Title

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Publication Date

2007-05-20

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Abstract: One of the challenges faced by transportation and environmental practitioners is to keep pace with policy and technology advancements and capitalize upon new tools and methods as they become available. Several existing efforts and new initiatives are underway to improve practices in the use of tools within transportation program delivery. For example, the FHWA Headquarters Project Development and Environmental Review Office, FHWA Division Offices, state departments of transportation, NatureServe, and Defenders of Wildlife hosted workshops in Arizona, Arkansas, and Colorado to bring together transportation and environmental practitioners to discuss ways to link efforts for conservation and transportation planning. One result from the workshops is an expanded awareness of available information, data, and tools that can support the integration of conservation and transportation efforts and transportation program and project delivery. Another result from the workshops is evidence of the importance of face-to-face interactions between professionals in transportation and environmental and resource agencies. This paper includes a discussion of the approaches used in the workshops and successes and lessons learned. Several other existing efforts and new advancements that are moving forward to expand the use of data and tools in transportation decision-making are also discussed. The purpose of this paper is to highlight examples of specific types of expertise, data, and tools that can immediately be used to assist transportation and environmental practitioners achieve their goals and meet their requirements.

Introduction

Transportation programs and projects include many environmental responsibilities. It is an on-going challenge to harmonize long-standing federal, state, and local requirements with emerging requirements and best available science and technology. During the past years, several Congressional Directives, FHWA initiatives, and Presidential Executive Orders have emerged to support environmental efforts and improve timely delivery of transportation projects. Examples include: Eco-Logical: An Ecosystem Approach to Infrastructure, Environmental Streamlining and Stewardship, Context Sensitive Solutions, and Planning and Environment Linkages. Various other complimentary initiatives are underway at the federal, state, and local levels, for example, Cooperative Conservation and watershed management. Transportation legislation, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), includes changes in environmental review processes at both the long-range transportation planning and project levels (SAFETEA-LU 2005).

As background material for this paper, the following summary highlights some of the content for SAFETEA-LU and the Code of Federal Regulations (CFR 2007) for long-range transportation planning and the content of the plan as:

- Develop the long-range statewide transportation plan, as appropriate, in consultation with State, tribal, and local agencies responsible for land use management, natural resources, environmental protection, conservation, and historic preservation
- Include a discussion of potential environmental mitigation activities (at the policy and/or strategic-levels). *[23 CFR 450.214(j) and 450.322(f)(7)]*, developed in consultation with Federal, State and Tribal wildlife, land management, and regulatory agencies
- Compare transportation plans to State/Tribal conservation plans or maps, and to inventories of natural or historic resources, if available *[23 CFR 450.214(i)]*
- Fulfill the long-range planning factor to: "protect and enhance the environment, promote energy conservation and improve quality of life" expanded to also include "promote consistency between transportation improvements and State and local planned growth and economic development patterns" *[23 CFR 450.206 and 450.306]*

Several benefits arise from meeting these requirements and improving practices for the use of information and tools to support transportation decision-making. Throughout all stages of transportation program delivery, transportation and environmental practitioners are benefiting from interdisciplinary approaches to decision-making that support transportation activities as well as environmental goals. These integrated approaches provide benefits for:

- Compliance with existing and new requirements
- Better outcomes and results
- Avoidance of late-process surprises and engineering re-work
- Better interaction between environmental and transportation offices
- Facilitation of multi-purpose goals
- Improved mitigation and demonstration of sequencing *(avoid, minimize, compensate for unavoidable impacts)*

- Larger scale mitigation strategies developed in advance of projects
- Reduced duplication of efforts, including information and data sets
- Fewer delays in environmental reviews to support streamlining of efforts
- Reduced costs

These benefits can be accomplished through improved practices in the use of information, expertise, and tools to integrate environmental information and expertise more fully into transportation program delivery.

Expertise, Data and Tools

Many sources of expertise, data, and tools can be utilized to support existing and new efforts for transportation. The Transportation Research Board (TRB) suggests that in order to meet environmental requirements, transportation and natural resource agencies will have to rely on advanced geospatial tools and a more collaborative approach to all transportation activities (Transportation Research Board 2006). Computer tools, GIS, and maps are particularly powerful tools for facilitating integration of information, people, and decision-making for planning and projects.

