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Optimizing Conservation and Improving Mitigation Cost/Benefit:

Task 2: Evaluation and Selection of Approaches

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I. Introduction

The goals of Task 2 were to develop criteria by which to evaluate the differences between the traditional and innovative approaches identified in Task 1, compile a list of documented compensatory mitigation approaches/case studies (hereinafter approaches), evaluate the identified approaches, and develop a list of five recommended approaches for analysis in Task 3.

Below (Section II) is a description of the methodology that was used to select the five final recommended approaches that we propose to evaluate in Task 3. These final recommended approaches are outlined in Section II. d. The list of 15 approaches recommended for consideration and the criteria that the team used to select the final approaches below, are included in Appendix A.

II. Methodology

A. Compilation of Approaches/Case Studies

The first phase of Task 2 required the team to compile a list of documented approaches to compensatory mitigation site selection under §7 of the Endangered Species Act (ESA) and §404 of the Clean Water Act (CWA), or analogous regulatory efforts at the federal or state level, being carried out nationwide. We identified these approaches through a number of sources, including the literature review and interviews completed in Task 1, the Federal Highway Administration's (FHWA) state practices database, the American Association of State Highway and Transportation Officials' (AASHTO) programmatics database, Transportation Research Board's (TRB) SHRP C06B case study databases, the Environmental Law Institute's (ELI) database of scientific studies addressing the ecological effectiveness of aquatic resource compensatory mitigation, abstracts presented at TRB's September 2010 SHRP C06 Symposium in Boulder, CO, academic journal articles, and the group's collective professional knowledge. We maintained a running list of all documented approaches in a spreadsheet.

This database is available upon request.

B. Categorizing Approaches/Case Studies

During Task 1, the research team identified and defined three distinct categories of compensatory mitigation approaches: traditional, "midway," and innovative. After identifying applicable ESA and CWA approaches, we categorized the documented case studies into one of the three categories. Our criteria for assigning approaches/case studies to each category were based on the methodology utilized in compensation site selection. The mechanism a program uses for compensatory mitigation, such as permittee-responsible mitigation (PRM), mitigation banks, conservation banks, and in-lieu fee programs (ILFs), was not a criterion for categorizing case studies, except when the mechanism dictated a program's site selection methodology.

As discussed in the Task 1 Technical Report, traditional approaches to compensatory mitigation are those that allow a permit applicant or mitigation provider to propose compensation sites on a project-by-project basis, usually based on best professional judgment, but do not involve any further analysis of landscape or watershed functional needs. Sites selected using traditional approaches to compensatory mitigation are generally chosen opportunistically to minimize costs, rather than maximize environmental outcomes. Our research identified 41 examples of traditional approaches to compensatory mitigation site selection.

Midway approaches were defined as those that use some sort of evaluation of landscape setting, but do not include holistic watershed- or landscape-scale planning. This category includes single-priority analysis, such as watershed plans that assess just one aquatic resource function or service. The midway category also included qualitative mitigation guidelines that describe the types of compensation projects that resource agencies prefer, and decision-making frameworks to guide the selection of appropriate locations for compensation projects, but neither provided specific science-based methods to carry out the selection of sites. We identified 34 midway approaches, including four that focused on single-priority analysis, 29 efforts with qualitative mitigation guidelines, and one site selection decision-making framework.

Innovative approaches are those that seek to use a strategic, analytic approach to compensation site design and selection that rely on a robust analysis of a suite of data/information on the watershed/landscape in which the mitigation project is being proposed. These approaches, whether banking programs, in-lieu fee programs, or other types of compensatory mitigation, seek to characterize a watershed/ecosystem's functional deficiencies in order to site and design compensatory mitigation projects that will improve the overall condition of an ecological unit. These holistic planning approaches consider multiple ecosystem functions or services. In the case of watershed planning, they address the entire suite of aquatic resource functions or services. Landscape planning efforts address the habitat needs of multiple species. These watershed- or landscape-scale evaluations allow permittees to move beyond project-by-project compensatory mitigation site selection; more comprehensive analyses of impacts from infrastructure and development are merged with conservation planning to proactively identify priority areas for ecological and economic investment. Innovative programs include ILFs approved or seeking approval under the 2008 Final Compensatory Mitigation Rule, as these federal regulations require compliant ILFs to develop a compensation planning framework that geographically guides ILF investment. Our research identified 47 innovative case studies; six of these studies were ILFs that have developed or are developing compensation planning frameworks.

C. Ranking Case Studies

In order to select compensatory mitigation case studies with sufficient data for the Task 3 economic and ecological analysis, we developed a suite of criteria by which we could evaluate each categorized case study. These criteria were designed to evaluate the quality and quantity of documented data on biophysical function, mitigation costs, ecosystem service values or benefits, and data credibility. ELI and NatureServe evaluated data availability through a simple binary response for each of the following criteria and sub-criteria:

- Use of biophysical outcome measures (biophysical conditions that result from the project)
- Definitions and monitoring criteria
- Both on-site and off-site outcome measures
- Biophysical measures that facilitate social evaluation and comprehension
- Use of measures to characterize costs
- Up-front engineering, construction, restoration costs
- On-going management and operations costs
- Project planning, monitoring, and other assessment costs
- Use of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing
- Use of social indicators, data, or projections to describe project benefits
- Monetary valuation of improved ecological outcomes

- Stakeholder, or beneficiary-based evaluation of benefits
- Use of standard, scientifically credible data (often evaluated based on the credibility of the data provider or developer)

ELI and NatureServe first evaluated whether case studies had documented their approach in enough detail to enable an evaluation and then provided binary responses to evaluate whether each case study meet the criteria documented above. ELI and NatureServe also provided relevant comments about each case study to assist in the final selection. The evaluation criteria indicated which regulatory program(s) the compensatory mitigation efforts addressed (CWA and/or ESA), whether landscape analysis incorporated consideration of avoidance and minimization of resource impacts, and the general geographic region of the project. Finally, to ensure that case studies evaluated in Task 3 can offer transferable results, ELI and NatureServe evaluated whether the efforts utilized repeatable, scientific approaches for selection of mitigation sites and conservation objectives.

After providing binary evaluations of each approach using the rating criteria, ELI and NatureServe recommended several approaches for consideration in the traditional, midway, and innovative categories based on the quality and quantity of data available for the Task 3 analysis and the regulatory program(s) that a case study addressed. ELI and NatureServe recommended for consideration six traditional case studies, four midway case studies, and five innovative case studies. ELI and NatureServe attempted to suggest case studies that represented a variety of methodologies and geographic diversity. The full list of 15 approaches recommended for consideration and the criteria that the team used to select the final approaches below, are included in Appendix A.

D. Selection of Final Five Approaches/Case Studies

Based on the binary ratings of criteria for data availability, case study transferability to other settings, regulatory program(s) addressed, and geographic distribution, the team members from the Institute for Natural Resources (INR) and Resources for the Future (RFF) selected the following five case studies for analysis in Task 3:

Traditional: Florida and Ohio

Midway: Minnesota

Innovative: Maryland and Oregon’s Willamette Basin

Innovative

The innovative areas were selected first, with both Maryland and Oregon's Willamette Basin standing out as the best examples to select. The Willamette Basin was chosen because:

1. There are many overlapping projects and detailed studies of the basin,
2. Methodology equally addresses wetlands and endangered species,
3. Innovations occur in a number of areas,
4. The methods are being deployed elsewhere in Oregon and in adjacent Washington, and
5. Team members have extensive knowledge of the methodologies and implementation costs.

Maryland stood out because:

1. Mitigation prioritization, while focused on 404, also included considerations of Endangered and at-risk species,
2. Was developed jointly by EPA and the Army Corps of Engineers with extensive community development, and
3. The methodology can and is being deployed across the state and potentially other adjacent states.

