

SHRP 2 Capacity Project C06

Integrated Ecological Framework Outreach Project

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TRANSPORTATION RESEARCH BOARD

Washington, D.C.

2014

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ACKNOWLEDGMENT

This work was sponsored by the Federal Highway Administration in cooperation with the American Association of State Highway and Transportation Officials. It was conducted in the second Strategic Highway Research Program, which is administered by the Transportation Research Board of the National Academies.

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Co6 Integrated Ecological Framework Outreach Project Final Report

September 2013

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Lisa Gaines
Shara Howie
Jimmy Kagan

Prepared by

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Created by the Oregon Legislature through the 2001 Oregon Sustainability Act, the Institute for Natural Resources' mission is to provide access to integrated knowledge and information to inform natural resource decision making and develop solutions in the context of sustainability.

The Institute for Natural Resources is an Oregon University System institute located at Oregon State University and Portland State University.

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Research leading to the Integrated Ecological Framework (IEF) was funded by the Transportation Research Board's second Strategic Highway Research Program.

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Executive Summary

Funded through the second Strategic Highway Research Program (SHRP 2) of the Transportation Research Board (TRB), the Integrated Ecological Framework (IEF) was developed as a technical guide to provide a step-by-step process for implementing the *Eco-Logical* approach (see Figure ES.1). It is the key product of the SHRP 2 C06 project, Integrating Ecological Mitigation to Enhance Efficiency. This C06 IEF Outreach Project Final Report documents outreach activities in support of all the C06 projects and the C21 pilot projects. Chapters 1 and 2 provide background information; the discussion of outreach support activities begins in Chapter 3.

The IEF, which supports transportation planners and natural resource specialists, uses a standardized, science-based approach to identify ecological priorities and integrate them into transportation and infrastructure decision making. The IEF draws on well-established and innovative approaches to conservation assessment and planning. It is also informed by efforts currently under way at federal and state natural resource and transportation agencies to address known organizational, process, and policy challenges related to accelerating project delivery while still achieving net environmental benefits. The success of the IEF depends on transportation and natural resource agencies working together to use not only cutting-edge science, tools, and current data, but also their respective expertise in transportation and conservation analyses and implementation.

The IEF is primarily intended to support mid- to long-range transportation and infrastructure planning rather than individual project assessment and design. However, by proactively addressing information needs at the regional scale, the IEF supports better project level design, construction, and maintenance. The IEF products lay the foundation for implementing a watershed approach to Sections 301, 303, 401, and, most often, 404 of the Clean Water Act. They also lay the foundation for an ecosystem-scale

The IEF provides science- and data-driven technical guidance to ensure that ecological considerations are integrated early in the transportation process.

approach to conservation and consultation under the Endangered Species Act, Section 7. Federal agencies have defined these approaches as strategic habitat conservation or landscape- and watershed-based approaches. Such ecosystem approaches aim to deliver the greatest benefits under existing

laws and regulations supporting aquatic resource restoration, species and habitat recovery, and greater landscape-scale resilience.



Figure ES.1. Representation of IEF steps.

Presentations, Workshops, and Conferences

Numerous conference presentations and briefs were conducted with federal and state regulatory agencies, departments of transportation (DOTs), and metropolitan planning organizations (MPOs), both to obtain review of the products and to provide outreach to the transportation and agency planning community.

TRB SHRP2 C06B: Development of an Ecological Assessment Process and Credit System for Enhancements to Highway Capacity

Objective
Develop a reliable ecological assessment method and framework for transportation planning that takes physical environments and existing facility conditions into account.

Overview
The project research resulted in the development of a framework, Integrated Ecological Framework (IEF), and a credit system, Ecological Credit System (ECS), for use in transportation planning. The IEF is designed to support and guide regional transportation and conservation planning for existing transportation projects.

Key Findings
Using the IEF, the Framework, state transportation agencies (DOTs) and regional planning organizations (RPOs) and local agencies can together develop strategic planning to identify strategic transportation projects that provide environmental impacts and conservation opportunities. The data analysis is completed.

Framework
The Framework allows transportation leaders to use the Framework to identify potential strategic projects that provide environmental benefits. It is a comprehensive, dynamic process that addresses the integration of regulatory and transportation activities and empowers the opportunity to achieve ecosystem health.

Through the integration of regulatory agencies and transportation activities, the Framework can improve resource planning, efficiency and reduce redundancy. This section details the Framework.

Key Steps (IEF Framework)

Step	Purpose
Step 1: Build and strengthen an integrated planning process that integrates transportation and transportation planning.	Build a strong working group of stakeholders to work as a cohesive and integrated planning process that integrates transportation and transportation planning.
Step 2: Develop a baseline ecological assessment process and data system, with input from local agencies, state agencies, and transportation planning organizations.	Develop an initial ecological assessment that integrates transportation and transportation planning, with input from local agencies, state agencies, and transportation planning organizations.
Step 3: Develop a regional transportation and conservation strategy, with input from local agencies, state agencies, and transportation planning organizations.	Develop a regional transportation and conservation strategy, with input from local agencies, state agencies, and transportation planning organizations.
Step 4: Identify and prioritize transportation projects that provide environmental benefits and conservation opportunities.	Identify, prioritize, and evaluate transportation projects that provide environmental benefits and conservation opportunities.
Step 5: Develop a credit system for transportation projects that provide environmental benefits and conservation opportunities.	Develop a credit system for transportation projects that provide environmental benefits and conservation opportunities.
Step 6: Develop a credit system for transportation projects that provide environmental benefits and conservation opportunities.	Develop a credit system for transportation projects that provide environmental benefits and conservation opportunities.
Step 7: Develop a credit system for transportation projects that provide environmental benefits and conservation opportunities.	Develop a credit system for transportation projects that provide environmental benefits and conservation opportunities.
Step 8: Develop a credit system for transportation projects that provide environmental benefits and conservation opportunities.	Develop a credit system for transportation projects that provide environmental benefits and conservation opportunities.
Step 9: Develop a credit system for transportation projects that provide environmental benefits and conservation opportunities.	Develop a credit system for transportation projects that provide environmental benefits and conservation opportunities.

Key Findings
The IEF provides a framework for the collection and management of data, including the collection, management, and use of data for the IEF. The IEF provides a framework for the collection and management of data, including the collection, management, and use of data for the IEF.

TRB SHRP 2 C06B annual meeting – Portland, Oregon (2010)

C06 Symposium – Boulder, Colorado (2010)

Agency webinars – U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, DOTs and MPOs, U.S. Fish and Wildlife Service (2011)

C06B Multi-Agency Summit – Washington, D.C. (2011)

International Conference on Ecology and Transportation (ICOET) – (2011, 2013)

Transportation Research Board annual meetings – Washington, D.C. (2011, 2012)

Transportation Research Board summer meetings – multiple locations (2011, 2012)

C21 IEF Pilot Project Peer Exchange – Washington, D.C. (2011)

- American Society of Wetland Managers meeting – Shepherdstown, West Virginia (2011, 2012)
- FHWA Preimplementation All-Hands meeting – Washington, D.C. (2011)
- C21 IEF Pilot Project Wrap-Up meeting – Washington, D.C. (2012)
- American Association of State Highway and Transportation Officials’ Standing Committee on the Environments (SCOE) meetings – multiple locations (2011, 2012)
- TRB Performance Measures Committee meeting – San Diego, California (2012)
- MPO-Level and Local Outreach – St. Louis, Missouri (2012)
- NatureServe Biodiversity without Boundaries Conference – (2011, 2012, and 2013)
- Implementation Planning Workshop for SHRP 2 Project C06 – Washington, D.C. (2012)
- American Society of Wetland Managers state–tribal–federal coordination workshop (2013)
- Institute of Transportation Engineers Technical Conference and Exhibit – San Diego, California (2013)
- Eco-Logical Webinar Series: Developing a Crediting Strategy (2013)

Technical Assistance and Implementation



SHRP 2 funded four pilot projects in California, Colorado, Oregon, and West Virginia to test the frameworks and recommendations documented in *An Ecological Approach to Integrating Conservation and Highway Planning, Volumes 1 and 2*. The C06 project team provided technical assistance to the pilot projects.

SHRP 2 C40A and C40B Technical Expert Task Group helped develop the requests for proposals to integrate national-level geospatial, ecological tools and data and to conduct a proof-of-concept of applying geospatial, ecological tools and data in the planning and programming (pre-National Environmental Policy Act of 1969 [NEPA]) phases of delivering new highway capacity.

Technical assistance was provided to the Pikes Peak Council of Government (Colorado) to use the IEF.

Publications, Reports, and other Documents



Practitioner’s Guide to the Integrated Ecological Framework (2014)

Manager’s Guide to the Integrated Ecological Framework (2014)

Ecosystem Services and Transportation (2013)

SHRP 2 Solutions Fact Sheets (2012, 2013)

Implementation Plan: Implementing Eco-Logical (2012)

Preliminary Survey of Tools and Protocols That Support an Ecosystem Approach to Decision Making (2012)

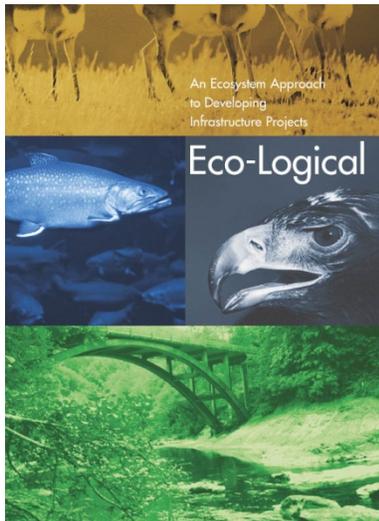
SHRP 2 C41: TCAPP and IEF Pilot Projects: Synthesis of Lessons Learned (2013)

An Ecological Approach to Integrating Conservation and Highway Planning, Volume 2 (2012)

National Wetlands Newsletter: Getting Out Front on Wetland Conservation Planning (Vol. 35, Issue 3, 2013, p. 5)

TR News Magazine: The Integrated Ecological Framework: A Step-by-Step Approach for Integrating Transportation and Conservation Planning for Improved Outcomes (2013)

Outcomes



The Federal Highway Administration (FHWA) and the Association of American State Highway and Transportation Officials (AASHTO) selected the C06B work as one of six projects that they will promote for national implementation. FHWA issued a request for proposal (RFP) for approximately \$1.5 million for up to six state DOTs (up to \$250,000 each) to implement the IEF, as well as funds to other programs to do IEF-related projects. AASHTO provided funds for programs and trainings to implement the IEF and webinars, meetings, and presentations to promote the IEF.

SHRP 2 funded contracts valued at \$1 million that support moving the IEF and *Eco-Logical* forward: SHRP 2 C40A – Integration of National-Level Geospatial, Ecological Tools and Data; SHRP 2 C40B – Proof-of-Concept: Application of Geospatial, Ecological Tools and Data in the Planning and Programming (pre-NEPA) Phases of Delivering New Highway Capacity; SHRP 2 C41 – TCAPP (Transportation for Communities: Advancing Projects through Partnerships) and Integrated Ecological Framework Pilot Projects: Synthesis of Lessons Learned; and SHRP 2 C55 – Capacity Implementation Support.

Task Order RFP, SHRP 2 C06B, Step 6 (Crediting System Implementation) was issued under Transportation Environment & Reality ID/IQ Contracts, Task Area A (Wetlands Wildlife Habitat and Other Ecological Resources).

Identification of states already implementing some aspect of the IEF included Arizona, California, Colorado, Florida, Maryland, Massachusetts, Minnesota, Montana, New York, North Carolina, Oregon, Pennsylvania, Virginia, and Washington.

Chapter 1 Introduction

Broader-scale and programmatic approaches to avoidance, minimization, and mitigation coupled with analysis and decision making in planning offer significant efficiencies in the regulatory process and associated time savings for transportation agencies. The Federal Highway Administration's (FHWA's) document *Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects* (Brown 2006) provides a conceptual groundwork for integrated conservation plans and mitigation activities that transcend individual agency jurisdictional boundaries and encourage an outcome-based ecosystem approach to conservation.

However, *Eco-Logical* stops short of providing the tools to implement the principles. To provide the tools needed to implement the *Eco-Logical* approach, the second Strategic Highway Research Program (SHRP 2) of the Transportation Research Board (TRB) of the National Academy of Sciences funded the Oregon State University Institute for Natural Resources and its national partners (the C06B team) and the C06A team to develop an ecological assessment process and framework to integrate conservation planning and transportation planning. The C06B project report was approved by TRB and published as *An Ecological Approach to Integrating Conservation and Highway Planning, Volume 2* (Institute for Natural Resources et al. 2012).

The primary objectives of the C06 projects were to

- Create an ecological framework for making environmental decisions about transportation capacity enhancements;
- Solve the problem of assurances so that agencies that invest in ecological-level action to minimize or mitigate impacts or restore resources to the ecosystem can be assured that they get credit for their actions with regulatory agencies and the public;
- Develop business cases for state departments of transportation (DOTs), metropolitan planning organizations (MPOs), and each major environmental regulatory agency for the *Eco-Logical* approach to environmental stewardship; and
- Create ecological assessment method(s) for highway capacity enhancements that support the ecological framework and business models.

The C06 projects resulted in the nine-step Integrated Ecological Framework (IEF) that

- Takes into account the barriers transportation agencies experience when working to implement ecological approaches to transportation planning and the scientific and technical processes needed to implement ecological approaches;
- Brings together a variety of well-tested methods, data, and tools into a cohesive ecological assessment framework;
- Takes into account regulatory assurances for resources regulated under the Clean Water Act (CWA) and the Endangered Species Act (ESA); and
- Provides guidance about how transportation agencies could develop and use ecosystem crediting systems and markets.

For each step in the IEF, critical data needs and tools that could greatly facilitate implementation of the framework were identified.

In September 2010 the C06 teams organized an invitational symposium (Appendix A) in Boulder, Colorado, to present the teams' research results and discuss next steps. Fifty-five local, state, and federal transportation agency and resource agency officials experienced in integrated transportation and conservation planning attended the symposium. The symposium produced more than 50 ideas for next steps that could be taken to implement the C06 research. It was clear that a first step must be to disseminate results into the many practitioner communities involved in associations with the regulatory agencies having jurisdiction. It was also clear that technical assistance and guidance needed to be provided to groups piloting the C06 products.

This report documents two activities in support of SHRP 2 C06 projects: technical assistance to the pilot tests of Project C06 results and the outreach activities subsequently requested by SHRP 2. Chapters 1 and 2 provide background information; the discussion of outreach support activities begins in Chapter 3.

Chapter 2 About IEF

Overview

There is compelling evidence that integrating landscape-scale ecological needs early in transportation and infrastructure planning processes can achieve significant ecosystem, economic, and societal benefits. Many efforts are under way across the United States that promote and use these landscape-scale ecological needs as part of a more integrated and collaborative approach to transportation and infrastructure planning and project development. These efforts are demonstrating that through early collaboration and proactive identification and response to resource needs, transportation and resource agencies, as well as local and regional governments, can more purposefully avoid and minimize impacts, restore watersheds, and recover species. Prior to these recent efforts, many opportunities to avoid, minimize, and contribute to environmental priorities were missed. Regulatory decisions did not require interagency involvement, short-staffed agencies were hard-pressed to find time to provide input on the planning level, and a majority of transportation plans moved forward without considering ecological needs.

Transportation agencies face significant costs meeting environmental mitigation requirements. Over \$3.3 billion is spent annually on compensatory mitigation under the CWA and ESA (Environmental Law Institute 2007). Furthermore, environmental permitting can encompass 3% to 59% of road construction costs (Louis Berger & Associates, Inc. and BSC Group 1997). These transportation project costs represent one of the largest sources of funding for conservation action in the United States. The potential benefits from a more strategic application of these funds would therefore be enormous, supporting both conservation and streamlining and cost reduction for transportation improvements.

Realizing the high costs and lost opportunities, a team that represented nine federal agencies produced *Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects* (Brown 2006). The *Eco-Logical* approach recommends a collaborative, integrated, watershed- or ecosystem-scale approach to decision making during transportation and infrastructure planning, environmental review, and permitting that emphasizes using resources more effectively to enhance the environment, species viability, and watershed restoration.

The benefits of integrating ecosystem-scale natural resource or conservation planning and highway planning are widely recognized. As advances in computing capacity, data, and geographic information system (GIS) modeling have made it possible to facilitate better, more informed, and scientifically sound environmental planning, the need for practical and technical guidance on how to effectively implement these approaches became apparent. This guidance came through a SHRP 2–funded research project that resulted in the IEF.

The IEF is a peer-reviewed, nine-step technical framework that supports transportation–infrastructure planners and resource specialists in the use of a standardized, science-based approach to identify and integrate ecological priorities into transportation and infrastructure decision making. The IEF draws on both well-established and new approaches to conservation assessment and planning, as well as on existing efforts being led by federal and state natural resource and transportation–infrastructure agencies to address known organizational, process, and policy challenges related to accelerating project delivery while still achieving net environmental benefits.

Benefits of the IEF

- Supports more coordinated and consolidated administrative and decision-making processes that result in significant time and resource efficiencies for transportation–infrastructure and natural resource agencies.
- Creates a more efficient and predictable consultation and project development process by early identification of needs and solutions.
- Allows for a clearer understanding of landscape-scale considerations and opportunities, including landscape- and watershed-scale goals and priorities, and the potential for impact avoidance or minimization, restoration, and recovery.
- Directs resources for mitigation to ecosystem-scale conservation priorities.
- Provides transparent and measurable processes that can be duplicated, contributing to better accountability and the ability to measure success.
- Creates additional knowledge about priority conservation areas, thus driving incentives to develop programs and funding to conserve and restore these areas.

Primary IEF Products

- Regional maps of conservation and restoration priorities;
- Regional maps identifying affected resources and the quantification of the direct and cumulative impacts for each transportation scenario being considered;
- Identification and evaluation of potential mitigation and enhancement areas within a state or region;
- A dynamic database of regional resources, goals, gaps, and achievements; and
- A process for keeping these maps, databases, and agreements up-to-date.

Chapter 3 IEF Outreach

Scope of Work

With the completion of the research projects and the feedback from the September 2010 symposium, the next steps were outreach and technical assistance. Specific tasks were revised throughout the course of the IEF outreach project on the basis of the expanding partnership with FHWA.

Outreach

The purpose of the outreach component of the project was to engage key federal and state agencies in reviewing, refining, and promoting the IEF through presentations and dialogues at key conferences, as well as technical webinar presentations. Specific tasks included

- Working with an agency planning team to help with outreach workshop selection and workshop and webinar design and content.
- Coordinating, designing, conducting, and participating in a variety of outreach efforts and presentations (Appendix B) to introduce and highlight elements of the IEF to natural resource managers and regulators, MPOs and DOTs, and other interested parties.
- Organizing and conducting a series of four 60- to 90-minute agency-specific webinars (Appendix C) to prepare for the multiagency implementation planning workshop “Integration of Conservation Planning, Highway Planning, Environmental Review, and Permitting.”
- Participating in planning and conducting the multiagency implementation planning workshop “Integration of Conservation Planning, Highway Planning, Environmental Review, and Permitting” that was held in Washington, D.C., on November 1 and 2, 2011 (Appendix D).
- Conducting an initial tool scan by reaching out to key staff in federal and state agencies to characterize the tools and protocols agencies are involved in developing or supporting. The end goal was to characterize the similarities and differences between various ecological assessment and planning tools and frameworks that regulatory, conservation, and land use stakeholders could use now or (with some modifications) in the future to support their efforts in taking an *Eco-Logical* approach to decision making.
- Conducting other webinars, as needed.

