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Standard Guide for Assessment of Wetland Functions¹

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1. Scope

1.1 This guide covers assisting wetland managers by prescribing a sequence of steps for defining and assessing wetland functions. This guide also identifies properties that must be considered in the selection of a wetland assessment procedure to determine whether it will assist in satisfying the requirements of wetland regulatory programs or produce valid design criteria for planned wetlands, or both. This guide can help wetland managers use existing assessment procedures more effectively during the decision-making process. The outcome of the assessment is dependent on many factors including the selected procedure, the sampling design, and assumptions; therefore, decisions and assumptions made should be documented throughout the process. While this guide is developed to assist in satisfying the requirements of wetland regulatory programs, it can also be used in a variety of planning, management, and educational situations.

1.2 The guide is not intended for use in assigning values to wetland functions in terms of economic (for example, dollars) or other value units. However, the information that is gathered while assessing wetland functions may be useful in meeting this objective when used in conjunction with other information (for example, see Refs (1)² and (2)).

1.3 This guide applies to assessment procedures designed for application at the ecosystem scale. It does not address the less commonly used landscape level models or the use of wetland assessment procedures for cumulative impacts analysis (3-5).

1.4 *Limitations*—This guide does not include a standard wetland assessment procedure or models for assessing function. This guide has been written primarily to complement and to aid in the selection of current procedures. There are several procedures for quantifying wetland functions and each has been developed for specific purposes. The suitability of a procedure depends on assessment objectives, wetland type, availability of applicable models given the wetland type and

objectives, and policy of local decision makers. There are continuous efforts to develop new and improved methods that could override any one recommended standard procedure.

1.5 The values stated in inch-pound units are to be regarded as the standard. The SI units given in parentheses are for information only.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 Definitions:

2.1.1 *wetland assessment procedure, n*—a definitive procedure for identifying, characterizing, or measuring the functions that a wetland performs, or a combination thereof.

2.1.2 *wetland functions, n*—the physical, chemical, and biological processes or attributes that contribute to the self-maintenance of wetland ecosystems (6) and (7). Wetland functions result directly from the characteristics of a wetland ecosystem and the surrounding landscape and their interaction.

2.1.2.1 *Discussion*—A wetland function is distinguished from wetland value. Wetland functions are a direct result of the characteristics of a wetland and the surrounding landscape. Examples of functions include the removal of dissolved substances, cycling of nutrients, maintenance of plant and animal communities, and short-term storage of surface water. These functions provide benefits, goods, and services which may be assigned a value (economic or noneconomic) describing the relative importance of a wetland function to an individual or group of people. The values of wetlands are estimates, usually subjective, of the worth, merit, quality, or importance of wetland functions (8).

2.2 *Definitions of Terms Specific to This Standard*—Most of the following definitions are from Refs (9) and (10).

2.2.1 *assessment model, n*—a simple model that defines the relationship between ecosystem and landscape scale variables and functional capacity of a wetland; it is used to derive a measure of functional capacity (that is, the functional capacity index).

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² The boldface numbers given in parenthesis refer to a list of references at the end of the text.



2.2.2 conceptual design, *n*—a design that provides a brief description of the planned wetland through drawings and text which confirms feasibility and facilitates early review by decision makers.

2.2.3 functional capacity, *n*—the magnitude or rate at which a wetland performs a function. Functional capacity is dictated by the characteristics of the wetland ecosystem and the surrounding landscape, and the interaction between the two.

2.2.4 functional capacity index (FCI), *n*—an index of the capacity of a wetland to perform a function relative to other wetlands from a defined region or wetland class, or both. Functional capacity indices are by definition normally scaled from 0.0 to 1.0. An index of 1.0 indicates that a wetland performs a function at maximum functional capacity. An index of 0.0 indicates the wetland does not perform the function.

2.2.5 functional capacity units (FCs), *n*—a measure of the capacity of a wetland to perform a function that links functional capacity with area ($FC = FCI \times \text{size of wetland area}$).

2.2.6 planned wetland, *n*—design or an implemented design for a constructed, created, restored, or enhanced wetland.

