regions of the country, riparian zones are critical to wildlife and ecosystem integrity.

6. General permitting of activities in headwater or isolated wetlands without review or notification is not scientifically justified based on evidence of wetland functions such areas perform. Nationwide Permit 26 is controversial because of cumulative wetland losses and should be reviewed for validity considering the goals of the Clean Water Act.

7. Methods and requirements for delineation, functional assessment, and management of wetlands must consider regional variation and requirements. Regionalization should meet standardized national objectives and criteria.

8. The National Wetland Plant List is a valid, scientific tool for classifying vegetation. It should be maintained in a central repository and continually updated as new information becomes available.

9. Aerial photography is useful for wetland delineation and mapping if appropriately planned and obtained. Interpretation requires special training and ground truthing. Satellite and other high altitude imagery should be evaluated further for mapping potential where large areas of land are concerned.

10. Hydrologic models are useful in evaluating hydrology of wetlands, but require field verification.

11. All Federal Agencies involved in wetland delineations should participate in jointly managed, rigorous, delineation training and be part of a continuing-education program. The delineator certification program should be made available to Federal and non-Federal practitioners. Jurisdictional delineation on a permit application should be postponed when a short delay (60-90 days) might substantially improve the accuracy of the delineation.

12. Records of jurisdictional delineations should be centrally maintained in a usable, accessible format to enable agencies to develop accurate inventories of jurisdictional wetlands and to facilitate research.

13. Consolidation of all wetland regulation into a single Federal Agency would improve consistency of wetland management and regulation, but should not be implemented without appropriate oversight and quality assurance.

14. Although wetland functions can be evaluated, the relative precision is low for some functions. Functional assessment is most useful in the context of watershed or landscape planning. The creation of a watershed planning framework increases the likelihood that regulatory management of wetlands will be acceptable to all parties.

15. The hydrogeomorphic functional assessment approach is likely to improve the precision, consistency, reliability and timeliness of wetland functional assessment. However, it is subject to many of the same limitations as previous procedures. Limitations involve the quality and quantity of background information, landscape perspectives, and societal values. Physical and chemical functions are understood less well than biological functions. Research on reference wetlands to quantify functions has not been sufficiently supported to generate accurate, comprehensive information.