COMPENSATING FOR WETLAND LOSSES UNDER THE CLEAN WATER ACT

Committee on Mitigating Wetland Losses

Board on Environmental Studies and Toxicology

Water Science and Technology Board

Division on Earth and Life Studies

National Research Council

NATIONAL ACADEMY PRESS
Washington, D.C.

Design Standards and Detailed Performance Standards

With detailed assessment of the impacted sites and/or reference systems selected as targets, the committee could set detailed performance standards. But neither data set is typically available. Thus, projects are designed without adequate knowledge, and performance criteria are general and few in number (Streever 1999b). Ecologists, hydrologists, and other scientists who study mitigation sites find many shortcomings in comparing mitigation sites with reference systems (see Chapter 2). Thus, it seems that regulators need to agree that either (1) design standards constitute reasonable performance criteria, or (2) detailed assessment of functions lost must be matched by detailed assessment of mitigation site performance and penalties developed for failure to achieve performance standards.

A consistent set of procedures to identify wetlands is required in order to permit wetland filling under the guidelines of the CWA. The Corps created preliminary guides to regional wetlands and developed techniques for identifying wetlands (USACE 1978a,b,c,d; Reppert 1979; USACE 1987; NRC 1995). The resulting schemes were based on a triad of wetland characteristics: hydrological conditions, soil characteristics, and plant communities. Lists of wetland plant species and hydric soils were created for all parts of the country (USDA 1982, 1985, 1987, 1991). Hydrological requirements were codified (such as number of days of flooding and depth to groundwater) and, to some extent, adapted to various regions. Hydrological data were not available for many wetland sites; therefore, procedures were developed for estimating hydrological conditions from soils and other features (NRC 1995). More detail on the history of the federal wetland manuals and current and past practices in wetland delineation is presented in NRC (1995).

Basic to all wetland restoration and creation projects is the need to set goals for each site's hydrological conditions. Hydrology is most often cited as the primary driving force influencing wetland development, structure, function, and persistence (Gosselink and Turner 1978; Carter 1986; LaBaugh 1986; Day et al. 1988; Novitzki 1989; Wilcox 1988; Gosselink et al. 1990; Sharitz et al. 1990; FDER 1991a; Reaves and Croteau-Hartman 1994; Bedford 1996, 1999; Morgan and Roberts 1999). Consequently, establishment of the appropriate hydrology is fundamental to wetland mitigation whether through restoration or creation (NRC 1992, 1995; Brinson 1993; Bedford 1996; Mitsch and Wilson 1996; Shaffer et al. 1999; Cole and Brooks 2000b). In a survey of 175 federal, state, private, and environmental professionals working in wetland restoration, hydrology was considered one of the most difficult structural features of a wetland to establish and the most important component of a project (Holman and Childres 1995).

One measure of mitigation compliance is the restoration of jurisdictional hydrology. An explicit hydrological standard is the percentage of the growing season that soils need to be saturated. Clark and Benforado (1981) suggested that areas saturated less than 5% of the growing season clearly exhibited upland hydrological characteristics and that areas saturated more than 12.5% clearly exhibited wetland hydrological characteristics. The 1987 Corps wetland delineation established the 5% criterion as the jurisdictional threshold, a quantitative value that was reaffirmed by the NRC (1995). However, there are major differences in depth to water table between a wetland that satisfies the 5% standard and one that meets the 12.5% standard (see Figure 6-1). These differences in wetness lead to very different ecological communities (Scherrer et al. 2001).

Because the permittees responsible for the mitigation need some time frame that clearly defines the length of their mitigation responsibility, hydrological performance standards may be based on 5 years or less of water-table monitoring. However, the hydrological regime in nonriverine, intermittently saturated freshwater wetlands varies not only seasonally but also year to year (see Figure 6-2). During a short monitoring period,

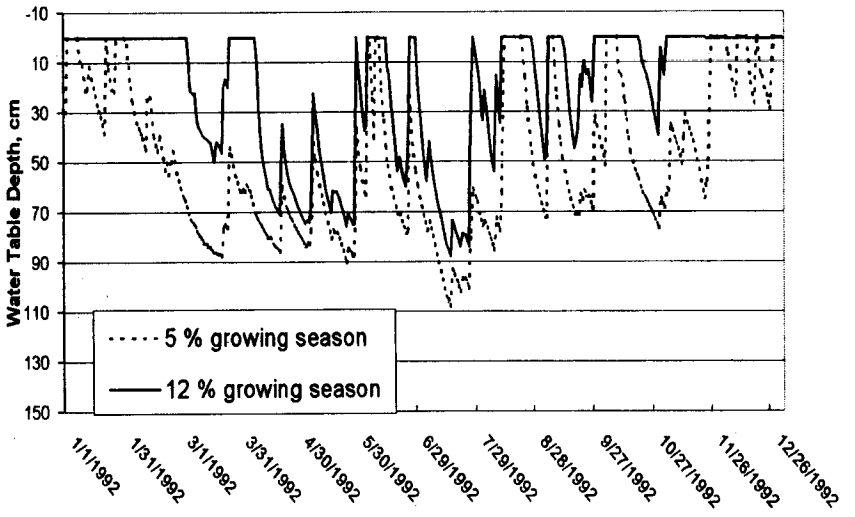

FIGURE 6-1 Water-table position and duration of root zone saturation for wetland site that satisfies the jurisdictional hydrology criteria (5% of growing season) as compared with wetland site that satisfies the criteria (12% of the growing season). Simulation modeling (DRAINMOD) was used to determine values. SOURCE: Skaggs (1978). Reprinted with permission; copyright 1978, Water Resources Research Institute of the University of North Carolina, Raleigh.