- Modifying the current IEF into multiple and usable formats through an updated *Manager's Guide to the Integrated Ecological Framework*.

Technical Assistance

The purpose of the technical assistance component was to work with SHRP 2 staff to provide leadership and technical assistance to SHRP 2 C21 awardees (four pilot projects in California, Colorado, Oregon, and West Virginia) in using the IEF.

Specific tasks included

- Assisting in coordinating, hosting, and facilitating a 1½-day kickoff workshop and peer exchange in Washington, D.C., with the four pilot projects.
- Providing technical assistance to the pilot projects as needed and appropriate to budgetary constraints.
- Leading periodic check-in meetings with all the pilot project principal investigators to discuss progress using the IEF, share lessons learned, and work through implementation issues.
- Participating in Cambridge Systematics' synthesis meeting and the C21 final wrap-up meeting after the pilots were completed (both in April 2012).
- Coordinating and participating in conferences with the C21 project team for case study presentations about how the IEF was used, implications of its use, and how the C06 team and partners are modifying the IEF for improved use and effectiveness.
- Integrating C21 information into a modified IEF users' guide based on feedback from the pilots.

C21 Pilot Test Projects

Colorado State University

Environmental and transportation collaboration along I-285 corridor within Colorado DOT's District 1, a diverse region with hundreds of species at risk.

Rogue Valley Council of Governments

Testing the first three steps of the IEF with multiple stakeholder groups in southern Oregon.

University of California, Davis Road Ecology Center

Using the ecological approach during early stages of corridor planning for California SR-37; issues include sea level rise, an economically depressed community, and wetlands restoration along an active corridor.

West Virginia University Research Corporation

Applying the ecological approach and tools on several proposed major highway capacity projects where National Environmental Policy Act (NEPA) work has been done, but mitigation actions are being revisited.

Highlights of Project Activities

Activities 2010

C06 Symposium (Boulder, Colorado, September 2010). Led by the C06A and C06B teams, an invitational symposium was held in September 2010 to present the SHRP 2 C06 research to transportation and resource agency participants. Next steps for implementation were also discussed. Specific suggestions, which set the stage for the current outreach and technical assistance project's activities, were made to

SHRP 2 on how to implement the results of the C06 research projects. Suggestions included (but were not limited to)

- *Sharing the research results with key public officials.* Engage the American Association of State Highway and Transportation Officials (AASHTO) regarding streamlining project delivery and groups such as the Environmental Council of the States, Association of Fish and Wildlife Agencies, Western Governors' Association, and National Governors' Association.
- *Documenting the benefits of the approach.* Documentation should include the business case and should address time savings, cost savings, triple bottom line cobenefits and quality-of-life benefits, and improved conservation outcomes. Examples of success should be included. Opportunities for streamlining processes or programs should be demonstrated.
- *Requiring implementation.*
- *Funding more pilot projects* to illustrate how to implement the approach.
- *Providing interagency training.* Regional seminars and interagency training are needed to implement the approach beyond the *Eco-Logical* grants and customary technology transfer.
- *Producing a guidebook and website.*

Activities 2011

Transportation Research Board Annual Meeting (Washington, D.C., January 2011).

- 11-0958: *Ecological Assessment Process and Credit System for Highway Capacity Projects*
- P11-1053: *C06A Integration of Conservation, Highway Planning, and Environmental Permitting Using an Outcome-Based Ecosystem Approach*
- P11-1054: *C06B Development of an Ecological Assessment Process and Credits System for Enhancements to Highway Capacity*

SHRP 2 C21 Peer Exchange (Washington, D.C., March 17 and 18, 2011). The purpose of this workshop was to present overviews of the pilot test concepts; provide an overview of Transportation for Communities: Advancing Projects through Partnerships (TCAPP) and its philosophical basis and foundation; and meet with Oregon State University, ICF, FHWA, and TRB support staff to discuss technical issues, possible technical support needs, and questions.

International Conference on Transportation and the Environment (Seattle, Washington, August 21 to 25, 2011). Session SUS-4: Show Me the Money: Effective Mitigation and Costs of Impacts. *Comparing the*

Ecological and Economic Outcomes of Traditional vs. Programmatic, Multi-Resource Based Mitigation Approaches. Presented an update on the C06 project at the Ecology and Transportation Committee TRB Committee – ADC30 Business Meeting.

FHWA and SHRP 2 Preimplementation All-Hands Meeting (Washington, D.C., August 21 to September 2, 2011). The aim was to help coordinate the efforts of all who were working on different portions of the SHRP 2 C06 preimplementation, to provide additional transparency in the work being done on SHRP 2 preimplementation, and to begin to actively work toward the C06 summit meeting to be held in November.

Agency webinars (October 2011). The purpose of the webinars was to familiarize participants with efforts to operationalize ecosystem-scale decision-making processes and tools across the country during transportation planning and environmental review and permitting and to hear from webinar participants about what they thought was needed to be successful in achieving this goal. The results of these webinars guided the creation of draft implementation ideas that were developed and prioritized at the November 2011 workshop. During the webinar, C06 leaders provided background information on SHRP 2 research and products and *Eco-Logical*-related initiatives. The range of existing agency initiatives from across the country that supported the SHRP 2 research recommendations was summarized, and participants were asked to respond with questions, ideas, and recommendations based on their own agencies' initiatives to help the C06 team determine the questions that needed to be answered (from an agency perspective) to move to an ecosystem-scale approach to decision making; how these questions could be answered; and what tool functions could help the team visualize what would be needed. Webinars were conducted with representatives of the U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers, MPOs and DOTs, and the U.S. Fish and Wildlife Service (Appendix C).

Tool and protocols survey to inform *Eco-Logical* (October 27 to November 30, 2011). The C06 team distributed a brief survey to several agencies to document key information about specific tools or protocols that each agency was involved in developing or implementing within their agencies. The intent was to use this information as examples in the November 2011 workshop. The tools and protocols were selected because they were seen to support ecosystem-scale decision making, and therefore could be leveraged or expanded to help operationalize ecosystem-scale decision making across the country

during transportation planning and project delivery. A summary of the survey results were documented in an Excel spreadsheet and distributed at the November 2011 workshop.

Multi-Agency Workshop: Integration of Conservation Planning, Highway Planning, Environmental Review and Permitting (Alexandria, Virginia, November 1 and 2, 2011). The purpose of this workshop (Appendix D) was to identify implementation strategies that would enable agencies to operationalize the *Eco-Logical* approach to decision making in the context of the SHRP 2 C01 TCAPP Decision Guide and the IEF developed under SHRP 2 C06 projects. The anticipated product of the workshop was the identification of one or more high-priority implementation actions to be considered for SHRP 2 funding in 2012 to 2013 and other related activities that FHWA and partner agencies could support. The charge to the participants was to identify next steps to move from SHRP 2 research and pilot projects to implementation. Specific outcomes for the workshop were (1) a written proposal for funding to develop a system or effort that would further implement the *Eco-Logical* approach and the research products developed in SHRP 2 Projects C06 and C01 to be presented to the SHRP 2 Capacity Oversight Committee, and (2) a list of actions and strategies that FHWA and other agencies could take to implement *Eco-Logical* without additional SHRP 2 funding.

American Society of Wetland Managers Meeting (March 2011). Presentation and discussion about mitigation, with general information on the importance of developing a regional environmental framework to identify mitigation opportunities. There was also discussion on the utility of working with FHWA and state transportation agencies and the wetlands information needed to identify mitigation opportunities.

NatureServe Biodiversity Without Boundaries Conference (Nebraska City, Nebraska, May 2011). A presentation, *Integrating Conservation Data into Planning and Regulatory Decisions-Making*, highlighted C06 research to state and federal natural resource agencies attending the conference to get input and encourage local actions to support implementation.

Activities 2012

Transportation Research Board Annual Meeting (Washington, D.C., January 2012).

- SMP13-003: *SHRP 2 Capacity: Works in Progress and Emerging Products*. SHRP 2 Capacity addressed the triple bottom line of economic, social, and environmental concerns associated with adding highway capacity.
- P13-5055: *C06 A&B Implementation of an Ecological Approach to Integration of Conservation, Highway Planning, and Environmental Protection*.
- P12-5044: *C06 A&B An Ecological Approach to Integration of Conservation, Highway Planning, and Environmental Protection*.

American Society of Wetland Managers Meeting (Shepherdstown, West Virginia, March 2012).

- Presentation: *Innovations in Integrated Resource Mapping*.

C21 Wrap-up meeting (Washington, D.C., April 2012). *Joint Meeting of the Pilot Projects on Ecological Approaches to Integration of Conservation Planning, Highway Planning, and Environmental Review*. The meeting centered on the final presentations from the C21 pilots in California, Colorado, Oregon, and West Virginia; general recommendations based on the pilots' experiences testing parts of the IEF; and a roundtable discussion "Multi-Agency Path Forward—Maintaining the Momentum and Keeping the Communications Open."

TRB Performance Measures (ABC30) Committee Meeting (San Diego, California, April 2012).

In addition to discussing reauthorization challenges, this meeting considered themes that focused on the use and application of performance data by decision makers; how performance data can be better deployed and made accessible for decision making; and barriers that hamper performance data use by executives, such as too much or too little or even the wrong data.

Eco-Logical: Policy, Planning, and Tools to Support Sustainable Transportation, Land Use, and Resource Conservation (St. Louis, Missouri, April 2012). This conference was an MPO-level outreach effort via networking and two presentations:

- Presentation: *What We Can Do with Better Data: The Big Picture*.
- Session: *Using the Data: Case Studies from Other Communities*.

Joint Meeting of the Pilot Projects on Ecological Approaches to Integration of Conservation Planning, Highway Planning, and Environmental Review (Washington, D.C., April 2012). Participants in the four

pilot tests of the *Ecological Approaches to Integration of Conservation Planning, Highway Planning, and Environmental Review* project shared their experiences and outcomes and made recommendations to the C06 team about the IEF.

Biodiversity Without Boundaries (Portland, Oregon, April 2012).

- Workshop: *Establishing the Network of Natural Heritage Modeling and Mapping Centers.*
- Symposium: *Ecosystem Services Part 1. Panel on Ecosystem Services and Information Needs.*
- Presentation: *Demonstrating the Benefits of an Ecosystem-Scale Approach to Planning and Regulatory Processes.*



Transportation Research Board Summer Meeting (Little Rock, Arkansas, June 2012). The research workshop session focused on examining research topics review processes facilitated by FHWA, TRB, and AASHTO representatives. Speakers highlighted best practices for creating and proposing research topics and the decision-making processes used to select and carry out funded projects. The majority of the workshop was an interactive session in which participants identified research topics in the areas of environmental analysis, air quality, and ecology and transportation, and then began connecting these topics as cross-cutting research needs. Research topics included

- *Internal institutional change*: Transportation, the way business is done, regulatory agencies and incentives for change; how to build incentives; human behavior.
- *Incentives for change*: Demonstrating the costs and benefits of change (preimplementation); evaluating methods to examine the incidence of the cost and benefits of change; synthesis across disciplines; merger processes.
- *Collaborative governance*: How can decisions be made across entities? How is collaborative governance created? Who is in charge, and who makes decisions? Concept of cabinets (information sharing), but elevating to integrating plans.
- *Broad-scale indicators*: Speaking to people and telling a story of the status of the environment and transportation; tying to existing data, and how to modify that existing data; how to roll up

existing performance measures and other indices that have been (or are being) developed; integration across entities.

Panels presented the C21 and C18 pilots about the IEF and case studies of the pilots using the IEF and the TCAPP site.

SHRP 2 Joint Knowledge Transfer Workshop and Implementation Planning Workshop for SHRP 2 Capacity Project C06B: Integrated Ecosystem, Transportation Planning, and Mitigation Strategies (Washington, D.C., September 11 and 12, 2012). The goal of the workshop was to develop a product implementation plan and budget for C06B. To accomplish this goal, the workshop convened 30 representatives from transportation agencies, nonprofit organizations, and academia to

- Share information about research products from the C06B research team.
- Identify and define marketing and implementation strategies and tactics.
- Identify potential champions for this technology and early adopters of the product.
- Develop a near-term action plan and budget for the implementation of the product.
- Define demonstration projects, technical assistance, and other implementation activities.
- Define roles and responsibilities for implementation, including possible continuing roles for the workshop participants and others who should be involved in implementation activities.
- Develop product performance monitoring and reporting procedures.
- Discuss the need for some type of follow-up group to oversee and monitor demonstrations and implementation activities.

C06 Implementation Planning Workshop (Washington, D.C., September 2012). The C06B project was selected for early implementation attention by FHWA and AASHTO. The plan was approved in June 2012 by the SHRP 2 Oversight Committee. An implementation planning workshop was held with representatives of TRB, FHWA, AASHTO, federal and state regulatory agencies, MPOs, DOTs, and members of the C06 team to develop a national implementation strategy.

Activities 2013

Transportation Research Board Annual Meeting (Washington, D.C., January 2013).

- P13-5055: *C06 A&B Implementation of an Ecological Approach to Integration of Conservation, Highway Planning, and Environmental Protection.*

- P13-6267: *Testing the Integrated Ecological Framework in Colorado: Not Just Another Episode of South Park.*

Institute of Transportation Engineers (San Diego, California, March 2013).

- Session 17: SHRP 2 Capacity Products for Delivering Highway Planning Decisions: *Integrating Conservation, Planning, and Environmental Permitting into an Ecosystem Approach.*



American Society of Wetland Managers State, Tribal, and Federal Coordination

Meeting (Shepherdstown, West Virginia, March 19, 2013). *Setting Mitigation and*

Restoration Priorities: Planning Tools. This panel provided a transition from the

earlier discussions on challenges and problems to talking about tools that provide solutions.

Biodiversity Without Boundaries 2013 (Baltimore, Maryland, April 14 to 18, 2013).

- Presentation: *How an Ecosystem Approach to Decision Making Can Improve Environmental Outcomes.*
- Presentation: *Prioritizing Oregon Wetlands for Mitigation and Restoration.*

International Conference on Transportation and the Environment (Scottsdale, Arizona, August 2013).

- Presentation: *New Web Resources for Connectivity Practitioners.*

White Paper: Methods to Develop a Crediting Strategy for Transportation and Metropolitan Planning

Agencies (April 2013). One of the steps of the IEF is to develop a crediting strategy (Step 6) that is designed to take advantage of what was thought to have been the rapidly emerging development of crediting information and tools. The ecosystem services crediting methodology is the part of the IEF that needs the most additional development to make it easily usable and meaningful to transportation agencies. This white paper focuses on identifying the ways in which this development can be most effectively done (Appendix E).

Eco-Logical Webinar Series: Developing a Crediting Strategy (August 2013). Webinar attendees were presented findings and effective approaches from *Methods to Develop a Crediting Strategy for Transportation and Metropolitan Planning Agencies*, a white paper by the Institute for Natural Resources; examples of innovative crediting strategies, with a discussion of the actions and partnerships that contributed to the success of these strategies; and tools, protocols, and resources for agencies seeking to implement a crediting strategy.

Practitioner's Guide to the Integrated Ecological Framework (August 2013). This guide was designed to assist managers and decision makers who want to understand what is entailed in conducting a transportation–infrastructure planning process that involves the appropriate types of stakeholders, information, and expertise to ensure the best transportation–infrastructure and conservation outcomes possible. The guide moves the reader from what the IEF is to how to conduct it, provides a high-level description of the IEF steps and technical methods used, and provides practical considerations needed to accurately scope the work and assemble the technical and scientific teams and stakeholders.

Project Outcomes

Outreach Outcomes

- FHWA and AASHTO recently selected the C06 work as one of six projects they will promote for national implementation. FHWA made awards to state DOTs to implement the IEF, as well as to other DOTs and MPOs for smaller IEF-related projects.
- SHRP 2 funded four projects to support moving the IEF and *Eco-Logical* forward, including SHRP 2 C40A: Integration of National-Level Geospatial, Ecological Tools and Data, and SHRP 2 C40B: Proof-of-Concept: Application of Geospatial, Ecological Tools and Data in the Planning and Programming (pre-NEPA) Phases of Delivering New Highway Capacity.
- SHRP 2 allocated funds to integrate IEF lessons learned into the TCAPP (now called PlanWorks) system. Funding was provided under the SHRP 2 C41: TCAPP and Integrated Ecological Framework Pilot Projects: Synthesis of Lessons Learned project.
- Task Order Proposal Request, SHRP 2 C06B: Step 6: Crediting System Implementation, was issued under Transportation Environment and Reality ID/IQ Contracts, Task Area A (Wetlands Wildlife Habitat and Other Ecological Resources).

- States already implementing some aspect of the IEF include Oregon, Washington, California, Arizona, Montana, Florida, Virginia, North Carolina, Minnesota, New York, Massachusetts, Pennsylvania, Maryland, and Colorado.

Pikes Peak COG (Colorado) used the IEF in its implementation project, which resulted in the creation and adoption of the environmental option as the preferred plan.

Collaboration. The presentations made supported mutual understanding of the roles and benefits for natural resource and transportation agencies, and as a result support increased communication across state natural resource agency and local DOT and MPO contacts. In particular, presentations at the Biodiversity Without Boundaries conference helped local natural resource agencies understand how to integrate their data and expertise into planning rather than focusing on project-by-project environmental reviews.

Data. One of the primary outcomes was an identification of a number of deficiencies in the data and information available to DOTs and MPOs early in the planning process to better allow them to plan while avoiding sensitive or important areas. As a result of the project and continued outreach, significant progress has been made to help develop some of the most critical data sets across the country. A group of 14 NatureServe member programs working with NatureServe created a national network of modeling centers, a charter, and a plan to develop detailed, rangewide distribution maps for all federally listed species in the United States. Pilots are under way in Oregon, Virginia, New York, Wyoming, Florida, and Colorado to test the methodology and create rangewide models, working with the U.S. Fish and Wildlife Service and state ESA regulatory offices. In addition, the project spurred efforts in most of the states lacking a digital National Wetlands Inventory to get any available paper maps digitized, so that maps are now available for all parts of the nation except for parts of Idaho, Montana, and Utah, and very small areas in California, Arizona, and New York. The maps are being improved across the country, with many states including additional information to help agencies prioritize areas for mitigation and restoration.

Ecosystem services. Although the initial information in the IEF on creating an ecosystem services crediting program for DOTs and MPOs may have been insufficient to allow for many of these agencies to adopt a system, it has been a catalyst to spur additional research and work. The National Science Foundation provided funding to the University of Maryland to create the National Socio-Environmental

Synthesis Center with a focus on ecosystem service. This effort is leading to the creation of a number of teams to help remove the barriers related to measuring and valuing ecosystem services and to the creation of markets across the globe. The President's Council of Advisors on Science and Technology report on the nation's natural capital and biodiversity has also spurred research and federal interest in making progress in this area. Some states have begun work on mitigation methods that take advantage of new crediting tools and methods.