Expertise

Transportation decision-making relies upon various experts working together. Transportation and environmental expertise is available at the national, Tribal, state, and local levels within both the public and private sectors. An ongoing challenge is to identify the expertise that is needed and use interdisciplinary approaches to coordinate expertise into the decision-making process.

Including expertise in the selection and use of information and data helps ensure the credibility of the decision-making process and the outcomes. In fact, with the Internet providing a conduit for vast quantities of unfiltered information, the need for knowledgeable people to select what information is credible and to make the best use of this information will continue to increase. The assistance of transportation and environmental experts can help define information needs as well as information sources.

Using appropriate experts for interpretation and analysis of data can be critical for ensuring successful planning and project outcomes. For example, a coordinated examination of the methods used to assess the sensitivity of an ecological feature could reveal that the potential for an adverse impact is much lower than originally thought and options to avoid an adverse impact become available. Interdisciplinary approaches can help clarify how to develop and deliver information with the most useful content and format to be shared with the diversity of individuals involved in all aspects of transportation decision-making. Agreements on methods for analyzing data in planning will aid in downstream agreements on methods to be used in NEPA and project delivery and to meet the requirements of SAFETEA-LU Section 6002, Environmental Process Provisions.

Some information is most usable in computer format as data. Some information is most useful in other formats such as hardcopy maps or reports or photographs. Several types of analyses, maps, inventories, surveys, aerial photographs, plans, and reports exist and are available. The following section focuses on examples of environmental data that have been identified as useful for transportation practitioners and their responsibilities.

Data and Methods

Although many sources of data exist, it is essential that data is selected and used based on how well the data matches information needs within the decision process. It is important to include the proper expertise in data selection and use. Some data can be useful at a broad-brush scale for some screening and scoping decisions, while other data needs to be at a finer scale for use in detailed design tasks. The scale, quality, and credibility of data are important so that data can be used effectively by the experts participating in the planning and decision-making processes.

Prior to developing new environmental data, a worthwhile step is to conduct a review of already existing data. There are some excellent sources of environmental data that are directly relevant to the needs of transportation and environmental practitioners. The following sections describe examples of sources for environmental data and uses of the data.

In some cases, environmental practitioners and the staff of transportation agencies and their consultants have already compiled environmental data from various existing data sources (such as environmental agencies) and they can also be “data producers.” In other cases, coordination with environmental agencies and organizations reveals other available data sources and “data producers.” Examples of coordinated efforts to develop and share data as well as the use of data “clearinghouses” are highlighted in later sections of this paper.

Data and inventories on threatened and endangered species, ecological resources, and environmentally sensitive areas are available and in use to support transportation responsibilities at the project level. The data includes information about the species and habitats that exist in a region, their condition or conservation status, the location of sensitive or other important features, and how these resources are likely to be affected by proposed activities. This type of data exists in every state in the state natural heritage programs and in a centralized national database managed by NatureServe, a conservation non-profit organization that provides coordination for the network of state natural heritage

programs. For more than 30 years, NatureServe has worked in partnership with its international network of member programs (known in the U.S. as state natural heritage programs) toward its joint mission of collecting, managing, and applying data on rare and endangered species, and threatened ecosystems. NatureServe provides national coordination and technical support for the development and use of scientifically-based standards, data and tools that are used by the member programs and integrates these data into a national view. The data is updated continually and is accessible to federal and state agencies, as well as private and non-governmental organizations and the public.

The state natural heritage programs locally collect, analyze and distribute their data, and provide local expertise to local, state, and region-wide efforts. Today, the data housed at NatureServe's central database along with data aggregated from the individual state natural heritage programs' databases collectively is the most comprehensive, standardized inventory on at-risk species and ecosystems that exists for North America. Transportation offices in many states are benefiting from the use of this data and expertise. The state natural heritage programs function by carrying out field inventories, collaborating with federal and state agencies, and others to collect data in the state, and manage their data according to consistent national standards. They serve as a 'clearinghouse' of data on plants, animals and ecological communities that are legally protected, or otherwise of conservation concern. Since the mission of NatureServe and its member programs is to maintain and expand this database over time, inventories and results of studies done across the state can be integrated into their data management system, and therefore be easily utilized by all.