2.2.7 variable, *n*—an attribute or characteristic of a wetland ecosystem or the surrounding landscape that influences the capacity of a wetland to perform a function; used in assessment models to derive a measure of functional capacity (that is, the functional capacity index). Variables may be described by direct measures or indicators. A direct measure is a quantitative measure of an assessment model variable. An indicator is an observable characteristic that corresponds to identifiable variable conditions in a wetland or the surrounding landscape.

2.2.8 wetland assessment area (WAA), *n*—the wetland area being assessed. In regulatory situations, the WAA will usually be jurisdictional wetlands confined to the area of direct or indirect impact or both.

2.2.9 wetland classification, *n*—the grouping of wetlands into different categories based on specific criteria (that is, vegetation type, hydrology, geomorphology) for the purpose of inventory, assessment, and management.

2.2.9.1 Discussion—There are several wetland classification schemes including the Classification of Wetlands and Deepwater Habitats of the United States (11) and the hydrogeomorphic classification (12). Each has been prepared for different purposes. One or more of these classifications may be used in the process of assessing wetland functions.

2.3 Additional Terminology—The following definitions and discussions, taken directly from the publication “Form and Style for ASTM Standards,” shall be included in full in every standard guide or practice produced and passed by Committee E-50 or any of its technical subcommittees; approved April 16, 1997.

2.3.1 guide—a series of options or instructions that do not recommend a specific course of action.

2.3.1.1 Discussion—Whereas a practice prescribes a general usage principle, a guide only suggest an approach. The purpose of a guide is to offer guidance, based on a consensus of viewpoints, but not to establish a fixed procedure. A guide is intended to increase the awareness of the user to available

techniques in a given subject area and to provide information from which subsequent evaluation and standardization can be derived.

2.3.2 practice—a definitive procedure for performing one or more specific operations or functions that does not produce a test result.

2.3.2.1 Discussion—A practice is not a downgraded test method. Examples of practices include procedures of interlaboratory testing programs or other statistical procedures; for writing statement on sampling or precision and accuracy; and for selection, preparation, application, inspection, and necessary precautions for the use, disposal, installation, and maintenance, and operation of testing equipment.

2.3.3 standard—as used in ASTM, a document that has been developed and established within the consensus principles of the Society and that meets the approval requirements of ASTM procedures and regulations.

2.3.3.1 Discussion—The term “standard” serves in ASTM as an adjective in the title of documents such as test methods or specifications, to connote specified consensus and approval. The various types of standard documents are based on the needs and usages as prescribed by the technical committees of the Society.

3. Summary of Guide

3.1 This guide is summarized in Table 1, that shows the steps in defining and assessing wetland functions and the sections of this guide that apply.

3.2 The remainder of this guide identifies properties to consider when selecting a procedure or models, and a summary of existing procedures (see Section 7). Appendix X1 describes the specific application of wetland assessment to planned wetlands.

4. Significance and Use

4.1 Wetland managers may be aware of wetland assessment procedures, but not use them as effectively as possible for a variety of reasons. There is no one universally accepted procedure; therefore, time is often lost to identifying and agreeing upon a suitable approach. The absence of guidance

TABLE 1 Suggested Steps in the Assessment of Wetland Functions

Steps	Rules
Characterization Phase:	6.2
Define objectives of the assessment	6.2.1
Select functions	6.2.2
Describe the project area	6.2.4
Identify wetland assessment area(s)	6.2.6
Screen for red flags	6.2.7
Identification of Assessment Approach:	6.3
Identify, modify, or develop assessment models	6.3.1
Select the units of measure	6.3.2
Assessment Phase	6.4
Analysis Phase:	6.5
Types of comparisons	6.5.1
Other criteria to consider when comparing wetland assessment areas	6.5.5



describing the sequence of steps to assessing wetland functions causes confusion and delays the decision-making process. Only recently has guidance been published by the U.S. Army Corps of Engineers (9).

4.1.1 This guide shows the person(s) performing an assessment the steps to assess wetland functions. This guide also provides a summary of the variety of procedural options for measuring function, and includes a list of properties to consider when selecting an appropriate procedure.