North Carolina was considered but not selected because of geographic proximity to Florida and Maryland, although it is an excellent example which is well studied. It was also not selected because the methodology used is in the process of being significantly updated to merge considerations from the states more traditional stream mitigation method. Both Michigan and California also seem to be excellent places to work. California's vernal pools in the central valley were selected as the backup site, in case the team has the ability to address six areas. The central valley is interesting because the vernal pools include both traditional and innovative methods which have been extensively evaluated, and the team will use this site as a backup if additional time is available or if it either Oregon or Maryland cannot be evaluated. Michigan, while interesting, did not appear to address endangered species as well as Maryland. Also, since Minnesota appeared to be the best midway choice, Michigan did not provide geographic representation. Lastly, the development of the key data for the Michigan project required investments that might not be possible across the country, making it seem less easily transferable.

Midway

Minnesota was chosen as the best midway site because it represents a direction many states are taking, and as such, the results may be transferable. Also, the state has extensive biological inventories which may help evaluate the results, and has the best studies.

The two ESA projects, the Desert Tortoise and Indiana Bat were not selected because they both represent unusual ESA efforts that probably are not going to be widely applicable to other states or areas with ESA impacts. Bats are particularly difficult to address, because they occur widely and don't have typical habitat associations, since hibernacula and roosts are often the limiting factor, as opposed to the more traditional limitations of habitat for other species. The Desert Tortoise was considered, and would have been selected if two midway types were to be identified. However, the iPaC methodology is currently still in development, and it is unclear how quickly it could be implemented in other areas of the country, aside from the new iPaC pilot in Colorado.

Traditional

Florida was the easiest choice for a number of reasons. First, while the EMDT focuses on wetlands, it includes and addresses endangered species in a traditional way. Secondly, the EDMT is widely considered as a model system, in spite of involving fairly traditional logic and considerations. And finally, Florida appears especially promising because of the economic/socioeconomic studies that are available.

The second traditional area was a bit more difficult to select, largely because there were so many possible case studies. As mentioned above, Ohio was selected, with the primary reasons being the large number of existing scientific studies and evaluations of their wetlands program, and the fact that the Ohio program and their rapid assessment protocol are often used as models for other states.

The case studies almost selected and reasons for their not being included are summarized below.

- North Carolina: The traditional stream methodologies are currently under revision, and appear likely to be revised and incorporated into their innovative wetlands program.
- Virginia: Virginia also is revising their wetlands methodologies, with new priorities identified, plus it is adjacent to Maryland.
- California: The Valley Elderberry Longhorn Beetle programmatic was considered, but rejected because the vernal pool case studies in California address both wetlands and Endangered Species.

- Missouri: The Missouri DOT's study was identified because the state helps address geographic diversity, since few of our cases studies are located in this part of the country, and because Missouri has exceptional information resources and priorities identified in their state wetlands action plan. IT was not selected be because their biophysical outcome measures seemed fairly simplistic (mostly qualitative assessments of vegetation, hydrology, and sometimes soils) when compared to some of the other studies we reviewed. The study was also designed to assess regulatory success instead of ecological effectiveness.

III. Appendix

A. RECOMMENDED TRADITIONAL CASE STUDIES

Clean Water Act §404 or similar programs

- Florida
- Ohio
- Iowa Department of Transportation

Endangered Species Act §7 or similar programs

- Indiana Bat: Programmatic Biological Opinions
- Valley Elderberry Longhorn Beetle Programmatic Biological Opinion

B. RECOMMENDED MIDWAY CASE STUDIES

Clean Water Act §404 or similar programs

- Minnesota wetland permitting program
- NC Stream Mitigation Guidelines
- VA Off-Site Mitigation Location Guidelines

Endangered Species Act §7 or similar programs

- Mojave Desert Tortoise (AZ, CA, NM, NV, UT); Fort Irwin National Training Center, CA Mojave Desert Tortoise Spatial Decision Support System

C. RECOMMENDED INNOVATIVE CASE STUDIES

Clean Water Act §404 or similar programs

- North Carolina Ecosystem Enhancement Program (EEP)
- Maryland Watershed Resources Registry and the Integrated Approach to Transportation Project Mitigation and Stewardship
- Michigan watershed-scale aquatic resource mitigation planning

Endangered Species Act §7 or similar programs

- California's Regional Advanced Mitigation Planning (RAMP) initiative
- Clean Water Act & Endangered Species Act
- Overlapping Programs in Willamette Basin, OR: Willamette Basin Partnership, Natural Capital Project, Oregon State INR Willamette Basin Conservation Project

A. RECOMMENDED TRADITIONAL CASE STUDIES

Clean Water Act §404 or similar programs

Florida

Criteria:

Geographic Region: Southeast

Use of repeatable, scientific approach for selecting mitigation sites and establishing conservation goals: Traditional wetland compensatory mitigation in Florida was conducted through on-site, permittee-responsible mitigation (PRM), mitigation banks, and public offsite mitigation areas, which operated similarly to traditional in-lieu fee (ILF) mitigation programs. The documentation we reviewed provides no explanation of site selection methodologies for traditional mitigation projects in Florida.

Use of biophysical outcome measures: The most comprehensive study providing analysis of the biophysical outcomes of traditional Floridian compensatory mitigation projects is Reiss et al.'s 2007 assessment of the ecological and regulatory success of 58 wetland assessment areas within 29 mitigation banks across the state. The analysis of ecological success included use of a number of on-site and off-site measures, including the Uniform Mitigation Assessment Method (UMAM), Wetland Rapid Assessment Protocol (WRAP), two HGM guidebooks, Florida Wetland Condition Index (FWCI), and Landscape Development Intensity (LDI) Index. UNAM generates functional scores for location and landscape support, water environment, and community structure, which potentially could be used to evaluate a site's ecosystem services and values. WRAP seems particularly conducive to analysis of the social benefits resulting from a mitigation site, including scoring categories for wildlife utilization, overstory/shrub canopy, vegetative ground cover, adjacent upland support/buffer, field indicators of wetland hydrology, and water quality input/treatment. The HGM guidebook for depressional wetlands in central Florida evaluates sites for surface water storage, subsurface water storage, nutrient cycling, characteristic plant communities, and wildlife habitat; the HGM guidebook for Everglades flats wetlands uses the same criteria but combines surface and subsurface water storage scores into one category. FWCI is probably less useful for social benefits analysis, as it uses detailed scorings of diatom, macrophyte, or macroinvertebrate community composition at a wetland site. Finally, researchers calculated values for the LDI based on a 100-meter radius surrounding each wetland assessment site and each entire mitigation bank. The LDI is "an index of human activity based on a development intensity measure derived from nonrenewable energy use (e.g., fertilizer, fuel, electricity) in the surrounding landscape."

Researchers have conducted a number of other local and regional studies recording qualitative or quantitative biophysical outcomes of traditional wetland compensatory mitigation projects in Florida. Lowe et al. (1989) evaluated the success of 29 wetland creation sites in the St. Johns River Water Management District (WMD) based on their success in meeting regulatory conditions of permits/consent orders and creating viable wetland habitat, as judged through qualitative assessments of a site's wetland species coverage, hydrology, and ability to support appropriate macroinvertebrate and fish populations. Erwin (1991) examined 196 wetland impact permits in the South Florida WMD and evaluated the regulatory compliance and ecological effectiveness (surface hydrology, vegetation) of the 40 permits that required mitigation. A 1991 study by the Florida Department of Environmental Regulation (FDER) reviewed 119 wetland creation sites required by 63 Florida Environmental Resource Permits (ERPs) for adherence to permitted design and the ecological success of the site, as judged by whether a site is, or appears on a trajectory to become a functional wetland of the intended type. Streever et al. (1996) compared 10 created and 10 natural wetlands in central Florida in 1993 to assess differences in dipterans in freshwater herbaceous wetlands. Shafer and Roberts (2008) returned to 18 tidal mitigation sites in central/southern FL in 2005 that were originally evaluated in 1988. Their research reassessed mangrove community composition and stand structure in 10 of these wetland mitigation sites to chart long-term trends in the development of vegetation at the site. Finally, Florida's 2000 OPPAGA report on the overall status of wetland mitigation in the state provides data on permit compliance, though the ecological performance measures used to measure compliance were not necessarily consistent across different wetland compensation projects.