A keystone of the natural heritage data includes the conservation rank. Using expert methodology, each species and ecological community is assigned a conservation rank that reflects its rarity at a global, national, and state scale. For example, if a species was ranked G1 after evaluating all defined factors, it would indicate that the species is critically imperiled across its entire range (i.e., globally). For species, the factors that are considered in assessing conservation status include:

- total number and condition of occurrences (e.g., populations)
- population size
- range extent and area of occupancy
- short- and long-term trends in the above factors
- scope, severity, and immediacy of threats
- number of protected and managed occurrences
- intrinsic vulnerability
- environmental specificity

This standardized method of ranking species has been developed in collaboration with many conservation organizations including the International Union for the Conservation of Nature (IUCN) Species Survival Commission (http://www.iucnredlist.org). The conservation status ranks for species and ecological communities are utilized by many federal agencies as a tool to prioritize conservation activities and assist in identifying actions that could prevent at-risk species from becoming listed for protection under the Endangered Species Act. In fact, a majority of the methodologies developed and utilized by NatureServe and its member programs is created in close collaboration with other partners including federal and state agencies, and other conservation organizations.

The following summary describes ways to access online data developed by NatureServe and its network of member programs.

- Access to generalized data for species and ecological data across North America is available on NatureServe Explorer (www.natureserve.org/explorer). Precise species locations are also available by contacting NatureServe directly. NatureServe is in the process of rolling out newly developed web services that will provide on-line access to more precise species and ecological data at a national scale.
- An increasing number of natural heritage programs are developing analytical products that map out environmentally sensitive areas, and provide other web-based conservation services such as environmental review tools. Access to local web portals for individual natural heritage programs is available at: (http://www.natureserve.org/visitLocal/index.jsp).

Activities for federal, state, and regional conservation plans have been a particular focus in recent years. These plans can be used to provide important environmental and ecological data and an ecological context for the transportation community. A few types of plans and efforts are summarized below.

The Endangered Species Act directs the U.S. Fish and Wildlife Service (USFWS), Department of Interior; and the National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA) to develop and implement recovery plans to promote the recovery and conservation of threatened and endangered species. These agencies support several other efforts as well. These recovery plans are available from the USFWS at: http://www.fws.gov/endangered/recovery/index.html and the NMFS at: http://www.nmfs.noaa.gov/pr/recovery. The goal of the Endangered Species Act is the recovery of listed species to levels where protection under the Act is no longer necessary.

Another important effort has been The Nature Conservancy's work to identify and map priority biodiversity areas within each ecoregion of the country. These "ecoregional plans" summarize conservation priorities, and include information on both plants and animals that are legally protected or are of conservation concern (http://www.nature.org/tncscience/). Still another regional planning approach focuses on what is variously termed green space, open space, or green infrastructure. A strategy, plan, or map for high priority areas for environmental values and conservation is developed as a "greenprint." Approaches to greenprints often focus on connecting existing green space and environmental and habitat areas together with new locations by identifying potential locations for connections and including these in the greenprint and strategy. Greenprints can extend across a geographic area of any size. A statewide example is Maryland (www.dnr.state.md.us/greenways/greenprint/). An example that includes multiple states is the U.S. Environmental Protection Agency's Southeastern Ecological Framework (http://www.geoplan.ufl.edu/epa/). At the state level, each state has completed a State Wildlife Action Plan (http://www.wildlifeactionplans.org/). All of these plans identify species in need of special attention, and many include maps of priority habitats or areas for wildlife conservation, and can help chart the course for wildlife conservation at local, state, and national levels.

In addition to environmental information and plans, a variety of other data sources exist in online data clearinghouses at the national, regional, state, and local levels. Environmental agencies are commonly data producers and data sources for environmental data. Geo-spatial datasets for transportation, infrastructure, and environmental topics can be accessed through the National Spatial Data Infrastructure (NSDI). This is a nationwide GIS data clearinghouse of free, downloadable data from federal, state, and local sources at: www.geodata.gov.

Links to other examples of state-based sources of information and data can be found through Defenders of Wildlife's Biodiversity Partners website (www.biodiversitypartners.org). Many other online data clearinghouses and data sets are available. The U.S. Geological Survey provides several types of data and also sponsors the National Biological Information Infrastructure (www.nbii.gov).

This paper illustrates that several existing sources of information and data are available to transportation and environmental practitioners. Proper use of environmental data can be highly beneficial to support the integration of the information and people that are part of the transportation decision process. Using data in combination with software tools can be powerful since it can support the use of available data and provide a framework to guide the decision-making process. The discussion below summarizes how demonstrations of computer tools were included in the workshop setting as a way to show tools in action and facilitate discussion about how to use tools to support transportation decision-making. The discussion also highlights several topics and insights about advancements in tools and their use.