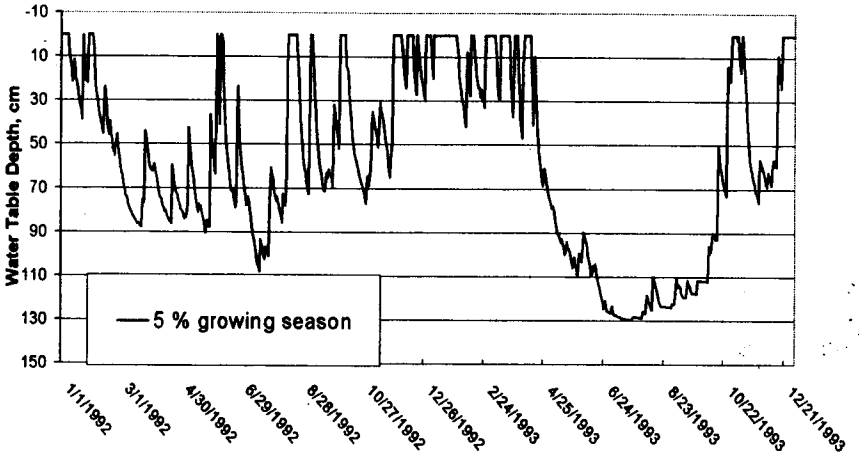

FIGURE 6-2 Year-to-year variations in water-table depth and duration of root zone saturation for a wetland site that satisfies jurisdictional hydrology criteria at least 5% of the growing season. Year-to-year extremes are typical for intermittently saturated wetlands. Values determined from simulation modeling using DRAINMOD. SOURCE: Skaggs (1978). Reprinted with permission; copyright 1978, Water Resources Research Institute of the University of North Carolina, Raleigh.

water levels might not meet hydrological standards for several consecutive years, even though the wetland could satisfy criteria over the long term. Depending on the date when the 5-year monitoring period began and ended, there could be six 5-year periods where the wetland did not satisfy hydrological criteria (see Figure 6-3). If this were a mitigation site and the 5-year monitoring period occurred during one of these six periods, the mitigation project would not comply with performance standards. Recognizing this potential shortcoming, practitioners tend to err toward the wet end of the range, creating wetlands that are much wetter than normal for the given landscape position (Cole and Brooks 2000b).

In many cases this approach has resulted in the creation of open-water areas as compensation for loss of intermittently inundated or saturated wetlands (Kentula et al. 1992a). The stable-water pond has come to typify mitigation efforts in many parts of the country (Cole and Brooks 2000b). Mitigation projects that stress the wet end of the range will not replace the functions provided by much drier impact sites. For example, use of a mitigation site as a stormwater storage, attenuation, or treatment wetland may compromise biodiversity goals.

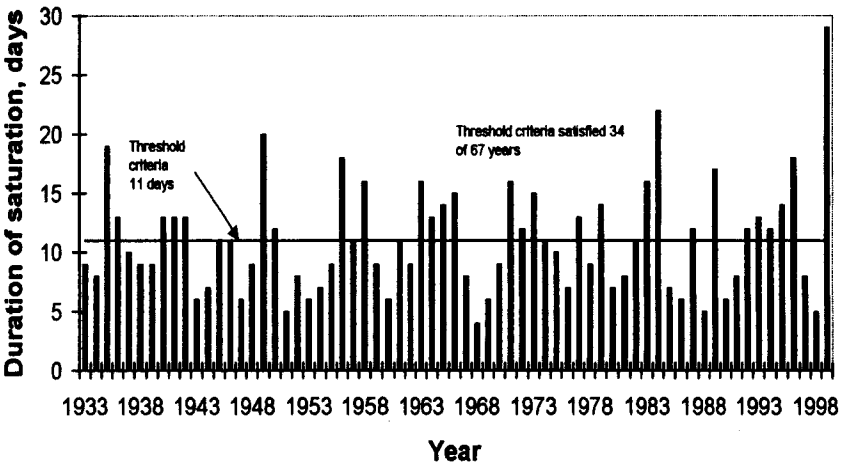

FIGURE 6-3 Year-to-year variation of the longest period that wetland hydrological criteria satisfied. Results obtained from long-term simulation modeling using DRAINMOD. NOTE: There are several 5-year periods where criteria are not satisfied 3 out of 5 years. SOURCE: Skaggs (1978). Reprinted with permission; copyright 1978, Water Resources Research Institute of the University of North Carolina, Raleigh.

Breaux and Serefiddin (1999) examined 110 compensatory wetland mitigation projects in California (permitted from 1988 to 1995) and determined that the most commonly measured parameter was vegetation (type or cover) (Table 6-4). Two of the most commonly assumed wetland val-

TABLE 6-4 Parameters Measured in 110 Compensatory Wetland Mitigation Projects in California from 1988 to 1995

Parameter	% of Sites Measured
Vegetation	72
Hydrology	22
Wildlife	38
Water quality	7
Soils	3
Invertebrates	3
Flood storage	Not mentioned

SOURCE: Adapted from Breaux and Serefiddin (1999).

ues, flood storage and water-quality improvements, were supposed to be examined in less than 10% of the permits.

The committee concludes that current permitting procedures do not always result in permit conditions that are clear and enforceable and lead to the development of viable mitigation that compensates for the functions and values of the permitted impact. Instead, permits typically contain performance standards that measure only one or several easily measured parameters of a mitigation site, and in many cases, these parameters do not reflect the overall viability of the mitigation site. Recommendations relevant to this conclusion are provided in Chapter 8.