Technical Assistance Outcomes

The connections and interactions with the C06 team were an important part of the successful implementation of the C21 pilot projects, and the resulting feedback was important to the modifications of the IEF and its future implementation. Learning outcomes from the pilots included but were not limited to the following:

A structured approach is beneficial. The Rogue Valley team observed that “[i]t is very helpful that [the IEF] . . . is laid out in a logical way.” The frustration was that the process does not move fast enough. The TCAPP–IEF approach has been useful in “breaking down compartmental walls and looking at data sets as part of a system for use in consideration in transportation planning.” The California team reported that the ecological approach had been supported in theory, but not fully implemented. The steps make it much easier, although it was noted that they do not typically happen in the order in which they are presented in the IEF, and that it is possible for benefits to come from implementing only certain steps depending on the local context. In California there was a desire to use the IEF and TCAPP structure to develop a model process at the state level. This state-level process was considered the missing piece. West Virginia was building support from the U.S. Army Corps of Engineers as they went through the steps.

Better support and guidance are needed for local implementation. Step 3 of the IEF was key to leading to better outcomes in Colorado by enabling another look at transportation project impacts and pulling things together. However, because the information in TCAPP–IEF is complicated and difficult, it presents a barrier for the agencies as they have limited resources to keep up with current work. In addition, the California team pointed out that the optional nature of the IEF and TCAPP approach makes it difficult to implement. All teams felt that it will be important to make the information as simple to understand as possible and to quickly guide the users to the specific information they need.

The crediting approach in the IEF is useful. California worked on expanding the ecological crediting approach incorporated in the IEF to develop a valuation system that accounts for what is important to those affected in the SR-37 corridor in order to compare alternatives.

A vehicle to roll out the process is needed. The pilot test teams considered it essential for the TCAPP–IEF process to be incorporated into existing transportation agency guidance and procedures (e.g., design guides) in order to become broadly relied on. There was considerable discussion about the appropriate method to support this integration. In particular, “regulatory agencies need to attend in a nonconfrontational setting to hear how this can be implemented.” Approaches identified include more pilot tests, more examples such as C01 and C06 pilot test case studies integrated into TCAPP, and state and regional conferences.

- The IEF defines issues and processes very logically and in a stepwise fashion.
- The IEF is adaptable, scalable, and agencies do not need to reinvent the wheel to use it.
- The order of some steps could be changed (i.e., Steps 3 and 4 with their resulting outputs before Step 1).
- GIS can capture patterns, structures, and composition; there is a need to refer to natural and human processes (e.g., how are changing values captured in the IEF?).
- Alleviating data bottlenecks is important.

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Appendices

Appendix A Invitational Symposium

Symposium

At a symposium held in September 2010, the SHRP 2 Capacity Project C06 research was presented to transportation and resource agency participants. The project team's work was presented after each step of the Integrated Ecological Framework (IEF) for integrated conservation, restoration, and transportation planning. The results of the pilot projects were summarized. This appendix summarizes the feedback received from participants, with a focus on the technical and scientific work done by the project (Institute for Natural Resources et al. 2012).

Feedback and discussion started by asking participants to write down what they saw as the greatest opportunities for implementing the integrated planning approach and what they thought was needed to make it practical for users. One comment summarized much of the discussion: "There is an emerging paradigm where transportation can be an ally, and not an enemy, in the conservation process that is starting to take hold." The written answers to the introductory questions were combined with discussions captured from facilitated breakout groups to summarize the principle themes raised at the symposium.

Approaches and Frameworks

Transportation agencies now are considering what the right project is and factoring in ecosystem approaches and watershed frameworks, rather than using a business-as-usual approach in which these factors may have been ignored. The new approach encourages better information sharing and allows information to be used and improved on an ongoing basis. New approaches such as ecosystem services markets are aligning interests of development entities, conservation groups, landowners, and investors. Development of these markets not only could provide on-the-ground conservation, but also could drive data collection and information generation to minimize investment risk.

Working Together

Resource agencies are collaborating and providing a basis for broader regional collaboration. Trust is growing, and interagency relationships are starting to build, which leads to more consensus on areas of ecological importance, improves conservation outcomes, and promotes leveraging funds for enhanced ecological success. As one participant said, “Agencies and organizations are coming together more and sharing initiatives, ideas, and priorities, realizing we are all going in the similar direction and making changes to work together (and not staying in our bubbles).”

Transportation and resource agencies are talking, learning, and sharing more at all levels. The conversations are moving beyond technical matters and legal requirements to a recognition of the need for trust to make progress. Collaboration such as this is needed at all levels, including with interest groups and stakeholders.

It is critical to develop a better understanding of terms being used (e.g., mitigation, avoidance, assurances, restoration, conservation) and systems being developed (e.g., *Eco-Logical*, regional ecosystem framework [REF]) to avoid confusion and ensure clear communication. This is vital in terms of building on all the work currently underway. The discussion suggested that transportation and resource agencies may use terms such as avoidance, mitigation, and restoration differently, but there was not time to sort out the differences at the symposium.

Awareness and Recognition

There is increasing recognition that all agencies can integrate conservation within their missions and work together toward shared goals. Recognition of the need to protect natural areas, functions, and services across jurisdictional and ownership boundaries is also growing. There is widespread recognition that the current process is failing us and failing ecosystems. This recognition has led to an emerging push to balance mobility needs with the need to preserve and restore ecosystem health.

Institutional Change

The participants identified several forces driving the need to shift to an integrated conservation and transportation planning system and several needs that must be met if these opportunities are to be realized. The upcoming transportation reauthorization bill and climate change both create a sense of urgency. It will be vital to build partnerships with other development and land use agencies beyond

transportation agencies, particularly land use decision makers, for the value of the approach to be fully realized.

These developments represent a major cultural shift for transportation and resource agencies from a project-by-project approach to a landscape approach focused on ecosystem results at a larger scale. The landscape approach allows more flexibility and requires more stakeholders. Ultimately, it is critical that all agencies look at ecosystems in their entirety, not just at regulated resources.

Regular face-to-face meetings at the regional level are needed to develop trust and maintain continuity for integrated planning. This approach also requires staff with specific responsibilities to support this integrated planning process in local government, state transportation, and resource agencies.

For the framework to be implemented, champions need to be recruited at all levels of transportation and resource agencies. The symposium participants said that resource agency staff do not know what *Eco-Logical* is, even if their agencies signed the agreement. Even in states or regions where the integrated approach has been embraced, staff changes and continuity pose major problems.

Funding

Transportation agencies have perhaps the largest source of dedicated public funding for restoration and conservation, and they have been willing to fund projects that do not necessarily benefit the transportation systems directly. Local agencies have also been willing to fund advanced mitigation. Flexible funding is needed for holistic solutions that address preexisting deficiencies and enhancements.

Regional Ecosystem Frameworks

The biggest issue raised regarding regional ecosystem framework (REF) preparation was the need for some entity to own it and ensure that it is implemented. Answering this question is critical to selling the approach. The second issue concerned responsibility for payment. One participant said that the framework underplays the amount of time, money, and effort needed for implementation. It needs to be able to explain how much these processes cost and what a state or local department of

transportation (DOT) needs to do to make this approach happen. The third issue was the audience. The audience needs to be targeted in the write-up of the framework.

An opportunity exists to use REFs for projects other than transportation projects. For example, the REF could be useful in determining the best way to replace aging infrastructure overall. Energy companies and other utilities should become partners in integrated planning efforts. The framework could support improved stormwater management, asset management, and climate change responses. The approach could be sold on the basis of these benefits.

Inevitably, in states where there are many listed species and wetlands, such as California and Florida, there is a demand and urgency for innovative solutions that do not exist in states without those species and wetlands. One participant also noted that transportation agencies are doing fewer new capacity projects. Most of the transportation projects in this state are categorically excluded from the National Environmental Policy Act of 1969 (NEPA), so there is little reason for a transportation agency to participate in the REF work because the projects are so small they have little cumulative effect.

Data, Tools, Scientific Information, and Decision Support

Advances in remote sensing and species and habitat inventories improve information on population distributions, but new decision support tools support the *Eco-Logical* approach and improve conservation outcomes. Landscape-scale and project-scale data differ, but this hierarchy can be flattened now given greater computing power and modeling methods. The new information and tools are more accessible and usable by nonspecialists, allowing agencies to share data, tools, and analysis. A wish was expressed for a database of potential mitigation and restoration projects that could meet multiple federal and state requirements and the goals of nongovernment entities.

Data needs and opportunities were discussed in some detail. The participants repeatedly noted the need for improved geospatially explicit data sets in digital form that capture historic, as well as current, information. Data set development needs should be prioritized for investment. The data need to be collected and maintained to provide ready access for multiple users and applications and to incorporate data from all levels and projects. Such data sets will require data for multiple functions, not just transportation.

The data need to be live to allow users to create their own data mashups. These data are needed to populate decision support systems. Tools need to be developed to use the data in implementing the framework, and the tools should have a common interface. There needs to be a primary funding source for gathering and managing these regional, state, and nationwide data sets.

Participants confirmed what the project team found in their research. Most DOTs and metropolitan planning organizations do not have protocols for data collection and management, and they do not require consultants to integrate the data they collect into an accessible central system. For an integrated planning system to work, consistent protocols are needed describing what type of data is to be collected, how data will be evaluated, and what data should be retained and managed. The overall system must be designed to ensure that data are updated regularly because natural events (fire, disease, flood, climate change) and development can alter resources of concern. A long-term commitment to gathering, managing, and sharing data also is required.

Crediting and Advance Mitigation

There are challenges with crediting that the framework cannot address, such as market development, double-dipping, and the sophisticated operations and management and accounting systems needed to ensure a market delivers results. Resource agency staff are often leery of crediting and concerned that mitigation done for one project not count for another. There is a tendency for regulatory agencies and transportation agencies to focus only on the project site.

In terms of both crediting and advance mitigation, metrics from the planning process need to carry through to project delivery and monitoring. At the planning level, transportation and resource agencies need to consider whether the right project for the context is being proposed. Participants also noted that for all planning and projects, there is a “sweet spot” at which money for the transportation project is available at the same time the mitigation or conservation opportunity exists. Mitigation is likely to be more effective for long-term conservation, and advance mitigation is more likely to occur when funds line up with opportunity in this way.

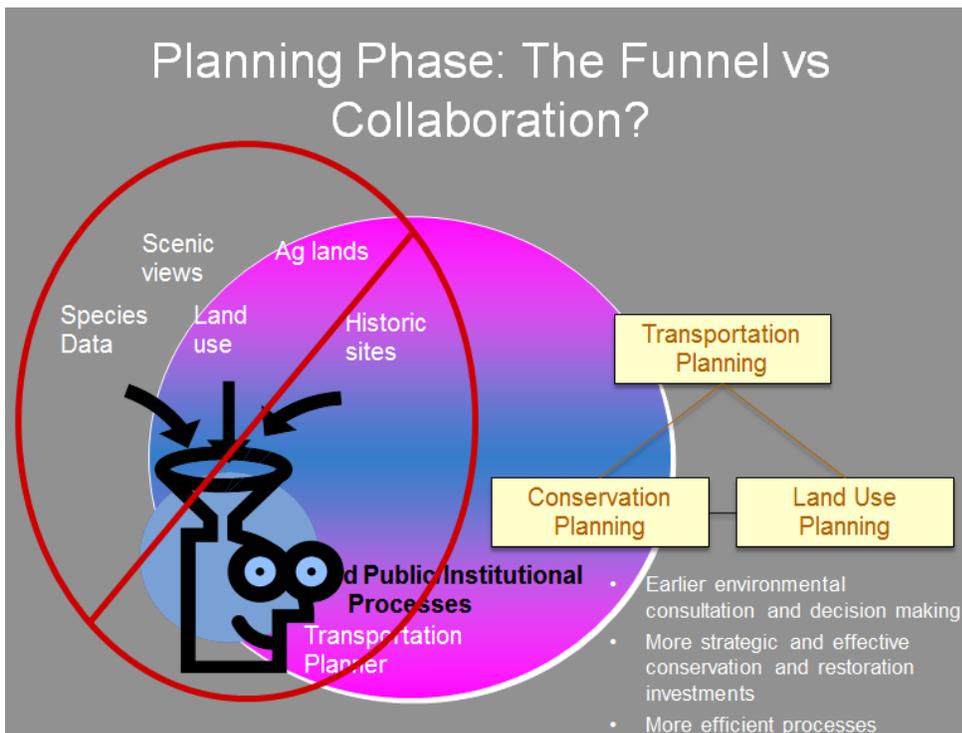
Participants emphasized that buying land and doing a mitigation or conservation project is not enough. Long-term land management is essential to ensure that the environmental outcomes are both achieved and maintained.

Implementation Activities

Specific suggestions were made to TRB on how to implement the results of the C06 research projects:

- *Share the research results with key public officials.* Engage the American Association of State and Highway Transportation Officials (AASHTO) regarding streamlining project delivery and groups such as the Environmental Council of the States, Association of Fish and Wildlife Agencies, Western Governors' Association, and National Governor's Association.
- *Document the benefits of the approach: sell it.* The documentation should include the business case (return on investment of time and money) and address time savings (especially if they made it possible to reallocate agency resources), cost savings, triple bottom line (people, planet, profit) cobenefits and quality-of-life benefits, and improved conservation outcomes. Examples of success should be included. Opportunities for streamlining processes or programs should be demonstrated.
- *Require implementation.* One participant suggested requiring it in legislation.
- *Fund more pilot projects.* More pilot projects are needed to illustrate how to implement the approach, including regional forums for engaging local, state, and federal agencies.
- *Provide interagency training.* Regional seminars and interagency training are needed to implement the approach beyond the ecological grants and customary technology transfer. Interagency training is especially useful if it is related to specific projects or permits so that it can be used as a demonstration.
- *Create a guidebook and website.* Prepare a guide with chapters and examples for each step and provide an accessible and searchable website.

Appendix B General IEF Presentation



Enable Environmental Decision Making on the Planning Level, Better Outcomes

C06 Goals & Purpose

- Develop a process to address the **institutional, scientific and technical obstacles** to integrating conservation and transportation planning **advocated by the Eco-Logical approach to infrastructure development and more recent refinements to watershed permitting and strategic habitat conservation planning.**
- Considers long range planning, corridor planning, environmental review and environmental permitting with **the objective of accelerating project delivery while improving environmental stewardship.**

Integrated Ecological Framework (IEF)

- **Step 1: Build & Strengthen Collaborative Partnerships and Vision**
- **Step 2: Integrate Ecosystem Plans**
- **Step 3: Create Regional Ecosystem Framework**
- **Step 4: Assess Transportation Effects**
- **Step 5: Establish & Prioritize Ecological Actions**
- **Step 6: Develop Crediting Strategy**
- **Step 7: Develop Agreements**
- **Step 8: Implement Agreements**
- **Step 9: Monitoring and Adaptive Management**

Obstacles to Success

– In Descending Order of Frequency



- **Lack of resources**
- **Lack of data**, information, and tools
- **Resistance to change** or lack of incentives to change
- **Lack of implementation know-how**
- **Lack of coordination**, communication, and collaboration
- **Differences in missions**
- **Restrictions or assumed restrictions** in regulations and guidance
- **Lack of assurances**
- **Insufficient documentation**

Top 3 Recommended Solutions

Integrate planning across agencies

Make needed data available early

**Identify priority
conservation & restoration areas**

Benefits of an Integrated Ecosystem-scale Approach

- **Better cost estimates** for environmental related needs in transportation projects
- **Reduced pressure/demand** on permitting staff
- **Reduced financial cost** associated with project delays and environmental compliance issues
- **Better environmental outcomes**
 - Identify the most viable and highly beneficial mitigation sites
 - Advanced buy-in for future mitigation opportunities
- **Ability to leverage** the investments of all public agencies

Innovative Initiatives Already Underway

Local to national scale methods and tools are supporting an integrated, ecosystem approach to decision-making.

- Watershed-based programmatic conservation, mitigation, or regulatory approaches
- Species and habitat-based programmatic approaches
- Merged programmatic approaches (addressing watersheds, species, habitats)
- Regional ecological vulnerability assessments
- Ecosystem-scale assessment & screening tools

Traditional vs. Strategic Approaches to Mitigation

Traditional	Progressive
Opportunistic	Strategic
Project-by-project impact analyses	Watershed/landscape scale impact analyses
Single-resource approach	Multi-resource approach
More reliance on <i>qualitative</i> information	More reliance on <i>quantitative</i> information
More reliance on expert opinion	More reliance on scientifically-based information in combination with expert opinion
Replacement of impacted resources only often resulting in only partial replacement	Contribution to broader hydrologic and ecological conservation priorities
Investments bring lower level of ecological & ecosystem benefits	Investments bring higher level of ecological and ecosystem benefits
Repeated project-by-project decision-making and administrative processes	Consolidated decision-making and administrative processes
Non-standard, difficult to replicate decision making process	Potential for more standardized, repeatable decision making process

Facilitating Collaboration Through:

- Common planning framework
- Integrated processes & products
- Common data library
- Standard tools





[Composition: In the slide below, if it's easy, please change first two lines to this:

Data have been lacking, not used, or deemed insufficient to use on a planning level, to:]

Data is a Primary Bottleneck

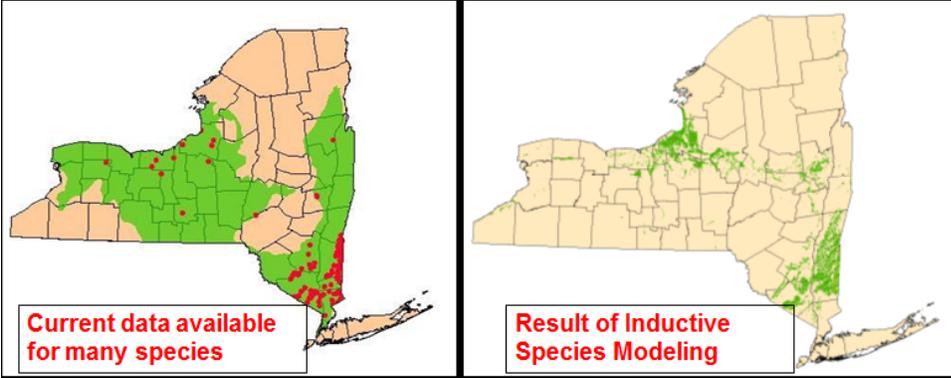
Data has been lacking, not been used, or have been deemed insufficient for use) on a planning level, to:

- (a) avoid and minimize impacts early in the planning process; and
- (b) identify reasonable alternatives and best siting for mitigation or conservation investments, early in the process

Result: Lost efficiencies and opportunities for better on-the-ground conservation and restoration, leveraging the investments of all agencies.