Tools

A variety of tools, some generic and some custom-built, are now available to transportation agencies. These tools make environmental and ecological data, analyses, and expertise more accessible than ever before. Expertise is needed to effectively define the need for tools and select tools that best match processes and decisions.

Several important concepts emerge in considering how technology can enable the integration of environmental and natural resource information and data into transportation planning and project delivery processes and vice versa. Transparency and accountability are keys for information and analyses to be credible and to stand-up to legal and political scrutiny. Such transparency can be supported by the use of analytical tools and can thereby assist in facilitating trust between a diversity of participants involved in an interdisciplinary process. In contrast, "black box" approaches to using computer tools can sometimes trigger mistrust between participants.

Because planning and project delivery involves a balance among multiple values, use of analytical tools should be based on clearly defined assumptions and values. A whole class of optimization techniques that are embodied in tools are becoming available to vastly improve the efficiency of evaluating various 'what-if' scenarios, and help practitioners decide among them. Using an iterative process for using tools and identifying alternative scenarios for meeting multiple goals has been found to be worthwhile. Examples of tools and their uses are provided below.

NatureServe Vista is an example of a decision-support tool specifically designed to help to integrate various types of data, and conduct evaluations of planning and project delivery scenarios (www.natureserve.org/prodServices/vista/overview.jsp). This GIS-based software supports the creation and use of maps of environmental, infrastructure, socio-economic, biological and non-biological features in a selected area of interest. Maps can be used individually or combined within GIS analyses. Based on the distribution and characteristics of mapped features, a "value map" can be generated from GIS analyses depicting areas of greater and lesser importance or sensitivity.

An option within the tool allows the selection and assignment of different scores and weights for features within maps that can be used in calculations using GIS analyses. An example of a credible and scientifically based environmental scoring system was previously described as the conservation ranking system. These options and tools assist with decision-making for particular interests, requirements, or priorities, and with integrating these together to support multi-purpose goals. Use of tools and maps can be focused on an individual feature or resource such as a legally protected species or can be expanded to integrate with any other features that can be mapped such as streams, wildlife areas, wetlands, historic resources, and socio-economic factors.

The map outputs can show high priority locations for conservation. Areas that are considered irreplaceable can also be shown. Early awareness of these priorities can support the selection of the best locations to serve the purposes of development and conservation. Maps can also be used to help accomplish mitigation to avoid adverse impacts to priority areas and avoid high compensatory mitigation costs.

In addition, NatureServe Vista supports an iterative decision-making process because many different scenarios can be analyzed and compared by using the tool. Evaluation of scenario results can help inform planning and project level decisions. The system also supports an open, transparent decision-making process with tools that can be used to document and report on the assumptions made at every decision point. Figure 1 below illustrates the type of results produced after running a specific scenario using NatureServe Vista to support analyses and decision-making toward defined goals.

