REPORT TO CONGRESS
ON
COSTS ASSOCIATED WITH THE ENVIRONMENTAL PROCESS:

Impacts of Federal Environmental Requirements on Federal-aid Highway Project Costs

October 25, 2006

A report to the Committee on Appropriations as requested by House of Representatives Report 108-792, which accompanied the Fiscal Year 2005 "Transportation, Treasury, Independent Agencies, and General Government Appropriations Act."

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EXECUTIVE SUMMARY

The Committee on Appropriations, U.S. House of Representatives, requested the U.S. Department of Transportation (USDOT), through the Federal Highway Administration (FHWA), to report on the costs associated with the environmental process for highway projects.[1] The Committee report language states:

> The Committee directs FHWA to determine the costs associated with the environmental process on a representative sample of projects. Analysis should include information on environmental costs associated with the project itself, such as, wetlands mitigation and 4(f); costs associated with preparing the document; and other related costs associated with the time it takes to complete the environmental process.

This "Report to Congress on Costs Associated with the Environmental Process: Impacts of Federal Environmental Requirements on Federal-aid Highway Project Costs**"** (Report to Congress) responds to that request. Because FHWA found that only limited environmental cost data are available, and that efforts to track environmental costs still are quite limited, this Report to Congress also discusses issues surrounding the definition and tracking of environmental costs.

The information contained in this Report to Congress is derived from research conducted by FHWA in 2005-2006, which resulted in a report titled "Costs Related to Compliance with Federal Environmental Laws: Case Studies in the Federal-aid Highway Program" (FHWA Case Studies Research).[2] That research report includes a brief review of earlier research in the field, protocols for defining and identifying environmental costs, descriptions and data from case studies of six different types of highway projects, and an analysis of the research results. A complete copy of the research report appears in Appendix A.

FHWA expects that the FHWA Case Studies Research will generate additional dialogue about environmental costs. The research, and the feedback received on it, will be valuable resources as FHWA develops and evaluates environmental procedures and policies in the future.

FHWA would like to acknowledge the assistance of the States that contributed to the FHWA Case Studies Research. The principal investigator for the research contacted the transportation agencies in Arizona, California, Florida, Illinois, Kansas, Kentucky, North Carolina, Maryland, Maine, Minnesota, Mississippi, Missouri, Montana, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, Texas, Utah, Washington, West Virginia, and Wisconsin. In particular, FHWA would like to thank the

[1] House of Representatives Report 108-671 (page 48), adopted by the Conference Committee in House of Representatives Report 108-792, which accompanied the Fiscal Year 2005 Transportation, Treasury, Independent Agencies, and General Government Appropriations Act.

[2] Prepared by TransTech Management, Inc. for FHWA Office of Planning, Environment, and Realty and FHWA Office of Policy and Governmental Affairs, and published in July 2006.

Case Studies States of Maryland, Montana, New Jersey, Oregon, Utah, and Washington for their efforts to assist the research.

Defining and Tracking Environmental Costs

Sections 2.0 and 3.0 of the FHWA Case Studies Research consider issues affecting the definition, identification, and tracking of environmental costs in the Federal-aid highway program. Costs incurred by Federal-aid projects to meet Federal environmental requirements (environmental costs) fall into two main categories.[3] The first and perhaps most well known type is compensatory mitigation. That includes project features that offset the human and natural environmental impacts of a project. Examples of compensatory mitigation include restoring or creating wetlands, relocating centers of community life, and building noise walls. The second category of environmental costs is avoidance costs. Those costs occur when actions are taken so that a project does not create an environmental impact, or so that unavoidable impacts are reduced or minimized. Examples include altering a proposed highway alignment to avoid impacts to wetlands or historic resources, and designing a river crossing with a clear bridge span to avoid construction in the waterway. Avoidance costs also include the costs of environmental studies and document preparation.

Highway projects incur environmental costs during the planning, environmental review, design, land acquisition, project permitting, construction, and operations phases. Efforts to identify the causes and extent of environmental costs are in early stages. The FHWA Case Studies Research found that many States question the benefits of tracking environmental costs in light of the expense of such efforts. The research identified only four states (Maryland, Montana, Oregon, and Washington) that currently have experience with extensive cost tracking efforts in the environmental area.

Case Studies Costs Results

Environmental costs can be viewed as an investment in protecting the environment, with transportation agencies acting as stewards for future generations of Americans. These values have strong public support. Yet there also is a need for effective management of the costs of environmental protection and stewardship. As indicated above, compensatory environmental costs encompass the actual "on the ground" activities such as constructing wetland mitigation or stormwater management. The costs of the decisionmaking process that precedes project construction, including delay costs, analysis costs, and public involvement costs, are considered to be avoidance costs. While there are occasions when investment in a particular compensatory mitigation measure may be questionable, on balance it is the avoidance cost category that presents the best target for improvements in environmental cost management.