4.2 *Situations Requiring Assessment of Wetland Functions*—While this guide is developed to assist in satisfying the requirements of wetland regulatory programs, it can also be used in a variety of planning, management, and educational situations.

4.3 *Rapid Assessment for Section 404 Permitting*—Section 404 of the Clean Water Act (33 U.S.C. 1344)³ directs the U.S. Army Corps of Engineers, in cooperation with the U.S. Environmental Protection Agency (EPA), to administer a program for permitting and regulating the discharge of dredged or fill materials in waters of the United States, including wetlands. A permit application undergoes a public interest review that includes an assessment of the impacts the proposed project will have on wetland functions.

4.3.1 An assessment may be performed during one or more of the following steps of the review sequence that are prescribed in the U.S. EPA 404(b)(1) Guidelines (40 CFR Part 230)⁴

4.3.1.1 *Step 1*—Determine whether the proposed project is water dependent.

4.3.1.2 *Step 2*—Determine whether practicable alternatives exist for the proposed project.

4.3.1.3 *Step 3*—Identify the potential impacts of the proposed project on wetland functions in terms of project specific and cumulative effects.

4.3.1.4 *Step 4*—Identify how potential project impacts can be avoided or minimized in terms of project-specific and cumulative effects.

4.3.1.5 *Step 5*—Determine appropriate compensatory mitigation for unavoidable project impacts.

4.3.1.6 *Step 6*—Grant or deny a permit to discharge dredged or fill material by comparing the value of the benefits gained from the proposed project versus the value of benefits lost from the proposed project.

4.3.1.7 *Step 7*—If a permit is granted, monitor compensatory mitigation.

4.3.2 Wetland functions are assessed during Step 2 to compare impacts of practicable alternatives and to identify which is least damaging. During Steps 3 and 4, wetland functions are assessed to identify and then determine how to avoid or minimize project-specific and cumulative impacts. Wetland functions are assessed in Step 5 to determine what constitutes appropriate compensatory mitigation for unavoidable impacts. Compensatory mitigation is wetland restoration

or creation, or enhancement or preservation of an existing wetland to compensate for wetland impacts. Several approaches to mitigation may be considered and compared at this time including in-kind, out-of-kind, on-site, off-site, and mitigation banking. Whichever option is chosen, the mitigation project is later assessed (during Step 7) to determine whether the function-based objectives have been met in the conceptual plans or the completed planned wetland, or both.

4.3.2.1 Many states and local governments have adopted regulatory wetland statutes which set forth procedures for permit applications similar to the federal Section 404 program (see review in Ref (13)). The need to assess wetland functions is similar, but specific requirements may differ depending upon the individual state program.

4.3.2.2 *Mitigation Banking*—One option for meeting any compensatory mitigation requirements is to use a mitigation bank. Mitigation banking is wetland restoration, creation, or enhancement undertaken expressly for the purpose of providing compensation credits for wetland losses from future development activities. A wetland assessment procedure can be used to assess the loss of functions at an impact site, to assess functions to date at the mitigation bank, and to determine the number of credits (expressed in terms of functional capacity or acreage, or both) that must be purchased at the mitigation bank to compensate for the impacts.

4.3.3 *Other Applications*—There are a variety of non-regulatory situations where there is a need to assess wetland function. A rapid wetland assessment procedure that is appropriate for the Section 404⁴ program could be used, but time and resources may also allow for more detailed analyses.

4.3.3.1 *Advanced Identification (ADID)*—Advanced Identification is a planning process authorized by Section 404 regulations (40 CFR Part 230.80)⁴ that allows the U.S. EPA, in cooperation with the U.S. Army Corps of Engineers and state and local agencies, to collect information on the functions of the wetlands in selected study areas. The agencies evaluate the information to determine which wetlands in the ADID study area should be protected from potential fill activities or which could serve as future disposal sites. This information is used by the agencies in the review of Section 404 permit applications, by local communities for land-use management, and by environmental organizations for wetland protection activities.

4.3.3.2 *Restoration*—Wetland restoration refers to the return of a wetland from a disturbed or altered condition by the reestablishment of one or more indicators of wetland hydrology, hydric soil, and hydrophytic vegetation. There are increasing efforts to restore wetlands, many of which do not require permits. The restoration goals may be broadly defined in terms of wetland type or functions, or both. Wetland assessment procedures can be used to define and measure the achievement of function-based goals.