<u>Use of measures to characterize costs:</u> OPPAGA's 2000 report provides the range of costs for acres or credits of wetland compensation derived from different types of compensatory mitigation (creation, restoration, enhancement, and preservation) and the three different mitigation mechanisms. ELI's 2007 study, *Mitigation of Impacts to Fish and Wildlife Habitat: Estimating Costs and Identifying Opportunities*, also includes cost estimates for wetland compensation credits from mitigation banks and ILFs in the Jacksonville Corps district.

<u>Use of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing:</u> The presence of multiple studies relating the biophysical outcomes of wetland mitigation to their value as ecosystem services makes Florida a particularly appealing case study. Ruhl and Salzman (2006) examined the socioeconomic effects of wetland mitigation banking throughout the state. The authors collected permitting information for all active and sold-out wetland mitigation banks in FL, and for the 24 banks with adequate information, analyzed demographic trends in population density, median income, and minority population induced by banking. Boyd and Wainger (2003)

performed a more detailed case study of the effects of a single mitigation bank, the Little Pine Wetland Mitigation Bank, on the value of wetland ecosystem services, as assessed through landscape indicators indicative of ecosystem service values. The authors used landscape indicators to assess services for improved drinking water quality/abundance, reduced flood damage, improved aquatic recreation, and open-space recreation, aesthetic, or species existence benefits. Landscape indicators were utilized to evaluate locational advantage, service scarcity, complementary inputs, risks and changed future conditions, and income and equity at impact and bank sites.

Sources:

Boyd, J. and L. Wainger. 2003. *Measuring Ecosystem Service Benefits: The Use of Landscape Analysis to Evaluate Environmental Trades and Compensation.* http://www.rff.org/documents/RFF-DP-02-63.pdf

Environmental Law Institute. 2007. *Mitigation of Impacts to Fish and Wildlife Habitat: Estimating Costs and Identifying Opportunities.* http://www.elistore.org/reports_detail.asp?ID=11248

Erwin, K.L. 1991. An evaluation of wetland mitigation in the South Florida Water Management District. In National Research Council. 2001. Compensating for Wetland Losses Under the Clean Water Act.

Florida Legislature's Office of Program Policy Analysis and Government Accountability (OPPAGA). 2000: *Policy Review: Wetland Mitigation.* http://www.oppaga.state.fl.us/MonitorDocs/Reports/pdf/9940rpt.pdf.

Lowe, G., D. Walker, and B. Hatchitt. 1989. *Evaluating manmade wetlands as compensation for the loss of existing wetlands in the St. Johns River Water Management District.* http://images.library.wisc.edu/EcoNatRes/EFacs/Wetlands/Wetlands16/reference/econatres.wetlands16.glowe.pdf

Redmond, A. 1997. *How Effective is Mitigation?* http://wetlandsnewsletter.org/pdf/14.01/14.1.pdf

Reiss, K.C., E. Hernandez, and M.T. Brown. 2007. *An Evaluation of the Effectiveness of Mitigation Banking in Florida: Ecological Success and Compliance with Permit Criteria.* http://www.dep.state.fl.us/water/wetlands/docs/mitigation/Final_Report.pdf

Ruhl, J.B., and J. Salzman. 2006. *The Effects of Wetland Mitigation Banking on People.* http://wetlandsnewsletter.org/pdf/28.02/Ruhl.pdf

Shafer, D.J. and T.H. Roberts. 2008. *Long-term development of tidal mitigation wetlands in Florida.* http://www.mangroverestoration.com/pdfs/Shaffer%20and%20Roberts%202008.pdf.

Streever, W.J., K.M. Portier, and T.L. Crisman. 1996. *A comparison of dipterans from ten created and ten natural wetlands.*
http://www.springerlink.com/content/q6p2vq65pn16vw41/

Ohio

Criteria:

Geographic Region: Upper Midwest

Use of repeatable, scientific approach for selecting mitigation sites and establishing conservation goals: Traditional wetland compensatory mitigation in Florida was conducted through on-site, PRM, and traditional mitigation banks. The documentation we reviewed provides no explanation of site selection methodologies for traditional mitigation projects in Ohio.

Use of biophysical outcome measures: Researchers have completed a number of studies recording various metrics for the ecological success of mitigation wetlands in Ohio, provided through both traditional PRM and traditionally sited mitigation banks. Two of the 12 studies identified in our literature review appear to be particularly useful for integrating biophysical outcomes into the context of the human environment for analysis of ecosystem services. First, Fennessy's 1997 comparison of 14 mitigation and 7 natural, reference wetlands in Ohio included evaluation of the functional capacity of wetland sites through a draft of the Buffalo District Wetland Evaluation Methodology (BWEM). The BWEM returns ratings for a wetland's water retention ability, water quality improvement function, and habitat value. Fennessy also evaluated ecological effectiveness of mitigation sites via plant community composition, Floristic Quality Assessment Index (FQAI), soil characteristics, wildlife observations, wetland size and basin morphology, and buffer area characteristics, invoking consideration of landscape influences on wetland function. Second, Wilson and Mitsch's 1996 in-depth evaluation of five wetland mitigation projects provides a detailed assessment of hydrology, soils, vegetation, wildlife, and water quality metrics.

Porej et al. (2003) investigated 76 wetland mitigation projects, which included 117 separate wetlands, for vegetative composition, presence of a shallow littoral zone, presence of predatory fish, surrounding land use classes (NLCD), and regulatory compliance. Fennessy et al. (2004) provides an in-depth study of the biophysical outcomes of ten mitigation wetlands as compared to nine reference wetlands, charting groundwater levels, vegetation, standing biomass, vegetation-based indicators, macroinvertebrate and amphibian sampling and indicators, and detailed metrics of the biogeochemical characteristics of soils and surface water. Porej (2004) sampled 41 wetland replacement sites in the Eastern Corn Belt Plains ecoregion of central OH for the presence of amphibians, birds, and landscape composition; this study additionally analyzed the presence of predatory fish and a shallow littoral zone at 117 wetland mitigation sites. Gamble and Mitsch (2007) provide a detailed comparison of the hydroperiods at ten created and six naturally-created vernal pool wetlands in central Ohio. Kettlewell et al. (2008) evaluated the "permit compliance, wetland structure, and landscape context" of state wetland permits in Ohio's Cuyahoga River Watershed. Furthermore, Gutrich, Taylor and Fennessy (2009) studied eight freshwater depressional emergent mitigation marshes in Ohio 5-19 years after their initial restoration efforts, assessing ecological effectiveness based on floristic equivalency and soil chemistry data.

Some of the studies of the biophysical performance of mitigation sites in Ohio include study tracts within mitigation banks. Mack and Micacchion (2006) evaluated nearly 400 ha of wetlands at 12 Ohio wetland mitigation banks, assessing achievement of performance standards, Vegetation Index of Biological Integrity (VIBI), wetland vs. non-wetland area at banks, percent cover by invasive species, and soil and water chemistry data. Spieles et al. (2006) evaluated two 10-year old wetland mitigation bank sites in Ohio by comparing vegetative and macroinvertebrate communities at banks with those in reference wetlands. Knapp (2006) sampled and calculated Wetland Invertebrate Community Index (WICI) values for wetland mitigation bank sites in Ohio's Huron/Erie Lake Plain ecoregion; invertebrate communities were sampled at 20 sites within 7 mitigation banks in 2004 and at 6 sites within 3 mitigation banks in 2001. Ten of the sites studied in Porej (2004) were parts of 5 private mitigation banks. Kettlewell et al.'s 2008 study includes permits that were replaced through both traditional PRM and mitigation bank credits.