[3] The term "environmental costs" as used in this Report to Congress and in the FHWA Case Studies Research does not include the value or cost of adverse effects on the human or natural environment. This report and the FHWA Case Studies Research report address only the direct and indirect financial costs of project compliance with Federal environmental requirements.

To date, research studies relating to environmental costs affecting highway projects have had one common finding--that there is insufficient reliable data on environmental costs from which to draw firm conclusions or to quantify the precise costs. At best, the work in this area provides indicators of costs based on professional judgment of experts and the analysis of the records available to researchers. The FHWA Case Studies Research improved on earlier studies because it conducted very detailed inquiries into project level environmental costs.

Research activities included both interviews with State department of transportation (SDOT) project personnel and the review of project documents. The research examined the costs for six typical project types, ranging from the rehabilitation of a two-lane rural highway in Montana, to the replacement of a major Interstate interchange in a rapidly-growing suburb of Seattle.[4] The case studies reflect the different types of environmental analysis and review required under Federal law. Two of the case study projects involved an environmental impact statement, two projects were evaluated through an environmental assessment, and two met categorical exclusion criteria under the National Environmental Policy Act, Title 42, U.S.C., Sections 4321-4347 (NEPA). While the study's small sample size of six projects prevents any statistical use of the case studies data, it can be viewed as indicative of ranges of various types of environmental costs.

The research results, discussed in Chapter II of this report, support the following key findings with respect to environmental costs for the case study projects:

- Environmental costs for the case study projects averaged about 8 percent of total project costs, with a range from 2 percent (12300/12600 S, Utah) to 12 percent (US 113, Maryland; Bob Creek Bridge, Oregon). These estimates do not include categories of costs that the research was not able to address, including costs associated with air quality activities prior to the environmental review process, costs of delay, costs borne by Federal agencies and State resource and regulatory agencies, environmental costs arising during facility operations and maintenance, and costs specifically attributed to the use of Context Sensitive Solutions (CSS).[5]

- Environmental costs incurred during planning, environmental review, and design phases averaged about 23 percent of the total costs for those preconstruction phases of the project. The range was from 8 percent (U.S. 113, Maryland) to 41 percent (Alexauken Bridge, New Jersey).

- Construction costs typically are the largest element of total project costs (ranging from 65 percent to 80 percent in the case study projects). Environmental costs typically represent a small percentage of construction costs, although the dollar costs

[4] Note that the FHWA Case Studies Research focused on projects that reflected experiences that can be expected on most projects in the Federal-aid highway program, rather than on projects that represent extremes of either cost or regulatory complexity. See Chapter I discussion "Determining 'Typical' Project Types for Study" for a detailed discussion of the factors used to identify typical projects for the FHWA Case Studies Research.

[5] For an explanation of the CSS initiative in highway programs, see Chapter III of this report.

for such work may be substantial. The case study projects experienced environmental-related construction costs that averaged 4 percent of total construction costs for the projects, with a range of 1 percent ($640,040 for 12300/12600 S, Utah) to 13 percent ($18,223,080 for US 113, Maryland) across the projects. Where mitigation construction was required, the construction-related environmental costs constituted the largest portion of the project's total environmental costs.

- For the small projects studied, environmental costs for preconstruction activities outweighed environmental costs incurred during construction. The reverse was true for larger projects.

- Expenditures on stormwater, landscaping, and wetlands during construction are large environmental cost drivers. Those construction costs had a much bigger impact on total project costs than staff and consultant time spent on the project studies and construction engineering.

- Environmental-related land acquisition costs vary among projects. Where such acquisition is required, the costs can be significant.

- Project design and construction changes to accommodate environmental concerns can add costs, but such costs are difficult to identify, segregate, and measure.

Chapter I of this Report to Congress provides information about the congressional request, the Federal regulatory backdrop for Federal-aid highway projects, and the scope of FHWA research in response to the request. Chapter II summarizes the FHWA Case Studies Research results. Much of the substance of Sections 1.0 through 4.2 of the FHWA Case Studies Research report is included in the first two chapters of this Report to Congress. Chapter III concludes this Report to Congress with information about FHWA actions to promote the identification and management of the time and costs involved with the environmental review process. Appendix A contains the complete FHWA Case Studies Research report. Appendix B is a brief description of the primary statutes and Executive Orders applicable to the development and review of transportation infrastructure projects.

CHAPTER I: BACKGROUND

Congressional Request

Federal and State environmental laws affecting highway projects, and the environmental review process that implements those laws, create costs as well as benefits. Legislators, transportation agency administrators, the public, and other stakeholders often debate how environmental costs, both direct and indirect, affect highway projects. For some, the concern is that the environmental costs are too high and that the dollars expended for environmental costs reduce the funds available for construction of improved highway infrastructure. This is a particular concern in light of the impacts of traffic congestion on the U.S. as a whole. Others consider the commitment to and investment in environmental analysis and mitigation to be inadequate. Much of the concern focuses on the effectiveness of environmental review requirements as applied to transportation decisionmaking. Ultimately, all of these parties share a desire to ensure that the mandated environmental review process produces good results at a reasonable cost.