4.3.3.3 *Resource Management*—Wetlands are resources that are managed by different government agencies, private organizations, or individual landowners for different purposes. Wetlands can be managed at site-specific (for example, water level and weed control management of waterfowl impoundment), watershed, or even larger scales (for example, a North American Waterfowl Management Plan, and a conservation plan).

³ Title 33, United States Code, Chapter 26, Section 1344: "Permits for Dredged or Fill Material."

⁴ Title 40, Code of Federal Regulations, Part 230: Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material.

by the United States and Canada to manage waterfowl habitat (14)). A wetland assessment procedure can be used to define and monitor the achievement of management objectives. For example, the assessment of a degraded wetland can be performed at the site-specific scale to reveal what characteristics need modification to enhance wildlife habitat. The habitat could be altered and later reevaluated to determine if the management objectives have been achieved.

4.3.3.4 Watershed/Regional Planning—There are several state initiatives to manage land-use within watersheds or regions. A wetland assessment procedure can be used to provide an inventory of wetlands within a watershed/region, to prioritize these wetlands for land-use decisions, and to identify wetlands for acquisition, protection, development, or restoration. Landscape level or ecosystem level assessment procedures, or both, may be used. At least two states have developed and are testing new landscape-level procedures that use Geographic Information System (GIS) data (for example, Refs (5) and (15)). The assessment of landscape level functions is limited by the data available in the GIS format. Greater accuracy may be obtained through the application of ecosystem-level assessment procedures; however, assessing all or most of the wetlands within a designated area is more time-consuming. The New Hampshire Method (16) and Indicator Value Assessment (17) were developed for this purpose, but other procedures may also be suitable. The EPA has developed a Synoptic Approach as a proposed method for assessing cumulative impacts and making comparisons between landscape subunits, such as watersheds, ecoregions, or counties (3)(4).

4.3.3.5 Swampbuster Conversion of Wetlands—Wetlands are managed under the Wetland Conservation (Swampbuster) Provisions of the 1985 Food Security Act as amended by the 1996 Farm Bill. The Farm Bill allows exemptions to be granted for conversion of wetlands where such conversions have minimal effect on wetland functions and values, or where impacts are compensated through mitigation actions. Wetland assessment procedures can be used to measure the effects of proposed conversions or mitigation actions on wetland functions, or both.

5. Function of Wetlands

5.1 Wetlands perform a variety of functions at different scales of complexity. These functions are difficult to characterize because they represent a wide range of scales from microscopic chemical reactions to landscape size changes in climate or environment. By compartmentalizing the activities that take place in a wetland into individual functions, one actually makes value judgments about the important processes in wetlands. For example, nitrogen removal is a function which can be considered a subset of more complex functions such as nitrogen cycling and nutrient cycling. A wetland would probably have a different functional capacity index if the assessment model was designed to assess general wildlife habitat rather than if the model was designed to assess anadromous fish habitat or habitat for amphibians. However, it is not practicable to assess all wetland functions at all levels of complexity. The functions that are assessed should be selected on the basis of wetland type and assessment objectives. The

following list of general functions is a starting point for identifying what kinds of functions a wetland performs. This list and definitions are taken or modified or both, from Refs (9) and (18). Other lists are available in individual wetland assessment procedures (refer to Section 7) and other publications (for example Ref (19) and (20)).

5.1.1 Functions Related to Hydrologic Processes:

5.1.1.1 Short-Term Storage of Surface Water—The capability of a wetland to detain or slow surface water or both for short periods of time. When water is detained in the wetland, downstream peak discharge and flood volume are reduced.

5.1.1.2 Long-Term Storage of Surface Water—The capability of a wetland to temporarily store surface water for long periods of time (for example, one week or longer). When water is retained in a wetland, the volume of flood water transported downstream is decreased. The retained water supports aquatic vertebrates and invertebrates and contributes to other ecological processes within the wetland.