Use of measures to characterize costs: ELI's 2007 study, *Mitigation of Impacts to Fish and Wildlife Habitat: Estimating Costs and Identifying Opportunities*, includes cost estimates for compensation credits in two of the three Corps districts found in Ohio. The Buffalo and Huntington Corps districts estimate mitigation bank and ILF credit prices for wetland mitigation, and provide general estimates for the cost of stream compensatory mitigation.

Use of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing: N/A

<u>Sources:</u>

Environmental Law Institute. 2007. *Mitigation of Impacts to Fish and Wildlife Habitat: Estimating Costs and Identifying Opportunities.* http://www.elistore.org/reports_detail.asp?ID=11248

Fennessy, M.S. 1997. *A Functional Assessment of Mitigation Projects in Ohio: Comparisons with natural systems.* http://www.epa.state.oh.us/portals/35/wetlands/1995_Mitigation_Report.pdf

Fennessy, M.S., J.J. Mack, A. Rokosch, M. Knapp, and M. Micacchion. 2004. *Ohio EPA Technical Report WET/2004-5: Biogeochemical and Hydrological Investigations of Natural and Mitigation Wetlands.* http://www.epa.state.oh.us/portals/35/wetlands/Part5_Mitigation_Study.pdf

Gamble, D.L. and W.J. Mitsch. 2007. *Hydroperiods of created and natural vernal pools in central Ohio: A comparison of depth and duration of inundation.* http://www.springerlink.com/content/l01104668w78jqv4/

Gutrich, J.J., K.J. Taylor, and M.S. Fennessy. 2009: Restoration of vegetation communities of created depressional marshes in Ohio and Colorado (USA): The importance of initial effort for mitigation success. http://www.sou.edu/envirostudies/Gutrich_et_al.2009.pdf

Kettlewell, C.I., V. Bouchard, D. Porej, M. Micacchion J.J. Mack, D. White, and L. Fay. 2008. *An assessment of wetland impacts and compensatory mitigation in the Cuyahoga River Watershed, Ohio, USA.* http://www.springerlink.com/content/l01104668w78jqv4/

Knapp 2006: Investigations of Invertebrate Communities of Wetlands in the Huron/Erie Lake Plains Ecoregion and Ohio Mitigation Banks. http://www.epa.state.oh.us/portals/35/wetlands/Part8_Addendum_InvertReport06.pdf

Mack, J.J. and M. Micacchion. 2006. *Ecological Assessment of Ohio Mitigation Banks: Vegetation, Amphibians, Hydrology, Soils.* http://www.epa.state.oh.us/dsw/wetlands/WetlandBankReport.aspx

Porej, D. 2003. *An Inventory of Ohio Wetland Compensatory Mitigation.* http://www.epa.state.oh.us/portals/35/wetlands/WetlandMitigationInventory_Nov2003.pdf

Porej, D. 2004. *Faunal Aspects of Wetland Creation and Restoration.* http://etd.ohiolink.edu/send-pdf.cgi/Porej%20Deni.pdf?acc_num=osu1078327758.

Sibbling, J.M. 1997. *Mitigation's role in wetland loss.* http://wetlandsnewsletter.org/pdf/19.01/19.1.pdf.

Spieles, D.J., M. Coneybeer, and J. Horn. 2006. *Community Structure and Quality After 10 Years in Two Central Ohio Mitigation Bank Wetlands.* http://www.springerlink.com/content/q51874p65430vqxw/

Wilson, R.F. and W.J. Mitsch. 1996. *Functional assessment of five wetlands constructed to mitigate wetland loss in Ohio, USA.*
http://www.springerlink.com/content/q51874p65430vqxw/

<u>Iowa Department of Transportation</u>

NOTE: This was a later addition and follows a slightly different format.

Iowa Department of Transportation evaluated regulatory compliance and ecological success; for sites where they evaluated ecological success they also used ecological measures that appear, from a first glance, to be conducive to looking at ecosystem service values. Iowa's ecological measures certainly are more sophisticated than those used in MO.

http://www.iowadot.gov/ole/pdfs/Ecological%20Performance%20of%20Mitigation%20Wetlands%20FINAL%20Report%20_8-31-08.pdf

Endangered Species Act §7 or similar programs

<u>Indiana Bat: Programmatic Biological Opinions</u>

Criteria:

Geographic Region: Upper Midwest

<u>Use of repeatable, scientific approach for selecting mitigation sites and establishing conservation goals:</u> The Ohio DOT's programmatic biological opinion (BO) notes that they will map projected impacts to Indiana bat habitat throughout the five-year life of the BO. This programmatic BO establishes that when transportation projects cause unavoidable impacts to Indiana bat habitat, "[t]he goal of the habitat protection and enhancement will be to enhance Indiana bat habitat in the long term by providing forested habitat, improving connectivity among blocks of existing habitat, and creating larger blocks of forested bat habitat." Compensatory mitigation should also occur within the same bat Management Unit; when impacts cross a Management Unit or are near the boundaries of a Management Unit, they may be compensated in an adjacent area.

However, as transportation project-induced impacts to Indiana bat habitat are all addressed on a project-by-project basis and do not involve landscape-scale planning under the programmatic BO, this program still constitutes a traditional compensation method.

Use of biophysical outcome measures: N/A

Use of measures to characterize costs: N/A

Use of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing: N/A

<u>Sources:</u>

U.S. Fish and Wildlife Service and Ohio Ecological Services Office. 2007. Biological Opinion on the Ohio Department of Transportation's Statewide Transportation Program for the Federally-listed endangered Indiana bat. http://tragusinc.com/Biological%20Opinion%20for%20Ohio's%20Transportation%20Program.pdf

U.S. Fish and Wildlife Service. Indiana Bat Section 7 Consultation: Biological Opinions. http://www.fws.gov/midwest/endangered/mammals/inba/inbaBOs.html

Vernal Pool Compensatory Mitigation in Great Central Valley, California

Criteria:

Geographic Region: Southwest

Use of repeatable, scientific approach for selecting mitigation sites and establishing conservation goals: N/A

Use of biophysical outcome measures: Wacker and Kelly (2004) evaluated past mitigation practices for vernal pools in California's Great Central Valley to determine if mitigation procedures are changing the distribution and composition of vernal pool types, as defined by soil type and geomorphology, in the landscape.

Use of measures to characterize costs: N/A

Use of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing: N/A

<u>Source:</u>

Wacker, M. and N.M. Kelly. 2004. *Changes in vernal pool edaphic settings through mitigation at the project and landscape scale.* http://kellylab.berkeley.edu/storage/papers/2004.Wacker.Kelly.WEM.pdf

Valley Elderberry Longhorn Beetle Programmatic Biological Opinion

NOTE: This was a later addition and follows a slightly different format.

The Valley Elderberry Longhorn Beetle programmatic BO in the FWS Sacramento Field Office. FWS has completed a good 5-year review on the ecological effectiveness of the programmatic.

5-year review: http://www.fws.gov/sacramento/es/documents/VELB%205-year%20review.FINAL.pdf

FHWA programmatic: http://www.fws.gov/sacramento/es/documents/96-F-156_FHWA_VELB_Programmatic_web_edit.pdf

Corps programmatic: http://www.fws.gov/sacramento/es/documents/velb_coe_programmatic.pdf

Conservation guidelines for VELB: http://www.fws.gov/sacramento/es/documents/velb_conservation.pdf

B. RECOMMENDED MIDWAY CASE STUDIES

Clean Water Act §404 or similar programs

Minnesota wetland permitting program

Criteria:

Geographic Region: Upper Midwest

Use of repeatable, scientific approach for selecting mitigation sites and establishing conservation goals: Regulations governing Minnesota's state-run, comprehensive freshwater wetland program stipulate certain preferences and necessary components of wetland compensation sites to promote ecologically suitable and sustainable mitigation. The regulations prefer that wetland replacement is "located and designed…to be self sustaining," located where it can maximize natural hydrogeomorphology and necessitate little landscape alteration, and require that it be "accomplished according to the ecology of the landscape area." Minnesota's wetland regulations further specify that compensation projects must consider "landscape position, habitat requirements, development and habitat loss trends, sources of watershed impairment, protection and maintenance of upland resources and riparian areas, and providing a suite of functions." The regulations also specify upland buffer requirements for all wetland replacement projects. Finally, Minnesota requires that wetland compensation follow detailed siting procedures based on an impact's minor watershed, major watershed, county, bank service area, and metropolitan area; these siting requirements vary based on the percent of presettlement wetlands intact in a county/watershed. Counties with a higher percentage of intact presettlement wetlands receive higher spatial flexibility for replacing wetland impacts.