In House of Representatives Report 108-792, which accompanied the Fiscal Year 2005 Transportation, Treasury, Independent Agencies, and General Government Appropriations Act, the Committee on Appropriations requested the FHWA to provide a report on the costs associated with the environmental process for highway projects.[6] The request states:

> The Committee directs FHWA to determine the costs associated with the environmental process on a representative sample of projects. Analysis should include information on environmental costs associated with the project itself, such as, wetlands mitigation and 4(f); costs associated with preparing the document; and other related costs associated with the time it takes to complete the environmental process.

This Chapter provides information about the Federal regulatory backdrop for Federal-aid highway projects and the scope of the FHWA research in response to the request.

Regulatory Backdrop

FHWA devotes a significant part of its efforts to working with States to ensure that projects fulfill Federal environmental requirements in an efficient and accountable manner, so that Federal-aid resources are used effectively. Ultimately, however, Federal environmental laws, and the agencies that administer them, shape much of the course of the environmental review process for a Federal-aid highway project. This Report to Congress and the FHWA Case Studies Research include references to various procedures under NEPA. That law mandates that Federal agencies consider the effects of their

[6] The text of the request is contained in the House of Representatives Report 108-671 (page 48). The Conference Committee adopted the request in the Division H, "Congressional Directives" part of House of Representatives Report 108-792, which accompanied the appropriation act.

actions on the quality of the natural and human environment before the Federal agencies make major decisions. The act provides the framework for systematic, interdisciplinary analysis of the environmental effects of Federal-aid projects, and serves as the umbrella under which a large collection of interests and concerns are considered.

Each Federal-aid project falls into one of three NEPA classes of action. Projects with significant impacts on the environment must advance using an environmental impact statement (EIS), and are referred to as Class I projects. Class II projects are those projects for which the environmental significance of the impacts is not clearly established and an environmental assessment (EA) is performed. The preparation of an EA is required in order to determine whether an EIS is needed.[7] Projects that do not individually or cumulatively have a significant effect on the environment, based on past experience with similar actions, are categorical exclusion (CE) projects, sometimes referred to as Class III projects.

NEPA regulations, promulgated by the President's Council on Environmental Quality, require mitigation of environmental impacts. The regulations define mitigation to include: (a) avoiding impacts altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (e) compensating for the impact by replacing or providing substitute resources.[8]

Other major laws and Executive Orders that are referenced in this Report to Congress or in the FHWA Case Studies Research include:

- *Endangered Species Act of 1973, as amended, Title 16, U.S.C., Section 1531 ET SEQ. (ESA)*. Section 7 of the ESA requires Federal agencies to work together to conserve threatened and endangered species. It mandates interagency consultation between FHWA and the Federal agency of jurisdiction (either U.S. Fish and Wildlife Service or National Oceanic and Atmospheric Administration Fisheries Service) to ensure that proposed actions are not likely to jeopardize the continued existence of listed species, or to destroy or adversely modify their designated critical habitats.[9]

- *National Historic Preservation Act of 1966, as amended, Title 16, U.S.C., Section 470 ET SEQ. (NHPA)*. The law, administered by the Federal Advisory Council on Historic Preservation, requires Federal agencies to consider preservation values when planning projects. Section 106 of the NHPA mandates agencies to consult with the designated State Historic Preservation Officer prior to taking any action that may affect a site included in, or eligible for inclusion in, the National Register of Historic Places.[10]

[7] 23 CFR 771.115.
[8] 40 CFR Part 1508.
[9] Implementing procedures are set forth at 50 CFR Part 402.
[10] Title 16, U.S.C., Section 470a(a)(1)(A).

- *Clean Water Act of 1977, as amended, Title 33, U.S.C., Sections 1251 ET SEQ. (CWA).* Sections 401, 402, and 404 of the CWA often apply to highway projects. The goal of the CWA is to protect water quality, including protecting of waters of the United States from the discharge of pollutants. The most widely known aspect of the CWA is Section 404, which regulates the discharge of dredge and fill through review and permitting procedures administered by the U.S. Army Corps of Engineers (USACE) under guidelines developed by the U.S. Environmental Protection Agency (USEPA).

- *Department of Transportation Act of 1966, as amended, Title 49, U.S.C., Section 1563(f), now codified in Title 49, U.S.C., Section 303 and commonly referred to as Section 4(f).* The Department of Transportation Act in Section 4(f) requires the preservation of publicly owned parklands, waterfowl and wildlife refuges, and significant historic sites. A specific FHWA finding is required that (1) the selected alternatives avoid protected areas, unless not feasible or prudent, and (2) the project includes all possible planning to minimize harm. Coordination with other Federal,[11] State, or local agencies having jurisdiction, and the State historic preservation officer (for historic sites) is required.[12]

- *Fish and Wildlife Coordination Act, Title 16, U.S.C., Sections 661-666(C) (FWCA).* The FWCA authorizes the Secretary of the Department of Interior to provide assistance to and cooperate with Federal, State, and public or private agencies or organizations in the development and protection of wildlife resources and habitat, to make surveys and investigations of the wildlife in the public domain, and to accept donations of land and funds that will further the purposes of the Act. The FWCA is the primary wildlife consultation mechanism in situations where the ESA does not apply. Proceedings for project permits under Section 404 of the CWA include coordination with the Federal Fish and Wildlife Service and State fish and wildlife agencies under the FWCA.