MITIGATION RATIOS

Mitigation ratios are the proportional requirements for replacing wetlands that are permitted for fill. A point that is frequently raised in assessments of mitigation is that the ratios (the number of required mitigation acres to the permitted acres) are too low (Morgan and Roberts 1999; Allen and Feddema 1996). Ratios vary across permits, often because the logic behind the ratios differs. Higher ratios might be required for sites and wetland types that are difficult to restore. Higher ratios might be also used if there is a long time expected between the permitted activity and the achievement of the desired endpoint for the compensation site. Ratios have been used to reflect the functional values of the impact site, that is, the ratio would be higher for a pristine wetland than for a severely degraded wetland. An example of ratio guidelines used by the California Department of Fish and Game incorporates this principle in its guidelines for mitigating impacts to streams and associated habitat (see Appendix D). Mitigation ratios are 1:1 for low-value habitat (e.g., unvegetated streams), whereas ratios can be as high as 5:1 for impacts to endangered species habitat (e.g., mature willow riparian inhabited by least Bell's vireo).

The Corps and the Environmental Protection Agency (EPA) mitigation Memorandum of Agreement (MOA) states that "mitigation should provide, at a minimum, one-for-one functional replacement (i.e., no net loss of values), with an adequate margin of safety to reflect the expected degree of success associated with the mitigation plan . . . [T]his ratio may be greater where the functional values of the area being impacted are demonstrably high and the replacement wetlands are of lower functional value or the likelihood of success of the mitigation project is low. Conversely, the ratio may be less than 1 to 1 for areas where the functional values associated with the area being impacted are demonstrably low and the likelihood of success associated with the mitigation proposal is high."

WRP Technical Note WG-RS-3.3
January 1999

Examples of Performance Standards for Wetland Creation and Restoration in Section 404 Permits and an Approach to Developing Performance Standards

PURPOSE: This technical note accomplishes the following: a) defines performance standards for wetland creation and restoration, b) provides 20 example performance standards for wetland creation and restoration projects required by Section 404 permits, c) summarizes seven sets of performance standard guidelines used by Corps of Engineers Districts and one set of guidelines under development, and d) outlines an approach to developing new performance standards or revising existing performance standards.

PERFORMANCE STANDARDS DEFINED: Under Section 404 of the Clean Water Act of 1977, wetland creation and restoration can be required as compensatory mitigation for unavoidable wetland loss. Performance standards, in the context of this technical note, are **observable or measurable attributes** that can be used to determine if a compensatory mitigation project meets its objectives. Performance standards are frequently called "success criteria" but may also be known by other names, such as "success standards" or "release criteria."

Individual Section 404 permits provide both general and special conditions regarding permitted activities. **General conditions** include standardized information relevant to all permitted projects, such as time limits for completion of permitted activities, requirements to report historic or archaeological remains found in the course of permitted activities, and requirements to allow inspection of permitted projects by U.S. Army Corps of Engineers representatives. **Special conditions** include additional information pertinent to specific projects or regions, such as refueling procedures for equipment, safety requirements, sediment control requirements, and seasonal timing of permitted activities. In permits that require restoration or creation of wetlands as compensatory mitigation, performance standards should be included as special conditions.[1]

WHY PERFORMANCE STANDARDS ARE IMPORTANT: Performance standards allow the Corps of Engineers to determine if the objectives of compensatory mitigation required by a Section

[1] "Army regulations authorize mitigation requirements to be added as special conditions to an Army permit. . ."–Memorandum of Agreement between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines, 1990.

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404 permit have been successfully fulfilled. Performance standards should generally reflect Corps of Engineers guidelines calling for a minimum of "one for one functional replacement"[1] of wetlands unavoidably impacted by permitted activities. Performance standards also facilitate enforcement actions for projects that fail to comply with Section 404 permit conditions.

PERFORMANCE STANDARDS AND FUNCTIONAL REPLACEMENT: In recent years, a large literature has developed that offers post hoc assessment of compensatory mitigation wetlands. Most post hoc studies compare created or restored wetlands to nearby natural reference wetlands on the basis of a number of attributes, such as vegetation community composition, benthic invertebrate community composition, and water quality. This literature suggests that many wetlands created and restored as compensatory mitigation do not replace the structure and functions of lost natural wetlands. Although many authors have offered opinions regarding the cause of poor structural and functional replacement, few authors have attempted to relate performance standards required by permits with results of post hoc studies comparing compensatory mitigation wetlands and natural reference wetlands. There is a clear need for studies designed to link performance standards required by permits with the ability of created or restored wetlands to replace lost wetland structure and functions.

EXAMPLES FROM PERMITS: Table 1 summarizes performance standards from Section 404 permits and mitigation plans referenced by permits. Examples were compiled by reviewing permit files available at Corps of Engineers District offices and requesting copies of permit files from District offices. Over 300 permits were reviewed to compile examples for Table 1; however, the table represents selected examples rather than a comprehensive summary of Section 404 permit performance standards.

Many permits that required compensatory mitigation did not include performance standards. In some permits, items designated as "performance standards" or "success criteria" did not meet the definition of performance standards used in this technical note; for example, instructions regarding planting techniques were frequently called performance standards. No attempt was made to comprehensively review or representatively sample all Section 404 permits, so no conclusions can be drawn regarding the number of permits issued without performance standards.

Table 1 shows that there are no universally used performance standards for compensatory mitigation. Even within Districts, performance standards may vary from permit to permit. The absence of universal performance standards probably reflects the ongoing evolution of the Section 404 regulatory process as well as differences in regional or site-specific ecological conditions and regional needs.

At least seven distinct approaches can be identified from the examples in Table 1. Most examples combine two or more of these approaches. These approaches include:

[1] As per the Memorandum of Agreement between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act, Section 404(b)(1) Guidelines, 1990.