<u>Use of biophysical outcome measures:</u> Though we could not gain access to wetland functional assessments in Minnesota over the Internet, it appears that the state maintains a database with this information. The state uses the Minnesota Routine Assessment Methodology for Evaluating Wetland Functions (MnRAM), which provides on-site measures useful for evaluating wetland mitigation performance criteria as well as off-site measures of a wetland's surrounding landscape. MnRAM is particularly conducive to social benefits analysis and, in fact, includes some metrics that incorporate judgments of the value or opportunity associated with a particular function. MnRAM allows regulators to assess a site's performance for the following categories of functions/values: "vegetative diversity and integrity, maintenance of characteristic hydrologic regime, flood and stormwater storage/attenuation, downstream water quality protection, maintenance of wetland water quality, shoreline protection, management of characteristic wildlife habitat structure, maintenance of characteristic amphibian habitat, aesthetics/ recreation/ education/ cultural/ science, commercial uses, groundwater interaction, wetland restoration potential, wetland sensitivity to stormwater input and urban development, and additional stormwater treatment needs." MnRAM also allows site assessments to utilize GIS analysis when appropriate. Minnesota additionally accepts functional assessments that utilize HGM.

<u>Use of measures to characterize costs:</u> Minnesota maintains data tracking overall costs of mitigation bank credits in the state. When reported voluntarily by a permittee or mitigation provider, the state posts the prices of completed mitigation bank transactions on the website of the state's Board of Water and Soil Resources (BWSR); prices are currently posted for transactions from 2005-08. BWSR also runs a state mitigation banking program and the state uses a legislatively-set formula to derive prices for credits sold in each county in the state. The formula and calculations of credit prices in each county are also available on the BWSR website. Finally, ELI (2007) reports past credit prices for BWSR's public banking program.

BWSR also oversees a publicly-accessible database of available wetland bank credits that is updated on a daily basis; this database allows users to group wetland credits by county, watershed, service area, and wetland type, though it does not post the prices for available wetland credits. This database also provides contact information for bankers supplying credits.

<u>Use of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing:</u> As mentioned, some of the functional assessments included in MnRAM include factors to evaluate that function's value.

Sources:

Environmental Law Institute. 2007. *Mitigation of Impacts to Fish and Wildlife Habitat: Estimating Costs and Identifying Opportunities.* http://www.elistore.org/reports_detail.asp?ID=11248

Fennessy, M.S., A.D. Jacobs, and M.E. Kentula. 2004. *Review of Rapid Methods for Assessing Wetland Condition.* http://epa.gov/wed/pages/publications/authored/EPA620R-04009FennessyRapidMethodReview.pdf

Minnesota Board of Water and Soil Resources. Table of wetland bank purchase transactions by Major Watershed for 2005-08. http://www.bwsr.state.mn.us/wetlands/wetlandbanking/Sales_Data-MajWatershed.pdf

Minnesota Board of Water and Soil Resources. Table of wetland bank purchase transactions by County for 2005-08. http://www.bwsr.state.mn.us/wetlands/wetlandbanking/Sales_Data-County.pdf

Minnesota Board of Water and Soil Resources. 2009. Wetland Banking Fee Policy. http://www.bwsr.state.mn.us/wetlands/wetlandbanking/fees-2009.html

Minnesota Board of Water and Soil Resources. 2010. Wetland Functional Assessment / MnRAM. http://www.bwsr.state.mn.us/wetlands/mnram/index.html.

Minnesota Wetland Conservation Act Regulations, 8420.0522, Subparts 5, 6, & 7. 2010. http://www.bwsr.state.mn.us/wetlands/wca/CH8420-August2009.pdf#page=67

NC Stream Mitigation Guidelines

Criteria:

Geographic Region: Southeast

Use of repeatable, scientific approach for selecting mitigation sites and establishing conservation goals: This case study would exclude stream mitigation conducted under the NC Ecosystem Enhancement Program (EEP), as EEP is grouped as an innovative mitigation program.

The Wilmington Corps District, NC Division of Water Quality, EPA Region IV, Natural Resources Conservation Service (NRCS), and the NC Wildlife Resources Commission released stream mitigation guidance that sets standards for site selection of stream compensation sites in North Carolina. The Guidance instructs that stream mitigation should typically take place on a stream with the same type of habitat (cold, cool, warm water) as an impacted stream, within one stream order of an impact, within the same HUC-8 and as close as possible to an impact, and within the same physiographic province as an impact. The guidance also notes that when projects impact trout species, mitigation should also occur in trout waters and that stream habitat improvements should be targeted to streams with state- or federally-threatened or endangered species. Finally, the guidance lists a number of characteristics of stream channels that may be appropriate for generation of preservation credits.

The Wilmington Corps District and NC DWQ also released a 2007 document entitled "Information Regarding Stream Restoration With Emphasis on the Coastal Plain," which emphasizes that stream mitigation should occur in locations that historically supported stream channels.

Use of biophysical outcome measures: NC DWQ, with support from RTI International, recently released a report assessing regulatory success rates of stream and wetland mitigation projects across the state. DWQ reviewed monitoring files and conducted site visits to evaluate a site's regulatory success. The report assessed stream compensation conducted by various mitigation providers outside of EEP, allowing analysis of the effect of guidelines on "midway" stream mitigation projects. While performance criteria determining regulatory success are generally tied to a site's ecological performance, the ecological metrics used by DWQ to assess different sites are by no means uniform.

Use of measures to characterize costs: Comparable stream mitigation cost data is available for projects conducted for the EEP (see Templeton et al. 2008, listed with EEP sources); however our research found no sources charting stream mitigation costs for other mitigation providers in North Carolina.

Use of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing: N/A

Sources:

Wilmington District, US Army Corps of Engineers, North Carolina Division of Water Quality, Region IV, US Environmental Protection Agency, Natural Resources Conservation Service, and North Carolina Wildlife Resources Commission. 2003. *Stream Mitigation Guidelines.* http://www.saw.usace.army.mil/WETLANDS/Mitigation/stream_mitigation.html

Wilmington District, US Army Corps of Engineers and North Carolina Division of Water Quality. 2007. *Information Regarding Stream Mitigation With Emphasis on the Coastal Plain.* http://www.saw.usace.army.mil/wetlands/Mitigation/Documents/Coastalinfo_4_4_07.pdf

Hill, T., E. Kulz, B. Munoz, and J. Dorney. 2010. *Compensatory stream and wetland mitigation in North Carolina: An evaluation of regulatory success.* http://portal.ncdenr.org/c/document_library/get_file?uuid=a431d714-f531-40ed-b3f5-86a6cbba4e34&groupId=38364

VA Off-Site Mitigation Location Guidelines

Criteria:

Geographic Region: Southeast

Use of repeatable, scientific approach for selecting mitigation sites and establishing conservation goals: The Norfolk Corps District's 2008 Off-Site Mitigation Location Guidelines encourage permittees and mitigation providers to consider certain landscape characteristics when selecting compensation sites. The Guidelines recommend that off-site mitigation consider upstream hydrologic interference with a mitigation site, nearby conflicting and complementary land uses, utilize riparian buffers for stream mitigation, consider local planning documents, and provide stream mitigation on streams of a similar order. The Norfolk Corps District also encourages off-site wetland and stream mitigation that supports habitat for threatened, endangered, or rare species, improves water quality in impaired waters, removes identified barriers to fish passage, provides environmental benefits identified in watershed/conservation plans, significantly reduces sediment/pollutant loads, and improves wild trout streams or Anadromous Fish Use Areas. The guidelines additionally stipulate the spatial scale at which off-site mitigation should occur.