5.1.1.3 Storage of Subsurface Water—The availability of storage for water beneath the wetland surface. The storage, that becomes available with periodic drawdown of the water table, may be the result of vertical and lateral drainage or evapotranspiration, or both. This storage helps to recharge surficial aquifers and maintain base flow and seasonal flow in streams. The periodic drainage results in a fluctuation between aerobic and anaerobic conditions. This fluctuation benefits the recruitment, survival, and competitiveness of wetland plant species and sustains conditions necessary for microbially mediated biogeochemical cycling.

5.1.1.4 Moderation of Ground Water Flow or Discharge—The capability of wetland to moderate the rate of ground water flow or discharge from upgradient sources or from ground water discharge within the wetland. This moderation in flow maintains ground water storage, base flow, seasonal flows, and surface water temperatures. Flows of subsurface water into the wetland in late fall or early spring sustain warmer soil temperatures resulting in a longer growing season for biological activity and other wetland functions.

5.1.1.5 Dissipation of Energy—The capability of a wetland to reduce the energy of water as it moves through, into, or out of the wetland. The reduction in the energy of moving water may result in reduced shoreline and floodplain erosion, improved surface water quality, and decreased downstream peak discharge.

5.1.2 Functions Related to Biogeochemical Processes:

5.1.2.1 Cycling of Nutrients—The conversion of elements from one form to another through abiotic and biotic processes. Nutrient cycling is accomplished through plant uptake and release, a process by which nutrients are adsorbed and assimilated into living plant tissue and released with litter production. By cycling nutrients, wetlands maintain sufficient nutrients to support living biomass and detrital stocks. Nutrient cycling also reduces downstream particulate loading which helps to maintain or improve surface water quality.

5.1.2.2 Removal of Elements and Compounds—The removal of nutrients, contaminants, or other elements and compounds on a short- or long-term basis through various

incorporation into biomass, or biochemical reactions. In addition to providing benefits on-site, this removal also reduces downstream loading which helps to maintain or improve surface water quality.

5.1.2.3 Retention of Particulates—The deposition and retention of organic and inorganic particulates from the water column, primarily through physical processes such as sedimentation. When particulates are retained in the wetland, downstream loading is reduced; this helps to maintain or improve surface water quality.

5.1.2.4 Export of Organic Carbon—The export of dissolved and particulate organic carbon from the wetland through leaching, flushing, displacement, erosion, and other mechanisms. The removal of organic carbon from living biomass, detritus, and soil organic matter contributes to the decomposition and mobilization of metals within the wetland. The exported organic carbon also provides support for aquatic food webs and biogeochemical processing downstream from the wetland.

5.1.3 Functions Related to Habitat:

5.1.3.1 Maintain Characteristic Plant Community—The maintenance of a plant community that is characteristic with respect to species composition and physical characteristics of the vegetation. Plant communities provide energy to drive food webs; provide habitat for nesting, resting, refuge; provide escape cover for animals; create roughness that reduces velocity of flood waters; and provide organic matter for nutrient cycling within the wetland. Plant communities also provide a source of propagules to help maintain species composition of adjacent areas and migratory pathways between habitats.

5.1.3.2 Maintain Spatial Structures of Habitat—The capacity of a wetland to support animal populations and guilds by providing a heterogeneous habitat. Structure provides potential feeding, resting, and nesting sites for vertebrates and invertebrates within the wetland. The structure of the wetland also provides habitat for wide-ranging and migratory animals and a corridor for gene flow between separated populations.

5.2 Wetlands provide benefits, goods, and services that are considered values, but sometimes referred to as functions. While these are not functions, wetland managers may choose to evaluate these aspects of the wetland. Examples include the following:

5.2.1 Recreation—Providing recreation sites for fishing, hunting, and observing wildlife,

5.2.2 Open Space and Aesthetic Values—Providing open space for visual enjoyment,

5.2.3 Education and Research—Providing educational opportunities for nature observation and scientific study,

5.2.4 Historical or Archeological Significance—Containing properties of historical or archeological significance, and

5.2.5 Timber Production—Providing timber resources for private or commercial uses.

5.3 The preceding list (5.1.1 through 5.2.5) is not all inclusive. Not all wetlands perform these functions and values; additional functions may be appropriate given a specific wetland type and other factors.

