



Eco-Logical Practitioner's Handbook

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Definitions

CWA	Clean Water Act
DOTs	Departments of Transportation
ESA	Endangered Species Act
IEF	<i>Integrated Ecological Framework (IEF)</i>
MPOs	Metropolitan Planning Organizations
NEPA	National Environmental Policy Act
REF	regional ecosystem framework
REIDF	regional ecosystem and infrastructure development framework
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SHRP2	Strategic Highway Research Program
TRB	Transportation Research Board's

Overview

The *Integrated Ecological Framework* (IEF) has the primary goal of making infrastructure planning and implementation, specifically transportation infrastructure, more sensitive to and more compatible with natural habitats and wildlife/aquatic life. At the heart of the IEF approach is establishing interagency partnerships between the transportation planning organization, resource agencies and the public to identify the greatest conservation needs in the transportation planning area, and making joint decisions to avoid, minimize, and mitigate unavoidable impacts to these resources. A significant portion of transportation budgets is committed to environmental compliance and mitigation. The IEF is intended to align this expenditure with conservation needs to make environmental compliance more efficient, to the benefit of transportation planning organizations, such as state Departments of Transportation (DOTs) and Metropolitan Planning Organizations (MPOs), and in the process achieve significant benefits for the ecosystem.

The concepts of the IEF are not new. Several guidance documents have been published by the Federal Highway Administration, American Association of State Highway and Transportation Officials, and National Cooperative Highway Research Program over the past decade on integrating environmental considerations into long-range planning, linking long-range planning with the National Environmental Policy Act (NEPA), and linking NEPA with Clean Water Act (CWA) permitting. Section 6001 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) raises the bar by making the interagency coordination process less of a good practice and more of a requirement. Consistent with Section 6001, the IEF rests on the cooperation of agencies working in partnership to guide transportation planning, with particular focus on ecological conservation. The IEF takes transportation planning beyond NEPA and CWA compliance by creating a plan for the overall benefit to the ecology of the planning region, and establishing standard procedures for addressing natural resource avoidance, minimization or mitigation for the transportation program as a whole.

Using modern mapping tools, the participants amass the available natural resource data to understand the ecosystem over which the transportation plan will be projected and to gain consensus on the most important areas for conservation and restoration potential. Jointly, the participants then overlay transportation program alternatives to identify conflicts, make adjustments to avoid and minimize the conflicts, and prioritize restoration opportunities for unavoidable impacts. The process improves the performance of the transportation agency in the area of ecological impact avoidance, minimization, and mitigation, and expedites environmental compliance by engaging the natural resource agencies and experts in the early planning process and establishing agreements on project implementation—that is, the rules for implementation

of all projects, not one at a time. The process requires full disclosure, joint goal-setting, and a commitment to problem-solving from all members of the partnership.

The purpose of this document is not to provide a detailed, step-by-step description of implementing the IEF. The reader is referred to the IEF web-based tools, the C06 Guide, and other resources for those details. This document is designed to assist planners in defining a path and realistic goals for implementing the IEF for their programs.

Background Briefing

Efficient agency coordination/agreement and environmental compliance is the “holy grail” of transportation planning. Add to that a process that directs funds normally set aside for project-by-project mitigation to conservation and restoration priorities identified by resource agencies, and the result is an indisputable win-win.

There is a growing emphasis on resource conservation and planning at the regional level rather than the ad hoc, project level. Consolidated, regional-level mitigation is being recognized as providing ecological economies of scale, in lowering the cost per acre of restoration, improving the restoration success rate, and increasing the value to resident species of larger, unfragmented habitats. Examples of this trend toward regional infrastructure planning include:

1. Watershed-level planning to address water quality in accordance with Sections 303 (impaired waters) and 403 (National Pollutant Discharge Elimination System) of the CWA.
2. Since 2005, the Federal Highway Administration has issued guidance and requirements (e.g., SAFETEA-LU) on linking project or programmatic NEPA process with long-range transportation planning, requiring the consideration of environmental features in long-range planning and mitigation requirements, and merging the NEPA process with Section 404/401 of the CWA compliance (see also the American Association of State Highway and Transportation Officials *Practitioners Handbook 10*, 2008).
3. The 2008 “Compensatory Mitigation for Losses of Aquatic Resources” published by the U.S. Army Corps of Engineers and U.S. Environmental Protection Agency states a preference for “...mitigation banks and in-lieu programs to improve the quality and success of compensatory mitigation projects for activities authorized by Department of the Army permits.”
4. Section 6001 of SAFETEA-LU and other federal transportation planning regulations require every state and MPO to consult with state, tribal, and local resource agencies when developing long-range plans, and require this consultation to involve a “comparison of transportation plans with state and tribal conservation plans or maps, if available,” and a “comparison of transportation plans to inventories of natural or historic resources, if

available.” Under Section 6001, statewide and metropolitan long-range plans must now include a discussion of “potential environmental mitigation activities and potential areas to carry out these activities, including activities that may have the greatest potential to restore and maintain the environmental functions affected by the plan.” This discussion must be developed “in consultation with Federal, state, and tribal wildlife, land management, and regulatory agencies.”

In 2006, a team of nine federal agencies published *Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects* (Brown, 2006). The Eco-Logical approach lays out a collaborative, regional-scale approach to decision making during transportation and infrastructure planning, involving not only the transportation planning organizations but also the natural resource agencies. The Eco-Logical regional approach to mitigation provides a mechanism for agencies to meet the Section 6001 requirement related to identifying “activities that may have the greatest potential to restore and maintain the environmental functions.”

Subsequently, the Transportation Research Board’s (TRB) Strategic Highway Research Program (SHRP2) funded the development of a technical guide to implement the concepts laid out in Eco-Logical, known as the IEF (Table 1). The IEF is

...a 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.
(Institute for Natural Resources, et al, 2010)

The IEF is based on the application of individual project planning protocols at the higher, planning level. In a way, the project development process of mapping resources, alternatives analysis, justification, impact analysis, and mitigation is met before the project-level analysis begins. The efficiency is found in agreement among the partners on the resources to be avoided (specifically identified on the ground), a program-level approach to minimizing impacts, and a regional or subarea approach to mitigating unavoidable impacts. Although the IEF is intended to primarily support mid- to long-range transportation and infrastructure planning rather than individual project assessment and design, it should result in agreements (Memorandums of Agreement, standard coordination procedures, standard designs) with resource agencies that define and direct coordination, avoidance, minimization and mitigation requirements that will apply at the project level, in a predictable manner, to help control costs and preserve project schedules.

Table 1: Summary of the Steps of the Integrated Ecological Framework

Step	Purpose
Step 1: Build and strengthen collaborative partnerships and vision	Build support among relevant stakeholders to achieve a statewide or regional vision and planning process that integrates conservation and transportation/infrastructure planning.
Step 2: Create a regional ecosystem framework (REF)	Develop an overall environmental conservation strategy that integrates conservation priorities, data, and plans, with input from and adoption by all conservation and natural resource stakeholders identified in Step 1 that addresses species, habitats, and relevant environmental issues and regulatory requirements agreed upon by the stakeholders.
Step 3: Define transportation and infrastructure scenarios for assessment	Integrate existing, proposed, and forecasted development, transportation/infrastructure, and, optionally, other plans into one or more scenarios to assess cumulative effects on resources.
Step 4: Create a regional ecosystem and infrastructure development framework (REIDF)	Integrate environmental conservation (REF) and transportation/infrastructure data and plans to support creation of an REIDF. Assess effects of transportation/infrastructure on natural resource objectives. Identify preferred scenarios that meet both transportation/infrastructure and conservation goals by using the REIDF and models of priority resources to analyze transportation/infrastructure scenarios in relation to resource conservation objectives and priorities.
Step 5: Establish and prioritize ecological actions	Establish mitigation and conservation priorities and rank action opportunities using assessment results from steps 3 and 4.
Step 6: Develop crediting strategy	Develop a consistent strategy and metrics to measure ecological impacts, restoration benefits, and long-term performance for all projects to promote progressive restoration and mitigation, and more-accurate accounting of results.