Use of biophysical outcome measures: N/A

Use of measures to characterize costs: N/A

se of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing: N/A

Sources:

Norfolk District, US Army Corps of Engineers. 2008. *Off-Site Mitigation Location Guidelines.* http://www.nao.usace.army.mil/technical services/Regulatory branch/Guidance/Virginia Offsite Mitigation Site Selection Guidelines.pdf - page=4

Endangered Species Act §7 or similar programs

Mojave Desert Tortoise (AZ, CA, NM, NV, UT); Fort Irwin National Training Center, CA Mojave Desert Tortoise Spatial Decision Support System

Criteria:

Geographic Region: Southwest

Use of repeatable, scientific approach for selecting mitigation sites and establishing conservation goals:

The draft Mojave desert tortoise recovery plan released by the FWS in August 2008 includes a general framework for directing improvement of tortoise populations throughout the geographic recovery units. As part of this general framework, the recovery plan institutes use of a decision support system which allows adaptive management of tortoise recovery. The decision support system uses models of spatial threats to tortoise populations, tortoise mortality models, and recovery action models to prioritize the actions that will best address threats to the recovery of tortoise populations. A key piece of the decision support system is the desert tortoise habitat model; the draft recovery plan estimates that the habitat model will be completed by USGS within the first year following the release of the final recovery plan.

While the actions and models proposed in the draft desert tortoise recovery plan have yet to be developed in detail and implemented throughout all of the geographic recovery units, the Redlands Institute has developed a spatially explicit decision support system to guide mitigation for impacts to tortoise habitat caused by the expansion of the US Army's Fort Irwin, CA National Training Center within the Western Mojave Recovery Unit (WMRU). The spatial model utilized ten different criteria—land ownership, habitat, proximity to major roads and highways, proximity to urban areas, road density, critical habitat units, off-highway vehicle use, tortoise "die-off" regions, and proximity to Fort Irwin—to model and prioritize the translocation potential of different regions within the WMRU. This model generated seven alternative translocation scenarios, which decision makers then merged to choose final recovery actions.

Use of biophysical outcome measures: N/A

Use of measures to characterize costs: The Nevada FWS office provides an overall estimate of $159 million for full implementation of the desert tortoise recovery plan until 2025, though it notes that this projection does not account for "additional costs." Detailed cost projections, divided by general recovery actions, are provided for the first five years of the entire program in the draft revised recovery plan (8/2008).

The Redlands Institute also notes on its website that it has received $11.7 million for implementation of the tortoise recovery plan within the WMRU, specifically for research on the Fort Irwin expansion.

Use of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing: N/A

<u>Sources:</u>

Heaton, J.S., K.E. Nussear, T.C. Esque, R.D. Inman, F.M. Davenport, T.E. Leuteritz, P.A. Medica, N.W. Strout, P.A. Burgess, and L. Benvenuti. 2008. *Spatially explicit decision support for selecting translocation areas for Mojave desert tortoises.* http://www.institute.redlands.edu/emds/manuscripts/pdf/heaton%20et%20al%202008.pdf

Region 8, California and Nevada, US Fish and Wildlife Office. *Draft Revised Recovery Plan for the Mojave Population of the Desert Tortoise.* http://www.fws.gov/nevada/desert_tortoise/documents/recovery_plan/DraftRevRP_Mojave_Desert_Tortoise.pdf

US Fish and Wildlife Service. Recovery Plan Action Status for Draft Revised Recovery Plan for the Mojave Population of the Desert Tortoise. https://ecos.fws.gov/roar/pub/planImplementationStatus.action?documentId=1002909&entityId=185

The Redlands Institute. Desert Tortoise Project. http://www.spatial.redlands.edu/redlandsinstitute/projects/dtp/Default.aspx

Nevada Fish and Wildlife Office, US Fish and Wildlife Service. Desert Tortoise Recovery Office. http://www.fws.gov/nevada/desert_tortoise/

C. RECOMMENDED INNOVATIVE CASE STUDIES

Clean Water Act §404 or similar programs

<u>North Carolina Ecosystem Enhancement Program (EEP)</u>

Criteria:

Geographic Region: Southeast

<u>Use of repeatable, scientific approach for selecting mitigation sites and establishing conservation goals:</u> EEP invests in-lieu fee payments based on basin-wide wetland and

riparian restoration plans for each river basin. These plans identify degraded wetlands and streams in each HUC-8 and prioritize potential compensation sites based on how well they can serve as restoration sites to enhance functions of the entire HUC-8; within each HUC-8, EEP also prioritizes restoration projects in high-need, Targeted Local Watersheds (HUC-14). EEP also conducts Local Watershed Plans in areas where the NC Department of Transportation (DOT) projects future impacts in order to better inform the selection of mitigation sites in those areas. Under EEP's new instrument, by 2015 the program is aiming to replace anticipated NC DOT impacts two years before permits are issued.

<u>Use of biophysical outcome measures:</u> NC DWQ, with support from RTI International, recently released a report assessing regulatory success rates of stream and wetland mitigation projects across the state. DWQ reviewed monitoring files and conducted site visits to evaluate a site's regulatory success. The report separately assessed wetland and stream compensation compliance under EEP's design-bid-build and full-delivery programs, along with the performance of other mitigation providers in the state (mitigation banks, private PRM, NC Department of Transportation PRM). While performance criteria determining regulatory success are generally tied to a site's ecological performance, the ecological metrics used by DWQ to assess different sites are by no means uniform.

BenDor et al. (2009) conducted a study of the landscape-scale effects of stream and wetland mitigation conducted by the EEP by pairing the EEP and Wilmington Corps district's permitting databases. EEP subsequently disputed the results of this study and conducted an in-house analysis demonstrating different spatial transfers of wetlands and streams across the landscape due to ILF program (see articles by Klimek 2010, BenDor and Doyle 2010).

<u>Use of measures to characterize costs:</u> Templeton et al. (2008) provides a very detailed analysis of the different components of credit costs for EEP-solicited design-bid-build stream mitigation projects, breaking down expenses by "project administration, acquisition of property rights, pre-construction engineering, construction management, construction, monitoring, maintenance, and perpetual stewardship." Templeton et al.'s analysis also investigates economies-of-scale in stream mitigation and the influence of urban setting on compensation costs. Venner (2010) and Anderson (2005) also discuss the overall cost- and time-savings captured by the state of North Carolina through use of the EEP. Finally, though not directly evaluating costs of compensatory mitigation, in 2007 RTI completed a detailed assessment of prices and cost-effectiveness for nutrient offsets managed by EEP.

EEP provides a fee schedule for compensatory mitigation credits for riparian buffers, streams, non-riparian wetlands, riparian wetlands, and coastal wetlands on its website. HUC-8s with higher wetland or stream mitigation costs are assigned a different fee schedule. EEP's website also contains publicly-accessible databases recording credits sold by its ILF program and nutrient offsets program. EEP's annual reports also provide general information on the program's financial status.

Use of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing: Our research revealed no studies documenting the value of ecosystem services or the socioeconomic effects of aquatic resource compensatory mitigation due to EEP. However, there may be a study of the socioeconomic effects of the EEP available through the Department of City and Regional Planning at UNC-Chapel Hill that was performed by a master's student using the disputed dataset from BenDor et al. 2009.