6. Steps for Assessing Wetland Functions

6.1 The phases outlined in 6.2 through 6.5 and discussion in 6.3.2 are modified from the Hydrogeomorphic (HGM) Approach (9), (21). Changes have been made in order to increase flexibility and incorporate concepts from other approaches. Many steps, particularly the identification of the assessment approach, require critical decisions. These decisions should be made by a team of experts. The term will differ in each case, but may include wetland scientists from appropriate federal, state, and local agencies as well as from the private sector and academia. The decisions and assumptions may affect the final outcome of the assessment. For this reason, these decisions should be agreed upon between the assessors and users of the results (for example, regulator) and also be documented throughout the process.

6.2 Characterization Phase—The following baseline information must be gathered during the characterization phase before proceeding with the assessment.

6.2.1 Define Objectives of the Assessment—Describe the proposed project, purpose, and objectives. Decide which wetland assessment area(s) are to be compared and the number of comparisons required. Predictions regarding future conditions may also be necessary. Therefore, it is important to define the time period for which the wetlands are being assessed (for example, predicted future conditions of planned wetland two years after construction). The three categories of objectives include documenting existing conditions, comparing different wetlands at the same point in time, or comparing wetland(s) at different points in time. For example, a simple objective for an alternative analysis may be to compare two wetland assessment areas (WAAs) in order to determine which project location will have the least impact. A more complex objective would be to compare a restored or enhanced wetland site. In this case, the impact area would be assessed for both future with-project and future without-project conditions. An independent assessment would then be performed for the enhancement area and its predicted future conditions, both with and without the enhancement project. Finally the gains from the enhancement project would be compared to the losses associated with the impact. As projects become more complicated and involve several wetlands, it is important that the objectives be described in specific terms to avoid any misunderstanding and unnecessary work.

6.2.2 Select Functions—Select the functions to be assessed on the basis of wetland type, the assessment objectives, the nature of the project, and expected impacts.

6.2.2.1 There is no standard set of wetland functions that are applicable to all wetland types. Applicable functions can be selected from existing assessment models or redefined, or both. In general, a suite of representative wetland functions should be assessed in order to provide a more complete description of a wetland area. Depending upon the assessment objectives, however, a limited number or even one function may be selected. For example, if the sole purpose of a wetland restoration project is to provide wildlife habitat, assessment may be limited to that single function.

6.2.3 Each function should be assessed and considered separately in the decision-making process. However, in more complex projects, decision makers may choose to assess



grand score that combines the measures of each function for a wetland. If functions are to be combined, pertinent regulatory agencies and other decision makers should agree upon which functions will be combined and how. Caution is advised (particularly for options 6.2.3.3 and 6.2.3.4) since no guidance is available, and the combined results could be subject to question. In summary, the possible options include:

6.2.3.1 Consider each function separately.

6.2.3.2 Develop scores for the major function categories (for example, hydrologic processes, biogeochemical processes, and habitat) which are derived from the weighted or non-weighted totals of FCs for functions in each category.

6.2.3.3 Develop a grand score that represents a total number of functional capacity units. (See definition in 6.3.2.3.)

6.2.3.4 Develop a grand total that represents a weighted total of functional capacity units, where multiplying factors are used to emphasize the more important functions.

6.2.4 *Describe the Project Area*—Describe the project area and surrounding landscape with a narrative and map(s). The narrative should include:

6.2.4.1 Project name and location,

6.2.4.2 Nature of the proposed project,

6.2.4.3 Assessment objectives,

6.2.4.4 Classification of wetlands (use National Wetland Inventory (NWI) (11) and hydrogeomorphic (12) classification, or other classifications as needed), and

6.2.4.5 Description of characteristics of the wetland ecosystem and landscape context that may be relevant to the assessment, (for example, climate, landform and geomorphic setting, hydrology, vegetation, soils, land use, ground water features, surficial geology, urban areas, potential impacts, and red-flag features (see 6.2.7)).