Table 1: Summary of the Steps of the Integrated Ecological Framework

Step	Purpose
Step 7: Develop programmatic consultation, biological opinion, or permits	Take advantage of identified regional conservation and restoration objectives to develop Memorandums of Understanding, programmatic agreements (404 permits or Endangered species Act (ESA) Section 7 consultations), or other CWA agreements for transportation/infrastructure projects in a way that documents the goals and priorities identified in Step 6 and the parameters for achieving these goals.
Step 8: Deliver conservation and transportation projects	Design transportation/infrastructure projects in accordance with ecological objectives and goals identified in previous steps (i.e., keeping planning decisions linked to project decisions), incorporating as appropriate programmatic agreements, performance measures, and ecological metric tools to improve the project.
Step 9: Update regional ecosystem framework, scenarios, and regional assessment	Maintain a current REF that reflects the most recent distribution and knowledge of natural resources, conservation priorities, and mitigation opportunity areas that can support periodic updates to scenarios, and regional cumulative effects assessments.

Key Issues to Consider

The Scale of the Planning Area

First, consider the geographic extent of the planning area. The IEF is scalable, and the scale will determine the scope and resolution of the database, practical goals, and the stakeholders.

Naturally, the larger the planning area unit, the lower the resolution of the data that can be effectively displayed and used. For statewide planning, lower-resolution data may be adequate, although the system is only limited by the power of the mapping tools and the data that are available. The beauty is that at the beginning of the IEF development, the low-resolution data that are available can be used as the foundation, and additions made as more data become available. The ideal IEF is a system that is frequently updated with new information of higher resolution, so this eventual growth in the database should be anticipated in the implementation of the IEF. The IEF becomes the new standard mode of operation for everyone in the partnership. Whatever the initial planning goal, the developer should keep in mind the power of amassing the

higher resolution data as they become available. More-powerful, web-based mapping tools continue to be developed that access national databases and local databases.

A larger planning area will limit the availability of high-resolution detail throughout the planning area, presenting a simple cost-benefit relationship. Without relatively uniform data coverage, the value of the high-resolution data decreases beyond the extent of the data. As a result, some data collection will still be left for the project-level analysis. That is not to say that all project data cannot be incorporated into the database (limited only by the power of the mapping equipment). In fact, it should be standard procedure to incorporate all available data into the database, whether it can be used in the planning wide analysis. Take advantage of the exercise to create a repository for all of the geographic resource data, to the benefit of all members of the partnership. This could be data gathered by the transportation agency from project-level studies; ideally, it could also include data from other sources, such as approved wetlands and waters jurisdictional determinations from the Corps of Engineers. Higher-resolution data can be imported for fine tuning as the planning turns to more localized areas to address specific planning area needs (such as particular environmental concerns in a watershed) or even the project level.

The level of effort and funding (see below) will also set the initial scale of the plan. The amount of information available may also determine the scale.

Resources – Staff Time and Funding

Implementing an IEF is not intended to be a discreet activity, but an ongoing mode of operation. Laying the groundwork, including building the resource model and team coordination, will take an initial investment of time and funds. The implementation will likely evolve over several years, as programmatic agreements and routine communications develop. There will be a continued investment in implementing the process as time goes on, but this investment should be the same or less because of efficiencies that should come from the IEF.

Consider what is really needed in terms of products to make decisions, the level of precision required of the data, results, and the available time, funding, and staff capacity.

As with many broad collaborative and data-driven projects, implementing the IEF can be time-intensive and require an extended time commitment. Focusing on developing the REF, scenarios, and initial cumulative effects assessment (IEF steps 2-4), often takes between 12 to 18 months. This timeframe does not take into account the partnership building phase (Step 1) and assumes there is a core, dedicated team of personnel and other experts who can provide timely inputs and review so the technical work can progress without delays.

Similar to the timeframe, a large number of variables affect the cost of the IEF. Focusing on IEF steps 2 through 4, an estimate of \$150,000–\$200,000 (2012 dollars) is not unreasonable. This

amount will only cover the direct costs for technical and ecological services. Direct costs can be greatly reduced through in-kind contribution of science and technical services by partners. Costs should be shared among the multiple partners that would benefit from this work.

Information needed to conduct an IEF includes spatial and non-spatial data from a large variety of sources, depending on the nature and location of the region. The Transportation Research Board SHRP 2 C06(B) project technical report (<http://www.trb.org/Main/Blurbs/166938.aspx>) provides much more detail on specific data and sources for each step.