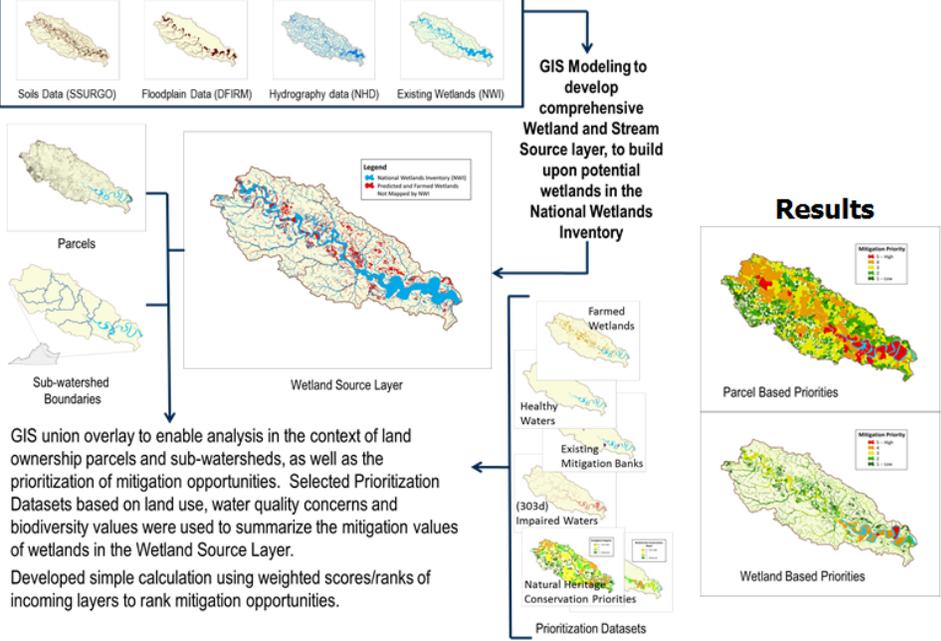
Primary Data Need: Inductive Species Models for all Federally Listed Species

Distribution Data for Bog Turtle (*Glyptemys muhlenbergii*) in New York



Red points are known occurrences of the Bog Turtle

Virginia Wetland Catalog Pilot



Components of IEF

CUMULATIVE EFFECTS ASSESSMENT & ALTERNATIVES
 Planning 4(a)

- STEP 1: Build and strengthen collaborative partnerships and shared vision/values
- STEP 2: Build the foundation for a regional ecosystem framework: Integrate conservation, natural resources, watershed, and wildlife management plans
- STEP 3: Populate the regional ecosystem framework: Integrate conservation and restoration priorities and plans for the target region into transportation long range plans and TIPs/STIPs.
- STEP 4: Assess transportation effects on resource conservation objectives stated in the REF.
- STEP 5: Establish and prioritize opportunities for ecological action.
- STEP 6: Develop an up-front crediting strategy to accompany the Regional Mitigation Strategy.
- STEP 7: Develop programmatic permits/consultations or other programmatic document agreements.
- STEP 8: Assure implementation on the transportation side. Design transportation project and integrate programmatic agreement measures to minimize impacts to resources.
- STEP 9: Update REF annually/as important new information becomes available and balance predictability and adaptive management so funding and staff time can be allotted appropriately and schedules can be met.

REGULATORY ASSURANCES
 Project Planning 4(b)

ECOSYSTEM MEASUREMENT
 Measuring Impacts, Mitigation 4(c)

Appendix C Summary of Agency Webinars

Introduction

On November 1 and 2, 2011, the second Strategic Highway Research Program (SHRP 2) of the National Academy of Sciences Transportation Research Board (TRB), in collaboration with the Federal Highway Administration (FHWA), hosted a workshop to support the development of strategies to operationalize a new approach to transportation decision making. The concept of this new decision-making approach was developed under a multiagency effort involving eight federal agencies and several state agencies that resulted in the development of *Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects* (Brown 2006). The *Eco-Logical* approach recommends a collaborative, integrated, watershed- or ecosystem-scale approach to decision making during infrastructure planning, environmental review, and permitting. It presents a framework for integrating planning across agency boundaries and achieving cost-effective infrastructure development without compromising ecosystem vitality. *Eco-Logical* describes a strategy for developing a regional ecosystem framework that identifies ecologically significant areas, potentially affected resources, areas to avoid, and mitigation opportunities in advance of infrastructure project initiation.

In an effort to ensure that this workshop would successfully identify implementation strategies to enable agencies to operationalize the *Eco-Logical* approach to decision making, preworkshop webinars were held for four audiences to present the results of research funded under the SHRP 2 C01, C06A, and C06B projects and to get feedback on several proposals developed by the workshop planning team (see next section for details on these proposals). This appendix provides a summary of the preworkshop webinars.

At each of these webinars the results of the SHRP 2 research were presented, including information on the Transportation for Communities: Advancing Projects through Partnerships (TCAPP), now known as PlanWorks, online transportation decision guide and a supporting technical guide called the Integrated Ecological Framework (IEF). The IEF provides guidance on appropriate and effective data, methods, tools, and processes that can support an *Eco-Logical* approach to decision making. The IEF is a step-by-step, peer-reviewed, science-based process that guides natural resource and transportation practitioners in developing conservation and restoration priorities and integrating such information into transportation planning and regional and local land use planning.

The anticipated product of the webinars and the workshop was the identification of one or more high-priority implementation actions to be considered for SHRP 2 funding in 2012 and 2013 and other related activities that FHWA and partner agencies could support.

Approach of Preworkshop Webinars

In preparation for the workshop, TRB and FHWA sponsored separate 90-minute by-invitation-only webinars for workshop participants and other key agency staff from four groups: the U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), Environmental Protection Agency (EPA), and department of transportation offices (DOTs) and metropolitan planning organizations (MPOs). These webinars are summarized below.

Purpose

The purpose of the webinar was to

- Familiarize participants with efforts to operationalize ecosystem-scale decision-making processes and tools across the country during transportation planning and environmental review and permitting;
- Hear from webinar participants on what they thought was needed to be successful in achieving this goal; and
- Use the results of these webinars to guide the development and implementation of the November 1 and 2, 2011, SHRP 2 workshop.

Agenda

The webinar agenda included

- Welcome remarks from TRB and FHWA representatives;
- Background information on FHWA's *Eco-Logical*-related initiatives;
- Background information on SHRP 2 research and products (including a recently funded technical guidance research project, SHRP 2 C06);
- An introduction of straw proposals that could help operationalize *Eco-Logical*; and
- A discussion asking participants to respond to the presentations and straw proposals and offer questions, ideas, and recommendations based on their own agencies' initiatives.

Webinar Presentation

The webinar presentation included a summary of SHRP 2 research and products and FHWA-sponsored activities, including the *Eco-Logical*–related initiatives.

Straw Proposals

The straw man proposals are summarized in Appendix D. These proposals presented various options that could support operationalizing ecosystem-scale decision making. The following are thumbnail descriptions of each straw proposal:

- Straw Proposal 1: Fund development and rapid implementation of an interoperable, interagency system for ecological assessment, building on existing systems.
- Straw Proposal 2: Interagency peer exchange on system integration.
- Straw Proposal 3: Pilot (two-state) investment in fundamental data that would promote programmatic approaches to decision making and better environmental outcomes.
- Straw Proposal 4: Interagency workshops and development of a week-long class on landscape-level ecological review.
- Straw Proposal 5: Further pilot testing of the IEF.

Webinar Schedule

EPA	Tuesday, October 11, 2011, 12:00–1:30 p.m.
USACE	Thursday, October 13, 2011, 2:00–3:30 p.m.
MPOs and DOTs	Friday, October 14, 2011, 2:00–3:30 p.m.
USFWS	Monday, October 24, 2011, 1:00–2:30 p.m.

Webinar Presenters

The webinar sponsors who gave presentations included Steve Andrie of TRB and FHWA staff members Shari Schaftlein, Marlys Osterhues, Michael Lamprecht, and Mary Gray. Members of the SHRP 2 C06 project team also helped lead the call and give presentations. This team included Lisa Gaines (C06 project investigator) and Jimmy Kagan of Oregon State University’s Institute for Natural Resources, Shara Howie and Patrick Crist of NatureServe, and Marie Venner of Venner Consulting, Inc.

Webinar Results

Audio Recording

An audio recording of each of the webinars held is available as follows:

- http://onlinepubs.trb.org/onlinepubs/shrp2/webinar_2011-10-11.wmv (EPA)
- http://onlinepubs.trb.org/onlinepubs/shrp2/webinar_2011-10-13.wmv (USACE)
- http://onlinepubs.trb.org/onlinepubs/shrp2/webinar_2011-10-14.wmv (MPOs, DOTs, and other agencies)
- http://onlinepubs.trb.org/onlinepubs/shrp2/webinar_2011-10-24.wmv (USFWS)

Webinar Questions

The following questions were asked during each webinar. These questions were in response to the straw man proposals that were sent to the participants before the webinar. The straw man proposals are summarized in Appendix D.

1. In which of the straw proposals would your agency be most likely to participate?
2. What additional research proposals do you think should be considered?
3. What would be the key changes?
4. Which of the straw proposals would your agency be most likely to lead?
5. Which of the straw proposals would your agency be most likely to support with changes?
6. Which of the straw proposals would your agency be most likely to support?
7. At first impression, which proposal do you believe could help to further implement the *Eco-Logical* approach at a national scale?
8. Please let us know which of the following strategies would be most helpful for implementing the *Eco-Logical* approach.
 - New data analysis and integration tools
 - Improvement of existing data tools
 - Interagency coordination forums
 - Training
9. Which of the following would help improve your agency's ability to implement *Eco-Logical*?
 - Training, technical assistance about *Eco-Logical* approach
 - Prioritization from management
 - Additional funding
 - Greater coordination with other agencies
 - Improved data availability or analysis tools

Summary of Webinar Attendee Responses

During the webinars input was received from the attendees in two ways. First, throughout the webinars polling questions were presented to gauge attendee interest in the straw proposals and related needs for operationalizing these proposals in their agencies. Second, the webinar was opened up to questions and discussion among attendees.

Online Poll Results

For the online polls, questions were posed online and attendees were able to select their answers online so that everyone on the webinar could see the results immediately.

As Figure C.1 illustrates, the polls resulted in Straw Proposal 1 (development and rapid implementation of an interoperable, interagency system for ecological assessment, building on existing systems) receiving the most support by the webinar attendees, followed by Proposal 3 (investment in fundamental data that would promote programmatic approaches to decision making and better environmental outcomes) and Proposal 5 (additional pilots to test the *Eco-Logical* approach developed by the SHRP C06 team). As mentioned, due to technical issues the USACE polling results were not available, and therefore USACE is not represented on this chart, but the viewable recording of the webinar indicated that a majority of the USACE webinar participants (67%) supported Proposal 3 (investment in fundamental data). The green bar labeled “Other” in the figure included the MPOs, DOTs, and other (non-EPA and non-USFWS) agencies.

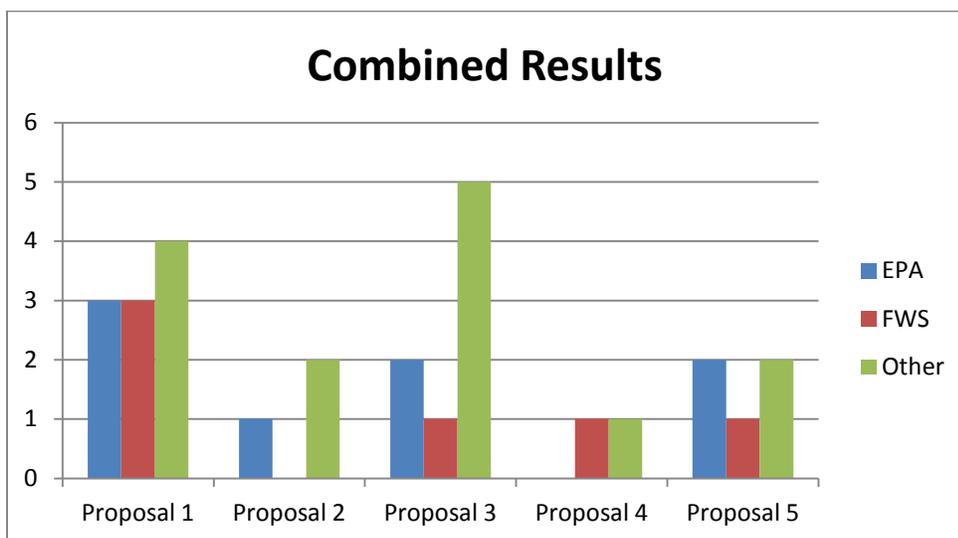


Figure C.1. Responses to the question “Which proposal do you believe could help to further implement the *Eco-Logical* approach at a national scale?”

Figure C.2 is a comparison of the webinar attendee responses to the following question: “Which of the following would help improve your agency’s ability to implement *Eco-Logical*?” Although “additional funding” received the most results overall, the results for the other categories of support varied by agency. EPA favored improved data and tools and greater coordination with other agencies, while USFWS also had support for the need for prioritization from management. The green “Other” bar included the MPOs, DOTs, and other (non-EPA and non-USFWS) agencies that favored training and technical assistance along with prioritization of management.

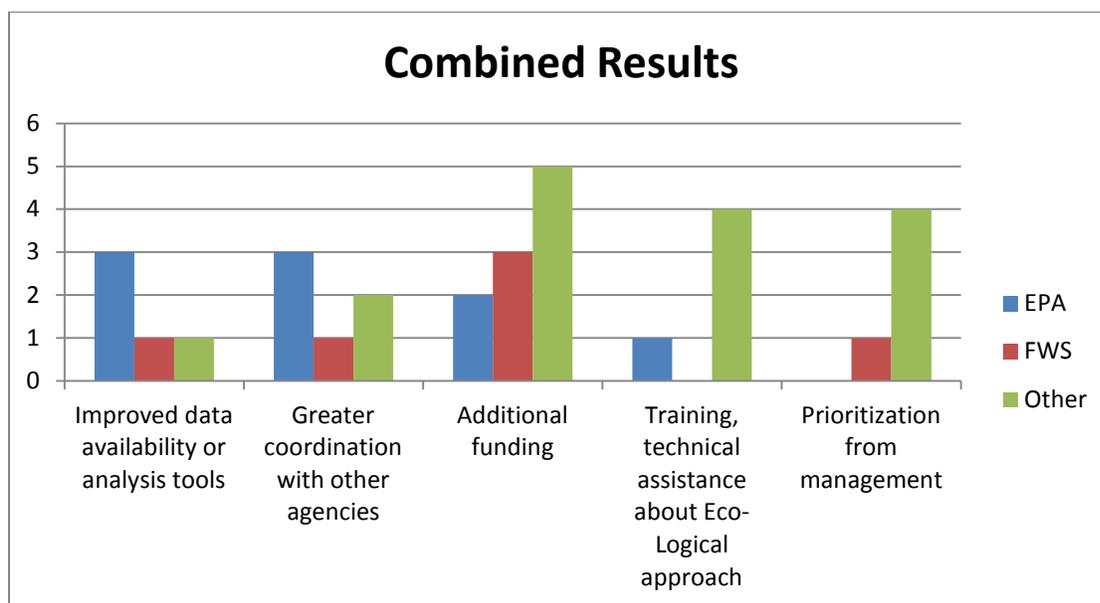


Figure C.1. Webinar group responses to the question “Which of the following would help improve your agency’s ability to implement *Eco-Logical*?”

Again, the “lost” USACE polling results are not represented on these charts, but the viewable recording of the webinar indicated that USACE webinar participants were pretty evenly split between the different types of support in Figure C.2, although “additional funding” (29%) and “improved data and analysis tools” (29%) had the most support from attendees.

Discussion and Comments

The following are some highlights based on the verbal discussion portion of the webinars divided into categories of issues or ideas related to implementation of an *Eco-Logical* approach to decision making.

Engaging local agencies in advanced planning

- There’s a need to create incentives for local agencies to engage in ecosystem-scale planning.

- Engaging MPOs could help because MPOs work with federal, state, and local agencies and therefore understand both sides of the issues (local land use and larger ecosystem-scale land use).
- Since the *Eco-Logical* approach to decision making is not a federal mandate, it is sometimes difficult to implement locally because local and state agencies are mostly focused on meeting federal regulations (i.e., there is no requirement to consider ecosystem services). Therefore, a shift in federal regulations or way to help shift the view on how to do planning is needed.

Ideas on making straw proposals successful: It is important to have a proposal that is implemented across all 50 states to demonstrate the ability for national success.

Data

- There was concern about the viability of creating national data sets of natural resource features (beyond forests and wetlands) since national data development might be more cost-effective and support better ecosystem service valuation.
- There is a need to link data collection to data sharing so that data are more available across states and regions (e.g., Indiana bat data).
- There are already multistate conferences in which discussion of ecological and species data sharing across states is a focus for particular species or issues, and perhaps those discussions could help support *Eco-Logical* priorities.
- Data need to be used in combination with expertise.
- A national framework for ecosystems and habitat connectivity data would be useful.
- A state-by-state data clearinghouse is needed to ensure that all decision makers are using the same data.
-

Gap between planning and project delivery

- There is still a disconnect between the DOT and MPO staff involved in planning and the DOT and MPO staff involved in project delivery. FHWA commented that progress has been made on this through a process developed through structured, transparent, accountable, reproducible, sustainable (STARS) workshops that focuses on documentation of decisions so that they are carried from planning to project delivery.
- There is also a need to close the gap between national resource agencies and transportation engineers.

Education and training

- Several webinar attendees suggested the need for training and education that supports implementation of processes known to work in some places (i.e., programmatic ESAs) and suggested that training should involve transportation planners and project delivery leads, as well as resource agency staff to help promote collaboration. FHWA commented that the Everyday Counts program supports this kind of approach to training.
- During the C06A organizational change research, transportation and natural resource practitioners said that they needed resources “in their offices” that would support learning best practices and implementing these practices.

Other ideas that were written by webinar participants during the webinar on how an *Eco-Logical* approach to decision making could be supported included

- A system or tool that ensures proper and early engagement by all the appropriate staff in agencies and organizations, including key data holders;
- A method for leveraging mitigation banks and in-lieu fee programs to achieve *Eco-Logical* goals; and
- A need to document avoidance and minimization achieved during planning and how much it may reduce mitigation needs so that the benefits of advanced planning are acknowledged.

Conclusions

The webinars were viewed by attendees as being helpful in understanding and preparing for the November 1 and 2, 2011, workshop (Integration of Conservation Planning, Highway Planning, Environmental Review, and Permitting: Multi-Agency Implementation Planning Workshop). Due to some technical difficulties it was sometimes challenging to have in-depth discussions on the webinar about the subject matter, but the input received was very helpful for the workshop planning team in preparing for the workshop. Interestingly, the top recommendation out of the workshop matched the top choices during the webinar polls, which was a focus on Straw Proposal 1 (to fund development and rapid implementation of an interoperable, interagency agency system for ecological assessment, building on existing systems), although there was support for aspects of all the straw proposals during the webinars and subsequent workshop. In addition to integration of systems and development of regional and national data to support an *Eco-Logical* approach to decision making, there were many comments during the webinars that strongly indicated the need for cross-agency education and training to ensure

better collaboration and expansion. There were also several comments regarding the need to create incentives for getting both local land use agencies and some transportation agencies engaged in ecosystem-scale planning and decision making.

Appendix D Multiagency Workshop Draft Report

This appendix provides the draft report of the workshop held to discuss how to identify implementation strategies that would enable agencies to operationalize the *Eco-Logical* approach to decision making. The Integration of Conservation Planning, Highway Planning, Environmental Review, and Permitting: Multi-Agency Planning Workshop was held in Alexandria, Virginia, in November 1 and 2, 2011.