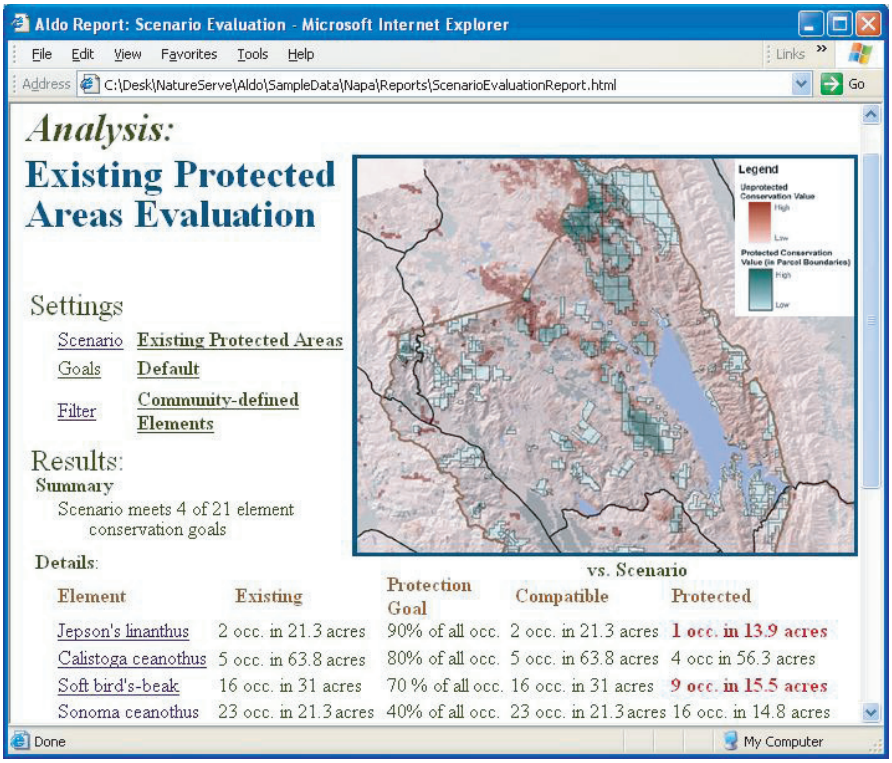

Figure 1. Results from NatureServe Vista Scenario Evaluation Analysis. (Source: Comer 2006)

The map output in figure 1 and various types of alternative scenarios that generated map outputs using NatureServe Vista were demonstrated and discussed in the workshop setting. Workshop demonstrations also showed how data outputs from one tool can be used as inputs to other tools as a "toolbox approach." A toolbox approach matches data and tools to individual needs and also supports interdisciplinary approaches. Computer advancements have pursued a toolbox approach so that decision support systems can support multiple goals for environmental and infrastructure and mission priorities (Goran et al. 1999, Majerus and Rewerts 1994, Sydelko and Majerus 1999).

One of the purposes of the workshop was to demonstrate a "toolbox" approach by using several example tools including NatureServe Vista, CommunityViz (www.communityviz.com/), and Quantm (http://www.quantm.net/). Demonstrations of a toolbox approach highlighted that CommunityViz is a GIS-based tool that provides a means to visualize analyses of land use alternatives and understand their potential impacts from environmental, economic, and social perspectives. Through the use of 3-D simulation, scenarios can be visualized from different angles. This feature supports decision-processes and enables citizen participation in planning processes. Quantm is a planning system for corridor and route Optimization. Quantm addresses complex route planning issues, transportation route alignment options, and consideration of alternatives. The workshop demonstrations showed that it is possible to utilize results from NatureServe Vista, Quantm and CommunityViz as data flows between tools. This approach leverages the uniqueness of data outputs generated from each tool to support evaluations of alternative land use and transportation scenarios. A toolbox approach maximizes flexibility in the use of tools by offering options to support decision-making for particular interests, requirements, or priorities as well as interdisciplinary approaches to balancing multi-purpose goals.

Other example tools were researched and discussed as part of the workshops. Details are summarized in the 'other tools' presentations and handouts for Day 2 for each state's workshop at: http://www.defenders.org/habitat/highways/workshops/home.html. Case studies illustrating other successes in the use of GIS tools are documented in the Transportation Research Board's Circular on 'Environmental GeoSpatial Information for Transportation' (Transportation Research Board, 2006).

The use of computer tools and GIS continues to advance at the national, state, and local levels. The following section offers a few examples of state natural heritage programs working with transportation agencies to support state, regional, and local planning and project efforts:

1. **Colorado**

   a. The Colorado Department of Transportation (DOT) partnered with The Nature Conservancy, U.S. Fish and Wildlife Service, Colorado Division of Wildlife (CDOW), and the Colorado Natural Heritage Program on a range-wide impact analysis on short-grass prairie. Impact analysis utilized the Gap Analysis Project (GAP) vegetation layer, predictive habitat layer (source: CDOW), nesting sites, and element occurrences. Breeding bird atlas data and expert opinion were utilized to develop 'presumed presence' maps of federally listed and potentially federally listed species. These maps were used to determine areas of impact or potential impact based on proposed transportation routes and plans. For unavoidable adverse impacts, the maps were the basis of developing recommendations for habitat areas as compensatory mitigation. Colorado DOT worked with the U.S. Fish and Wildlife Service on the mitigation effort, and the Conservancy helped purchase or conserve these lands through easements. See figure 2 below for an illustration of the type of analysis done for the shortgrass prairie in Colorado.

   b. Pikes Peak Council of Governments is working with the Colorado Natural Heritage Program and others on the use of the NatureServe Vista decision support tool to assist in transportation planning activities with a focus on two counties in Colorado.