- *Title VI of the Civil Rights Act of 1964, Title 42, U.S.C., Section 2000(d) ET SEQ. (Title VI).* Title VI declares that it is the policy of the U.S. that discrimination on the basis of race, color, or national origin shall not occur in connection with programs and activities receiving Federal financial assistance. The law authorizes and directs Federal departments and agencies to take action to carry out this policy. Among the measures USDOT uses to meet this requirement is the involvement of the potentially affected public in developing transportation projects that fit harmoniously within their communities without sacrificing safety or mobility. Actions to implement Title VI responsibilities also meet the requirements of E.O. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations."

A more detailed list of the major Federal laws and Executive Orders that apply to Federal-aid highway projects is available online at the FHWA website titled "Eco-

[11] The Department of Interior, Department of Agriculture, and Department of Housing and Urban Development.
[12] Implementing regulations appear in 23 CFR 771.135.

Logical: An Ecosystem Approach to Developing Infrastructure Projects" (http://environment.fhwa.dot.gov/ecological/eco_app_d.asp), and in the "Summary of Environmental Legislation Affecting Transportation" (December 1998) available at http://www.fhwa.dot.gov/environment/env_sum.htm. In addition, a comprehensive list appears in a May 6, 2004 notice in the Federal Register titled "Federal Environmental Laws and Executive Orders Applicable to the Development and Review of Transportation Infrastructure Projects."[13] A copy of that Federal Register notice appears in Appendix B to this report.

Scope of FHWA Research

There is no easy or universal answer to questions about how much the environmental review process for a Federal-aid highway project costs. Both FHWA and SDOTs have labored over the years to answer such questions, with limited success. Even defining what constitutes an environmental cost has been problematic because of the variability in factors that affect individual projects, particularly the unique mix of human and natural environmental conditions that create the context for each individual project and the "trade-offs" SDOTs make in response to State, local, and community needs or concerns.

The few environmental costs studies completed prior to 2005 readily acknowledge their own limitations in terms of data and scope. Studies prior to the FHWA Case Studies Research generally fall into two categories: national studies that largely rely on professional judgment rather than documented project-specific environmental costs, and State studies that reflect documented project-level costs but cover only a single state. FHWA determined that its response to Congress on this topic required an effort to capture project-level documented costs across multiple states, as well as across a representative sample of project types. As a result, FHWA undertook research in early 2005 to generate the information needed to respond to Congress's request.[14]

FHWA's Office of Planning, Environment, and Realty, working with FHWA's Office of Policy and Governmental Affairs, developed a research scope of work. The scope included a review of existing research on the topic, identification of SDOT definitions of environmental costs and SDOT environmental cost tracking practices, and an investigation of the ranges of environmental costs associated with representative Federal-aid highway projects.

The main challenge for the FHWA Case Studies Research lay in the small number of states that attempt to track environmental costs separately from other project costs. There is an extreme scarcity of reliable and detailed project-level environmental cost data. Solving this problem through comprehensive project-level data gathering was not

[13] 69 Federal Register 25451 (May 6, 2004).

[14] Since FHWA began its research, the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board of the National Academies initiated National Cooperative Highway Research Project (NCHRP) 20-24(54)(B) titled "Right-of-Way and Environmental Mitigation Cost Investment Needs Assessment." Publication of that study, which will report on environmental mitigation cost data gathered from multiple SDOTs, is expected in September 2006.

feasible. Accordingly, FHWA environmental experts and the research team developed a methodology intended to produce a reasonable sampling of project-level data. The FHWA research adopted a case studies approach, and targeted highway projects that could be characterized as "typical" or "middle range" experiences in terms of complexity and controversy. This was done to avoid the potential for distortion inherent in an examination of projects that are at the extreme ends of the "cost-time-controversy" spectrums.

One unavoidable problem with any inquiry into environmental costs in the Federal-aid highway program is that there are overlapping Federal, State, and local environmental requirements. That means that specific SDOT environmental activities often are undertaken to meet the requirements of more than one level of government. Accurate allocation of costs in such circumstances is not feasible. In addition, the overlapping jurisdictions also sometimes result in Federal-aid project costs incurred solely to satisfy State or local requirements.[15] For these reasons, the cost estimates developed by the FHWA Case Studies Research include costs that are not attributable solely to Federal environmental requirements.