6.2.5 The map(s) shall be prepared to a scale suitable for illustrating the following information, as appropriate:

6.2.5.1 Project area boundaries, property lines, and other relevant political boundaries,

6.2.5.2 Topographic contour lines in the project area and surrounding landscape,

6.2.5.3 Infrastructure (for example, roads, fences, buildings, railroad grades, and bridges),

6.2.5.4 Surface water features (for example, streams, rivers, lakes, ponds, and springs),

6.2.5.5 Hydraulic structures (for example, weirs, culverts, gates, pumps, and levees),

6.2.5.6 Seasonal water table elevations,

6.2.5.7 Soil type(s),

6.2.5.8 Plant communities,

6.2.5.9 Jurisdictional wetlands,

6.2.5.10 Location of wetland impacts (potential and relevant prior impacts),

6.2.5.11 Wetland assessment area(s),

6.2.5.12 North arrow (true north), legend or key, and distance scale,

6.2.5.13 Title block with the project name, investigators, dates, and sources of information, and,

6.2.5.14 Keep time for map preparation to a minimum by using existing maps or modifying as needed, or both. Multiple maps, or overlaps keyed to a base map, may be practical (examples provided in Ref (16).)

6.2.6 *Identify Wetland Assessment Area(s)*—Identify wetlands within the project area using a chosen wetland definition, for example, the jurisdictional wetlands in a regulatory situation. The project area may contain one WAA; however, in some cases, it may be large and encompass several wetland areas that function differently. These WAAs are identified on the basis of wetland classification, physical separation, and potential project impacts. The criteria for identifying WAAs will differ depending upon the selected assessment procedure (refer to Section 7) and local policy. Possible criteria for distinguishing WAAs are difference in wetland classification, physical separation, and differences in predicted project impacts.

6.2.7 *Screen for Red Flags*—Red flags are features of a wetland or the surrounding landscape to which special recognition or protection is assigned on the basis of objective criteria. The recognition or protection may occur at a federal, state, regional, or local level, and may be official or unofficial (21) (refer to Table 2). These features are identified to determine whether the area will require special consideration prior to or during the assessment of wetland functions.

6.3 *Identification of Assessment Approach:*

6.3.1 *Identify, Modify, or Develop Assessment Models*—There are a variety of assessment models from which to choose that are contained in existing procedures (see Section 7). Identify the purpose or objective for which the assessment is needed. The objective will dictate what method may be appropriate and which ones will provide the needed information. Review these to determine which are most appropriate. Criteria to be considered are listed in Table 3. Users of this guide should note that some of the procedures cited are no longer acceptable to all resource agencies. It is critical to determine in advance which procedures are acceptable.

6.3.1.1 Decide whether to use the assessment models without change, modify and then use the assessment models, or

TABLE 2 Red Flag Features (9)

Areas protected under American Indian Religious Freedom Act
Hazardous waste sites identified under CERCLA or RCRA
Areas protected by a Coastal Zone Management Plan
Areas providing critical habitat for species of special concern
Areas covered under the Farmland Protection Act
Floodplains, floodways, or floodprone areas
Areas of high public use
Areas with structure/artifacts of historic or archeological significance
Areas protected under the Land and Water Conservation Fund Act
Areas protected by the Marine Protection Research and Sanctuaries Act
National Wildlife Refuges
Native lands
Areas identified in the North American Waterfowl Management Plan
Areas identified as significant under the RAMSAR Treaty
Areas supporting rare or unique plant communities
Areas designated as sole source groundwater aquifers
Areas protected by the Safe Drinking Water Act
Special management areas
State or national parks
Areas supporting threatened or endangered species
Areas with unique geological features
Areas protected by the Wild and Scenic Rivers Act
Areas protected by the Wilderness Act
Wetlands that have been restored, created, or converted





TABLE 3 Criteria to Consider When Identifying Modifying, or Developing Assessment Models,