2. **Nevada** – Nevada Natural Heritage Program supplies Nevada DOT with sensitive species data for all DOT projects and efforts, such as gravel pit operations, bridge widening, and new construction. Turn around time in answering Nevada DOT requests is usually hours. In exchange, Nevada DOT provides funding to the Nevada Natural Heritage Program.
3. **Virginia** – Virginia DOT has a cooperative agreement with the Virginia Natural Heritage Program for the sharing and use of natural heritage data. In addition, the Virginia Natural Heritage Program staff works with Virginia DOT staff to address the effects of storm water runoff, sinkhole filling and collapse, surveys along roads to assist in protection efforts, and habitat fragmentation and management of habitat corridors.

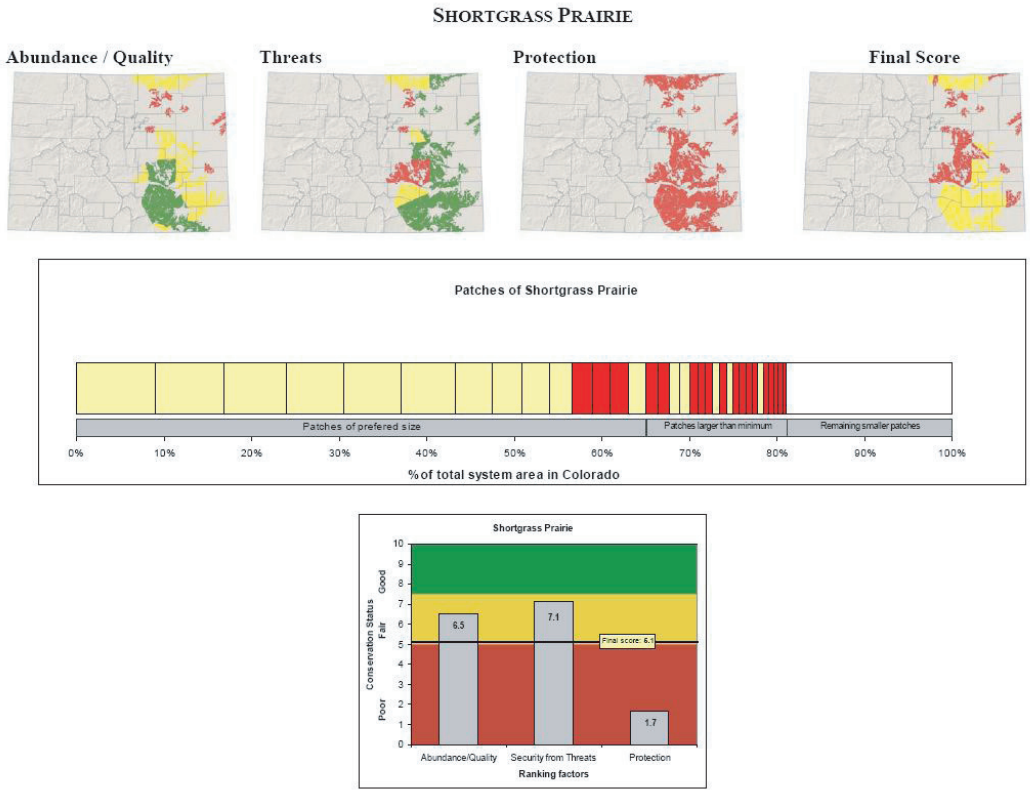

Figure 2. Analysis for shortgrass prairie in Colorado. (Source: Rondeau 2007)

One example of efforts underway by FHWA is the Planning and Environment Linkages (PEL) initiative. The PEL initiative represents an approach to transportation decision-making that considers environmental, community, and economic goals during the long-range transportation planning stage and carries them through to project implementation. An FHWA website offers a summary of PEL as well as links to information, case studies, and research findings available at: http://www.environment.fhwa.dot.gov/integ/index.asp.

Conclusions/Next Steps

Expertise and data and tools are readily available and can immediately assist transportation and environmental practitioners meet their requirements and accomplish multiple goals. Interdisciplinary approaches are highly beneficial to supporting both existing practices and advancements underway for the use of tools in transportation decision-making. Transportation practitioners are already experiencing the benefits of integrating environmental information and expertise into long-range transportation planning and project delivery. Benefits include: 1) improved planning and project decisions and outcomes; 2) more effective environmental mitigation; 3) selection of sites for compensatory mitigation in advance before they are converted to other purposes or before land costs increase; 4) improved processes for environmental approvals and permits; and 6) savings in cost and time.