The FHWA Case Studies Research required approximately 15 months. The resulting report (Appendix A) constitutes a "snapshot" of the recent past, reflecting costs and conditions for projects developed and constructed in recent years. The case studies are instructive and add substantially to the body of work on environmental costs in the Federal-aid highway program. There are, however, some types of expenditures that are not evaluated in depth in the FHWA Case Studies Research or in this Report to Congress even though they might be considered environmental costs. That is because such costs either are exceedingly difficult to measure, or opinions are mixed about whether those costs should be categorized as environmental costs. The costs that are not explored fully include:

- *"Context Sensitive Solutions" costs*. Many SDOTs develop project design and construction solutions that are more sensitive to the specific needs of project stakeholders than may have been the case historically. One example is the development of special architectural treatments to help a new bridge blend aesthetically with its surroundings. These solutions are voluntary, not mandated by Federal requirements. Practitioners often characterize such solutions as "the right thing to do" regardless of environmental or legal requirements. In addition, such measures often are considered important to obtaining public support for a project.

- *Costs borne by Federal agencies and non-transportation State agencies*. Federal agencies and non-DOT State agencies, particularly resource agencies, incur costs for time spent on project review and permitting. Those expenditures are thought to be significantly less than SDOT expenditures. They are difficult to identify and track.

[15] For an example of this situation, see the Washington DOT case study in Section 4.3 of the FHWA Case Studies Research (Appendix A).

Data, to the extent it exists, is scattered among the affected agencies. FHWA determined those expenditures to be beyond the achievable scope of its research.[16]

- *Costs of environmental-related highway maintenance and operations activities*. Once a project is constructed, costs may be incurred for activities such as culvert and drainage pipe repair, permit requirements for stormwater run off at maintenance facilities, solid waste disposal, hazardous materials, and control of vegetation and pests. FHWA concluded that it was not workable to attempt to gather detailed maintenance and operations costs data, or to apportion such costs among environmental, operational, and structural repair and replacement needs.

- *Costs related to air quality*. Federal-aid projects in air quality nonattainment or maintenance areas may incur costs related to air quality activities in two different ways. During planning, time and costs are incurred primarily through the transportation conformity process and related analyses required by the Clean Air Act, as amended (CAA).[17] Those costs are not segregated from other planning costs and would be difficult to identify accurately. For that reason, those costs are not addressed in this Report to Congress or in the related FHWA Case Studies Research. The research does encompass project level costs for NEPA air quality analyses. However, the need to invest additional time and costs related to project level air quality analysis has become apparent in some areas due to an increased interest in project specific air quality issues. This is particularly the case with respect to air toxics and the new USEPA requirement under the CAA for a project-level analysis of likely future localized pollutant concentrations for particulate matter (PM).[18] The full effects of this change are not known at this time and are not addressed by this report.

- *Costs of project delays related to environmental issues*. Because the participating States indicated that the case study projects did not experience delays due to the environmental process, the FHWA Case Studies Research does not offer any new insights into costs incurred as a result of delays. However, evidence suggests that environmental issues can delay projects, and that such delays can result in substantial

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[16] A partial insight into non-SDOT agency staff costs is available in a May 2005 analysis of SDOT-funded positions, published by AASHTO (available online at http://environment.transportation.org/center/products_programs/dot_funded.aspx). That report is titled "An AASHTO Center for Environmental Excellence Report on DOT-Funded Positions and Other Support to Resource and Regulatory Agencies, Tribes, and Non-Governmental Organizations for Environmental Stewardship and Streamlining Initiatives." The report found that in 2005 there were 275 positions funded by SDOTs under the authority of the Transportation Equity Act for the 21st Century, P.L. 105-178, Section 1309(e), for the purpose of expediting environmental reviews. The study also reported that most of the funded positions were the equivalent of a Federal GS-11 or GS-12 level. Based on the Federal Salary Table 2005-GS, it is possible to roughly estimate the annual salary costs for the supplemental positions discussed in that report to be in the range of $12-$19 million.

[17] Title 42, U.S.C., Section 7401 ET SEQ.

[18] PM_{10} refers to particles that are 10 micrometers in diameter or less. $PM_{2.5}$, or fine PM, refers to particles that are 2.5 micrometers in diameter or less. Many scientific studies have linked breathing PM to a series of significant health effects. FHWA has published a particulate matter brochure for transportation professionals, available online at http://www.fhwa.dot.gov/resourcecenter/teams/airquality/publications.cfm.

costs.[19] Measuring the extent and cause of delays is often highly subjective, and calculating costs associated with delays is complex. Some of the difficulties inherent in estimating the costs of delay due to environmental requirements are described below.