Potential Stakeholders/Users

There is no IEF without a partnership among the resource agencies and transportation planning agencies. The resource agencies add their data to the IEF, but also share in the decision making and creating standard procedures and setting priorities for avoidance and mitigation. Their cooperation is critical to the creation of an IEF that becomes the new normal mode of operation on which all parties have agreed.

The geographic extent of the region will determine the identity of some stakeholders. Other stakeholders, such as federal and state resource agencies that are normally consulted at the project level, will likely be involved in any case.

Like the transportation agency, these stakeholders will need to commit time and resources to participating in the development of the IEF. Also, the number of partners and the relative benefits of their participation and contributions needs to be considered (a larger number of partners increases the complexity of coordinating the partnership and making decisions). Although every voice can add value, decision makers will be limited to a select core of agencies whose upper-level management must ensure compliance with the agreements and procedures incorporated in the IEF.

Willingness to Make a Long-term Commitment

Like every innovation, IEF needs a “champion” to lead the implementation. The champion builds the enthusiasm, trust, and collaboration of the team, learns from the team, and engages the agency leaders who have the knowledge and the resources to achieve the goals of the IEF.

The champion will need to gauge the willingness of the partner agencies in developing the framework and meshing it with their own for the long run. If the IEF is to become a new mode of operation, the need for a long-term commitment by the participants to maintaining a “living” database/stakeholder agreements cannot be overstated.

Precursors - Establishing a Vision and Engaging Upper-level Management

The IEF is a transportation-centric effort, and the transportation planning agency must make the first assessment of the existing process and its vision for the IEF. However, the IEF need not stop with the transportation plan. Engaging other planning organizations, such as MPOs to incorporate future land use plans, for example, can help not only the transportation planning effort but also extend the IEF principles to other land use planning scenarios.

The IEF champion should consider questions such as these in defining the vision for the IEF:

- What is the scope of the long-range transportation plan?
- What proportion of the long-range plan comprises new roadway on new alignments versus reconstruction of existing roadways?
- What are the greatest obstacles in the current system to efficient program and project planning and compliance?
- Are there particular recurring issues that can be addressed from a programmatic level?
- What agencies are involved in those issues?

The answers to these questions relate to the size of the transportation program and the extent of potential involvement with ecological resources, and they will determine what can actually be accomplished with the IEF. A plan that comprises new roadways on new alignments will require a greater expanse of resource mapping, with a focus initially on avoidance. Reconstruction will have more localized impacts that are more predictable from the outset (less flexible), and may provide a greater opportunity for “righting old wrongs,” which is a different focus.

Either way, there is value in the exercise to setting priorities based not just on the transportation plan, but also on the value of the resources. Reconstruction requires permitting and mitigation, too. Further, not all of the projects to be considered are “future” projects. The current construction program could also benefit and could take priority if there are outstanding ecological issues.

Chances are, the person initiating this approach in the transportation planning organization will not be the director. There will be an initial investment, so it will be incumbent on the initiator/champion to educate those managers who control the resources on the benefits and efficiencies that can be gained from the IEF.

Information Requirements/Prerequisites

The root of the IEF is the resource mapping, known as the REF. No one needs to start from scratch in creating the REF. There are tools available to access a variety of national level, ecological geographic information system data, the most well-known being the National Wetland Inventory. At the state level, many if not all states maintain rare species records and statewide plans, such as the Wildlife Action Plan, in a geographic information system format. The difficulty may be in obtaining the resource information needed at the desired level of resolution and the needed coverage.

Practical Tips

Step 1: Build and strengthen collaborative partnerships and vision

The goals of this step are:

1. Break down organizational barriers.
2. Take an inventory of each stakeholder's goals, priorities, processes, and major areas of concern within a specified planning region.
3. Document significant issues that may affect agency goals and mitigation needs.
4. Create a shared regional planning vision.
5. Obtain formal agreements on roles, responsibilities, processes, and timelines that establish or reinforce partnerships.
6. Document criteria and opportunities for using programmatic consultation approaches to better address transportation and conservation planning needs.
7. Identify initial funding options.

