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## Landscape Indicators of Ecosystem Service Benefits

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# LANDSCAPE INDICATORS OF ECOSYSTEM SERVICE BENEFITS

JAMES BOYD AND LISA WAINGER

Section 404 of the Clean Water Act (CWA) requires mitigation for wetland losses caused by development and other activities. Wetland mitigation can involve direct restoration, enhancement, or preservation or payment into a compensation fund subsequently used for mitigation undertaken by the state or another entity. In some cases, wetland acres are explicitly traded via off-site wetland mitigation projects or mitigation banks (Scodari and Shabman).

## Wetland Trading and Compensation Ratios

Regulatory requirements for mitigation trades require regulators to determine how much restoration or compensating preservation is enough to offset permitted wetland losses. Surveys of wetland mitigation banking practice show that bank program administrators rely on relatively vague, function-based compensation ratios (Brady). Recent criticism of the Army Corp of Engineers' evaluation procedures has been based on the Corps' failure to address lost functions (National Research Council). Economic benefits arising from lost ecosystem functions are rarely evaluated. In fact, analysis of lost benefits is not required under the CWA. This is a weakness of current regulations geared toward compensation for ecosystem losses.

Ecosystem exchanges, such as tradable development rights or wetland mitigation trades, require more than good ecological analysis. They require the application of economic principles in order to guarantee that trades pre-

serve what is valuable about ecosystems and thus maximize net social benefits (Boyd, King, and Wainger). Wetlands generate value in numerous ways. They can harbor rare and endangered species, reduce flood damages, improve water quality, and enhance property and recreational area values. Unfortunately, in most cases, regulators are not adequately equipped, financially or technically, to judge the relative value of environmental assets to be exchanged in such markets. Until these challenges are met, badly regulated ecosystem trades may undermine, rather than advance, the achievement of environmental and social welfare objectives (Elliott and Charnley, Rose).

Current regulatory programs do not typically account for lost ecosystem service benefits when assessing compensation. The most common regulatory practice is simply to require an "acre for an acre" of biophysically similar wetland when another is destroyed. At best, biophysical equivalence is evaluated (Ruhl and Gregg). But acre-based or purely functional compensation evaluations fail to account for many of the things that determine the social benefits of a particular ecosystem, such as a site's location in the greater landscape, the importance of local substitutes for and complements to the site, and future risks to the site's ability to provide services. In contrast, econometric analysis, the economist's preferred evaluation method, is difficult and costly and typically does not capture the full range of service benefits at a site. In practice, econometric analysis is rarely, if ever, used in wetland permitting decisions.

## Study Goals

This study proposes a middle ground between no analysis of services and econometric analysis, which is not realistic for small-scale permitting applications due to its cost and reliance on specialized expertise. The goal is an evaluation method, applicable by noneconomists using existing data sources, that can identify

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