Table 1. Summary of Performance Standards from Selected Section 404 Permits Requiring Compensatory Mitigation[1]

Example Number	Performance Standards	Time Frame	Location/ Type/ Year	Size
1	50% survival of planted trees, including replanting efforts, after two growing seasons	3 years, after which natural regeneration is relied upon	Mississippi/ bottomland hardwoods/ 1997	Restoration of 2.17 acres
2	75% survival of planted *Juncus roemerianus*; 4,800 plants per acre after 3 growing seasons	3-year minimum, with 75% survival for 2 years following any replanting	Alabama/ salt marsh/ 1985	Creation of 40 acres
3	75% site survival, defined as [(number of "planting cells" with "species survival" over 35% ÷ total number of planting cells) x 100]; species survival is the [(number of surviving plants in each "planting cell" ÷ number of plants originally planted in the "planting cell") x 100]; the "planting cell" is a discrete cluster of plants as illustrated on the planting or landscaping plan, or, if planting is not in discrete clusters, the cell is the entire site; after 3 years, site will be 80% vegetated with hydrophytic vegetation having an indicator status of FAC or wetter, excluding *Typha* spp. and *Myriophyllum spicatum*, and with less than 5% cover by 28 noxious or invasive species (noxious and exotic species are listed in permit)	3 years following completion of construction	Massachusetts/ cranberry bog and shrub swamp/ 1998	Creation of 2.8 acres and enhancement of 1.1 acres
4	85% of the site vegetated by the planted species and/or naturally regenerated vegetation approved by regulatory agencies	5-year endpoint	Maryland/ forested wetland/ 1996	Restoration of 850 linear feet of stream banks
5	80% wetland vegetation cover in herbaceous wetlands and 80% survival of planted stock in scrub-shrub wetlands, as measured using an approved method	Not specified	Idaho/ herbaceous and scrub-shrub wetlands/ 1995	Creation of 8 acres
6	Sustain 85% or greater cover by obligate and/or facultative wetland plant species; less than 10% cover by nuisance plant species; "proper hydrological condition"	5 years, with requirement for contingency plan after 3 years if performance standards are not achieved and requirement for ongoing monitoring after 5 years if performance standards are not met	Florida/ forested and herbaceous wetlands/ 1991	Creation of 11.8 acres forested wetlands and 10.1 acres herbaceous wetlands
7	85% areal cover by planted herbaceous species and 75% areal cover by planted woody species; specifically prohibits open water ponds	2 years, with provision for replanting if areal cover requirements are not achieved	Maryland/ forested and emergent freshwater wetland/ 1990	Creation of 5.09 acres palustrine forested wetlands and 0.66 acre palustrine emergent and scrub-shrub wetlands

[1] Projects were selected to offer examples of a range of performance standards required by Section 404 permits. Abbreviations FAC, FACW, and OBL and the terms "facultative" and "obligate" refer to the *National List of Plant Species that Occur in Wetlands*. Throughout this table, performance standards were paraphrased directly from permit files; no attempt was made to clarify language used in permit files.

Table 1. (Continued)

Example Number	Performance Standards	Time Frame	Location/ Type/ Year	Size
8	Hydrology must meet wetland definition of 1987 Corps of Engineers Wetland Manual, with saturation to the surface of the soil for 12.5% (31 days) of the growing season; at least 50% of woody vegetation must be FAC or wetter, with woody vegetation stem counts of 400 per acre or canopy cover of 30% or greater by woody vegetation; at least 50% of all herbaceous vegetation must be FAC or wetter with aerial cover of at least 50% in emergent wetland areas (exclusive of "shrub/scrub or sapling/forest vegetation")	5 years	Virginia/ forested wetland/ 1995	Restoration of 8.5 acres and creation of 1.7 acres on-site; restoration of 17.2 acres off-site
9	Herbaceous zones will have 80% cover with 50% or more cover by species listed as FAC or wetter, with plants rooted for at least 12 months, with plants showing natural reproduction, and with no species other than sawgrass constituting more than 30% cover; forested zones to have a minimum density of 400 live trees per acre with natural reproduction and at least 50% cover by species listed FAC or wetter with no one species contributing greater than 30% of the species represented; cattail, primrose willow, Brazilian pepper, punk trees, Australian pine, and other exotic vegetation limited to 10% or less of total cover; muck layer in "Area C" must average at least 6 in. in depth at the end of 25 years; all conditions must be met without intervention in the form or irrigation, planting, or plant removal for 3 consecutive years in herbaceous wetlands and 5 consecutive years in forested wetlands	At least 3 years for herbaceous wetlands, at least 5 years for forested wetlands, and up to 25 years for development of muck	Florida/ herbaceous and forested wetlands/ 1998	Creation of 1,441 acres herbaceous wetlands, 145 acres forested wetlands, 40 acres "deep muck pockets," and 68 acres open water
10	Emergent and aquatic bed portions of mitigation site not to be inundated with salt or brackish water; less than 10% cover by invasive species during any monitoring event; staged vegetation requirements as follows: Year 1: 100% survival of planted stock, 50% cover in emergent areas Year 2: 80% survival by planted stock, 20% cover by native shrub species, 70% cover in emergent areas Year 3: 70% survival and 40% cover by native shrub species, 80% cover in emergent areas Year 5: 60% cover by native shrub species, 100% cover in emergent areas	5 years	Washington/ emergent, scrub-shrub, and forested wetland/ 1998	Enhancement of 1.12 acres scrub-shrub wetlands and 3 acres emergent wetlands; creation of 0.46 acre scrub-shrub, 0.4 acre forested, and 4.42 acres emergent wetlands
11	80% survival of planted stock each year; at least 50% native perennials by end of year 5; staged vegetation percent cover requirements for wet-mesic meadow / shallow marsh / "no planting zone" (used to experimentally assess natural recruitment) as follows: Year 1: 15% / 10% / no requirement Year 2: 30% / 20% / 20% Year 3: 45% / 30% / 30% Year 4: 60% / 40% / 40% Year 5: 75% / 50% / 50%	8 years	Illinois/ emergent wetland/ 1995	Enhancement of 1.47 acres and creation of 30.68 acres wet-mesic meadow and shallow marsh
12	Less than 5% cover by nuisance and exotic plant species; planted and non-nuisance wetland plant species to have areal cover of 50% in first year, 70% in second year, and 80% in third year, with provisions for remedial planting to meet percentage requirements	5 years, with requirement for ongoing monitoring if percentage requirements are not met	Florida/ freshwater marsh and wet prairie/ 1990	Creation of 10 acres freshwater marsh and wet prairie with additional enhancement and preservation of cypress domes and other wetlands