With a basic vision in mind and the commitment of the transportation planning organization to make the initial investment of resources toward the IEF, outreach to other planning organizations and resource agencies in the planning area begins.

Defining the area under the jurisdiction of the planning organization is straightforward. At this step, thought should be given to subdivisions depending on particular ecological issues. Dividing areas by hydrologic units (hydrologic unit codes or watersheds) is a convenient method, as mapping hydrologic unit codes at different levels (8- digit, 10-digit, 12-digit) is readily available nationwide from the Natural Resource Conservation Service. These units are referenced in some regulations (such as in CWA regulations), and may also correspond to the distribution of

particular habitat types, for example, rare species ranges. In any case, it is a convenient starting point.

Based on the planning area, develop the list of partners. The core stakeholders are the same agencies consulted in project-level ecological coordination. Federal agencies such as the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and their state counterparts are the root list. These agencies can cover the majority of ecological issues at the federal and state level, including both the resources protected by law and those that require sensitive approaches.

The list of additional stakeholders depends on the scale of the IEF. Add to that stakeholders with a local or sub-regional interest, such as county agencies, MPOs, cities, park districts, and non-governmental conservation groups.

Initiating the IEF may not be a simple affair, given workload priorities and availability of the partners. Having consolidated meetings is clearly the best choice, and may be possible for the kickoff and some interim meetings; however, the larger the group, the less likely all members will be in attendance. At the initial meeting, the method for future communication to keep all parties engaged should be a priority agenda item. Depending in the timing, the meeting could be preceded with a questionnaire to identify available mapping data/format, current software, and conservation/restoration priorities as a beginning point of discussion. The communication will likely be a balance of written communications and face-to-face meetings to provide partners the greatest flexibility to stay involved, but also occasional concurrence points to punctuate the process.

Models of project public involvement can be applied to this activity.

Depending on the scope of the planning effort, the stakeholders could be subdivided by role. The C06 Guide subdivides the planning group for a long-term partnership into:

- *The **Partners Team** provides leadership and direction to the other teams to ensure that their common and accepted objectives are met. Partners represent the agencies and organizations investing in the plan. [Upper level management engagement is needed not only to provide resources, but to enforce the agreements made among the stakeholders in each agency's policies.]*
- *The **Science Team** ensures that the REF represents best available scientific knowledge, makes recommendations about the natural resources that should be included in the REF and populates the REF with information about the resources' conservation requirements and response to stressors that would appear in the transportation and land use scenarios. Because all knowledge*

cannot be integrated into the REF, the team should also be engaged to review and validate assessments and inform decisions. The team itself is composed of subject matter experts for the resources and may be drawn from state and federal agencies, universities, and NGOs among others.

- *The **Technical Team** manages and conducts the technical work of the IEF. A single project team member may have more than one of the necessary skill sets; for example, a staff member managing the project may also facilitate the partnership.*

State DOTs were given the authority to enter funding agreements with other federal and state agencies. However the team is constructed, the best outcome is that all partners share in a practical benefit, the mapping product, and standard procedures that they might apply across their organizations.

Step 2: Characterize resource status

The goals of this step are:

1. Compile the existing available data and plans into a refined map that identifies locations of all resources of interest and areas for conservation and mitigation action.
2. Understand historical/long-term trends, priorities, and concerns related to aquatic and terrestrial species and habitats in the region.
3. Identify data gaps that need to be addressed to achieve a complete and reliable product at the appropriate level of resolution and accuracy.
4. Identify past impacts at critical locations, such as stream crossings and migration corridors (especially if retrofitting will be a mitigation option)
5. Arrive at an agreed-upon set of conservation and mitigation goals.

Web-based mapping tools are available that reference a number of national datasets. Some, such as C06 tool, also allow adding more-detailed local layers to the REF base map and sharing that data.

Thought should be given to the format of the base mapping that is compatible with and accessible by all potential users, including the stakeholder agencies, planning consultants, agency and consulting design engineers, and construction managers. If the IEF will be the new mode of operation, all who are expected to follow it must have easy access and be able to integrate their data and plans.

