The Ecosystem Approach and Transportation Development

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Background - The Ecosystem Approach

"Ecosystem management" is a new phrase being heard more and more often with respect to resource management and planning issues. Ecosystems are interconnected communities of living things, including humans, and the physical environment within which they interact. Healthy and well-functioning ecosystems are vital to the protection of our diverse biological resources, and to sustaining our economies and communities that rely on their products. Ecosystem management recognizes the interrelationship between the natural environment and healthy, sustainable economies, and emphasizes the integration of planning for the protection and preservation of both.

The ecosystem approach is characterized as a method for sustaining or restoring natural systems and their functions and values. It is goal driven, and is based on a collaboratively developed vision of desired future conditions that integrates ecological, economic, and social factors. It is applied within a geographic framework defined primarily by ecological boundaries. An example of such an ecosystem might be the South Florida Ecosystem, Upper Yellowstone Ecosystem, the Chesapeake Bay Ecosystem, or the Lake Michigan Ecosystem, where geographic boundaries can be drawn around an interacting area of concern. Traditional resource management tends to be site specific, with little consideration of how a proposed action fits into the context of the broader ecosystem or landscape. Under the ecosystem approach, the frame of reference and management objectives are much broader. Although site-specific actions are still necessary, they would be developed and conducted within a broader ecosystem context, and evaluated over a longer time span.

The Federal Response

Vice President Gore's National Performance Review called for agencies of the federal government to adopt a proactive approach to ensuring a sustainable economy and environment through principles of ecosystem management. The Interagency Ecosystem Management Task Force was established in August of 1993 to carry out this mandate. The Task Force formed a working group which conducted case studies to learn about ecosystem efforts to date, to identify barriers to implementing the ecosystem approach, and to identify ways the federal government could assist in overcoming these barriers. Seven areas were selected as case studies: Anacostia River watershed, Coastal Louisiana, Great Lakes basin, Pacific Northwest forests, Prince William Sound, South Florida, and Southern Appalachians. The working group also examined major issue areas that influence the effectiveness of the ecosystem approach, categorizing problems into issue areas such as budget, institutions, public participation, science and information, and legal authority. The Task Force developed a report focused on the activities of federal agencies and what they can and should be doing to implement the ecosystem approach.

Volume I of the Interagency Ecosystem Management Task Force Report: The Ecosystem Approach: Healthy Ecosystems and Sustainable Economies, provides an introduction and overview of principles and practices for ecosystem management. Volumes II and III will present Implementation Issues and Case Studies, respectively.

Volume I of the Task Force Report recommends that Federal agencies adopt common principles for an ecosystem management approach. The principles should act as a guide for implementing and participating in ecosystem-based management activities. Because there is a wide variety of Federal programs, the report recommends that agencies develop specific ways to incorporate the following principles into their specific missions:

1. Develop a shared vision of the desired ecosystem condition that takes into account existing social and economic conditions, and identify ways in which all parties can contribute to and benefit from, achieving ecosystem management goals.

2. Develop coordinated approaches among federal agencies to accomplish ecosystem objectives, collaborate on a continuous basis with state, local, and tribal governments, and other stakeholders to address mutual concerns.

3. Use ecological approaches that restore or maintain the biological diversity, productivity, and sustainability of the ecosystem.

4. Support actions that incorporate sustained economic, socio-cultural, and community goals.

5. Respect and ensure private property rights and work cooperatively with private landowners to accomplish shared goals.

6. Recognize that ecosystems and institutions are complex, dynamic, and variable through time and over space.

7. Use an adaptive approach to management to achieve both desired goals and a new understanding of ecosystems.

8. Integrate the best science available into the decision-making process, while continuing research to improve scientific knowledge and understanding.

9. Establish baseline conditions for ecosystem functioning and sustainability against which change can be measured; monitor and evaluate actions to determine if goals and objectives are being achieved.