Sources:

Anderson, M. 2005. Enhancing wetlands and watersheds using wetland banking, land trusts, and preservation within transportation mitigation: An analysis of the North Carolina Ecosystem Enhancement Program. http://www.defenders.org/resources/publications/programs_and_policy/habitat_conservation/habitat_and_highways/reports/enhancing_wetlands_and_watersheds_using_wetlands_banking,_land_trusts,_and_preservation_within_transportation_mitigation.pdf

BenDor, T., J. Sholtes, and M.W. Doyle. 2009. *Landscape characteristics of a Stream and Wetland Mitigation Banking Program.* http://www.unc.edu/~bendor/nwn/bendor_doyle_ecoapps_appendices.pdf

BenDor, T. and M.W. Doyle. 2010. *The authors respond.* http://wetlandsnewsletter.org/pdf/32.04/32.4.pdf#page=16

Hill, T., E. Kulz, B. Munoz, and J. Dorney. 2010. *Compensatory stream and wetland mitigation in North Carolina: An evaluation of regulatory success.* http://portal.ncdenr.org/c/document_library/get_file?uuid=a431d714-f531-40ed-b3f5-86a6cbba4e34&groupId=38364

Klimek, S. 2010. *Deficiencies Documented in Spatial Analysis of the Ecosystem Enhancement Program.* http://wetlandsnewsletter.org/pdf/32.04/32.4.pdf#page=18

North Carolina Department of Environment and Natural Resources. North Carolina Department of Environment and Natural Resources' Ecosystem Enhancement Program In-Lieu Fee Instrument. http://www.nceep.net/pages/pdfs/interim_final_instrument_8_2_10.pdf

NC Ecosystem Enhancement Program. 2009. *EEP's 2008-08 Annual Report: A New Concept.* http://www.nceep.net/news/annualreport/2009/EEP-annual-report(2009)_web.pdf

NC Ecosystem Enhancement Program. 2010. EEP Resources (see EEP In-Lieu Fee Program Payment Data). http://www.nceep.net/pages/resources.htm#payment

NC Ecosystem Enhancement Program. 2010. EEP Schedule of Fees. http://www.nceep.net/pages/fee.htm

RTI International and Center for Watershed Protection. 2007. A Study of the Costs Associated with Providing Nutrient Controls that are Adequate to Offset Point Source and Nonpoint Source Discharges of Nitrogen and Other Nutrients. http://www.nceep.net/pages/Final_RTI_Report_Nutrient_Offset_June_2007.pdf.

Templeton, S.R., C.F. Dumas, W.T. Sessions, and M. Victoria. 2008. *Estimation and Analysis of Expenses of Design-Bid-Build Projects for Stream Mitigation in North Carolina.* http://econpapers.repec.org/paper/agsaaea09/49552.htm

Venner, M. 2010. The Case for an Ecosystem Approach to Transportation Decision Making: A More Effective and Efficient Environmental Review & Permitting Process. http://shrpc06.com/index.php?option=com_content&view=article&id=1&Itemid=1&dir=%2Fhome%2Fbvenner%2Fshrpc06.com%2Fpublic%2Fjoomla%2Fjsmallfib_top%2Fshrpc06%2FAgency+Cases+for+Ecosystem%2C+Watershed%2C+and+Strategic+Habitat+Conservation+Approaches&download_file=%2Fhome%2Fbvenner%2Fshrpc06.com%2Fpublic%2Fjoomla%2Fjsmallfib_top%2Fshrpc06%2FAgency+Cases+for+Ecosystem%2C+Watershed%2C+and+Strategic+Habitat+Conservation+Approaches%2FBusiness+Case_FHWA+and+State+DOTs_Final.doc

Maryland Watershed Resources Registry and the Integrated Approach to Transportation Project Mitigation and Stewardship

Criteria:

Geographic Region: Southwestern Maryland (for both studies)

Use of repeatable, scientific approach for selecting mitigation sites and establishing conservation goals: The Watershed Resources Registry (WFF) is a geographic information system based mapping tool designed to support the development of a watershed profile by integrating information from various stakeholder including federal and state agencies, NGOs and others. The result is a system that can easily identify priority resources and resource goals including water quality, habitat, storm water management, land management, existing watershed plans, etc. By integrating information from multiple resource agencies and NGOs into one system WRR supports the identification of high priority resources for mitigation and the development of conservation goals utilizing a standard, scientifically based and repeatable process that is encapsulated in the WRR . The information includes information on resource type and/or quality, providing quantitative and qualitative descriptions of land cover, land use, soil types, wetlands, streams, forest hubs and corridors, endangered species, critical birding habitat, etc._– providing information on the health and needs of the watershed. Utilizing the information in the WRR, local scientific experts and conservation professionals document recommended actions in the watershed profile that support conservation goals in the watershed. The WRR maps those areas in the watershed that would benefit from the actions identified in the watershed profile. The WRR creates eight ecological maps using logical and arithmetic processes that include opportunities for: 1) wetland preservation, 2) wetland restoration, 3) wetland enhancement, 4) riparian zone preservation, 5) riparian zone restoration, 6) upland preservation, 7) upload reforestation, and 8) stormwater management. The maps show areas that scored high for each opportunity type. WRR utilizes widely available and accepted datasets like USGS watershed layers, NRCS soils data, and §303(d)-listed impaired streams as well as locally developed priority areas. The WRR can easily identify areas that can provide multiple benefits if targeted for mitigation.

Prior to the development of the WRR, the Conservation Fund worked with federal and state agencies in a very in-depth environmental data integration and assessment process – including species and ecological communities. It appears that the data analyses results and the data itself was integrated into the WRR and likely made the tool much more effective.

Use of biophysical outcome measures: Although the WRR case study did not mention performance measures, and only recommended that monitoring protocols be developed, the standard, scientifically based evaluation and method of selecting mitigation sites included specific factors and site-specific goals that could be translated into measures for monitoring the success of these goals in the areas selected for mitigation.

<u>Use of measures to characterize costs</u>: In addition to overlaying many datasets in order to 'score' sites that could be targeted for restoration or preservation efforts, they developed a benefit-cost optimization tool to help identify parcels that would bring the most conservation benefit with the least amount of monetary investment. The ecological metrics were used to create an overall parcel conservation score, which was then compared with land costs to choose conservation sites under hypothetical budget scenarios of $15 million and $5 million. The model run with a $15 million limitation was compared with a rank-based prioritization method, with the benefit-cost optimizer resulting in 15% more green infrastructure area and a 7% higher net ecological score. Under the $5 million budget scenario, the optimizer resulted in a 14% higher overall ecological score as compared with a ranking method, although it did result in 28% less green infrastructure area due to the enhanced ecological value of the selected parcels. Unfortunately, Weber and Allen's empirical model results were limited to conservation prioritization and did not extend to restoration, though the framework is established for such analysis by comparing restoration potential with cost (Weber and Allen 2010).

<u>Use of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing</u>: The WRR case study did not address social values. But using the type of data found in the WRR (like stream restoration and water quality) in combination with data on the proximity of these selected sites to communities and the effect on property values for example could be used to demonstrate social value or wellbeing.

<u>Sources:</u>

Bryson, E., Spagnolo, R., Hoffman, M., and Seib, W., (2010). "Achieving Ecosystem Health Using a Watershed Approach: The Watershed Resources Registry Pilot Project in Southwestern Maryland," National Wetlands Newsletter, Vol. 32, No. 3, pp. 8-11.

Weber, Theodore C. and Allen, William L. 2010. Beyond on-site mitigation: An integrated, multi-scale approach to environmental mitigation and stewardship for transportation projects. Landscape and Urban Planning, Vol. 96, pp. 240-256.