Table 1. (Continued)

Example Number	Performance Standards	Time Frame	Location/ Type/ Year	Size
13	Permanently vegetated stand over 85% of disturbed area after first growing season (replacement of dead plants required); documentation of saturated soil; documentation of tidal hydrology; no *Phragmites* infestation; documentation of "animal use" for portion of site	5 years	New Jersey/ salt marsh/ 1990	Creation of 4.2 acres *Spartina alterniflora* marsh and 24 acres open water and intertidal wetland
14	Must meet the regulatory definition of wetlands, and water within the mitigation area should function "as the intended type of water of the United States"	Indefinite (active until performance standards are met and verified by Corps of Engineers)	Texas/ emergent and open water/ 1997	Creation and preservation of 54 acres emergent wetland and 145 acres open water
15	Must meet the regulatory definition of wetlands; specified portions of the mitigation area must meet the definitions of palustrine forested, palustrine scrub-shrub, and palustrine emergent wetland types as per the document *Classification of Wetlands and Deepwater Habitats of the United States*; cover by hydrophytic plants ("those with a regional indicator status of FAC, FAC+, FACW+/-, or OBL"); vegetation not to consist of more than 10% areal cover by any combination of *Phragmites australis* (common reed) or *Lythrum salicaria* (purple loosestrife); all performance standards must be met for 3 consecutive years	5 years, to be extended as necessary to fulfil the requirement of meeting all performance standards for 3 consecutive years	New York/ forested, scrub-shrub, and emergent palustrine wetlands/ 1998	Creation of 12.9 acres and enhancement of 12.13 acres
16	No rills or gullies greater than 12 in. deep; no single plant species from the seeding mixture may constitute more than 50% of species found in the site; two or more native species present; vegetative cover equal to 75% of test plot cover (test plots are plots established at numerous locations to determine viability of plant community development)	5 years, with provisions for early release	Alaska/ emergent wetlands/ 1998	Restoration of up to 261 acres, as needed to restore impacts from gold mining
17	No less than 33% of natural stem densities found in adjacent areas	1 year	Alaska/ emergent wetlands/ 1997	Restoration of up to 19 acres, as needed to restore "exposed earthworks" resulting from construction
18	Areal cover in 90% of planted area equivalent to natural reference marsh; benthic invertebrates and fish with 75% similarity to natural reference marsh, and fish with 75% biomass of fish in natural reference marsh; upper soil horizon with 1% organic matter by dry weight	5 years, after which additional mitigation acreage is required	Alabama/ salt marsh/ 1988	Creation of 25.3 acres
19	Vernal Pool Habitat Suitability Index (VPFI) ≥ 0.55 with 60% of pools > 0.7 [VPFI = a ÷ (a + b), where a = number of species the pool and the "vernal pool species list" share, and b = number of species in the pool not on the "vernal pool species list;" the list includes those species typically found in the region's vernal pools]; hydrology assessed as suitable on the basis of presence of wetland plants	4 years, with requests for extensions to be given favorable consideration	California/ vernal pools/ 1996	Creation of 27 acres

Table 1. (Concluded)

Example Number	Performance Standards	Time Frame	Location/ Type/ Year	Size
20	The combined relative cover of targeted exotic species, including *Senecio mikanioides* (German ivy) and *Vinca major* (periwinkle), will be less than 5% after 5 years; visual observations of inundation, soil saturation within 12 in. of the soil surface, water marks, drift lines, sediment deposits, and drainage patterns will indicate that the site is as wet or wetter than a nearby reference site; over time, there will be an increase in the numbers and kinds of riparian obligate bird species relative to the numbers and kinds of generalist bird species; 0.23 stems of woody vegetation m^{-2} unless deviation from this density appears to be caused by natural phenomena, the results of which are also apparent at a reference site; 75% cover by native riparian scrub species including herbaceous and shrub strata; evidence of natural seedling recruitment; within 5 years, the mitigation wetland must show conditions similar to pre-impact conditions at the site to be impacted by permitted activities on the basis of narrative descriptions that characterize 14 variables described in the sixth draft *Model for the Santa Margarita River Watershed*— these variables, which are part of a hydrogeomorphic (HGM) approach to functional assessment of wetlands, include 1) V_{config}, for contiguous vegetation cover, 2) V_{subin}, for subsurface flow into wetland, 3) V_{topo}, for topographic complexity, 4) V_{organ}, for soil organic matter, 5) V_{trees}, for abundance of trees, 6) V_{offsap}, for off-channel saplings, 7) $V_{offshrub}$, for off-channel shrubs, 8) V_{ratio}, for ratio of native to non-native vegetation, 9) V_{offcwd}, for off-channel coarse woody debris, 10) V_{offfwd}, for off-channel fine woody debris, 11) V_{decay}, for stage of decay of coarse wood, 12) $V_{offlitter}$, for off-channel leaf litter, 13) $V_{agedist}$, for stand age distribution, and 14) V_{arundo}, for presence of *Arundo donax* (requirements to meet variables are staged over 5 years to recognize improved function with time but only the 5-year requirements are presented here)	5 years	California/ floodplain wetland/ 1997	Restoration of 8.9 acres

a. Requirements for survival of planted stock (examples 1-3, 5, and 10-11).

b. Requirements for plant density or percent cover by plants (examples 2-13, 16-18, and 20).

c. Requirements that are staged over time so that different performance standards must be met as the wetland matures (examples 10-12 and 20).

d. Requirements that specifically reference documents developed for the purpose of wetland delineation, such as the 1987 *Corps of Engineers Wetlands Delineation Manual* (the "87 Manual") and U.S. Fish and Wildlife Service lists of wetland indicator status for plant species (examples 3, 6, 8, 9, 14, and 15).

e. Use of indices to compress large amounts of information (examples 3 and 18-20).

f. Reliance on natural reference wetlands (sometimes called "control" wetlands) or other sites as a benchmark (examples 16-20).

g. Requirements specifically limiting occurrence of exotic and nuisance plant species (examples 3, 6, 9, 10, 12, 13, 15, and 20).