Although these principles may be incorporated into Federal agency missions and goals, specific actions will likely be required to make the ecosystem approach a reality in the day-to-day operations of agency programs. Along these lines, the Task Force report recommends that Federal agencies take the following actions to implement an ecosystem approach:

1. Ensure that all relevant and identifiable ecological and economic consequences (long and short term) are considered.

2. Improve coordination among concerned agencies, federal and other.

3. Form partnerships between federal, state, and local governments, Indian tribes, landowners, and other stakeholders.

4. Improve communication with the public.

5. Carry out federal responsibilities more efficiently and cost-effectively.

6. Use the best science to address planning and problem solving.

7. Improve information and data management.

The Ecosystem Approach of ISTEA

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) includes measures and policies requiring or encouraging an approach to transportation development which integrates considerations for management of both the natural and constructed environments. ISTEA, through measures in the Transportation Improvement Program, encourages Metropolitan Planning Organizations, local, and State transportation agencies to involve the public and other resource management and development concerns in long-range transportation planning. It also requires that transportation agencies consider the likely effects of transportation policy decisions on land use and development, and the consistency of transportation plans and programs with the provisions of all applicable short- and long-term land use and development plans. In a sense, these provisions incorporate an ecosystem approach into highway planning, resource development, and land-use by moving land use decisions to the front end of the transportation planning process. This should encourage better decision-making processes and long range planning for both transportation and land use development compatible with sustainable ecosystem productivity and integrity.

ISTEA provides clear and specific authority for advance inventory of wetlands resources, participation in local and regional planning efforts for management of wetlands

ecosystems, and development of mitigation banks for mitigation of unavoidable wetlands impacts. It also establishes the eligibility of mitigating impacts on other natural ecosystems and wildlife habitat for Federal-aid funding. All of these approaches support an ecosystem management concept.

Relationship to Programs of the Federal Highway Administration

The principles and actions listed above are incorporated into FHWA regulations, policies and practices through compliance processes relative to NEPA, the Clean Water Act, Endangered Species Act, and Clean Air Act, and other environmental regulations. FHWA regulations and policies have increasingly supported an ecosystem management approach to transportation planning and development. FHWA regulations implementing NEPA emphasize consideration of ecological resources in early planning phases of highway projects, and encourage planning to avoid undesirable ecological impacts. Where impacts are unavoidable, authority is provided for other alternatives to mitigate impacts which affect critical or highly important resources

The Federal Highway Administration and State Highway Agencies have broad responsibility for ensuring the planning, construction and operation of an environmentally sound, effective, and safe national transportation system. These responsibilities encompass almost all ecosystems where any human development has occurred. Transportation projects often have important direct and indirect impacts on natural ecosystems, and connect adjacent or distant ecosystems through travel corridors and right-of-way management practices. Highways affect ecosystems by altering and replacing existing biological communities, by creating barriers between different habitats, by introducing new species and activities, by providing new access for socio-economic development and construction, by altering drainage patterns, and by changing the basic geochemistry of a region (for example, water and air quality). Many of these impacts are long-term, even those which we often consider to be temporary. An example is erosion and sedimentation. While the source of erosion might be temporary, the effects of the sediment are long-lasting once it has entered the aquatic system. Other impacts, such as those generated by access, can be both long term and progressive, depending on local land use and development planning.

Administrator Slater, in a speech recently delivered at ceremonies for the Boston Central Artery, emphasized the need for environmental agencies to become actively involved in the long-range transportation planning process, where projects are conceived and the purpose and need established. He clearly stated that FHWA and other highway agencies need invest more effort in environmental inventories and analysis at the planning stage and in scoping out key issues. He identified the need for environmental agencies to make a greater commitment to participating in the highway planning and project development process through the commitment of personnel time and information resources. The Administrator also clearly stated the need to provide the public with the best environment and transportation value for shrinking public dollars, even if that means abandoning some planned transportation projects when the environmental impacts are too severe.

An interagency Memorandum of Agreement (MOA) on the merging of the Section 404 compliance and NEPA processes is an example, and FHWA is encouraging the full implementation of the 404/NEPA process merger by all states. This will move consideration of environmental impacts on wetlands to a point earlier in the project design and review process, and help involve resource agencies in the decisions critical to project impact assessment and selection of the least environmentally damaging alternative. The agency has responded to this national agreement by entering into several regional and State level Section 404/NEPA merger procedures and agreements.