- Multiple or Unclear Causes of Project Delay. The underlying causes of delay are not always apparent or simple in nature. For example, sometimes design review results in an engineering decision to alter proposed project limits or other features. Similarly, often there are decisions to accommodate requests from local governments for specific project elements. Such situations necessitate corresponding changes to the parameters used in right-of-way activities and in environmental reviews. Those changes often generate new acquisition or environmental compliance requirements, or the need for revision of project documentation. If the modifications require a substantial amount of such rework, then adjustments in project schedule and budget occur. Those adjustments nominally appear as delays generated by the disciplines doing the rework. In this manner, a decision by one operating unit has effects that cascade throughout the various SDOT disciplines, and the original cause often is obscured. Furthermore, often there are independent and unrelated delays in multiple functional areas (e.g., design, right-of-way, and environment). In all delay cases, to decide whether delay really resulted in late project delivery would require a determination of the critical path elements that actually affect project delivery.

- Varying Consequences of Delay. The most obvious effect of delay is on project costs. As time passes, there may be inflation or deflation in construction materials and labor costs, changes in technology, or changes in regulatory requirements. More significant, but less well recognized effects of delay stem from the lack of availability of a completed highway facility. That is, the costs of deferring congestion relief or other benefits that flow from a completed project. A third consequence of delay, specific to the environmental review process, is the "opportunity cost" that may occur when private investment in highway projects is deterred by the perceived constraints and uncertainty of the environmental review process and the potential for subsequent litigation. At the present time, the scope, frequency, and extent of these latter two types of possible costs are not readily or reliably identifiable.

[19] Various studies have considered the causes of delay and the extent of delay, but little appears to have been done on the costs of delay. See, e.g., "Environmental Streamlining: A Report on Delays Associated with the Categorical Exclusion and Environmental Assessment Processes," prepared by TransTech Management, Inc., for the AASHTO Standing Committee on Highways and NCHRP (October 2000). See also, NCHRP Project 25-25(5), "Causes and Extent of Environmental Delays in Transportation Projects," also prepared by TransTech Management, Inc. (December 2003).

- Net Economic Effects of Delay. The actual cost effects of delay present another area of uncertainty. If a project is delayed, a SDOT may choose to transfer its forces and funding to expedite advancement of another project in the State's transportation plan. Therefore, the net delay costs to the SDOT must take into consideration both changes in costs on the deferred project and cost adjustments on the accelerated project. By contrast, if the project involves funding through a public-private partnership between the SDOT and a private entity, the option to offset delay impacts by substituting another project does not exist.

It is important to recognize another dynamic that substantially affects the ability to accurately account for environmental costs. Many of the issues that are addressed under the "NEPA" umbrella are not actually environmental review requirements, or even environmental issues in the truest sense. Yet, in general, the environmental review process has become the "default" home for non-engineering project activities and costs.

Public involvement provides one example. The public today expects to have substantial opportunities to be informed about, and involved in, transportation project development decisions. Even though there are some legal requirements for public involvement in NEPA and other environmental laws, those requirements primarily are designed to satisfy due process and public notice standards. Public involvement, as it is practiced by SDOTs today, stems from needs largely independent of environmental requirements. While substantial public involvement benefits projects, contributes to "good government," and is an asset to the environmental review process, it exceeds the basic requirements found in current environmental laws.

Finally, FHWA recognizes that environmental expenditures by SDOTs also generate many important benefits. Identification and quantification of the environmental benefits associated with highway projects represents an entire complex and evolving field of its own.[20] For that reason, the topic of environmental benefits was not addressed as part of the FHWA Case Studies Research or in this report.

Determining "Typical" Project Types for Study

FHWA representatives identified a number of types of highway projects that could be considered reasonably representative of Federal-aid projects across State highway programs. Project types targeted for inclusion in the research included:

- new roadway on new alignment
- new capacity on existing roadway alignment, such as a highway widening of two lanes to four lanes

[20] See, e.g., "Valuing Ecosystem Services: Toward Better Environmental Decision-making," published by The National Academies and authored by its Water and Sciences Technology Board and Division on Earth and Life Studies (2004).

- roadway construction with no capacity increase, such as reconstruction, rehabilitation, or repair
- bridge replacement in new location
- bridge replacement in existing location
- new interchange.

Required Characteristics for Case Study Projects

FHWA defined additional selection standards for the basic project types listed above. The purpose was to help ensure that the case study projects would provide complete data and that the projects would represent characteristics broadly shared among highway projects underway across the United States. FHWA determined that the selected projects should have the following characteristics:

- *Open to traffic*. Case study projects should be open to traffic and all work contracts closed out to allow full identification of costs.
- *Typical for SDOTs*. Case studies should avoid projects that were unusually large in cost and scope, or that were subject to atypical delays due to environmental or other causes. The case studies should include a range of low to moderate cost projects that are typical of projects that SDOTs handle on a regular basis, rather than case studies of high-profile, but unique "mega" projects that are less representative of typical projects.[21]
- *Recently completed*. Case study projects should have finished construction close in time to the commencement of the research, so that project costs reasonably represent current dollar values. The projects also should have started their NEPA process within 10 years of construction.
- *Reflect a mix of geographic settings*. Case study projects should represent a variety of climate, socio-economic, land use, and ecological conditions.