Criteria	Specific Considerations
Wetland type	Is the model applicable to the wetland type(s)? An existing model describing one wetland type may be suitable, require minor modifications, or be unsuitable.
Functions	Is there a model for each of the pertinent functions?
Geographic area	Is the model applicable to the geographic area (for example, ecoregion, state, watershed)? Define the geographic region or context, and determine whether the model is appropriate. Minor or major modification may be required to ensure that the model is calibrated to the defined region.
Assessment situation	Is the model applicable to the assessment situation, (for example, watershed planning, regulatory action, management, use as guide to wetland design)?
Comparison of different wetland types	Is there a need to compare different wetland types? Note that when models are calibrated to describe particular wetland types within a region, it is inappropriate and meaningless to compare different wetland types. Choose models that will facilitate a comparison, if needed, or decide on how comparisons can be made.
Acreage	How does the model consider wetland acreage? Does or can the resulting measure of functional capacity incorporate acreage? Note that the assessment results are often used to make decisions regarding wetland function and acreage. For example, in permit actions it is necessary to define not only the functional capacity of the mitigation wetland, but also the acreage required to compensate for wetland impacts.

develop new assessment models. Models may be developed using available information including best professional judgment, expert opinion, published literature, empirical data, or a combination thereof. The rationale for the assessment models should be supported by the available information, particularly if models from an established assessment procedure are not being used. For guidance on developing, adapting, and calibrating assessment models, refer to (9) and (17).

6.3.1.2 Select or develop the assessment models to adequately address the concerns of the decision makers. For example, the U.S. Fish and Wildlife Service would likely be concerned that the habitat function models adequately address fish and wildlife resource needs. The Service may specify that habitat function models be consistent with HEP (22) and thoroughly address the necessary food, cover, water and breeding requirements of all terrestrial and aquatic species expected to utilize a particular habitat type.

6.3.2 *Select the Units of Measure*—Wetland functions can be measured and expressed using quantitative (that is, interval or ratio) or qualitative (that is, nominal or ordinal) scales (23). This guide recommends that the assessment models be used to express functions in terms of functional capacity index (FCI)

and functional capacity units (FCs) to be consistent with the HGM Approach developed by the U.S. Army Corps of Engineers (9) (and similar indices used in the New Hampshire Method (16), Evaluation for Planned Wetlands (10), Indicator Value Assessment (17), Index of Biological Integrity (24), Water Quality Index (25), Wetland Rapid Assessment Method (26), and Habitat Evaluation Procedure (22).

6.3.2.1 A functional capacity index (FCI) is an index of the capacity of a wetland to perform a function relative to other wetlands within a defined region or wetland class, or both. The index of 0.0 indicates that the wetland does not perform the function. An index of 1.0 indicates that the wetland is performing a function at maximum functional capacity. It is possible for an FCI to exceed 1.0.

$$FCI = \frac{\text{functional capacity of a wetland assessment area}}{\text{maximum functional capacity}} \quad (1)$$

The meaning of maximum functional capacity varies depending upon the assessment model, and whether it defines a standard of comparison (reference). Many assessment models simply define a maximum for wetlands, in general, and the standard of comparison is implied but not defined. In contrast, models being developed following the HGM Approach produce an FCI that measures the capacity of a wetland relative to reference standards. Reference standards are the conditions exhibited by a group of reference wetlands that corresponds to the highest level of functioning (highest sustainable functional capacity) across the suite of functions performed by the regional wetland subclass (9). These reference standards are established for wetlands within a defined geographic region that belong to a single hydrogeomorphic subclass. The highest level of functional capacity is assigned an index score of 1.0 by definition. Guidance for establishing the standard of comparison (reference) following the HGM Approach is provided in (9) and (21).

6.3.2.2 The FCI is measured by using an assessment model. Existing assessment models may be used and their results converted easily to FCIs. For example, an index of 1.0 may be considered equivalent to the “high” of a model that rates wetland functions as low, moderate, or high. Numeric results of models using other scales (that is, 0 to 100) can also be converted to the 0 to 1.0 scale.

6.3.2.3 The functional capacity unit (FC) is measured as follows:

$$FCs = \text{FCI of a wetland area multiplied by size of wetland area} \quad (2)$$

This measurement facilitates the comparison of different size wetlands. For example, the results of an assessment may show that two wetlands have the same functional capacity index (for example, FCI = 0.7), suggesting that there is no difference between them. A decision based solely on the FCI for these two wetlands could lead to erroneous conclusions, particularly if the wetlands are different sizes (that is, Wetland A = one acre