Background

A multiagency effort involving eight federal agencies and several states developed *Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects*, a guide for making infrastructure development more sensitive to the environment. The *Eco-Logical* approach recommends a collaborative, integrated, watershed- or ecosystem-scale approach to decision making during infrastructure planning, environmental review, and permitting. It presents a framework for integrating planning across agency boundaries and achieving cost-effective infrastructure development without compromising ecosystem vitality. *Eco-Logical* describes a strategy for developing a regional ecosystem framework that identifies ecologically significant areas, potentially affected resources, areas to avoid, and mitigation opportunities in advance of infrastructure project initiation.

The *Eco-Logical* approach is supported by a Presidential Memorandum entitled “Speeding Infrastructure Development Through More Efficient and Effective Permitting and Environmental Review” (August 31, 2011), which states

As an immediate step to improve the effectiveness and efficiency of Federal permitting and review processes, this memorandum instructs agencies to (a) identify and work to expedite permitting and environmental reviews for high-priority infrastructure projects with significant potential for job creation; and (b) implement new measures designed to improve accountability, transparency, and efficiency through the use of modern information technology.

The second Strategic Highway Research Program (SHRP 2) Capacity Program of the National Academy of Sciences Transportation Research Board (TRB) aims to develop tools for systematically integrating environmental, economic, and community requirements into the analysis, planning, and design of new highway capacity. The SHRP 2 C01 research project resulted in a collaborative decision-making product, *Transportation for Communities: Advancing Projects through Partnerships (TCAPP)*, which focuses on how to manage projects cooperatively and how to accomplish more in planning phases that will hold up

during alternative selection and environmental review. TCAPP includes a decision guide that maps out decisions that occur in each phase of the transportation planning and environmental review and permitting process, indicates potential involvement of various agencies at each decision point, and points to data sources that can inform decisions. The SHRP 2 C06 research project resulted in the development of the Integrated Ecological Framework (IEF), which provides specific recommendations on data, tools, and methods that can be used to implement an ecological approach to decision making. The IEF is congruent with the decision guide and is a nine-step process designed to bring about efficient, integrated consultation on natural resources to inform transportation and mitigation decisions. SHRP 2 C21 pilot projects have tested the ecological methods for integrating environmental concerns into transportation planning. The research and pilot projects suggest that better transportation and environmental decision making result from applying ecological principles at the corridor and long-range transportation planning levels.

To translate these concepts into on-the-ground practices, implementation strategies are needed that can achieve greater environmental benefit and potential cost savings through collaboratively identifying protection, restoration, and recovery priorities at a landscape scale. Specific objectives include (1) more consolidated and coordinated decision-making processes, (2) improved impact avoidance and efficient identification of highly viable mitigation priorities, (3) the ability to make preliminary (first-cut) regulatory decisions at the planning (and preplanning) level that can be advanced to the regulatory process, and (4) the inclusion of realistic avoidance, advanced mitigation, and compensatory mitigation costs in the project cost that is incorporated in the fiscally constrained transportation plan.

Together, the National Academy of Sciences and the Federal Highway Administration (FHWA) planned the *Integration of Conservation Planning, Highway Planning, Environmental Review, and Permitting Multi-Agency Planning Workshop* to identify follow-on implementation activities that would carry forward the *Eco-Logical* approach and the recommendations of the SHRP 2 C01, C06, and C021 research projects.

Purpose of the Workshop

The purpose of this workshop was to identify implementation strategies that would enable agencies to operationalize the *Eco-Logical* approach to decision making in the context of the SHRP 2 C01 TCAPP decision guide and the IEF developed under SHRP 2 C06A and C06B. The anticipated product of the

workshop was the identification of one or more high-priority implementation actions to be considered for SHRP 2 funding in 2012 and 2013 and other related activities that FHWA and partner agencies could support. The charge to the participants was to identify next steps to move from SHRP 2 research and pilot projects to implementation. Specific outcomes for the workshop were

1. A written proposal for funding to develop a system or effort that would further implement the *Eco-Logical* approach and the research products developed in SHRP 2 C06 and C01 to be presented to the SHRP 2 Capacity Oversight Committee; and
2. A list of actions and strategies that FHWA and other agencies could take to implement *Eco-Logical* without additional SHRP 2 funding.

Participants

The target audience for the workshop was state departments of transportation (DOTs), metropolitan planning organizations (MPOs), and federal and state resource and regulatory agencies. In addition, participants were drawn from nongovernmental agencies and consultants who had conducted relevant research, organizations that had participated in the SHRP 2 C21 pilots, representatives from the National Academy of Sciences SHRP 2 program, and FHWA.

Workshop participants included representatives from federal agencies including FHWA, the U.S. Army Corps of Engineers (USACE), the U.S. Environmental Protection Agency (EPA), the U.S. Fish and Wildlife Service (USFWS), the U.S. Department of Agriculture Forest Service, and the National Park Service; state DOTs, including the California Department of Transportation (Caltrans), Kansas DOT, Maine DOT, and North Carolina DOT; nongovernmental organizations, including NatureServe, The Conservation Fund, and the Colorado Natural Heritage Program; universities, including University of California–Davis and Oregon State University; state natural resource agencies from Idaho and Oregon; MPOs from Colorado, Missouri, and Texas; agencies and consultants (ICF, Marie Venner Consulting) who had worked on the SHRP 2 C06, C01, and C21 projects; representatives from the American Association of Highway and State Transportation Officials (AASHTO), the U.S. Department of Transportation Volpe National Systems Center (Volpe Center), and the SHRP 2 program; and facilitation consultants (CDR Associates).

Preparation for the Workshop

A planning committee was convened to develop an agenda and materials for the workshop, identify potential participants, and design and implement a strategy for preparing participating agencies to engage productively in the workshop.

A subgroup of the planning committee prepared a set of straw proposals to help the participants focus quickly on the range of options for an implementation support strategy and move toward concrete recommendations for follow-on activities. (Please see below and Appendix C for a list of these straw proposals.) The proposals were not intended to limit the ideas discussed by the agencies, but to stimulate participants' thinking, facilitate preworkshop intraagency deliberations, and potentially generate additional proposals.

The workshop was preceded by four webinars with the intended participants of the workshop. One webinar was conducted with each of the major resource and regulatory agencies with transportation responsibilities (EPA, USACE, USFWS), and one webinar was conducted with state DOTs and MPOs to prepare these agencies for meaningful participation in the workshop. Each webinar provided an orientation to the *Eco-Logical* approach, the SHRP 2 program, and the draft straw proposals and elicited preliminary feedback on the proposals. The webinar dates were

Tuesday, October 11, 2011 (EPA)

Thursday, October 13, 2011 (USACE)

Friday, October 14, 2011 (MPOs and DOTs)

Monday, October 24, 2011 (USFWS)

Workshop Process

The workshop was held at the Hilton Alexandria Mark Center Hotel in Alexandria, Virginia, on November 1 and 2, 2011. After a welcome from Steve Andrie, representing the National Academy of Sciences, and Shari Schaftlein and Marlys Osterhues, representing FHWA, the participants introduced themselves and held a brief discussion of the problems that the *Eco-Logical* approach can address. This exercise was intended to engage everyone from the outset and to help the group recognize the range of concerns that drive the agencies' interest in seeking implementation strategies. A summary of this discussion is included in this appendix.

To set the stage for the workshop, a brief orientation was given on the SHRP 2 C06, C01, and C21 projects and the FHWA *Eco-Logical* program. In addition, FHWA described the Surface Transportation

Environment and Planning (STEP) Cooperative Research Program. STEP is a federally administered research program authorized in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The STEP program is intended to improve the understanding of the relationship between surface transportation, environment, and planning and is a potential source of funding for follow-on implementation identified in the workshop.

Steve Andrie presented the parameters related to SHRP 2 funding to provide guidance to the participants. These parameters are as follows:

- SHRP 2 can conduct research to fill gaps in current work and provide extensions of research aimed at implementation.
- SHRP 2–funded implementation activities must be completed in about 18 months. However, since FHWA and others can continue implementation activities, a SHRP 2–funded activity could be a Phase I of a longer-term project.
- SHRP 2 is not authorized to make any recommendations to any federal agency.
- SHRP 2 must work within the current body of law and regulations.
- SHRP 2 cannot fund the ongoing program operations of any agency.

The facilitator provided a summary of the five straw proposals and reminded the participants that the proposals were designed to focus but not limit their discussion and that new ideas would be welcomed, whether as part of any of the straw proposals or as new suggestions of implementation activities. The five straw proposals are summarized below:

1. *Rapid implementation of a system for integrated ecological assessment, building on existing systems or approaches.* The intent of this proposal was to take a tool (or tools) that currently exists, improve it, and develop a way to apply it in the phases of transportation decision making and make it useful and accessible across agencies and across geographic boundaries. Simply put, the concept was to provide a form of one-stop shopping for data and data analysis methods.
2. *Interagency peer exchanges on ecological information systems and data integration.* This proposal would provide forums in which multiple agencies could hold further discussions on systems or tools and how to apply them to make the transportation decision-making process more cost-effective and efficient and result in better environmental outcomes. Such forums could further interagency collaboration and promote the use of new tools and programs throughout the field.

3. *Invest in fundamental data that would improve transportation decision making while promoting better environmental outcomes.* This proposal could result in the development of data sets that would make a difference in promoting early thinking on conservation and help MPOs and DOTs make early decisions related to avoidance and minimization of adverse environmental impacts and engage in mitigation planning or other collaborative programmatic conservation efforts. It was acknowledged that the potential \$1 million funding available through SHRP 2 would not be enough to gather any new data on a nationwide basis, but that the data sets might be developed in a specific geographic area through a pilot.
4. *Provide technical assistance for teams interested in applying an integrated ecological approach.* Technical assistance could encompass activities such as team-based training and coaching for interagency efforts to develop transportation and conservation strategies and/or the development of courses to promote the application of the *Eco-Logical* approach, TCAPP, IEF, and available tools.
5. *Support fieldwork and/or additional pilots to test the implementation of an integrated ecological approach.* This proposal would provide for additional pilot projects to test and learn from such efforts as implementation of the IEF steps, a national system to select mitigation sites, or demonstration of how an early *Eco-Logical* approach in planning can inform subsequent regulatory decisions.

The participants then formed breakout groups to compare the proposal, do a preliminary assessment of their merits, and generate additional ideas. Groups were structured around the participating agencies: USFWS, EPA, USACE, and DOTs and MPOs. Other participants distributed themselves among the agency breakout groups. Each group had a facilitator and a note taker, and each group appointed an individual to report back to the plenary session.

Day 2 began with plenary presentations from each of the Day 1 breakout sessions, followed by a summary of the common themes that emerged from the breakout sessions. No additional strategies were suggested in any of the Day 1 breakout sessions.

The breakout session presentations and subsequent plenary discussion strongly indicated consensus on the following:

- No one proposal can serve as a stand-alone implementation activity.
- The primary need is for a system for integrated ecological assessment that would support multiagency access to and use of data for *Eco-Logical*-based transportation and conservation planning.
- This system should leverage existing systems.
- Interagency forums, data set development, training and marketing, and the use of pilots are necessary components to develop and test the multiagency integrated system.

Participants self-selected to engage in breakout groups tasked to develop the elements of the implementation system. The groups were organized to address (1) the overall implementation plan (i.e., a big-picture vision of the system as a whole and a framework for how the other proposals could support that vision); (2) the technological aspect of integrating and improving on existing tools to create an integrated data-access system; (3) a capacity building, marketing, and outreach plan to support the use of the system; or (4) follow-on pilots to test, refine, and demonstrate the data integration and accessibility system. As an assumption was made that interagency forums or peer exchanges would be a natural part of the development of the data integration and accessibility system and that data gaps would be identified in the course of developing the data integration system and conducting pilots, there were no breakout groups assigned for these two topics.

Plenary presentations from each of these breakout sessions resulted in an overall package consisting of a vision and a general plan incorporating the various strategies identified in the straw proposals; a roughly defined initiative for developing a data integration and accessibility system building on existing data tools; ideas for outreach, marketing, and training to support the use of the data-access system; and pilots to customize and apply the tool in different geographic areas. The synthesis of the participants' discussion on this package may be found below.

The facilitator then polled the participants to determine the level of consensus in the group and ascertain specific recommendations regarding future SHRP 2 investment. She asked the participants to respond individually to the question, "If you had a million dollars to spend to implement the *Eco-Logical* approach in transportation and conservation planning, what would you do?" Over 80% of the participants named "tool integration," "integrated toolkit," "data integration," "an integrated decision-support platform," "integration of agencies' systems" or "collaborative platform" as their first choice for investment. Others mentioned expansion of the Water Resources Registry pilot (Maryland) to other states to test its transferability; conducting a nationwide pilot to build on lessons learned from existing

pilots; establishing a network of current ecological stakeholders; developing a training framework and using university-based transportation centers to introduce the use of the *Eco-Logical* approach for DOTs and MPOs; initiating a public–private clearinghouse to serve as an advocate for the *Eco-Logical* approach; and applying the *Eco-Logical* guidebook in a particular state in the development of a state 10-year transportation plan or statewide transportation improvement program (STIP). Several participants suggested secondary activities that would support the development and use of an integrated tool. The discussion ended with a recognition that significant momentum had been generated through the workshop and preparation for the event and that there were many things the participants could do to continue this momentum without waiting for SHRP 2 funding or an FHWA initiative. The facilitator invited participants to state what they, as individuals, would do as a result of this workshop. Participants expressed how they, as individuals, would foster the use of the transportation decision-making tools, the *Eco-Logical* approach, and existing data tools.

Many participants made commitments to such steps as becoming more familiar with existing tools; learning about and spreading the word about *Eco-Logical* and TCAPP and how different agencies can be integrated into the TCAPP process; holding multiregional forums of environmental practitioners; holding webinars to share information across agencies about the existing tools; using an existing university program to provide training on TCAPP; talking to universities about their interest in supporting this approach through their educational programs; engaging nongovernmental agencies; participating in planning on a watershed scale; and, as a resource agency, supporting FHWA in its advocacy with the Council on Environmental Quality.

Steve Andrle, Shari Schaftlein, and Marlys Osterhues thanked the participants for their active engagement and described the next steps for proposing these ideas to SHRP 2 and FHWA.

Following the workshop, problem statements incorporating the key recommendations from the workshop were drafted and presented to the SHRP 2 Capacity Program Technical Coordinating Committee on November 7, 2011. That committee recommended these proposals for advancement to the SHRP 2 Capacity Oversight Committee in December 2011.

Progression of Thought Through Breakout and Plenary Discussions

Opening Discussion of Problems That Can Be Addressed by *Eco-Logical* Approach

As a warm-up exercise, the facilitator invited participants to begin thinking about what is needed to implement the *Eco-Logical* approach and carry forward the work of the SHRP 2 projects by discussing at

their tables the problems that can be addressed through a landscape-level ecosystem assessment. The problems and needs identified included the following:

- An ecosystem approach has been applied on individual projects. These efforts need to be translated into models that can be applied elsewhere.
- There is a huge gulf between the concepts presented in the *Eco-Logical* document and how agencies do business on a day-to-day basis.
- Data are needed early in projects to avoid future problems and to help develop strategies to deal with population growth and climate change.
- An ecosystem assessment can help make a business case for restoring the environment.
- Different agencies work differently and protect different resources. The protection of one resource may result in harm to another resource. What is needed is a way to consider all the resources together.
- There are good tools and good data sets. However, these need to be linked with the regulatory process.
- There is a need to select mitigation projects that have multiple benefits and provide value on an ecosystem scale.
- Earlier integration of environmental information in the decision-making process can help avoid environmental problems.
- There is a need to strengthen relationships across agencies. *Eco-Logical* provides a way to do that.

Initial Response to the Five Straw Proposals

Participants held small group discussions in breakout sessions, organized by agency. They discussed the five straw proposals, compared them, and evaluated their utility in serving as follow-on to the SHRP 2 projects and to *Eco-Logical*. Reports from the breakout sessions indicated considerable agreement that all the proposals are essential ingredients in a larger, longer-term implementation plan and that none of the proposals should stand alone. The participants recognized that such a plan could not be implemented with \$1 million and two years; it is necessary to develop a long-term work plan with a longer, stepwise approach. Implementation would begin with a one-year initiative in a 20-year process. The focal point for the plan is the development of a means to bring together existing data assessment tools, get them to communicate with each other and pass information back and forth, and provide a

platform through which multiple agency users can easily access information from the existing tools and link this information to key decision points.

Proposal 1 (rapid implementation of a system for integrated ecological assessment, building on existing systems or approaches), which emerged as the primary focus of the group, was generally described as a system for integrated ecological assessment that would support multiagency access to and use of data for transportation and conservation planning.

All the groups identified the need to include elements of Proposal 2 (holding interagency peer exchanges), Proposal 3 (identifying data gaps and finding ways to fill those gaps), Proposal 4 (providing training, technical support, and marketing strategies to build awareness of, buy-in to, and expertise in using an integrated ecological assessment), and Proposal 5 (pilots to test the integrated data assessment system and to build on other efforts to integrate information and decision-making systems across agencies) as part of an integrated plan.

None of the groups suggested new proposals for consideration.

Synthesis of Recommendations from the Workshop, Including Implementation Details Developed by the Participants

Vision and Overall Implementation Plan

Through the workshop, a clear vision for the adoption of the *Eco-Logical* approach emerged:

Within 20 years, transportation, resource, and regulatory agencies at all scales of governance will use a commonly accepted *Eco-Logical* framework that is collaboratively utilized to plan, review, permit, construct, and maintain infrastructure projects; to implement transportation projects more efficiently and cost-effectively; and to achieve meaningful environmental outcomes. The *Eco-Logical* framework will become not just a tool, but an expected part of making infrastructure investment decisions.

Workshop participants agreed that ongoing outcomes of this vision would include the integration of conservation and transportation planning by transportation agencies; the employment of earlier ecosystem-level analysis and decision making to avoid and minimize impacts on natural resources; and the development of mitigation opportunities that benefit the environment.

The vision includes the common use of a well-known and creditable process in which multiple users can have the same access to data and in which all interests will use the data in a collaborative way to achieve better outcomes.

The overall implementation plan consists of a set of steps, some of which can be undertaken simultaneously, and some of which are sequential:

1. Establish and support a collaborative network on multiple levels, including an interagency structure that can serve as a public–private clearinghouse that fosters change, advocates for investment in the *Eco-Logical* approach, serves as a champion for the development and use of the data integration and accessibility system, and promotes a community of practice. A broader network can start with participants from this workshop and include agency staff who will be involved in implementing the *Eco-Logical* framework. The network should include frontline practitioners, decision makers, and policy creators.
2. Use the network to serve as an ongoing collective marketer for the vision and for education and outreach to agencies and other potential users. Members of the network will engage with each other through forums, blogs, a website of existing tools, and a calendar of events and webinars. The network will promote the *Eco-Logical* approach and the data integration and accessibility system, conduct outreach, and maintain momentum to create buy-in for the vision. More detail may be found in the section Capacity Building and Marketing Plan.
3. Develop a collaborative data-sharing platform that builds on existing data tools and existing integrated regional frameworks to facilitate the application of the *Eco-Logical* approach. Focus initial funding on this activity. Design the platform in such a way that agencies and states can plug their data into the system or make their data accessible by way of the system. Design the platform so it can be altered or customized by the user (e.g., to accommodate the different conditions and weighting of ecological priorities in different geographic areas).
4. Test the platform and apply the principles of adaptive management. Make the platform available nationally to agency users and the public; gather feedback from their experience; foster the improvement of the system to fill gaps in functionality and strengthen its utility to decision making.
5. Develop performance measures.
6. Conduct pilots that require collaboration between agencies and apply the IEF.
7. Address the data gaps identified during application of the data-sharing and integration system.