The knowledge of our ecological systems, the list of threatened and endangered species, and even climate change will continue to modify the base map over which the transportation plan is

laid. The transportation plan will change with changing transportation needs. The system must be able to be updated, and the updates able to be made easily, and by more than one stakeholder. The more integrated the base map is with the resource agencies' own products, the more likely it will be a living database. Ideally, the transportation planning organization's planned improvements must interface readily and automatically update as the plans are modified. The better the system is "shared," with a division of labor among the stakeholders for keeping the information up to date, the more likely it will be used and valued.

Define the list of sensitive habitats to be included in the REF, based on regulations, habitat uniqueness, water quality assessments, or rare species habitat requirements. Using available data, identify features and categorize them with a weighting system. The weighting system could be as straightforward as assigning points for location, habitat features, historical protection, and restoration potential. A consolidated score identifies the more "valuable" habitats. The sites can also be separately scored for a number of habitat features with different intent, such as a separate score for a particular species or for wetlands. The weighting and habitat categorization is at the discretion of the stakeholders and will depend on the quality and resolution of the data available.

The base map with categorized habitats provides the basis for assessing the current resources, historical impacts, data gaps, and conservation and restoration goals.

Steps 3 and 4: Create the REF and assess land use and transportation effects

The goals of these steps are:

1. Create transportation program scenarios that address short- and long-term improvements and include all features that may cause impact to natural resources.
2. Obtain a shared understanding of the current and planned/proposed locations, quantities, and patterns of all development, uses, and resource impacts in the region.
3. Create a regional-scale picture of potential and cumulative impacts on natural resources based on transportation scenarios.
4. Agree on preferences regarding avoidance, minimization, potential conservation, and restoration investments to support selection of the best transportation plan scenario.
5. Identify and quantify mitigation needs.

At these steps, the partnership creates planning scenarios. Alternative scenarios could be developed depending on factors such as near-term versus long-term and low growth versus high growth assumptions. The transportation planning organization would provide its plan for the

planning region and its assumptions. Other land use planning, such as community land use and management plans from the major local, state, and federal regulatory, land management and planning agencies in the region, could be included for a cumulative view. The combination of the plans defines the “footprint” of consideration of impacts.

The alternate scenarios can be overlaid on the resource mapping. It is likely that some conflicts will be readily visible.

The stakeholders then evaluate the scenarios, jointly review and prioritize the affected resources, not unlike a project-level alternatives analysis, to optimize the transportation/infrastructure objectives *and* minimize adverse environmental impacts. This activity is largely driven by the Science Team, which must quantify the important elements of the affected resources, conservation needs (including the “must avoid” core habitats, minimum habitat sizes, connectivity), and the potential impacts. The team may also identify and prioritize retrofitting sites. At this point, scenarios may be modified to avoid and minimize impacts. The level of avoidance and minimization that can be obtained and quantification of impacts will depend on the resolution of the data. The need for mitigation for unavoidable impacts can be identified, by type/resource, and the quantity approximated. The goal is to obtain an estimate of the total mitigation needs of the program by type.

Step 5: Establish and prioritize ecological actions

The goals of this step are:

1. Create a regional conservation, restoration, recovery, and mitigation strategy, with quantitative and qualitative valuation of mitigation sites.
2. Identify the preferred conservation and restoration actions needed to achieve the priority conservation goals.
3. Develop strategies and actions that consider regulatory requirements and programmatic implementation opportunities.
4. Identify crediting opportunities (see Step 6).
5. Designate a lead agency or agencies for each strategy and method for achieving each strategy.

The resource agencies have already identified the habitats in most need of conservation and restoration in the planning area. This step evaluates these areas and others in the planning region to achieve the mitigation goals defined in Step 4.

This step involves the stakeholders building a mitigation plan to meet the needs of the transportation program at a regional level. These collaborative, holistic, regional-scale

approaches allow transportation and resource agencies to eliminate redundant investments, share data, and identify potential mitigation sites more effectively. The value to the transportation agency of having pre-certified, as it were, mitigation sites cannot be overstated. The process should reduce the level of coordination required on a particular project, and the uncertainty at the initiation of any project, for the transportation agency and the resource agencies, as to the potential ecological impacts and likely level of effort needed to address those impacts. It also provides the opportunity for stakeholders to pool their financial resources to achieve the greatest benefit.

Operating principles are similar as those used for mitigation banking—that is, identifying sites with greatest conservation value, the most “credits” per dollar amount, and long-term sustainability.