To achieve these benefits, some recommended next steps to both support and improve decision-making include:

- Initiate workshops and coordination between transportation and environmental and conservation practitioners to move forward to support an informed process for defining collective goals and outcomes in planning, project development, design, construction, operations, and maintenance.
- Identify and implement a process for tracking identified environmental and conservation priorities and commitments and ensuring the priorities are taken into account at all levels of transportation decision-making.
- Demonstrate and promote successes in interdisciplinary and collaborative processes and projects, and in use of data and tools.
- Work with local, state, and federal agencies and conservation organizations toward identification and development and use of key environmental and biological datasets needed to inform transportation planning and project delivery.
- Develop guidance on how to coordinate with local agencies and organizations to develop and supply standardized data on endangered and imperiled natural resources in order to compile best available data.
- Initiate effort to develop toolkits and question and answer (Q&A) summaries on how to meet SAFETEA-LU provisions for long-range transportation planning.
- Encourage and pursue efforts to integrate transportation and conservation planning. (For example, conduct annual statewide interdisciplinary planning meetings.)
- Develop or refine standards and methods for sharing of data to support long-range planning processes and implementation of projects.
- Evaluate the need for tools, and apply the use of tools to both support and document transportation decision-making processes.
- Promote and implement the multi-agency initiative for 'Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects' (Eco-Logical 2006) within planning and project delivery.
- Participate in the FHWA *Eco-Logical* grant solicitation available at: http://www.environment.fhwa.dot.gov/ecological/eco_index.asp. Supported by FHWA with seed funding to implement Eco-Logical efforts at the planning and project levels.

Biographical Sketches:

Shara Howie is currently a Sector Relations Manager for NatureServe's Conservation Services Division and works out of the Western Regional Office of NatureServe located in Boulder, Colorado. Shara has over 12 years of experience supporting the development and maintenance of conservation data and data management systems. Shara has years of experience as a project manager supplying U.S. and Canadian federal agencies and other organizations with conservation data, analyses and other conservation services in collaboration with NatureServe's international network of member programs (Natural Heritage Programs). Shara is currently working on projects with Parks Canada, the Canadian Wildlife Service, Federal Highway Administration, the National Park Service, and The Nature Conservancy. In the past, Shara worked extensively with the Department of Defense, USEPA and other federal agencies, and she specializes in the facilitation of data sharing between organizations. Before joining NatureServe in 2001, Shara worked for The Nature Conservancy's Science Division for 10 years and the Smithsonian's Botany Department for 3 years. Shara has a Bachelor's Degree in Biology from George Mason University.

Kimberly Majerus is a natural resource and GIS analyst with the FHWA-Resource Center near Chicago, Illinois. She partners with FHWA Divisions and HQ to deliver technical assistance and customized sessions to support transportation state and environmental offices nationwide. A 20 year career includes the Illinois Department of Transportation and Corps of Engineers and University of Illinois as project manager, environmental unit head, and GIS lab coordinator as well as President of the Illinois Environmental Council (IEC), not-for-profit organization. Kimberly's experience includes 10 years of participation in nationwide, multi-agency programs and projects toward integrated efforts and decision support systems for multi-purpose goals and benefits. B.S. and M.S. degrees earned at University of Illinois at Urbana-Champaign.

Shari Schaftlein has been the Team Lead for Program/Policy Development in FHWA's Project Development and Environmental Review Office in Washington, D.C. for the past 3 ½ years. Activities that she champions include: the Context Sensitive Solutions (CSS) Program, the Center for Environmental Excellence, the National Liaisons, the Executive Order on Streamlining and Stewardship, SAFETEA-LU Rollout, the Green Highways Partnership, and Linking Planning and NEPA. She serves as the FHWA representative on the NCHRP 25-25 Panel on AASHTO Standing Committee on Environment (SCOE) Quick Response Research and is a Member of Transportation Research Board (TRB) ADC10-Environmental Analysis Committee. Prior to FHWA, she worked in the Washington State Department of Transportation, Environmental Office for 11 years, where she held the positions of Water Quality Program Manager, Streamlining Initiatives Manager, and Deputy Director. She has also held environmental management positions with the West Michigan Environmental Action Council in Grand Rapids, and the Quileute Tribe in La Push, WA. Degrees include a B.S. and M.S. in Environmental Science from Indiana University.

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