In FHWA Region 9, Arizona, Nevada, and California DOTs have signed and implemented a similar joint MOA with to merge Section 404 and NEPA procedures which will move consideration of wetland impacts to the front of the project development process. This will enable agencies to submit and approve a 404 permit application concurrent with the approval of the final EIS and issuance of the decision document. Hawaii, the other state in the region, signed a separate MOA because the State is under a different COE district office. The FHWA Region 8 office, in cooperation with the COE, EPA, and other agencies, developed a "Statement of Principles" relative to NEPA/Section 404 procedures.

As these procedures and policies are implemented and the flexibility inherent in ISTEA is utilized, ecosystem-based actions and decisions will become more apparent. Although the ecosystem management approach is new to many State DOTs and FHWA, there have been several notable examples of how it can work.

Examples of the Application of Ecosystem Management Approaches and Principles

1. Reducing the effects habitat fragmentation and barriers to animal movement.

One of the impacts of highways on an ecosystem is the formation of barriers between existing ecological communities. These barriers can cause impacts on wildlife and fisheries populations which have requirements for areas on both sides of a facility. Loss of range necessary for feeding or territorial behaviors may reduce the vitality of animal populations by decreasing diversity and abundance of food sources and disrupting nesting or other reproductive activities. Transportation barriers may also cause increases in mortality animals attempting to cross to another portion of their fragmented range. Migrating or moving wildlife can also cause safety hazards to vehicles and motorists. Mitigation of these impacts can involve the use of structures to provide travel corridors, fencing to control animal movements, or alternative alignments to eliminate or minimize the interaction between wildlife and the highway.

In Florida, the State DOT has installed 23 wildlife crossings, 13 bridge extensions of 40 feet each, and right-of-way fencing along 40 miles of highway during a recent upgrade and reconstruction of U. S. Highway 75 in south Florida. These efforts were implemented to overcome the range restriction barrier presented by the highway in the south Florida ecosystem. The measures were used also to protect and provide passage for the Florida panther and black bear, both of which are endangered

species in that area. The structures cost approximately $13 million state highway funds, plus $ 2 million federal-aid funds. Right-of-way fencing was paid for with a combination of state highway and federal aid highway funds. The 120 foot long "wildlife underpasses" were designed in consultation with the U. S. Fish and Wildlife Service, and monitored photographically after construction. Both Florida panther and black bear have been documented using the structures. Other species using the structures include alligators, deer, raccoons, bobcats, turkeys, and opossum. Fencing has been highly effective in keeping wildlife off the roadway, and has reduced wildlife mortality significantly.

Similar structures have been used to provide connections between essential migration habitats for wildlife. In California, Wyoming, and Colorado, deer underpasses were constructed to allow major deer migrations to move between critical summer and winter ranges along several State routes and Interstate highways. Deer-proof fencing and one-way gates were installed on rights-of-way adjacent to major deer movement corridors to keep deer off the highway and to channel them to crossing structures. In Nevada, culverts and right-of-way fencing have been used to provide corridors for movement of the endangered desert tortoise in its desert environment. Other states have also used culverts and other structures to provide wildlife passage.

2. Mitigation Banking

Ecological mitigation banking can enhance management and functioning of ecosystems by encouraging development of larger, more sustainable mitigation sites. Such sites often can provide more public and ecosystem benefits while being easier to manage than small, and often isolated, measure at a project site. Properly planned banks can also release sites critical to construction and economic development. Habitat banking measures can also include provisions for critical combinations of different habitat types. Wetlands, for example, often depend on surrounding areas to sustain many of their ecological functions. Wetland habitat banks often include "buffer zones" that enhance hydrology and prevent deterioration of water quality, while providing critical wildlife links or corridors to adjacent upland areas.

DOTs in Florida, Texas, Tennessee, Arkansas, Montana, California, New Jersey, Michigan, and other states are promoting the development of larger scale mitigation projects which will contribute to preserving and maintaining local and regional ecosystem integrity, as well as seeking opportunities for on-site mitigation where appropriate. Federal, state, and local resource management agencies and authorities, plus private organizations are commonly involved in the planning and implementation of these activities.

