Scientific and Policy Background for Addendum to New England District Compensatory Mitigation Guidance: Compensation for Impacted Aquatic Resource Functions.

The 1990 Memorandum of Agreement (MOA) between the Corps of Engineers and the Environmental Protection Agency states:

> "Appropriate and practicable compensatory mitigation is required for unavoidable adverse impacts which remain after all appropriate and practicable minimization has been required.… In determining compensatory mitigation, the functional values lost by the resource to be impacted must be considered. Generally, in-kind compensatory mitigation is preferable to out-of-kind. There is continued uncertainty regarding the success of wetland creation or other habitat development. Therefore, in determining the nature and extent of habitat development of this type, careful consideration should be given to its likelihood of success. Because the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, restoration should be the first option considered.
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> "The objective of mitigation for unavoidable impacts is to offset environmental losses. Additionally for wetlands, such 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, recognizing that this minimum requirement may not be appropriate and practicable and thus may not be relevant in all cases, …. In the absence of more definitive information on the functions and values of specific wetland sites, a minimum of 1 to 1 acreage replacement may be used as a reasonable surrogate for no net loss of functions and values. However, this 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."

We have found that 1:1 acreage replacement has not equaled 1:1 functional replacement in New England.

Since the signing of this MOA, many additional guidance documents on mitigation have been generated, all building on the basic philosophy espoused above. In 2001, the National Research Council reviewed federally-required compensatory mitigation and offered several technical recommendations. Some of these recommendations were incorporated into Corps Regulatory Guidance Letters. An interagency group continues to work on developing a National Mitigation Action Plan.

The goal of these efforts is to develop more effective compensatory mitigation to fully replace the impacted functions and values of authorized aquatic resource impacts. There have been numerous studies to date which have shown that this is not occurring. These studies have been conducted by federal and state agencies, universities, and non-governmental organizations. In 2001, the National Academy of Sciences' National Research Council published their findings, *Compensating for Wetland Losses under the Clean Water Act*. Some of their main points and observations include (emphasis added):

- "Are Wetland Functions Replaceable? Wetlands provide a number of ecological functions. The three most commonly cited wetland functions are related to water quality, hydrology, and habitat, but other functions also exist (e.g., alteration of microclimate, carbon sequestration). Some ecological functions provide human benefits, such as improvement of downstream water quality, whereas others may benefit only nonhuman organisms (i.e., wetland flora and fauna). Knowledge of the existence of wetland functions increases with increasing scientific understanding, but the perceived importance of different wetland functions changes as human values change. For example, the carbon-sequestration function of wetlands has recently assumed increased importance with our increased understanding of the role of atmospheric trace gases in global climate change (Bridgham et al. 1995). **The establishment of wetland structure does not necessarily restore all the functions of a wetland ecosystem.** For example, denitrification (an ecological process that benefits water quality) requires the presence of nitrate supply, a labile carbon source, anaerobic conditions, and microbial activity. Thus, a site that has wetland structure in terms of its vegetation assemblage might not provide the function of denitrification if these four requirements are not met." (p.27)

- "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." (p.108) This is pertinent to functions which are area sensitive.

- "**The adjustment of ratios is one of the principal tools for addressing risk and temporal loss with the ultimate goal of achieving permit compliance**." (p.110)

- Study (Table 6-16) found that **functional equivalency of completed mitigation was 21%** (p.121)

They also noted that, for five main functions of wetlands (which do not include all functions of wetlands), there were often problems with mitigating impacts to these functions. For the suite of hydrological functions, efforts to make sure the sites had wetland hydrology often left the sites too wet. They noted that water quality functions can be mitigated (net impacts lessened), but not duplicated. Invasive plant species are a serious problem for support of vegetation functions. The migratory pathways and upland buffers, so important in support of wetland fauna functions, are often neglected. Finally, soil functions were often impeded by levels of organic matter and nitrogen that were too low. (pp.27-34)

Some of the other studies that have been done on compensatory mitigation success have made useful observations and recommendations. Zedler (1996) found that successfully compensating for wetland losses requires duplication of wetland structure and function; however, simple measures of function do not exist. She also noted that **in order to have no net loss of wetland function, wetland mitigation efforts should create sites that equal or exceed the impacted area's functional value.**

In a study concentrating on soils, Stolt, et al., (2000) examined forested and scrub-shrub mitigation wetlands in comparison to adjacent natural wetlands. The data from their study suggest that **constructed wetlands may not function in the same capacity as natural, undisturbed wetlands**. In some cases, the factors controlling the functions may need more

time, decades to centuries, to develop. Even though created/restored marshes often appeared indistinguishable from the adjacent natural marshes, they may not have the same level of function. Matthews and Minello (1994) found that **created salt marshes generally have lower sediment organic content, below ground biomass, densities of benthic infaunal prey organisms, and densities of nekton on the marsh surface. Some habitat functions may develop quite slowly, if at all.**

Whigham (1999) questioned whether there is any scientific justification for the underlying assumption of mitigation, that restored and created wetlands function similarly to natural wetlands with regard to biodiversity and nutrient cycling. He also noted that **concentrating on replacing lost acreage amounts fails to account for the wetland degradation and functional loss resulting from creation and restoration of mitigation wetlands of lower functional value. In this regard, greater compensatory mitigation acreage is required to replace the lost functions of impacted systems, i.e., mitigation to impact ratio must be greater than 1:1**.

Kourtev, et al. (2002), found that **exotic invasive species can have profound effects on the microbial community of the soil. This, in turn, affects the functions performed by the microbial community, including nutrient retention and transformation and other water quality functions.** The Natural Resources Conservation Service's Wetland Science Institute (1999) noted that exotic plant species threaten the success of wetland restoration and creation by replacing native vegetation, reducing biodiversity, reducing wildlife habitat and food, changing ecosystem processes, and increasing hybridization.

In 2002, the New England District conducted a study on the success of 60 randomly-chosen mitigation sites throughout New England. The data was presented in a 2003 document noting that **only 17% of the 60 mitigation projects in the study seemed to be capable, currently or in the foreseeable future, of replacing the lost functions (particularly wildlife habitat and water quality functions) of the impacted wetlands.** This was due in part to inadequate mitigation amounts for permitted impacts and also for inappropriate functional replacements, e.g., replacing forested wetlands with open water, emergent, and/or scrub-shrub systems. Even where a specific function may have been replaced, it was often at a different or lower level than had been lost.

The study conclusions noted that "mitigation should be designed to replace the impacted wetlands as closely as possible to compensate for the lost impacts. **In order to fully, or even approximately, replace lost functions, increased quality and quantity efforts should be considered**. This is especially important for mitigating impacts to systems which entail large temporal losses in function, e.g., forested wetlands," for the area-sensitive functions. Mitigation site inspections subsequent to this study have yielded similar results, finding compensatory mitigation functions degraded in several ways, especially through inappropriate hydrology and invasive species.

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