Based on the resource mapping available, mitigation plan “scenarios” can be developed to meet the program needs and conservation priorities. The “mitigation opportunity inventory” ranks sites based on their ability to meet mitigation targets, along with: a) the anticipated contributions to cumulative effects; b) the presence in priority conservation/ restoration areas of the REF; c) the ability to contribute to long-term ecological goals; d) the likelihood of viability in the regional context; e) cost; f) eventual management (ownership) by a resource agency to insure sustainability; and g) other criteria determined by the stakeholders. This step will require field effort to verify the conditions of the targeted sites and their expandability/improvement potential.

For impacts that do not appear practicable to mitigate in-kind, the transportation agency should review with appropriate resource agency partners the feasibility of mitigating out-of-kind (for example, by helping secure a very high-priority conservation area supporting other resource objectives).

The stakeholders will jointly review the mitigation scenarios. Once adopted, the transportation agency can move to secure sites in advance as a “bank” or consolidated mitigation site for foreseeable projects.

This exercise is consistent with the in-lieu fee wetland mitigation programs in some states (for example in North Carolina and Florida). In these programs, rather than requiring site-by-site mitigation for CWA or state wetlands/waterways permits, the applicant instead pays a fee, correlated with the amount of impact, to the resource agency charged with performing mitigation at a state level. The resource agency has the duty to identify areas with the greatest mitigation/restoration need and sites with the greatest chance of success and ecological value.

Performing this step in concert with the resource agencies helps minimize the level of effort spent on a project-by-project basis identifying suitable mitigation sites, defining mitigation goals, and

ensuring mitigation success, and could help to consolidate funds from various sources to undertake a restoration/mitigation project that meets the needs of the transportation agency as well as the goals of the resource agency. Performed at a statewide level, this effort could have the extended value of providing a guide to mitigation prioritization and siting for all public (including county and city transportation officials, who often follow the state DOT guidelines and policies, and other infrastructure) and private permittees.

Step 6: Develop crediting strategy

The goals of this step are:

1. Identify practical habitat measurements that can be used to set mitigation goals
2. Establish habitat measurements on which to base tools such as advanced mitigation banks, programmatic permitting, and ESA Section 7 consultation.
3. Create agreements on the use of offsite mitigation and out-of-kind mitigation where necessary.
4. Informed adaptive management and updates of the cumulative effects analyses.
5. Enable measurement of gains and losses of ecological functions, and benefits and values associated with categories of transportation improvements or specific project-related impacts.
6. Characterize project mitigation benefits related to currently unregulated services, such as carbon storage or late season water provision.
7. Provide a means to track progress toward regional ecosystem goals and objectives.

This step is perhaps the most challenging in that it requires a clear understanding of the habitat needs of affected species and definition of measures of the functions and values of the habitats to be mitigated.

Begin by gathering existing mitigation crediting protocols, such as for wetlands or stream mitigation where the mitigation ratios are specified based on functions and values according to state law (for example, wetland rapid assessment methods). Also, collect precedent mitigation approaches/ratios for as many of the priority habitats identified in Steps 2 through 4 as possible, such as from NEPA documents and Section 7 ESA taking permits. Preferably these precedents originate within the state or planning region, but also search adjacent areas if none are available. (Depending on the variability of the ecosystem, the applicability of the protocols borrowed from other regions may need to be tested for applicability to local conditions.) The resource agencies should be able to provide these precedents and policies within their jurisdiction. The point is to identify measurement criteria for each affected resource on which to base the mitigation credit

system. For example, wetlands may be categorized using a rapid assessment method, and mitigation ratios established based on the categories. Also, the density of suitable habitat trees may determine the value of a habitat for a particular rare species and define mitigation ratios.

Next, confirm that the resource agencies have the authority and the will to establish rules for mitigation crediting for each priority resource and willingness to enter into memorandums of agreement. This will require the authority of high-level managers to ensure enforcement.