All examples explicitly consider vegetation. Some examples explicitly consider vertebrate and invertebrate abundances and diversity, soil characteristics, and hydrological conditions.

SUMMARIES OF PERFORMANCE STANDARD GUIDELINES: Performance standard guidelines were compiled from permitting guidelines provided by Corps of Engineers District offices. Summaries presented here focus on the portion of permitting guidelines dealing with performance standards. All but one example, the *Washington State Department of Transportation* guidelines, are in use at Army Corps of Engineers District offices. The *Washington State Department of Transportation* guidelines, which are still in draft form, are part of an effort undertaken by a committee of wetland professionals, including employees of the Army Corps of Engineers.

All seven of the approaches to performance standards described from examples in Table 1 also appear in performance standard guidelines. Several of the summarized guidelines elaborate on definitions of terms, such as "objective" and "performance standard." Similarly, several of the summarized guidelines elaborate on the need for unambiguous language within permits, including both the language used to describe performance standards and the language used to describe required methods for monitoring performance standards. Several guidelines also recognize a need for flexibility when writing performance standards.

- **St. Paul District's 1992 Guidelines.** *Compensatory Wetland Mitigation: Some Problems and Suggestions for Corrective Measures*, by Steve Eggers, was published by the U.S. Army Engineer District, St. Paul, in February 1992. This document, based in part on field inspections of 30 compensatory mitigation wetlands in Minnesota and Wisconsin, offers guidance on goals, design, construction, long-term protection, and monitoring, as well as performance standards. The report notes that "Lack of specific requirements for measuring the success of compensatory mitigation was one of the most notable deficiencies of past permits." The report also notes that up to 50 years may be necessary to determine success of some systems, but that this is not feasible for most projects, and that fair evaluation of performance standards for herbaceous wetlands may require less time than evaluation of performance standards for shrub or forested wetlands. Comparison to a reference wetland is advocated as a means of determining success of compensatory mitigation wetlands, as is use of performance standards with predetermined levels of vegetation cover, such as "80 percent survival of planted shrubs after 3 years, or 75 percent of the mitigation site must be vegetated by the end of the second growing season."

- **New England District's Guidelines.** The New England District's guidelines regarding Section 404 permit special conditions are given in an undated document entitled *New England District Staff Guidance for Mitigation Special Conditions*. The document includes suggestions regarding topics such as plant species that should be excluded from areas around

compensatory mitigation sites and the use of conservation covenants. Several performance standards are listed, including the following:

a. Three-quarters of all cells at a site should have at least 35 percent survival of planted stock. ("Cells" and "survival" are defined in example 3 of Table 1.)

b. Areal cover of 80 percent, excluding open water areas, by noninvasive hydrophytes should occur by a specific date. Purple loosestrife (*Lythrum slicaria*), cattails (*Typha latifolia, Typha angustifolia*, and *Typha glauca*), common reed (*Phragmites australis*), and reed canary grass (*Phalaris arundinacea*) are listed as invasive species.

c. No unstablilized slopes should be present.

This document is periodically reviewed and revised based on experience and "lessons learned."

- **Norfolk District's 1995 Guidelines.** Norfolk District has a document dated 16 November 1995, entitled *Branch Guidance for Wetlands Compensation Permit Conditions and Performance Criteria*, that covers topics such as required information for site design plans, performance bonds, and requirements for hydrological data assessment before planting. The document stresses the need for flexibility: "This guidance is intended to be flexible; it is the decision of project managers and their supervisors whether any condition is appropriate for a particular wetland construction project." Point 6 of the document lists performance standards, or "performance criteria." These performance standards include:

a. Hydrology must meet the criteria for a wetland as per the *Corps of Engineers Wetlands Delineation Manual*, with growing season specified. The number of days with saturation to the soil surface should also be specified in order to allow some control over the wetland type that would develop on a site.

b. At least 50 percent of all plants must be facultative or wetter.

c. For woody vegetation, stem counts of 400 per acre must be achieved until canopy cover is 30 percent or greater.

d. In areas of emergent herbaceous vegetation, areal cover must be at least 50 percent.

- **Baltimore District's 1994 Guidelines.** Baltimore District's 1994 guidelines, entitled *Maryland Compensatory Mitigation Guidance*, were developed by the Interagency Mitigation Task Force, with representatives from eight state and Federal agencies. Guidelines include information about topics such as replacement ratios, site selection, monitoring reports, sampling methods, and performance standards. Different performance standards are given for tidal emergent wetlands, non-tidal emergent wetlands, non-tidal scrub-shrub wetlands, and non-tidal forested wetlands. For example, tidal emergent wetland performance standards include:

a. Forty-five percent cover by emergent wetland species with a minimum stem density of 43,650 living stems per acre by the second growing season.

b. Seventy percent cover by emergent wetland species with a minimum stem density of 43,650 living stems per acre by the third growing season.

c. Eighty-five percent cover by emergent wetland species with a minimum stem density of 43,650 living stems per acre by the fifth growing season.

d. For regularly flooded compensatory mitigation wetlands (intended to support plant species such as *Spartina alterniflora*, *Scirpus robustus*, and *Peltandra virginica*), tides must alternately flood and expose the land surface at least once each day, while for irregularly flooded compensatory mitigation wetlands (intended to support species such as *Spartina patens*, *Iva frutescens*, *Juncus roemerianus*, and *Typha angustifolia*), tides should flood the land surface less often than once daily.