Development of a Multiagency Data Integration and Accessibility System

The participants' discussion coalesced around the desire to develop a system to bring critical data resources together in a seamless, accessible way and enable users to apply that data efficiently to

transportation and conservation decisions. This system would pull data from existing permitting and assessment tools to improve access to and use of ecological data in the transportation planning, decision-making, and permitting processes.

There was consensus that the goal is not to create a new data management system, but to find a way to integrate existing data management systems and make them accessible by and useful to multiple agencies.

Each federal agency involved in environmental review and conservation planning has taken the initiative to create geographic information system (GIS)–based platform tools. The challenges are that there are data gaps so the tools cannot be used on a nationwide basis; that the tools are proprietary in nature, and the data cannot be accessed by agencies outside the developer agency; that the scale of the data is not necessarily congruent with the scale of the data used by other tools; that different transportation decision-making processes (e.g., DOT and MPO) and phases (e.g., planning and permitting) require different scales of data; that there is no widely accepted means of applying these tools and data to transportation decisions; that the tools have been developed independently and do not communicate with each other; and that there is limited awareness of the existence and nature of these tools. There have been some initiatives to combine two or more of these tools for a particular pilot or geographic area.

Participants mentioned current tools or initiatives to build on, including (but not limited to) the Western Governors' Association standardized wildlife linkages; state wildlife action plans; Green Infrastructure Planning; the National Water-Quality Assessment (NAWQA) regional water assessment system; the Atlas system, including the EPA Regional Ecosystem Assessment Protocol; NEPAassist; the U.S. Geological Survey water data system; the Watershed Resources Registry (WRR) piloted in Maryland; the Environmental Conservation Online System; California's Statewide Advance Mitigation Initiative; Wyoming's Landscape Energy Action Plan; the USFWS Information Planning and Conservation System; and the USACE Regulatory In Lieu Fee and Bank Information Tracking System. There are about a dozen GIS-based platforms that need to be assessed for their ability to be used in conjunction with others and their relevance and applicability to transportation and conservation decisions beginning at early phases of decision making.

Characteristics and functionalities suggested by the participants included the following:

- A simple, user-friendly web services–based interface that enables users to access data without having to go separately to different agencies to obtain the data;
- Interoperability of multiple tools;

- The ability to take advantage of known data and to allow agencies and state organizations to add their own data to the system;
- Support for a collaborative, interagency decision-making process by providing multiple agencies the ability to access the same data;
- Linkage of the data to the decisions that need to be made at any step in the decision-making process. In particular, the participants supported TCAPP as a framework for transportation decisions;
- An interpretive element, as well as data. For example, it could include a question-driven application that points to appropriate data layers;
- The ability to remain dynamic, given the changes that will occur in technology and the availability of data;
- How-to guidance to support the use of the system and its application to decision making;
- Applicability across the nation while enabling customization to accommodate the conditions and data sophistication of different localities;
- Benefits to multiple agencies in helping them achieve their goals, resulting in buy-in from those agencies;
- A governance mechanism that enables an entity to champion, update, and improve the system over time;
- The potential for supporting efforts to standardize approaches, data usages, and applications; and
- A mechanism to address security issues.

Suggestions on how to proceed with the implementation of this system included the following:

- Use a collaborative process to develop the system in order to get multiple agency buy-in to the system and ensure its applicability to the needs of multiple agencies, including fulfillment of regulatory requirements, as well as joint conservation planning. Seek collaborative participation of resource and regulatory agencies to develop the system and to enhance their support of the system and its application to their transportation-related decisions.
- Begin by having the resource and regulatory agencies that have invested in GIS platform tools share information about those tools and become familiar with other agencies' tools and initiatives. Identify how these tools have been applied in multiagency, multiresource evaluation efforts.

- Establish a steering committee to work in conjunction with a consultant to oversee the development of the system.
- Conduct an initial scoping of the requirements for tool integration, building on the C06B research on existing data tools.
 - Convene a small-scale “tool summit” and subsequent working sessions with the technical developers and programmers of these tools to identify methods to provide easy access to the tools through an integrated platform. The tasks for these technical experts would be to (1) identify the best aspects of the tools, limits of the tools, and function gaps; (2) ascertain how the tools can address questions germane to transportation and environmental decision making; (3) explore how the tools or a subset of the tools can be used in conjunction with each other through a user-friendly interface; (4) assess the function of the tools relative to the IEF; and (5) identify the top six (or so) existing data tools to be included in the data integration and accessibility system.
 - Assess key information needed by transportation practitioners (e.g., information needed to aid critical stormwater management on a watershed basis, as modeled by the Maryland State Highway Administration’s WRR tool).
 - Obtain and include input from policy-level staff at the resource and regulatory agencies on acceptable uses of available data to inform decisions at key steps in the transportation planning process that can ultimately inform permitting decisions, including guidance on what type and scale of data would be acceptable to use in making which decisions.
 - Convene resource and regulatory agency and DOT and MPO practitioners to review the system and provide feedback on how they can use it.
- Develop a blueprint for backend code to integrate data from various tools into a centralized point of access that maintains the function and design of each tool but allows data to be shared between them. This development must include close collaboration with the developers and programmers of the six data tools.
- Demonstrate how this backend code template can be adopted by different localities throughout the nation for multiagency application to transportation and conservation planning and customized with their preferred user interface.
- Document data gaps that become apparent during the development of the integration assessment system and make recommendations on how to fill those gaps.

- Develop collateral materials and lessons learned to promote and guide use of the data integration and accessibility system throughout the country.
- Connect the data integration and accessibility system with the TCAPP steps.
- Demonstrate and test the data integration and accessibility system in at least two areas, each with different geographic conditions, data availability, and experience with collaborative interagency processes.

Development of the data integration and accessibility system is predicated on various shared assumptions:

- Access to usable data is essential to the consideration of environmental values in early transportation thinking.
- Cross-agency use of existing data tools will increase if user-friendly accessibility, data compatibility, and increased understanding of the role of such data in the transportation decision-making process are all promoted and supported.
- Agencies have invested significant resources in developing data tools, and use of these tools by other agencies is limited by a lack of access and, more importantly, by a lack of awareness and understanding of how and when the data can serve transportation and permitting decisions. Existing tools should be leveraged to improve conservation and transportation decision making.
- Given the differing environmental conditions and regulatory approaches around the country, as well as varying levels of data availability, experience, and expertise, the data integration and accessibility system must be customizable to local needs. Customization will occur through individualized user interfaces developed for local end users.
- The data integration and accessibility system must serve decision making for multiple resource sectors in diverse geographic areas.
- Agencies that have developed existing tools will be more willing to contribute their tools to and use the data integration and accessibility system if they will also benefit from better decision making as a result of this integration, whether for transportation, conservation, or other infrastructure decisions.
- The source of the data (e.g., the agency that collected it) will need to maintain the data.

The initial reaction in the breakout sessions was that interagency peer exchanges are a low priority because these have already occurred and that interagency discussions that are only about developing guidance or that only result in a rehearsing of complaints do not accomplish enough. However, after discussion of the other proposals, breakout groups acknowledged that such interagency exchanges would be a first step in implementing Straw Proposal 1 and should be incorporated as part of a larger plan. The advice was that interagency exchanges should be facilitated and should be action oriented, with an initial focus on integrating data systems and tools and a larger role in promoting the application of *Eco-Logical*, TCAPP, and IEF.

Investment in Fundamental Data That Would Improve Transportation Decision Making While Promoting Better Environmental Outcomes

The DOTs and MPOs expressed interest in new collection of data, especially in geographic areas where data appear to be lacking. Over all, the participants expressed the view that data are important but that investment in data collection, by itself, might not be the best use of funds. The ultimate conclusion was that data gaps would be identified while implementing the development of the integrated data system and while conducting pilots, and that the question should then be addressed as to how to fill these data gaps.

There was general recognition that

- Data are expensive to obtain, especially in a large geographic area. There is always a need for more data, but there is not enough money to gather data on a wide-scale basis, and it is difficult to prioritize what data needs should be filled.
- A lot of data already exists; these data could be made more accessible and used more effectively.
- Data collection needs to be connected to a purpose for the data. Data collected for the sake of collecting data are of low utility if decision makers do not know how and why to apply the data to their decisions.
- There is a need for a consistent, underlying data baseline to support the business process and decision making. Data are needed to identify and support conservation and restoration priorities.
- Data availability is not consistent throughout the nation. There are data-rich and data-poor areas.

- There is a difference between lack of data, lack of awareness of existing data, and lack of ability to access existing data. For example, although data are collected at local and county levels, state DOTs often are not aware of these data. A first step may be to identify what data have already been gathered in the state and at what scale. A question to address is whether the need is for new data sets or for new user mechanisms to access and manipulate existing data.
- The development of data needs to be accompanied by long-term maintenance and clear definition of who is ultimately responsible for the data set.
- Some agencies have systems to manage the data but need to generate data as input to the system; other agencies have data but lack a means to package the data.

Other comments included

- Sources for data problems for regulators and transportation planners include application delay from lack of information; lack of information on cultural resources; lack of information on endangered species; and existing data being out of date.
- A useful subset of a data collection effort could be wetland probability mapping. This mapping, combined with soil attributes as a methodology, would help inform decision making on transportation projects. The methodology would need to apply to the whole nation.

Capacity Building and Marketing Plan

The participants embraced a combination of training and marketing to support the implementation of the *Eco-Logical* approach and the awareness and use of the data integration and accessibility system. There was agreement that there is a lack of knowledge among DOTs, MPOs, and environmental staff of what the ecological approach can accomplish. Teams working in pilot projects need joint training and technical assistance to support the success of the pilots; later, training is needed to carry the learning from the pilots to other areas. Education and training are essential to create change in how the agencies do business together in transportation and conservation planning. A train-the-trainers model is needed to provide sufficient training and education to promote change and to enable practitioners to access data and use tools effectively. In addition to training on the *Eco-Logical* approach and the use of the data integration tool, it was suggested that there is a need for a course on collaborative decision making for decision makers.

The breakout group that developed implementation details related to training and marketing emphasized the role of universities in educating the next generation of practitioners. The merits of university-based training included the following:

- A number of universities already have transportation centers and would be a logical home for courses related to the application of *Eco-Logical*, a consistent protocol for transportation and environmental decision making, and use of the data integration and accessibility system.
- Universities are engaged in training the next generation of practitioners.
- Some of the universities provide applied courses for existing professionals to enhance their expertise.
- Universities are perceived to be unbiased.
- The training could engage nonengineering disciplines, as well as engineering.

There was additional interest in providing regional training to support multiple agencies' local application of the data integration system and other tools within the ecological context.

Participants identified the following needs to achieve the desired educational results:

- The development of training materials to support the use of the data integration and accessibility system and to link this system to the steps identified in the transportation decision-making process. These materials could include a user's guide to ensure proper implementation of the process.
- The development of a curriculum that can be used by universities and condensed to a one-week training program to be delivered to environmental and transportation practitioners on a state or regional basis or for an interagency project team.
- The development and delivery of a training-for-trainers program.

The participants added the concept of marketing to the training and technical assistance proposal, with the recognition that (1) decision makers need to understand the benefits of the ecological approach and to be encouraged to ask the right questions and use the right data for those decisions at key decision points and (2) staff need to know how to access data and use tools effectively. A marketing program was seen as essential to maintain momentum for implementing the *Eco-Logical* approach and continuing to gain support from the *Eco-Logical* signatory agencies. The participants noted that the momentum generated by this multiagency workshop must be sustained to effect the organizational, attitudinal, and procedural changes needed to further institutionalize the *Eco-Logical* approach. An ecological concept

campaign to maintain the momentum could have a “Johnny Appleseed” effect and could include the following:

- Establish a network of practitioners who will promote the use of the *Eco-Logical* approach and the data integration and accessibility system within their agencies and to other potential users. This network should include AASHTO, university transportation centers, nongovernmental agencies, and other relevant stakeholders and should take advantage of the interest expressed by participants in this workshop.
- Tap into AASHTO’s relationship with CEOs and chief engineers of highway agencies; provide a series of webinars through AASHTO, focusing on *Eco-Logical* and the tools that are available.
- Develop and disseminate marketing materials on *Eco-Logical* and the data integration and accessibility system.
- Continue with FHWA’s support to hold regular meetings of the *Eco-Logical* signatory agencies to leverage additional support for the *Eco-Logical* approach and the data integration and accessibility system on an agency-to-agency level.
- Continue with FHWA’s Transportation Liaison and Liaison Manager Community of Practice, through which it will work with practitioners on issues germane to the *Eco-Logical* approach.
- Select and use additional pilots to demonstrate and test the application of the *Eco-Logical* approach and the data integration and accessibility system under different conditions and in different phases of transportation decision making. Use the results of these pilots to promote awareness of the potential benefits from using the *Eco-Logical* approach.

Use of pilots for marketing and adaptive management purposes

The participants generally recognized the value of pilots. The following suggestions emerged related to additional pilots:

- Pilots should be used to move the use of the *Eco-Logical* approach forward on a national basis by (1) selecting pilot projects in which the *Eco-Logical* approach will be applied and that are likely to generate momentum and demonstrate a practice that can be scaled up and transferred to other areas, (2) building a constituency for the process through participation in the pilot, and (3) publicizing the success of the pilot as a means to promote the *Eco-Logical* approach.
- The data integration and accessibility system should be tested and demonstrated through a pilot, with agreement from the relevant agencies to the application of that system in the pilot.

- The WRR has been developed and tested through a pilot; a new pilot could test its transferability and replicability to another area.
- A pilot could target the creation of an integrated network of natural areas (as opposed to protection of individual species) as an application of the *Eco-Logical* approach.
- Pilots would reveal certain types of data that are lacking and could explore different ways to fill those data gaps.
- Pilots and technical assistance have been concentrated in areas that already have capacity, are more data rich, and are innovative; pilots need to be conducted in areas where there is more need, such as where data or data use has been scarce or where the local planning community could use technical assistance to engage in collaborative ecological decision making.
- Technical assistance, such as bringing in a “SWAT team” of expertise, is needed to support the success of the pilots. This is especially important when pilot projects will be in the national spotlight.
- Selection of pilots should take into account the readiness of the DOT and/or MPO to apply a tool or process in an upcoming cycle of decision making.
- Consider small-scale pilots to demonstrate the applicability of the *Eco-Logical* approach and the tools to typical projects or typical decision making. Sometimes the achievements of big projects are discounted because significant financial resources were invested that are out of scale with everyday operations.
- When consultants are part of a pilot, ensure that data that are developed during the pilot become an accessible resource and do not remain solely on the consultant’s computer.
- Pilots could be (1) tool driven, such as the WRR; (2) project driven; or (3) agency driven (e.g., an agency or set of agencies that want to keep moving forward with *Eco-Logical*).
- Pilots could be an extension of an existing pilot (such as the WRR); a grouping of the three Texas FHWA pilots to achieve an economy of scale in applying *Eco-Logical* at a higher level; or doing a combination in another geographic area, such as the Kansas City area (involving the Mid-America Regional Council, Kansas DOT, and Missouri DOT) or the Minneapolis–St. Paul, Minnesota, area. Pilots could focus on a corridor or megaproject, or they could involve a program of small projects or the preparation of a long-range plan; or a state could apply the *Eco-Logical* guidebook to a STIP or a 10-year plan and could work with the data integration tool and the resource and regulatory agencies to come to an agreement on what to avoid, what to protect, and what to restore.

- The results of pilots should be presented to a high-level, interagency group or a multiagency advisory group comprising some private-sector organizations and federal agencies, including FHWA and resource agencies. The interagency or advisory group would give feedback on the pilots.

A primary focus for one or more pilots is to test, demonstrate, and improve the utility of the data integration and accessibility system in different geographic areas of the country, including localities where there has been a history of proactive use of environmental data and localities where environmental data availability and use have been limited. Activities as part of this pilot would include

- Identification of the phases and decision points in the transportation decision-making process in which the pilot locality will focus its application of the data integration and accessibility system;
- Training and technical assistance for relevant local stakeholders on the use and benefits of the system and the various tools integrated within the system;
- Identification of desired outcomes from the application of this system;
- Holding a peer exchange with the WRR team to better understand the successful integration methods used in the WRR;
- Agreement by federal, state, regional, and local transportation, resource, and regulatory agencies and other stakeholders to participate in the application of this system;
- Programming to create a local user interface and to connect that tool to the blueprint designed in the data integration and accessibility project;
- Application of the data accessed through the pilot tool to inform decisions at predetermined decision points or for programmatic decision making;
- Consultation with the WRR team to identify watershed-based conservation, enhancements, and mitigation opportunities and priorities and how to implement stormwater best management practices within the pilot area;
- Documentation of how use of the system influenced transportation, environmental, and permitting decisions and the acceptability of these decisions;
- Identification of data gaps and recommendations on how to address those gaps; and
- Evaluation of the transferability of the tool, including a focus on whether the WRR model adequately addressed stormwater management needs and regulatory requirements.

Next Steps As a Result of the Workshop

The development of the Multi-Agency Data Integration and Accessibility System to Support Implementation of the *Eco-Logical* Approach to Transportation Decision Making will be submitted to SHRP 2 for \$250,000 in the upcoming funding cycle. The use of two pilots to test and demonstrate this system will be submitted to SHRP 2 for \$750,000 funding, to start six months after the start of the data integration and accessibility system project, to allow time for sufficient results from the data integration and accessibility system to be available for adaptation and testing in the pilots.

FHWA, in conjunction with other agencies, will continue to support the *Eco-Logical* approach and engage in activities that deliver the approach to transportation and environmental practitioners.

Appendix E White Paper: Methods to Develop a Crediting Strategy for Transportation and Metropolitan Planning Agencies

White Paper: Methods to Develop a Crediting Strategy for Transportation and Metropolitan Planning

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THE INSTITUTE FOR NATURAL RESOURCES

Created by the Oregon Legislature through the 2001 Oregon Sustainability Act, the Institute for Natural Resources' mission is to provide access to integrated knowledge and information to inform natural resource decision making and develop solutions in the context of sustainability.

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Acknowledgments

The authors thank Nicole Maness of the Willamette Partnership, Chris Hartley of the USDA Office of Environmental Markets, and Mike Ruth of Federal Highways for their edits to this document.

The authors also recognize the work of Philip Womble, Shara Howie, and Jessica Wilkinson in the unpublished Task 2 submission for the NCHRP 25-25 project, which provided the basis of much of the included information on state practices. The authors also recognize the support of the Transportation Research Board of the National Academy of Sciences.

Disclaimer

The contents of this white paper reflect the views of the authors, who are solely responsible for the facts and accuracy of the material presented.

This white paper does not constitute a standard, specification, or regulation.

Methods to Develop a Crediting Strategy for Transportation and Metropolitan Planning Agencies

Background

The Integrated Ecological Framework (IEF) is an ecological assessment process and framework to integrate conservation planning and transportation planning. The nine-step IEF

- Takes into account the barriers transportation agencies experience when working to implement ecological approaches to transportation planning and considers the scientific and technical processes needed to implement ecological approaches.
- Brings together a variety of well-tested methods, data, and tools into a cohesive ecological assessment framework.
- Takes into account regulatory assurances for resources regulated under the Clean Water Act (CWA) and the Endangered Species Act (ESA).
- Provides guidance about how transportation agencies could develop and use ecosystem crediting systems and markets.