- Tennessee now has approximately 1400 acres under agreement or planned for development as wetland mitigation banks. The banks are distributed in several different regions of the state, and represent different regional ecosystems and wetland types. The initial banking site, located near Memphis in the Wolf

River drainage, will involve the restoration of bottomland hardwood wetlands on approximately 400 acres of prior converted agricultural fields. It will provide wintering habitat for waterfowl, as well as habitat for many forest dwelling species throughout the year. Multiple federal, state, and local agencies, as well as private organizations, were involved in the planning of the bank.

- Michigan DOT, in cooperation with the Nature Conservancy, FHWA, and U.S. Fish and Wildlife Service (FWS), is in the process of developing an "ecological mitigation bank" as habitat for the endangered Mitchell's Satyr butterfly. A planned acquisition of approximately 1,200 acres of fen wetlands and surrounding buffer areas will preserve some of the region's rarest wetlands. It will also provide a permanent habitat reserve for the Mitchell's Satyr and other fen-dependent species of plants and animals. Although this project was initiated as a requirement for mitigation of impacts to an endangered species, it also will provide mitigation of other highway impacts and provide long-term ecosystem benefits to the local area. A unique aspect of this project is the proposal for long-term management by the Nature Conservancy.

- Florida DOT has established several large mitigation banking sites, for both regional wetland types and for upland habitats critical to recognized rare and endangered species. The DOT now has over 3000 acres under management or planned for acquisition in different regions of the state. Wetlands functions being emphasized include protection of water quality and drinking water supplies as well as wildlife habitat. The Florida DOT, with cooperation of the FWS, Nature Conservancy, and State Resource Agencies, has established a 1600 acre upland habitat bank in central Florida which will provide future mitigation for a variety of endangered and threatened species as a natural preserve within which the public can view and study wildlife. This bank was established with State highway funds, but as credits are withdrawn from the bank for federal-aid projects, federal aid highway funds will be used to buy out the credits on an as-needed basis. Other mitigation banks in Florida are being established on the same funding basis. In each case, all the concerned agencies were involved in the planning and development of the banks.

3. Advanced Ecosystem Planning and Management Activities

Advance data collection, thorough coordination, and shared objectives and information are critical elements in an ecosystem management approach to land-use planning. The NEPA process was designed to ensure that those elements occur in the development of Federal activities, such as highway and other transportation projects.

- The FHWA and Florida DOT are participating partners in a multi-agency effort

to restore and manage the south Florida ecosystem. Termed the South Florida Ecosystem Management Task Force, the group agreed to a series of actions to achieve a broad range of restoration and management objectives. for example, the Task force recently published a draft report of recommendations for water management and other related activities. Several objectives emphasize the status of Florida Bay and the Florida Keys marine sanctuary. The Corps of Engineers is heading a major study of the south Florida aquatic ecosystems and hydrology. Other emphasis areas include the Big Cypress Preserve and Florida panther refuge.

Also, under a State MOU, the Florida DOT is a participant with other state agencies that have agreed to pursue the goals of the Florida Department of Environmental protection relative to managing the south Florida ecosystem. As such, Florida DOT will strive to maintain hydrology patterns, install wildlife crossings, and maintain ecosystem integrity, as appropriate and necessary. These activities are to be carried out under the general consultation with resource agencies relative to project design and management.

- In West Virginia, a comprehensive mitigation plan has been developed as the result of interagency coordination and public input on the Appalachian Corridor H project. West Virginia DOT, West Virginia FHWA Division Office, and other federal, state, and local agencies developed plans and recommendations to reduce and mitigate environmental impacts associated with the 100 mile, 4-lane highway, including the mitigation of the loss of aquatic and terrestrial wildlife habitat. Activities identified in the Comprehensive Mitigation Plan include compensation for impacts to wetlands and terrestrial habitats, controls for clearing and grubbing during construction to minimize plant loss and erosion, fencing and other activities to protect area streams and stream crossings, and acquisition of excess right-of-way to enhance protection of natural habitats. This plan was developed during the draft EIS process through extensive cooperation and information sharing between the concerned agencies. It demonstrates the environmental approach needed to successfully plan and construct a major highway project in the current regulatory, management, and economic environment. But above all, the plan addresses a variety of issues deemed critical to maintaining the integrity of the Allegheny highlands ecosystem type, through which the highway will pass.