Emphasis on vegetation is justified because "sites without sufficient plant biomass support low populations of fish and wildlife and provide insignificant water quality functions. . . [and] techniques to measure vegetation are accomplished economically and require minimum training and equipment."

- **Seattle District's 1994 Guidelines for Freshwater Wetlands.** Seattle District's *Guidelines for Developing Freshwater Wetlands Mitigation Plans and Proposals*, dated March 1994, resulted from collaboration of six federal and state agencies. Guidelines include information on ecological assessment of impacted sites, wetland delineation, mitigation sequencing, monitoring, goals and objectives, and performance standards. The document clearly links objectives and performance standards by defining performance standards as "the measurable values of specific variables that establish when objectives have been met" and by stating that specific performance standards will depend on project objectives. Variables that might be considered for use as performance standards include dissolved oxygen, nutrient levels in water, survival rates of planted vegetation, species diversity, water flows, and water depths. The document also offers several specific examples that show how performance standards could be linked to objectives, two of which are transcribed verbatim here:

  Objective c. The vegetated portions around the open water will have 3 acres each of emergent, scrub-shrub, and forested vegetation classes.

  Performance Standard #1: *The emergent vegetation will cover at least 3 acres of the wetland after five years, and the cover of native emergent species will be at least 80% in these 3 acres as measured by belt transects. The standard deviation of the mean cover value in the sampling quadrats will be less than 1/4 of the mean value (i.e. SD < (1/4 x 0.8); therefore SD < 0.2).*

  Performance Standard #2: *The scrub/shrub vegetation will cover at least 3 acres after five years with an 80% cover of native scrub shrub species in this area as measured by belt transects. The standard deviation of the mean cover value will be less than 1/4 of the mean.*

  Performance Standard #3: *The forest vegetation will cover at least 3 acres after 20 years with a canopy cover of at least 40% of native species in these 3 acres.*

  Objective d. The area of open water will provide habitat for at least two species of amphibians within five years.

  Performance Standard: *The use of the wetland by two species* [of] *amphibians will be documented by live trapping, and/or observation of egg masses during the breeding season.*

- **Los Angeles District's Proposed Guidelines for Riparian Habitat.** Los Angeles District's document *Special Public Notice; Proposed Riparian Habitat Mitigation and Monitoring Guidelines*, distributed for comment between 15 August and 15 September 1997, includes information on topics such as sequencing, site selection, identification of riparian habitat, and compliance assurance. In part "e" of a section on mitigation design and planning, performance standards (called "success criteria" in this document) are briefly discussed, as transcribed verbatim below:

  e. Propose realistic success criteria based on the purpose of the mitigation, design of the site, and the variables and functions found in the HGM. Develop initial HGM scores for the mitigation site after the proposed grading based solely on physical characteristics. Estimate performance curves and time to establish partial and full success of the site based on HGM score. The Corps will be intimately involved with this aspect of the plan.

  HGM refers to the hydrogeomorphic approach to wetland assessment. The decision to use HGM in performance standards resulted from studies suggesting that compensatory wetlands could meet performance standards required by earlier guidelines even though they "were unsuccessful at restoration or creation of fully functional, riparian habitat." The philosophy behind the HGM approach is described in Smith et al. (1995).

- **Chicago District Mitigation Guidelines.** The *Chicago District Mitigation Guidelines and Requirements*, dated 30 April 1998, describes issues such as site selection, mitigation ratios, long-term management requirements, and enforcement. A section on performance standards for compensatory mitigation focuses on vegetation but also suggests that applicants should propose performance standards for other functions, such as improvement of water quality and provision of wildlife habitat. Use of existing measures, such as the Index of Biological Integrity, is encouraged. Vegetation performance standards include the following:

  a. The mean coefficient of conservatism must be greater than or equal to 3.5. Coefficient of conservatism values for plant species found in the Chicago District are designated in Swink and Wilhelm (1994). These values indicate the degree to which a plant species is representative of an undisturbed native community; a value of 0 is assigned to

plants that occur almost exclusively in altered habitats, such as highway verges, while a value of 10 is assigned to plants that occur almost exclusively in remnant undisturbed habitats, such as some fens. Coefficients are not assigned for introduced species.

b. The native floristic quality index, described in Swink and Wilhelm (1994), must be greater than or equal to 20. The native floristic quality index is computed as $I = CN^{1/2}$, where I is the index value, C is the mean coefficient of conservatism value, and N is the number of native species.

c. The mean wetness coefficient (based on regional wetland indicator status) must indicate the presence of a wetland.

d. After 5 years, no area greater than 0.5 m^2 will be devoid of vegetation in areas intended to be vegetated, except in areas with emergent and aquatic communities.

e. After 5 years, the three most dominant species in wetland communities cannot be non-native or weedy. Non-native and weedy species include *Typha* spp., *Phragmites australis*, *Poa compressa*, *Poa pratensis*, *Lythrum salicaria*, *Salix interior*, *Echinochloa crusgalli*, and *Phalaris arundinacea*.

Performance standards are staged over time in that there are requirements for annual increases in native mean coefficient of conservatism values and native floristic quality index values.