National Cooperative Highway Research Program (NCHRP) Project 25-25, Task 67. October 2010. Optimizing Conservation and Improving Mitigation Cost/Benefit: Task 1: Literature Review and Interviews

Michigan watershed-scale aquatic resource mitigation planning

Criteria:

Geographic Region: Michigan

Use of repeatable, scientific approach for selecting mitigation sites and establishing conservation goals: MDOT initiated use of a geospatial site selection tool for strategic identification of ideal compensation areas – called the Wetland Mitigation Site Suitability Index (WMSSI). This wetland mitigation tool allowed MDOT to analyze watershed trends in aquatic resources and subsequently rank possible mitigation sites by restoration potential; projected restoration value was measured based on hydric soils, historic wetlands, and topographic wetness data. The tool calculates composite suitability rankings by determining the weighted geometric mean of the environmental variables. Higher index values indicate more suitable locations. This technique builds on methods published by Van Lonkhuyzen (2004) and on the USFWS Habitat Evaluation Procedure (1981). The result of the WMSSI tool analyses in combination with a property selection tool integrates MDOTs methodology for acquiring real estate for mitigation sites with locations identified by WMSSI. The property selection tool includes criteria like size of parcel, adjacency to roads, existing wetlands and MI Dept of Natural Resource lands.

Use of biophysical outcome measures: N/A

Use of measures to characterize costs: Under a project-by-project mitigation strategy, MDOT reported that staff commonly accompanied regulators on at least 4-5 site visits to determine the ecological suitability of potential restoration sites; now, MDOT's progressive approach to mitigation prevents consideration of less promising compensation sites and MDOT receives approval for around 95% of mitigation sites on their first site visit (Venner 2010a). Over the past decade, Michigan DOT (MDOT) has transitioned from a traditional, project-by-project approach to aquatic resource compensatory mitigation, which coupled timelines and funds for wetland mitigation with individual transportation projects, to a watershed approach that separated compensation and transportation project funding. Allowing holistic consideration of wetland mitigation has permitted MDOT to achieve economies of scale via off-site, consolidated wetland mitigation sites, reducing per-acre compensation costs from typically exceeding $100,000, and generally falling between $75,000 and $150,000, to a present-day average cost of $25,000-$30,000 per acre (Venner 2010a).

Use of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing: N/A

Sources:

Venner, M. 2010a. The Case for an Ecosystem Approach to Transportation Decision Making: A More Effective and Efficient Environmental Review & Permitting Process. Webpage. <<http://shrpc06.com/>>.

Brooks, C., Powell, R. and Shuchman, R. Wetland Impacts – MTRI Wetland Mitigation Site Selection Synthesis Report, National Consortium for Remote Sensing in Transportation.

Endangered Species Act §7 or similar programs

California's Regional Advanced Mitigation Planning (RAMP) initiative

Criteria:

Geographic Region: California

Use of repeatable, scientific approach for selecting mitigation sites and establishing conservation goals: An example of providing compensation prior to impacts is the Regional Advance Mitigation Planning (RAMP) effort in California (Thorne et al 2009). This innovative effort estimated potential future impacts to resources by developing a "footprint" of future projects, using that to identify resources that may be impacted, and then developing a method for identifying sites that could offset these particular impacts in a way that contributes to regional and statewide conservation priorities. This framework was tested in a subregion of the Central Valley near Sacramento, California. Once a list of the species and habitat types that would potentially be impacted in the region was identified, the locations of these species and habitats were mapped across the region and overlaid with many other data layers including ownership, land cover, species habitat, minimum size of habitat, priority conservation areas, etc. to evaluate each parcel's contribution to restoring potentially impacted ecological components. MARXAN was used to evaluate each parcel and identify the ones with the most potential for high quality compensatory mitigation. Some of the resources that were identified for compensatory mitigation included vernal pool complexes, Giant Garter Snakes, and Burrowing Owls. Although this type of "systematic planning of ecological offsets" has been demonstrated in other publications (Kiesecker et al. 2009), this project illustrated an effective process that "integrated the mitigation needs of more than one infrastructure agency."

Use of biophysical outcome measures: n/a

Use of measures to characterize costs: n/a

Use of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing: n/a

Sources:

Venner, M. 2010g. California Statewide Advance Mitigation Initiative (SAMI) and Regional Advance Mitigation Planning. Webpage. <<http://shrpc06.com/>>.

Thorne, J.H., P.R. Huber, E.H. Girvetz, J. Quinn, and M.C. McCoy. 2009. Integration of Regional Mitigation Assessment and Conservation Planning. *Ecology Letters* 14(1): 47-66.

Clean Water Act & Endangered Species Act

Overlapping Programs in Willamette Basin, OR: Willamette Basin Partnership, Natural Capital Project, Oregon State INR Willamette Basin Conservation Project

Criteria:

Geographic Region: Pacific Northwest

Use of repeatable, scientific approach for selecting mitigation sites and establishing conservation goals: The General Crediting Protocol for the Willamette Basin Partnership references priority areas for ecological improvements to salmonoid habitat, prairie habitat, wetland habitat, and water temperature impairments. The Partnership identifies priority rivers and streams for improved salmon habitat based on NMFS data, priorities for investment in prairie habitat and thermal pollution mitigation based on the Willamette Basin Synthesis Map, and priorities for wetland mitigation based on the Synthesis Map or areas with surrounded by high-function wetlands as determined by ORWAP. The Synthesis Map was produced by a mix of conservation groups, academics, and government agencies, including Oregon State University and the Willamette Partnership, to identify priority terrestrial and freshwater sites for conservation and restoration. Important for CWA mitigation, the Synthesis Map integrates priority wetland sites for conservation and restoration developed by the Wetlands Conservancy. The Partnership also cites the Oregon Department of State Lands' mitigation guidelines to aid site selection for compensatory mitigation.

Use of biophysical outcome measures: Our research identified no studies assessing the biophysical outcomes of particular mitigation site selection methodologies in the Willamette Basin.

However, perhaps the primary emphasis of the Willamette Basin Partnership is developing scientifically valid ecosystem service accounting protocols that can measure and register the functions and values associated with improvements and impacts to unbundled ecosystem services. The Partnership is currently developing credit/debit protocols for wetland habitat, prairie habitat, salmanoid habitat, nitrogen and phosphorus loadings, and thermal pollution offsets. Approved site assessment metrics include Counting on the Environment's Salmon Credit Calculation Method, Counting on the Environment's Prairie Credit Calculation Method, the Oregon Wetland Assessment Protocol (ORWAP), and the Shade-a-Lator (for water temperature); all of these measures are conducive, and within the framework of the Partnership, intended to be used for ecosystem services valuation.

Furthermore, the Natural Capital Project's recent papers (Nelson et al. 2009; Tallis and Polasky 2009) evaluating ecosystem service values in the Willamette Basin first must address the biophysical functions present in the basin before assessing their social value.

Use of measures to characterize costs: N/A

Use of repeatable, scientific approach for relating biophysical outcomes to social value or wellbeing: A recent paper by researchers in the Natural Capital project (Nelson et al. 2009) presents one of the first published applications of a spatially explicitly modeling tool for ecosystem services valuation; the paper uses the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) to assign monetary values to ecosystem services in the Willamette Basin. While the paper does not model the economic value of ecosystem services associated with a particular compensatory mitigation program, the researchers modeled three stakeholder-defined scenarios of land cover change in InVEST, one of which was a "conservation" scenario. A second paper published by Natural Capital further expounds how use of modeling tools such as InVEST can inform natural resource management (Tallis and Polasky 2009).

Sources:

The Nature Conservancy. Willamette Valley Synthesis Map.
http://www.dfw.state.or.us/conservationstrategy/docs/532_BellWVrefmap.pdf

Nelson, E., G. Mendoza, J. Regetz, S. Polasky, H. Tallis, D.R. Cameron, K.M. Chan, G.C. Daily, J. Goldstein, P.M. Kareiva, E. Lonsdorf, R. Naidoo, T.H. Ricketts, and M.R. Shaw. 2009. *Modeling multiple ecosystem services, biodiversity conservation, commodity production, and tradeoffs at landscape scales.*
http://www.regionalpartnerships.umn.edu/public/Nelson%20et%20al.09.Modeling%20Eco%20Srvices.pdf

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