- The Western Federal Lands Highways Office (WFL) of FHWA is planning the Mountain Loop Road (Washington Forest Highway 7). To optimize the project design and facilitate environmental review, WFL funded an integrated watershed analysis by U. S. Forest Service to ensure that the highway project was compatible with long-term forest management plans for the Sauk River watershed. These analyses represent comprehensive ecological reviews of

watershed land cover type and use, using a multi-disciplinary approach. These analyses focus on resource conditions, including wildlife, plant communities, mineral resources and development potential, and human uses. The goal is to identify critical elements or improvements necessary to obtain the highest possible ecological condition consistent with productive use and human development objectives.

- The Headquarters office of FHWA and Montana DOT are working with the FWS to develop and fund a proposal to use digital data and Geographical Information Systems (GIS) technology to analyze the location of important "linkage zones" used by wildlife to move between different ecosystems and habitats. One aspect of the project will try to determine some of the effects of highways on these linkage zones, and evaluate different strategies for maintaining wildlife movements. The proposed study uses GIS analysis techniques developed by the FWS Grizzly Bear Recovery Team to analyze bear movements in the Northern Rocky Mountains and Flathead River Ecosystem. The project is the result of an interagency workshop on the impacts of highways on large carnivores in the Northwest, held in Missoula, Montana, May 1995. Initiated as a cooperative effort by FHWA and FWS, the workshop was attended by highway and resource agency managers and biologists from Montana, Idaho, Washington, Wyoming, and Colorado.

4. Ecosystem-based Research Efforts

FHWA policy supports research on measures in highway planning, design, and construction which reduce environmental impacts due to highway construction, use, and maintenance. The FHWA and State Highway Agency research programs has evaluated the effects of highway construction on animal movement, fish and wildlife habitat use and mortality, wetlands, species diversity, plant distribution and community composition.

- The New England Transportation Consortium recently funded a research project by the University of Massachusetts to develop a computerized, interactive, set of regional habitat utilization models for birds, mammals, reptiles, and amphibians in the New England States. These models are designed to be used for assessment of the impacts of highways on biota within the New England geographical region. The results of the project have been very well received by resource agencies. The FHWA headquarters office subsequently funded a cooperative project with the FWS to develop similar models for wetland-dependent birds.

- FHWA and State Highway Agencies support on-going research and practices for an ecosystem approach to right-of-way re-vegetation and vegetation

management. These efforts promote the use of economical landscaping and restoration measures that maximize the use of native and regionally appropriate species. FHWA highlights this work by publishing a quarterly newsletter, *Greener Roadsides*. The newsletter recently received a national award from the American Society of Landscape Architects for reporting the innovation occurring nationwide in right-of-way management and landscaping programs. For example DOTs in Iowa, Minnesota, Wisconsin, Illinois are using native species for re-vegetating rights-of-way whenever practical and appropriate. The States of Florida, Montana, California, Idaho, Texas, and Oregon are also implementing roadside management programs that include standard techniques for incorporating native species into landscaping plans.

Summary

Although the ecosystem approach as a formally defined objective of the Federal government is a fairly recent concept, transportation agencies have implemented a variety of projects and programs which are consistent with the principles of sustainable environments and economies. These projects and programs vary widely in both geographic location and intended overall purpose. However, certain similarities are evident. All involve ways to bring together sometimes divergent, stakeholder interests into a coordinated plan of action with a well-defined purpose. All contain provisions imploring the use of sound science as a basis for decisions made to both plan and implement the intended action or actions. Finally, all attempt avoid the environmental myopia that often plagues single-issue, project specific actions. Broad thinking and acting are the keys to success. Agencies throughout the nation are demonstrating that the ecosystem approach is not only possible, but actually beneficial to the safe, efficient, and environmentally sensitive transportation of people and goods.

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