- **Washington State Department of Transportation.** State, Federal, and private sector wetland professionals in Washington have been working together since May 1997 to "bring more clarity to the issues surrounding the use of success standards in wetland mitigation." A working draft of their suggestions has been published on the World Wide Web.[1] This document suggests that appropriate development of performance standards requires consideration of regulatory requirements, wetland functions, wetland construction methods, wetland monitoring methods, and expected or achievable quantitative values for monitored wetland attributes. Also, this document suggests that attempts to develop universally applicable performance standards are not appropriate because every project is unique. A number of terms are defined as part of this document, including "goal," "objective," "performance objective," and "success standard (or performance standard)." A goal is a broad statement about a project's intended outcomes, objectives are more specific statements about intended outcomes, performance objectives are the subset of objectives that will be considered in evaluating the project, and performance standards are observable or measurable attributes linked to performance objectives. For example, a goal might be restoration of 10 acres of scrub-shrub wetland. Objectives might include provision of floodflow attenuation and storage, food chain support, habitat for fish and amphibians, and water quality improvement. One performance objective related to the water quality improvement objective might be sediment retention.

[1] http://www.sws.org/regional/pacificNW/98meeting/Ossinger2.html#fnO

The performance standard linked to this performance objective could be 90 percent cover by herbaceous vegetation, which, according to the technical literature, acts to some degree as a surrogate measure of sediment retention. Suggested potential performance standards include herbaceous plant cover, woody plant cover, survival of planted species, cover by invasive plant species, plant species diversity, slope, aquatic invertebrate diversity, presence of specific aquatic invertebrate taxa, presence of specific hydrological conditions, presence of specific soil conditions, and site use by specific wildlife taxa. Despite the long list of potential performance standards offered in this document, the authors recommend restraint in applying these and other standards: "DON'T GET CARRIED AWAY! Remember the purpose of stating performance objectives and success standards: you want to evaluate the success of your project. Usually it takes only a few performance objectives to adequately do this."

DEVELOPING OR REVISING PERFORMANCE STANDARDS: To streamline the Section 404 permitting process, regulatory staff should be provided with performance standard guidelines or templates listing minimum performance standards for various wetland types. While guidelines could help regulators prepare performance standards for permit special conditions, templates could be inserted directly into permit special conditions and be altered as needed to fit specific situations.

Ideally, performance standards should a) refer to practicably measurable or observable attributes that reflect compensatory mitigation objectives, and b) lead to compensatory mitigation that replaces the structure and functions of wetlands lost as the result of permitted activities. When research results linking performance standards with successful replacement of lost wetland structure and functions are not available, development or revision of performance standards relies on the opinions of wetland professionals involved with the regulatory process. The 12-step plan outlined below offers one means of generating performance standard guidelines or templates based on a consensus opinion of wetland professionals, including regulatory staff, scientists, and others.

A 12-step Plan

Step 1. Staff identifies the region for which performance standards are to be developed, recognizing that community needs and expectations–particularly in the sense of what might be considered "practicable"–will vary from region to region, as will ecological conditions. In some cases, the region will be defined by District boundaries.

Step 2. Staff identifies wetland types for which performance standards are to be developed. In general, it will be difficult or impossible to develop performance standards that could be applied to all wetland types.

Step 3. Staff identifies workshop participants and a coordinator. Workshop participants should include experienced Corps regulatory staff, representatives from other government agencies, and at least one person with extensive knowledge of wetland restoration research; consultants and others might also be invited to participate. The coordinator will be responsible for facilitating two workshop sessions, reviewing relevant documentation, and writing and revising performance standard guidelines or developing a template. Workshop coordinators should plan to devote 80 hr or more to development of guidelines or templates. Other workshop participants should plan on a 4- to 8-hr commitment.

Step 4. Coordinator gathers and reviews relevant documentation, including selected permits issued in the region and reports from studies designed to assess regional mitigation success. HGM model variables and functional capacity indexes may be useful as performance standards, so relevant models should be reviewed along with other information.

Step 5. Coordinator gathers information about practices outside of the region that might be of interest to workshop participants. (This technical note summarizes some of this information.)

Step 6. Coordinator summarizes information gathered in steps 4 and 5 for participants in the first of two workshops. The coordinator's presentation should be limited to existing information; it should not suggest new or improved performance standards. Workshop participants offer opinions regarding important issues and potential new or improved performance standards.

Step 7. Based on opinions of workshop participants and other information, coordinator drafts performance standard guidelines or templates. In general, performance standard guidelines should be no more than one or two pages in length, and templates listing minimum performance standards may be as short as one page.

Step 8. Coordinator presents draft guidelines or templates to workshop participants who discuss them in an open forum in the second of two workshops.

Step 9. Coordinator revises draft guidelines or templates based on participants' comments.

Step 10. Regulatory supervisors review revised draft guidelines or templates.

Step 11. Coordinator finalizes draft guidelines or templates to the satisfaction of regulatory supervisors.

Step 12. Guidelines or templates are distributed for use by regulatory staff.

By bringing together regulators, scientists, and other stakeholders, the 12-step plan ensures that the best available professional knowledge will be considered while practical issues will not be ignored. However, effectiveness of guidelines or templates developed from the 12-step plan should be periodically reviewed. Ideally, the review process should include collection of data that relate achievement of performance standards to replacement of lost wetland structure and functions.

POINT OF CONTACT: For additional information, contact Dr. Bill Streever (601-634-2942, *streevw@ex1.wes.army.mil*). This technical note should be cited as follows:

> Streever, B. (1999). "Examples of performance standards for wetland creation and restoration in Section 404 permits and an approach to developing performance standards." *WRP Technical Notes Collection* (TN WRP WG-RS-3.3). U.S. Army Engineer Research and Development Center, Vicksburg, MS. *www.wes.army.mil/el/wrp*

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Swink, F., and Wilhelm, G. (1994). *Plants of the Chicago Region*. Indiana Academy of Science, Indianapolis, IN.