[21] At the time that FHWA developed the study parameters, the threshold for status as a Major Project was a project with an estimated total cost greater than $1 billion, or that involved a high level of interest by the public, Congress, or the Administration. Such projects are few in number, with only 21 in progress when the study started. Major Projects usually have greater than normal levels of direct oversight by a variety of governmental entities, as well as greater involvement by the public in the decisionmaking process. Those factors easily can increase the costs and resources required to execute the project. In addition, the environmental analysis process required by NEPA often provides the legal avenue for interested parties to influence, delay, or stop a project that they do not support. The time required to address issues raised in the public debate about the features of a project often is characterized as an environmental cost and an environmental delay, which can make it difficult to determine the extent of "true" environmental costs.

- *Reflect a mix of urban and rural settings*. Projects in urban locations often face different environmental challenges than those located in rural areas. Higher real estate prices in urban areas, for example, may add to mitigation costs that require additional land in the project area, such as land for stormwater treatment ponds.

- *Represent a range of NEPA documentation requirements*. The level of effort required for NEPA documentation varies according to the extent of anticipated environmental impacts. Case study projects should involve a range of NEPA documentation requirements, including projects that require CEs, EAs, and EISs.[22]

Diversity in Host State Characteristics

FHWA established host State criteria for the six States from whose programs the case study projects would be drawn. First and foremost, the State had to take an interest in the research and be willing to devote the resources necessary to provide the data needed for the research. Because of the detailed work involved, States would be making a significant commitment. FHWA sought demographic diversity as well. Representation of a mixture of highway investment and use was preferred.

The selection process resulted in participation by Maryland, Montana, New Jersey, Oregon, Utah, and Washington (Case Studies States). The selected Case Studies States possess a wide range of physical conditions, from coastal plains to mountains, deserts, and grasslands. The mix also well represents the range of State sizes in terms of population. New Jersey is ranked 9th largest, and Montana is ranked 44th. The other States fall along a spectrum in between. The same is true of population density for the States selected. New Jersey ranks second, with a density of 1,134 people per square mile. Montana, with a population density of six people per square mile, ranks 49th. Washington falls in the middle with a ranking of 26th and a population density of 89 people per square mile. Maryland ranks 6th, Oregon ranks 40th, and Utah ranks 42nd.

Four of the selected States (New Jersey, Maryland, Utah, and Washington) rank in the top half of the nation in terms of average household income per year. Two (Oregon and Montana) rank in the bottom half. The home ownership rate of the group ranges from Utah at the 11th highest, with a rate of 71.5 percent, to Oregon at the lowest of the selected States, ranking 42nd with a rate of 64.2 percent. All six States are within the group of 42 States that consume between 70-137 millions of British Thermal Units per capita for transportation energy, which is in the middle range.

The States accept a diverse amount of funding from the Federal Highway Trust Fund. Montana receives about the 10th lowest amount of payments, and New Jersey receives

[22] In 2003, 36 projects, representing three percent of all projects and nine percent of the $30 billion in Federal-aid funds, were advanced using EIS documents. See FHWA's *Report to Congress on FHWA Environmental Streamlining Activities During 2003* (FHWA, 2004). The same report indicates that 230 projects, or about six percent of all projects and fifteen percent of all Federal-aid funding in 2003, were advanced using EA-FONSI documents. By contrast, 91 percent of projects and 76 percent of all Federal-aid funds in 2003 required only a CE document.

about the 10th highest amount of payments. The other States are about evenly spaced in ranking between those two points.

Research Structure

Using information provided by the Case Studies States and other SDOTs, the FHWA Case Studies Research developed a definition of environmental costs for transportation projects and a method for calculating their magnitude from initial project planning to the time the project is opened for travel.[23] The study used that definition to quantify environmental costs for the six case study projects based on actual data from SDOT financial management information systems and other sources.

Each of the FHWA Case Studies Research project descriptions included the context for the project, and summarized key project information such as significant environmental issues affecting the project, environmental cost issues, project environmental costs, and total costs. The case studies reported environmental costs in detail, using the following categories:

- *Planning, environmental review, and design-related costs*. This category included all SDOT staff time and other direct costs, as well as consultant services costs, associated with the environmental review process during the planning, environmental review, and design phases. This preconstruction category incorporated costs for NEPA activities such as document preparation, impact studies, and coordination with other agencies.

- *Land acquisition costs where required for environmental purposes*. This included all SDOT staff time and other direct costs, consultant services costs, fee or easement purchase costs, and relocation costs associated with any land acquisition for environmental purposes.

- *Construction engineering costs*. This category included all SDOT staff time and other direct costs incurred to support construction engineering that may be attributable to environmental requirements. Activities captured in this category included environmental monitoring, permit acquisition, and oversight of erosion control.

- *Construction contract costs*. This included costs for all bid items that are completely or partially related to environmental requirements, as well as a portion of construction mobilization where appropriate. Costs included both labor and materials.