For each step in the IEF, critical data needs and tools that could greatly facilitate implementation of the framework were identified. The IEF is a congruent technical framework to the [Eco-Logical](#) approach, developed by eight federal agencies in 2006, which recommends a collaborative, integrated, watershed- or ecosystem-scale approach to decision making during infrastructure planning, environmental review, and permitting. . (See Attachment A for an outline of the steps for the research community.)

One of the steps of the IEF is to develop a crediting strategy (Step 6; see Attachment B) that is designed to take advantage of what was thought to have been the rapidly emerging development of crediting information and tools. The ecosystem services crediting methodology is the part of the IEF needing the most additional development to make it easily usable and meaningful to transportation agencies; the focus of this paper is to identify the ways in which this development can be most effectively done.

Ecosystem Services Introduction

The ability to measure and value the services provided by the environment holds great promise for society's ability to ensure these services are maintained over time. In 2008, Congress directed the Secretary of Agriculture to facilitate the development of environmental markets and ensure the participation of America's farmers, ranchers, and forest landowners. The U.S. Department of Agriculture (USDA) established the [Office of Environmental Markets](#) (OEM) to work across government and in

consultation with experts and stakeholders to build market-based systems for quantifying, registering, and verifying environmental benefits produced by land management activities.

Ecosystem services are commonly defined as benefits people obtain from ecosystems. The [Millennium Ecosystem Assessment](#) (2005), a four-year United Nations assessment of the condition and trends of the world's ecosystems, categorizes ecosystem services as follows:

- *Provisioning services*, or the provision of food, fresh water, fuel, fiber, and other goods;
- *Regulating services*, such as climate, water, and disease regulation as well as pollination;
- *Supporting services*, such as soil formation and nutrient cycling; and
- *Cultural services*, such as educational, aesthetic, and cultural heritage values, as well as recreation and tourism.

As population, income, and consumption levels increase, people are putting greater pressure on the natural environment to deliver these benefits. The Millennium Ecosystem Assessment, prepared by a group of over 1,300 international experts, found that 60% of ecosystem services assessed globally are either degraded or being used unsustainably. Seventy percent of the regulating and cultural services evaluated in the assessment are in decline. Millennium Ecosystem Assessment scientists predicted that ecosystem degradation could grow significantly worse in the first half of the 21st century, with important consequences to human well-being.

Considering ecosystem service values, costs, and benefits is an efficient way to consider both impacts and improvements to the environment, and as such can represent a new way for transportation agencies and regulatory agencies to address unavoidable losses and associated mitigation.

Ecosystem Services and Transportation

Ecosystem services measurement and crediting tools can improve the transportation planning and implementation process in two ways. First, they improve the process of mitigating environmental impacts by reducing transaction costs, improving environmental outcomes, and shortening the time needed to implement projects. The majority of this white paper provides a discussion of the best way for departments of transportation (DOTs) and metropolitan planning organizations (MPOs) to take advantage of newly developed or developing methods and tools.

Second, these methods and tools can benefit transportation agencies by aiding the development of environmental performance measures that can be incorporated throughout the transportation planning process. In this case, environmental performance measures often require the same information needed to measure ecosystem services. There are several examples of work that have been done to design

these measures. For example, as a result of the Oregon DOT's success in using performance measures in the Oregon Transportation Investment Act Bridge Delivery Program, the department was tasked by the state legislature in 2008 to include environmental performance measures in their state transportation improvement plan (STIP). The goal was to use more general measures describing environmental outcomes related to projects to ensure they always achieved the most effective avoidance and minimization in the planning and design phases. Oregon DOT is currently finalizing these internally with their senior management team, after which they will make them available to the general public.

Ecosystem Services Crediting and Mitigation

Ecosystem service credits are essentially units of environmental benefit. [Credits](#) are created through the conservation or high-quality restoration of naturally functioning ecosystems. They represent the quantification of things ranging from provision of clean water for community drinking supplies, to pollination of agricultural crops, to sequestering carbon to help mitigate climate change. Of these, carbon, water quantity and availability for drinking and irrigation, endangered species, and water quality are the closest to having established crediting systems or methodologies available for DOTs and MPOs. Tools for water quality crediting, particularly for nitrogen, phosphorus, and temperature, are well along in development; tools for addressing erosion and stormwater crediting still need extensive work and may need to be a priority for transportation research.

Using an ecosystem services approach to mitigation requires two components: (1) methods and protocols to quantify units of environmental benefit (credits) or impact (debits) and (2) a crediting framework in which regulatory agencies and stakeholders agree to a common set of standards and operating procedures that govern how credits and debits can be used to meet mitigation requirements. Transportation planners should develop a crediting framework or strategy to provide consistent methods or tools to measure ecological impacts, restoration benefits, and long-term performance at the project level. By doing this, planners can align mitigation objectives and have greater efficiency and proficiency in identifying mitigation and restoration opportunities that address multiple ecosystem services. Accurately measured project impacts and mitigation site benefits can be more

The objective of a crediting system is to create a strategic, analytic approach to compensatory mitigation, resulting in improved environmental outcomes and faster project approvals.

readily converted into credits. Standards and procedures agreed to a priori can expedite regulatory approval.

When proposed for permitting under the terms of the CWA (Section 404) and ESA (Sections 7 and 10) programs, many transportation, infrastructure, and development projects cannot avoid impacts to wetlands, streams, and the habitat of sensitive species. In

these cases, state and regional transportation agencies must work with federal and state regulatory agencies to avoid and minimize adverse impacts to aquatic resources and habitat. Environmental performance measures can assist in ensuring this happens.

Although ecosystem services crediting can provide many benefits and opportunities in developing conservation and restoration plans, transportation agencies and MPOs attempting to work through the IEF only need to address the ecosystem services that are protected by current regulations. Once an MPO or DOT develops or adopts quantification tools and protocols for regulated services, they could choose to implement them for some of the unregulated services.

After impacts to aquatic resources and habitat are avoided and minimized as much as possible, transportation agencies are required to compensate for unavoidable impacts to these resources. Compensation, or compensatory mitigation, is both expensive and time-consuming, and often results in suboptimal environmental outcomes. However, if done correctly, it can be an important method of maintaining healthy, economically valuable ecosystems.

The objective of a crediting system is to create a strategic, analytic approach to compensatory mitigation. It addresses site design and selection and should include a robust analysis of the suite of data on the watershed or landscape for which the compensatory mitigation project is being proposed. Much of this work has been described in earlier steps of the IEF. However, when it is related to mitigation (whether applied through a mitigation or conservation bank, an in-lieu fee program, or another compensatory mitigation mechanism), planners whenever possible should seek to characterize a watershed or ecosystem's functions.

The presence of a local set of measurement or crediting tools should not determine if a DOT or MPO attempts to create a crediting system. Rather, if there are significant impacts to wetlands, streams, rivers, or endangered species, significant cost benefits can be obtained by implementing a crediting program.

Although there is often some confusion between *functions* and *ecosystem service values*, in general the differences do not affect transportation planners. However, when dealing with wetlands and streams, the regulatory community has chosen to require both the functions and values to be maintained or replaced (Stokstad 2008). Therefore, in siting and designing compensatory mitigation projects, it is necessary to ensure the site will improve the overall condition of a hydrologic or ecological unit and will provide at least the important functions. In summary, to be effective, these regulatory approaches to compensatory mitigation must at least consider the entire array of multiple ecosystem functions or services that must be addressed under the current regulatory framework.

Many states have developed or are in the process of developing mitigation programs and programmatic agreements to address wetlands; a few states have been developing similar programs for endangered species. It is also possible to create crediting tools for transportation by working with regulators to develop methods to measure, map, and value services such as stormwater improvement, total maximum daily load, or CWA, Section 303(d) nutrient abatement.

Trading can lead to programmatic agreements and preapproved mitigation areas with established credits for multiple credit types.

A set of standard methodologies are needed to enable transportation agencies and MPOs to measure the

Information developed for both the crediting system and programmatic agreements are going to be almost identical.

ecosystem services and functions being lost from project impacts or gained from rehabilitation. At this point, almost all ecosystem crediting work has been done locally or regionally, rarely across a state and almost never across multiple states. It is unclear if the tools and processes developed to measure ecosystem services or convert them to credits for specific regional projects would be applicable in or transferable to different geographies. OEM and other groups supporting environmental market development are working to create effective tools and methods that can be modified on the basis of different ecosystems, services, and partners.

Some of the groups creating methods and tools, such as the Willamette Partnership, are working together with guidance from OEM to share the work and create standardized guidelines for methods and tools. OEM is currently working with partners on a variety of projects. Examples include the Natural Resources Conservation Service's award of conservation innovation grants for market development. These projects will serve as launching points for regional market development. Last fall, OEM and the Willamette Partnership created a document called "[In It Together](#)," which is aimed at providing

guidance for groups interested in building water-quality trading programs across the country. OEM believes that markets support environmental improvement in a cost-efficient manner, and working with partners is one approach to create consistent tools and guidance. Transportation agencies or MPOs may benefit by creating tools specific to promoting multiple services mitigation banking and programmatic agreements.

Currently, because of the degree to which existing mitigation has failed to meet conservation objectives, regulatory agencies have identified the need to use a watershed approach for mitigation (Stokstad 2008). The use of landscape measures, conservation priorities, and the evaluation of multiple services and functions can help identify mitigation sites where environmental outcomes will be improved. This practice should lead to more rapid regulatory approvals and simpler programmatic agreements.

Developing a regional mitigation strategy can be effective without a crediting protocol. The Maryland Watershed Resource Registry (created by the U.S. Environmental Protection Agency [EPA] and the U.S. Army Corps of Engineers [USACE] in Maryland) and Virginia's Wetland Restoration and Mitigation Catalog (created by the Virginia Department of Conservation and Recreation) both include functional wetland assessments to develop priorities for mitigation sites. Other models from California, Oregon, North Carolina, and other states strategically identify priority compensatory mitigation sites, although the Maryland and Virginia methods are the most integrated into the needs of CWA regulators regarding both Section 404 and 401 permitting (Weber and Bulluck 2010; Bryson et al. 2010).

Regardless of federal policy in this area, the tools and methods being developed in leading states can be used across the country; modifying the measures to address different local regulatory drivers is not complicated. For example, in the Pacific Northwest, most total maximum daily loads and water quality issues related to transportation (and public sewage systems and power generation) must focus on water temperature; in contrast, nitrogen and phosphorus pollution are the primary drivers of water quality issues in the Ohio River Basin. Though there may be specific tools required to measure stream shading in the Northwest that are not needed in the Midwest, the majority of the water quality measuring tools can be modified to work in either geographic location.

The presence of a local set of measurement or crediting tools should not determine whether a DOT or MPO attempts to create a crediting system. Rather, if there are significant impacts to wetlands, streams, rivers, or endangered species, significant cost benefits can be obtained by implementing a crediting program. Basically, these programs can be the basis of a programmatic agreement, and information developed for both the crediting system and the programmatic will be almost identical.

USDA's Office of Environmental Markets

OEM is tasked with establishing uniform guidelines for the development of science-based methods to measure the ecosystem services benefits from conservation and land management activities. OEM also works to facilitate the participation of farmers, ranchers, and forest landowners in environmental markets, which may include water quality trading, species banking, wetlands mitigation, greenhouse gas reductions, and carbon offsets. OEM facilitates environmental market efforts within USDA and across federal agencies to quantify environmental benefits and increase conservation.

Much of OEM's work has focused on the development of tools and metrics to quantify ecosystem service benefits. Quantifying these services is a challenging, but necessary, element to environmental markets and serves as the basis for creating units of trade. The nutrient tracking tool (NTT) is one example of a quantification tool that OEM is helping to develop. NTT quantifies on-farm losses of nitrogen, phosphorous, and sediment in waterways as a result of implementing best management practices. NTT can be applied across the country, and the number of watersheds parameterized for the tool is increasing. OEM is also involved in creating recommendations to integrate existing greenhouse gas models and is developing frameworks to support measurement of biodiversity and ecological integrity outcomes.

OEM works with partners to create guidance documents and case study examples of market development across the country. In addition to "In It Together," OEM worked with the Willamette Partnership to create "[Measuring Up](#)" in 2011, which outlines ways to standardize systems for measuring outcomes of biodiversity incentive programs and provides options for federal agencies. OEM also partnered with Forest Trends to develop "[Farm of the Future](#)," which profiles working farms, forests, and ranches that are participating in environmental markets or receiving payments for ecosystems services. These guidance documents can serve as useful references as the transportation sector becomes more involved with environmental markets.

Although OEM is involved with markets across the United States, it is heavily invested in Chesapeake Bay market development, and leads both a USDA working group and an [interagency team](#) aimed at facilitating environmental markets in the Chesapeake Bay area. These groups coordinate actions and create guidance and infrastructure for market development. One example is the USDA's partnership with the World Resources Institute to develop a platform for interstate water-quality trading in the Bay. This platform, called NutrientNet, reduces market transaction costs, standardizes calculations of nonpoint source reductions, and improves public participation and oversight.

OEM provides training courses, workshops, and outreach to engage stakeholders and build relationships as ecosystem markets continue to develop and grow. The office can serve as a resource for information related to ecosystem services crediting in transportation and should be targeted for engagement in creating guidance for involving the transportation sector in environmental markets on a national scale.

Examples of Current Use of Ecosystem Services Crediting in Transportation

Active programs to develop crediting for ecosystem services in transportation are under way in California, [Maryland](#), [Minnesota](#), [North Carolina](#), [Ohio](#), and Oregon; these programs are discussed individually below. Almost all of them are willing to share methodologies and tools. [The Bay Bank](#) (Chesapeake Bay), [Willamette Partnership](#), [The Natural Capitol Project](#), the [United Nations Environment Program](#), and [Earth Economics](#) all provide guidelines and program implementation examples and guides.

California

For a number of years, California was the only state with an active climate registry. The California Climate Action Registry was a voluntary organization created to promote early actions to reduce greenhouse gas emissions; the effort ended in 2010. Currently, California has the most extensive endangered species banks and trading systems in the country, many of which are established to meet the requirements of both the federal ESA and those of the California Environmental Quality Act. The most relevant projects for transportation may be the regional advance mitigation planning (RAMP) and statewide advance mitigation initiative (SAMI) programs. RAMP is a collaborative multiagency group charged with developing a statewide strategy for long-term conservation. SAMI is also a collaborative multiagency effort to implement advanced project mitigation through the preservation or restoration of acquired lands that meet multiple conservation objectives. These efforts will be achieved through the establishment of mitigation banks, conservation banks, and/or in-lieu fee programs. Memorandums of understanding have been signed by various agencies for collaboration that have fostered the institutional support to work collaboratively internally and externally to develop this initiative.

Maryland

There are a number of ongoing programs in Maryland that provide an opportunity to develop a crediting framework, although neither a statewide nor a regional program has been developed to date. The Chesapeake Bay restoration effort and work by the [Bay Bank](#) provide opportunities for private landowners. Also promising for the Maryland DOT and MPOs is the [Watershed Resources Registry](#), a statewide set of prioritized spatial data compiled by USACE and EPA that describe the significance of the

different resources (Bryson et al. 2010). Because these data were developed by the regulatory agencies, it is likely they would be accepted as part of a statewide programmatic agreement. The Watershed Resources Registry does not develop a credit system, but focuses on identifying mitigation and restoration opportunities, needs, and priorities within each watershed in Maryland. Maryland also has created a partnership between the Maryland DOT; the Departments of Natural Resources, Planning, and Agriculture; and the Governor's Office to create a [Smart, Green and Growing](#) program that outlines state priorities via a [Greenprint](#), along with efforts to restore habitats and address stormwater and other related concerns. These pieces are largely the same ones required to provide the first steps of a crediting framework.

Minnesota: Wetland Restoration Strategy and Rapid Assessment Method

Minnesota has several innovative plans, tools, and regulations in place that could support the incorporation of ecosystem service considerations into compensatory mitigation site selection and design. In 2009, several state agencies joined to release a unified wetland restoration strategy. Ecosystem services values are a central component of the strategy, though the strategy does not provide specific methods to incorporate these values into mitigation site selection.

Minnesota has also completed a Restorable Wetlands Inventory (RWI) in the state's prairie pothole region and uses geographic information system terrain analysis in the remainder of the state to identify restorable wetlands. The RWI is a collaborative effort between numerous state, federal, and local partners to map drained wetlands on the basis of county soil survey hydric soils data, USDA Farm Service Agency compliance slides, U.S. Geological Survey topographic maps, and National Wetlands Inventory maps. However, RWI and the state's other efforts to prioritize wetlands for restoration do not explicitly incorporate ecosystem service benefits (Minnesota Board of Water and Soil Resources 2009).

Minnesota also has a comprehensive freshwater wetland permitting program that explicitly encourages the selection of compensation sites based on landscape-scale consideration of watershed needs and ecosystem functions. Much like the 2008 Federal Compensatory Mitigation Regulations, Minnesota's wetland regulations 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 provide a suite of functions" (2010 Minnesota Wetland Conservation Act). 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 percentage of presettlement wetlands intact in a county or watershed. Minnesota's regulations support selection of higher-quality compensatory wetlands by explicitly requiring consideration of a suite of landscape features that influence wetland function and by promoting offsets that occur in high-needs watersheds or counties (2010 Minnesota Wetland Conservation Act).

In addition to the tools discussed above, Minnesota has in place a state-specific wetland rapid assessment method (MnRAM) that allows for more detailed field-based measures of a wetland's functional and economic value. MnRAM allows regulators to provide subjective ratings of a compensatory wetland's value for ecosystem services such as flood and stormwater storage, downstream water-quality protection, shoreline protection, habitat value, and recreational and commercial uses. MnRAM is used both in assessing potential wetland compensatory mitigation sites and in subsequent evaluation of mitigation sites for regulatory compliance with performance standards. The main wetland restoration prioritization tools and methods used in Minnesota (i.e., the wetland restoration strategy and state regulations), however, seek to guide wetland protection and restoration projects to previously drained wetlands and do not specifically institute more detailed consideration of specific ecosystem functions or services that can be evaluated using MnRAM (Fennessy et al. 2004).

North Carolina

[North Carolina](#) has implemented an ecosystem enhancement program (EEP) that is entirely funded by the North Carolina DOT. EEP, which is part of the state's Department of Environment and Natural Resources (DENR), works with watershed groups throughout the state to establish restoration and mitigation priorities, creating the equivalent of a statewide program for CWA issues. This overlap is possible because DENR also administers the state's water quality program. Although ESA issues are not an important part of EEP, the North Carolina Natural Heritage Program, which manages ESA location information for the state, is also part of DENR and provides information to the EEP office to ensure that state ESA priorities are at least addressed in the restoration priorities. In 2001, North Carolina DOT reported that 55% of its transportation developments were delayed by wetland mitigation requirements. After ramping up streamlined transportation planning and mitigation through EEP, there were no delays in transportation improvement projects associated with EEP (Venner 2010).