Ecological knowledge will evolve, and the doubt of resource agencies about habitat requirements will make them reluctant to set hard and fast mitigation ratios for particular species in perpetuity. Likely, the ratios will be slanted to the conservative side; that is, more mitigation will be specified to compensate for lack of knowledge, and may have expiration dates, much like CWA Section 404 Nationwide Permit conditions. Even mandated mitigation ratios, such as for wetlands according to state law, can change. So, even though not all of the future unpredictability can be removed from the process, it is reasonable to assume that agreements can be reached with the resource agencies, provided the mitigation plan can meet regulatory requirements and conservation priorities, at least for foreseeable short-term mitigation requirements, such as for projects in the state transportation improvements program or transportation improvement plan.

Step 7: Develop programmatic consultation, biological opinion or permits

The goals of this step are:

1. Reach agreement on resource management roles and methods.
2. Set outcome-based performance standards incorporated within programmatic agreements.
3. Create programmatic ESA Section 7 consultation, Special Area Management Plan for wetlands, Regional General Permit, or agreements that enable the transportation agency to proceed with conservation or restoration action with maximum assurance that their investments will count and will be sufficient.

This step is about developing the Memorandums of Agreement and project-level permitting procedures in concert with the resource agencies. It will include:

1. Specifying coordination protocols for the regulated resources, such as Section 404 permits and Section 7 consultation. These protocols will define responsibilities, document agreements at the project level, and set performance standards for mitigation.
2. Developing standard procedures and designs for projects to minimize impacts.
3. Specifying mitigation ratios and priority sites (where possible).

4. Monitoring protocols of mitigation sites.
5. Specifying responsibilities for long-term mitigation site ownership and management.

Step 8: Deliver conservation and transportation projects

The goals of this step are:

1. Link the early planning processes to the project implementation phase.
2. Incorporate tools and approaches into a monitoring and adaptive management strategy.
3. Provide accurate recordkeeping and tracking of all commitments by the transportation agency in project delivery.

With a view of mitigation requirements for foreseeable projects, and documented agreement with the agencies on mitigation requirements and priority sites, the transportation agency can pursue advanced mitigation. Priority sites that may not be accessible by the transportation agency alone may be accessible in concert with other stakeholders.

Analysis of alternatives for avoidance and minimization must still be practiced at the project level, in accordance with agreements and protocols established in Step 7. The commitments and agreements must be translated to the project level. Design standards to minimize impact must be included in the project design. It is likely that many will be incorporated as environmental commitments in the NEPA document, as well as conditions of regulatory authorizations and permits. The transportation agency should have a system for recording all mitigation requirements by project, actions taken, and monitoring completion. The system should be available to the regulatory agencies for verification.

Stakeholders should continue to monitor the outcomes of mitigation, design standards, and other specifications for opportunities to improve the outcome and benefits to the ecosystem.

Step 9: Update regional ecosystem framework, scenarios, and regional assessment

The goal of this step is to maintain a current REF consistent with best available data and expert knowledge.

Ecological conditions and the knowledge base will change over time, and ideally the IEF will change with them. Species distributions, land development, climate, and even conservation priorities will change. The conditions at priority sites and the base-mapping of resources, including successful mitigation efforts, will need to be updated from time to time. The accessibility of an interagency system will make this updating as seamless as possible and the new information readily available. This change may alter the availability or utility of some

mitigation sites that were previously identified. Mitigation strategies going forward may need to be updated.

Therefore, regular progress reviews between the transportation agency and the resource agencies are needed to verify the effectiveness of the program in promoting conservation goals, mitigation strategy, and programmatic agreements.

Conclusion

The development of the IEF requires a considerable effort and investment by the transportation agency, each of the cooperating agencies and, to some extent, the public. For a number of state DOTs and regional transportation agencies, elements of the IEF have already been integrated into their planning. Statewide mapping of priority habitats, cooperative agreements for impact assessment and organized inter-agency mitigation site selection and implementation are becoming more common as the benefits of the forward thinking are realized. For others, the IEF may amount to a sea change in their normal mode of operation.

The goals of the IEF are limited only by the imaginations of the participants. The implementation is limited by the dedication of funding and staffing by the participants. The opportunities that can be realized by participating agencies include the predictability of transportation delivery programs, efficiency in environmental compliance, and the results of better decision-making and preservation and mitigation planning for natural systems. By implementing Eco-Logical and using the IEF processes, a balance between infrastructure needs and environmental compliance and preservation can be found.