As a partnership between North Carolina DOT and DENR, EEP works well for stream and river impacts. Using a watershed framework, they equate all of these impacts to a programmatic agreement and address the ecosystem services provided by these streams. EEP Deputy Director Michael Ellison, who

presented at the recent Conference for Ecosystem Services in Florida, was asked if additional regulated resources, such as wetlands or endangered species, could be included in the EEP. His view was that EEP's existing agreement with North Carolina DOT and the compensatory nature of their agreement made it impossible to address different services. Research into the barriers preventing the development of an ecosystem services state program to address multiple services in a programmatic, regulatory framework is needed. In spite of EEP's success, the new Secretary of the North Carolina DENR has stated in the past that it competes with the private mitigation banking industry in an unfair way and should be eliminated.

Ohio River Basin Trading Project

The [Ohio River Basin Trading Project](#) is a nutrient trading program developed as a comprehensive approach implementing a nitrogen and phosphorus credit market. The program was designed to allow exchanges of water quality credits for nitrogen and phosphorus and to create a viable market for the credits. The ecological objective was to protect or improve water quality for lower overall costs in the watersheds of the Ohio River Basin. The Electric Power Research Institute coordinates the Ohio River Basin Trading Project on behalf of the power companies, with additional funding support from municipal wastewater treatment facilities and other local, state, and federal agencies.

Oregon and Willamette Partnership

The Oregon and Willamette Partnership, a program for addressing ecosystem services at the Oregon DOT, is summarized by Achterman and Mauger (2010). However, the most current and potentially useful work related to an overall crediting system for transportation is a set of overlapping projects undertaken by the Willamette Partnership. The work was initially focused on Oregon's Willamette Basin, but has expanded to the rest of Oregon and some of Washington State. The project is focused on expanding the protection and restoration of ecosystem services by using planning products and decision support tools that model the economic value of natural processes under different development and conservation scenarios. To date, the Willamette Partnership has developed one of the most advanced and comprehensive structures to integrate the economic values of ecosystem services into multiple regulatory programs requiring compensatory mitigation.

The Willamette Partnership is a 501(c)3 nonprofit organization focused on developing markets based on detailed accounting procedures for multiple types of ecosystem service credits. It has worked to create science-based ecosystem service quantification methods in partnership with regulatory agencies and

with agencies needing ecosystem credits. The process, called Counting on the Environment, is a multistakeholder agreement to use a shared accounting system for quantifying impacts and benefits to ecosystems in a markets-based and/or mitigation banking system. The quantification methods and associated crediting protocols are designed to measure the functions and values associated with improvements and impacts to separate ecosystem services. Tools for measuring improvements and damages to wetland habitat, upland prairie habitat, sagebrush and sage grouse habitat, salmon habitat, nitrogen and phosphorus loadings, thermal pollution offsets, and stream conditions have been developed. Several site-based calculation methods have already been approved by state and federal regulators, including those for salmon, prairie, wetlands (the Oregon Rapid Wetland Assessment Protocol, or ORWAP), and water temperature.

The Willamette Partnership is currently working with Oregon DOT and the Oregon Department of Fish and Wildlife to develop the quantification tools and protocols needed to pilot a mitigation banking approach to meeting fish passage requirements for Oregon DOT projects. Results from the pilot will be available for review in June 2014.

The Willamette Partnership's general crediting protocol, which provides the rules for using the ecosystem service accounting system, references priority areas for ecological improvements to salmon habitat, prairie habitat, wetland habitat, and water temperature impairments. The Partnership identifies priority rivers and streams for improved salmon habitat based on National Marine Fisheries Service 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 wetland priorities identified in the synthesis map, in areas surrounded by high-function wetlands as determined by ORWAP, or in wetland complexes with the highest restoration and mitigation scores in the newly developed state wetlands coverage (Willamette Partnership 2009).

The synthesis map was produced through a partnership of conservation groups, academics, and government agencies, including Oregon State University, the Oregon State Institute for Natural Resources, and the Willamette Partnership. It identifies priority terrestrial and freshwater sites for conservation and restoration within each subwatershed of the basin. In order to include wetland restoration and protection priorities, the partners needed to update the wetlands data set for the basin, which was a significant undertaking.

The two major components of the synthesis map are (1) probable species distribution maps for three endangered plants and an endangered butterfly that occur on wetlands and upland prairies in the

Willamette Valley (Achterman et al. 2011) and (2) data developed in support of the recovery efforts for threatened fish in the basin, most notably salmon.

Because the primary wetland compensatory mitigation activity is wetlands restoration, the project also developed a [wetlands restoration planning tool](#) that helps users identify the most appropriate sites and wetland types to target for restoration. Data sets used in the tool include the statewide wetland layer, rare wetlands, restoration targets based on eight-digit hydrologic unit codes, locations of wetland mitigation banks and wetland reserve program sites, wetland priority sites for the Willamette Valley, and hydric soils.

The Natural Capital Project, a joint research initiative between Stanford University, the University of Minnesota, The Nature Conservancy, and the World Wildlife Fund, aims to develop and promote tools to integrate the value of ecosystem services into environmental decision making. The project has evaluated ecosystem service values throughout the Willamette Basin and has produced one of the first published applications of a spatially explicit modeling tool called InVEST (Integrated Valuation of Ecosystem Services and Trade-offs) that places a monetary value on ecosystem services valuation (Nelson et al. 2009).

Much of the completed work by the Willamette Partnership was funded primarily with the Natural Resources Conservation Service's conservation innovation grant dollars, which are meant to help create markets for ecosystem services. Mitigation activity and planning were thus driven by a markets approach, which tends to demand both transparent criteria for measuring environmental improvements and damages and an assessment of benefits associated with alternative mitigation outcomes.

Regulatory Constraints and Institutional Barriers

Local Government Issues with State, Regional, and National Crediting Systems

In some jurisdictions, statewide, large watershed, or regional crediting strategies or conservation frameworks identify mitigation banks and restoration priorities that occur outside local jurisdictions, which means that local governments sometimes see these efforts as reducing their opportunities to conserve open space, wetlands, and the amenities associated with these lands. As a result, local opposition, especially in communities where local jurisdictions have significant regulatory authority, can become a barrier to implementation of crediting and advanced mitigation. There have not been many studies examining this, but recent work in Oregon (in the city of Gresham and in the water management district for the Tualatin watershed) demonstrated that a major obstacle to scaling down prioritization from the statewide level to local levels is a lack of equivalent data sets. This is an issue because many of

the characteristics needed to identify mitigation priorities that may be available at the local level, such as species distributions linked to stream reaches, are not available for entire watersheds. Several means to solve the data issue are recommended, including coordinating regional data collection efforts with local efforts and creating incentives to get local jurisdictions to provide updates on attributes such as wetland boundaries to state agencies and groups working on developing regional priorities.

Aside from barriers related to the scale and availability of information, there can be real issues when areas best suited for restoration and mitigation are located within a watershed but outside the jurisdiction where mitigated losses are occurring. Initially, regulatory agencies are likely to focus almost entirely on the ecological replacement and restoration needs. Eventually, however, an ecosystem services framework is perfectly suited for addressing these issues, because increased property values due to adjacent open space or recreational opportunities could be included in the analysis that identifies priority mitigation sites.

Regulatory Constraints

Most of the regulatory constraints related to developing or implementing a crediting protocol result from traditional regulatory barriers. Most, if not all, regulatory agencies are interested in moving to functional approaches that allow for more effective and efficient mitigation projects. However, many regulators are so overwhelmed with current permit processing tasks that they find it impossible to find or make the time to implement a new approach, even if it were faster and more efficient. In this case, sharing already implemented projects from elsewhere in the agency may overcome this barrier. The priorities that the Office of Management and Budget and the Council on Environmental Quality have established to focus on streamlining while improving environmental outcomes have the potential to address this issue, as well.

Funding and Organizational Barriers

One of the biggest institutional challenges both to creating a regional ecosystem framework and to developing a debit and crediting system for services is convening the transportation and resource agencies and deciding on who will lead, maintain, update, warehouse, and track transactions and fund such an effort (Institute for Natural Resources et al. 2012). This problem results from agency silos and occurs at both the state and federal levels. A regional or watershed conservation strategy with goals and objectives would be “owned” by EPA, the U.S. Geological Survey, the U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, and other agencies. Current agency cooperation mostly involves communicating what each agency is doing; rarely, such as in the Landscape Conservation Cooperatives, do two agencies in the same department

work together. In addition, mechanisms for integrating watershed- or local-scale priorities, methods, or plans into statewide or regional priorities, methods, or plans rarely exist, and almost never in state or federal government agencies.

Summary and Conclusions

A significant amount of work is clearly needed before a straightforward methodology for creating a transportation-centric crediting program is widely available. However, the successful programs in Oregon, California, North Carolina, and Minnesota all have a number of attributes in common. First, the states created programs cooperatively with the regulatory agencies, state and nongovernmental conservation programs, any people actively involved in mitigation banking, and the state and federal agencies and foundations interested in funding restoration activities. There were various ways the different programs used to engage these stakeholders, but all engaged them early and often. In addition, most successful programs have included many of the components identified in the IEF, including the development of some type of comprehensive conservation strategy for the state, watershed, ecoregion, or area in which the crediting system is to operate.

In general, because developing a crediting system related to regulated services is so complex, most existing programs limited themselves either to a single service (generally endangered species, wetlands, or streams) or to a specific set of projects in a location (e.g., the Oregon Bridge Project). There are a few programs, most notably the general crediting protocol of the Willamette Partnership, that work to develop a crediting system addressing transportation needs and multiple services. However, it appears likely that it will be a number of years before any program can provide meaningful guidance regarding a comprehensive crediting program for state DOTs or MPOs.

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Attachment A Steps for the Research Community

The information in this section is from the [NCHRP 25-25 Task 67 final report](#) on ecosystem services and mitigation, which outlines the steps for the research community. The third recommendation may be the one that is most relevant for transportation research.

It is important to understand mitigation's implications (via effects on ecosystem services) for households, communities, and other stakeholders. Social evaluation of ecosystem service outcomes requires two basic things: (1) ecosystem service outcome or evaluation measures that allow for social, economic, and policy interpretation; and (2) the application of economic valuation or evaluation methods to assess the benefits of a change (gain or loss) in ecosystem services. Research in the following four areas will support further advancements in effective mitigation:

1. Identify the right ecosystem service measures.

The centerpiece of ecosystem service-oriented mitigation policy is the definition, measurement, and evaluation of *ecological endpoints*. Biophysical production function studies should relate wetland mitigation actions to a specific, consistent set of outcome measures referred to as ecological endpoints. Ecological endpoints are a distinct subset of the larger universe of biophysical outcome measures. By definition, ecological endpoints facilitate evaluation that can be expressed in social, economic, and policy terms. Ecological endpoints are biophysical outcome measures that require little further biophysical translation to make clear their relevance to human welfare. These endpoints are the essential bridge between biophysical and economic assessment.

Progressive planning and assessment requires the measurement of ecosystem service outcomes whose value or importance can be meaningfully debated by stakeholders or detected by social scientists. In practice, this means choosing outcomes that are comprehensible and meaningful to nonscientists. Unfortunately, many of the most common mitigation outcome and assessment measures in current regulatory use do not directly facilitate or allow for economic evaluation. Outcomes like biotic integrity indices, chemical water-quality concentrations, hydrogeomorphic classifications, and biological productivity are of scientific interest, are related to ecosystem services measurement, and establish the scientific basis for accurately modeling ecosystem functions and services. But without more intuitive and tangible measures of these benefits, stakeholders cannot evaluate and communicate their social value.

2. Support more economic valuation studies.

Economic and social evaluation is built around analysis of biophysical production, more specifically, changes in biophysical production. If ecological evaluation can describe the relationship between

mitigation interventions and the suite of subsequent changes, the economic benefits (or costs) of those endpoint changes can be evaluated. By design, endpoints are meaningful to decision makers and society generally. This means that changes in those endpoints can more easily lead to economic evaluation and valuations.

3. Develop benefit transfer capabilities and data.

It is usually not practical for mitigation planners to conduct original, site-specific studies of a wetland's economic value. Such studies are expensive and time-consuming and require special statistical skills. A cheaper alternative is to conduct benefit transfer studies. The benefit transfer method takes the results of preexisting valuation studies (conducted by academics, agencies, and nongovernmental organizations) and applies the dollar estimates to new environmental contexts. For example, if existing studies show that certain wetlands are worth \$500/acre, benefit transfer studies ask whether wetlands in a new context are worth more or less than \$500/acre. The challenge for benefit transfer methods is that the value of wetlands (and the ecosystem services they provide) is highly dependent on the physical and social context in which they arise. Note that this is the primary motivation for pursuing the progressive mitigation concept. For the analyst, benefit transfers require methodological and conceptual sophistication. In order to judge the relevance of a particular study to a new site, it is necessary to know how comparable those sites are. Like any benefits, environmental benefits are a function of scarcity, substitutes, and complements. To transfer benefit estimates to new sites, it is necessary to adjust for these kinds of factors.

4. Conduct research on nonmonetary approaches to social evaluation.

Monetary valuation requires the use of methods that substantially add to the planner's assessment burden. Most decision makers also find econometric tools excessively complicated, which can undermine trust in economic assessment and limit the application of economic arguments in certain decision contexts. An alternative approach is the use of quantitative ecosystem benefit indicators (EBIs). EBIs are quantifiable features of the physical and social landscape that can be used to evaluate ecosystem benefits and relate to and describe the value of endpoint changes. They can usually be derived easily from existing geospatial data sets. EBIs relate ecological endpoints with data on the endpoint's scarcity, substitutes, and complements and with rough measures of the populations and economic activities they support.

Attachment B Integrated Ecological Framework, Step 6

These are the updated pages from the draft *Managers Implementation Manual* developed as part of the C06 outreach project. They are included here to provide additional guidance.

STEP 6. Develop a Crediting System

Purpose

Develop a consistent strategy and metrics to measure ecological impacts, restoration benefits, and long-term performance at the project level to ensure consistency with mitigation objectives and to allow for greater efficiency in identifying mitigation and restoration opportunities that address multiple services and impacts.

Outcomes

- Improve and integrate the mitigation sequence at a site level through avoidance and minimization, after which outcome-based performance standards can set the stage for compensation.
- Accelerate project implementation and improve mitigation outcomes.
- Reduce the transaction costs for mitigation and restoration.
- Support implementation of advanced mitigation, mitigation banks, and programmatic permitting and agreements.
- Support use of off-site mitigation and out-of-kind mitigation where appropriate, as equivalency of value can be determined across locations and resources.
- Inform adaptive management and updates of the cumulative effects analyses.
- Balance gains and losses of ecological functions, benefits, and values associated with categories of transportation improvements or specific project-related impacts.
- Provide the means of tracking progress toward regional ecosystem goals and objectives (assumes site-level ecological metrics are correlated to the landscape-level tools used to define the regional ecosystem framework [REF]).
- Characterize project mitigation benefits related to currently unregulated services, such as carbon storage or late-season water provision, which could provide additional funding for mitigation or could affect selection of mitigation sites.

Prerequisites to Conducting Step 6

- Regional mitigation strategies and other parts of Step 5 can significantly reduce the time and effort involved in this step.
- Many states have function- and service-based inventory methodologies included in their regulatory framework (such as rapid wetland assessment protocols) that have been developed to measure current functions and services. When adopted by the regulatory agency, these can provide a critical head start in this process.

Implementation Steps

- 6a. *Evaluate the effort to be included in this step.* Although ecosystem service measurement and crediting tools are being rapidly developed across the country, their adoption and the methods, tools, or markets they require may not exist in all areas, and therefore implementing such a program may be too costly or time-intensive. To determine whether to adopt or implement the program under consideration, the easiest method is to evaluate the plan (anything from a STIP, corridor, or project plan works) to determine if the project or projects are likely to have significant intersection with regulatory resources, particularly streams, rivers, wetlands, or endangered species. If the work in Steps 1 to 5 indicates that significant mitigation requirements are likely, developing a crediting system is likely to be both beneficial and cost-effective.
- 6b. *Diagnose the measurement need.* Define which ecosystem services need to be measured, or which could be beneficial and straightforward to measure. This includes examining the regulated ecological services potentially to be affected by transportation projects in the watershed or REF area, as well as other nonregulated resources that may be important within the ecological setting. Wetlands often provide multiple services, and so can be somewhat difficult to measure, but CWA services, including stormwater, temperature, and nutrients, are often affected by projects, and with a crediting protocol developed and accepted, mitigation can be faster and provide better ecological outcomes.
- 6c. *Identify ecosystem crediting platforms or protocols developed within the region and evaluate their ability to be used in the REF ecosystems and landscapes.* Currently, extensive frameworks have been developed in California, Oregon, the upper Midwest, and the Chesapeake Bay area. New work is ongoing in many other areas of the country, and state and regional protocols can be found on the Ecosystem Commons portal (<http://ecosystemcommons.org>) or the [Ecosystem Marketplace](#).

- 6d. *Select or develop units and rules for crediting.* Existing crediting platforms define regulator-approved rules for field measurement of ecological functions, approved mitigation and conservation banking, outcome-based performance standards, and how to buy and sell credits; these platforms should always be used or, at a minimum, evaluated. When such platforms do not exist, they can be adopted from those developed from the most similar landscapes and ecosystems, although this will require Steps 6d to 6f. If they are available, Steps 6d and 6e can be skipped.
- 6e. *Test applicability of units and rules in local conditions and evaluate local opportunities.* If new rules or methods for service measurement or crediting have not been developed, this step can be time-consuming, but as is the case with Step 6c, methods can be most easily adopted from adjacent areas. This includes a review of the protocols by the primary regulatory agencies along with other important stakeholders.
- 6f. *Negotiate regulatory assurance for credit.* Existing approved banks or credit registries such as [markit](#) or [tz1market](#) provide assurances for the credits they sell. If new banks or registry programs are being developed, they are most effectively developed in concert with the various regulatory agencies, usually tied to programmatic agreements.
- 6g. *Program implementation.* Active programs have been developed in [Oregon](#), [Maryland](#), [Minnesota](#), and [North Carolina](#); almost all these states are willing to share methodologies and tools. [The Bay Bank](#) (Chesapeake Bay), [Willamette Partnership](#), [The Natural Capitol Project](#), the [United Nations Environment Program](#), and [Earth Economics](#) all provide guidelines and program implementation examples and guides.

Technical Considerations

- How will debits and credits be calculated? Ensure reasonable ratios allow for mitigation to be most effective, while discouraging incompatible development.
- Is credit stacking allowed? Credit stacking can promote mitigation in sites that have multiple values, but regulators generally only focus on the one resource for which they have legal responsibility. So stacking should be used to take advantage of multiple credit needs without reducing the requirements for any regulated resource.
- What is the permissible service area for a bank, off-site mitigation? If possible, EPA and USACE rules can establish within-watershed guidelines, perhaps at the 10-digit watershed level.
- How will credits be registered and tracked? Whenever possible, use existing credit registry companies that are licensed and bonded, such as the Markit Environmental Registry.

- How long are regulatory decisions on a given project binding? Most credits and mitigation banks release credits after five years and are usually binding for 20 years.
- What long-term monitoring is needed? Monitoring is usually tied to mitigation banks and is tied to the release of credits. Long-term monitoring should be established to evaluate both restoration effectiveness and the overall uplift for all of the at-risk values in the watershed.