For each of these cost items, the case studies compared the environmental costs to total project costs (total project costs included the environmental cost element). While the six case studies should not be considered a statistically valid representation of environmental

[23] See discussion on defining costs in Chapter II of this report. Arizona, Florida, Kentucky, Maryland, Oregon, Utah, Washington, and Wisconsin provided information that the FHWA Case Studies Research used to develop the definition of environmental costs.

costs in general, since the sample size of data collected is too small, the work does provide a detailed contextual analysis of how environmental costs are incurred by SDOTs in the Federal-aid highway program.

Selected Case Study Projects

As the search process for case study projects progressed, FHWA found that some flexibility was required in selecting the actual projects because of the need to meet overall selection criteria. FHWA determined that variation from the specified selection criteria, even if the variation was in project type, would be acceptable if a candidate project offered a strong match overall and was likely to present the expected level of complexity in the environmental review process.

The selected projects meet FHWA's overall criteria. In addition, the projects reflect the breadth of potential project types as well as today's emphasis on system preservation and modernization. The FHWA Case Studies Research selected and evaluated the following projects:

- *US Highway 113, Maryland*. Widening of a rural two-lane state highway in Maryland's Eastern Shore region to a four-lane divided facility to address safety concerns.[24]
- *Montana Highway 84, Montana*. Roadway modernization including rehabilitation of pavement and correction of horizontal and vertical pavement design deficiencies on a rural state highway near Bozeman, Montana.
- *Alexauken Creek Bridge, New Jersey*. Replacement of an old bridge on a rural two-lane minor arterial road.
- *Bob Creek Bridge, US Highway 101, Oregon*. Replacement of an old bridge on a scenic rural two-lane principal arterial in an area of high natural value on Oregon's Pacific coast.
- *12300/12600 S, Utah*. Widening of an urban principal arterial and replacement of an interchange in a rapidly growing suburban area on the fringe of the Salt Lake City region.
- *I-90 Sunset Way, Washington*. Interstate interchange replacement in a rapidly growing suburb of Seattle, Washington.

A summary of the basic characteristics of the case study projects appears in Figure 1.1. The case study projects involved environmental impacts that are commonly encountered by SDOTs, including wetlands, stormwater, historic and cultural resources, and wildlife and ecosystems. Figure 1.2 summarizes the major types of environmental impacts present in the case study projects.

[24] Of the six case studies, only the Maryland project was still under construction at the time of report publication.

Figure 1.1
Summary of Case Study Projects' Characteristics

Project Name (State)	Project Type	NEPA Document	Project Duration	Project Cost	Setting
U.S. 113 (MD)	Dualization (2-lane to 4-lane)	EIS	1997 - present	$181,125,760	Rural
MT 84 (MT)	Roadway Modernization	EA	1992-2005	$ 10,291,345	Rural
Alexauken Bridge (NJ)	Bridge Replacement	CE	2005	$ 1,979,792	Rural
Bob Creek Bridge (OR)	Bridge Replacement	CE	2001-2005	$ 1,701,222	Rural
12300/12600 S (UT)	Arterial Widening	EA	1999-2005	$132,291,601	Urban
I-90 Sunset Way (WA)	Interchange Replacement	EIS	1996-2003	$112,800,000	Urban

Source: FHWA Case Studies Research (2006)

Figure 1.2
Summary of Case Study Projects' Environmental Impacts

	U.S. 113 (MD)	MT 84 (MT)	Alex-auken Bridge (NJ)	Bob Creek (OR)	12300/ 12600S (UT)	I-90 Sunset Way (WA)
Wetlands & Stream Restoration	▓	▓	▓		▓	▓
Stormwater Treatment	▓					▓
Erosion Control	▓	▓	▓	▓	▓	▓
Wildlife & Ecosystems		▓		▓		▓
Noise					▓	
Historic & Cultural Resources	▓		▓		▓	
NEPA Documentation	▓	▓	▓	▓	▓	▓
Project Design & Alignment Changes	▓	▓			▓	▓
Section 4(f)		▓				
Project Construction Changes	▓	▓			▓	▓

Source: FHWA Case Studies Research (2006)

CHAPTER II: FHWA CASE STUDIES RESEARCH RESULTS

Defining Environmental Costs

Environmental costs can be viewed as an investment in protecting the environment, with transportation agencies acting as stewards for future generations of Americans. These values have strong public support. Yet there also is a need for effective management of the costs of environmental protection and stewardship. In order to evaluate environmental costs, it is necessary to define the term. The FHWA Case Studies Research adopted a protocol that divides environmental costs into two categories, compensatory costs and avoidance costs.

Compensatory Costs

The first, and perhaps most well known type of environmental cost is compensatory mitigation. That includes project features that offset the human and natural environmental impacts of a project. Compensatory costs, particularly from construction of compensatory mitigation features, easily are distinguishable from other project activities because they involve discrete environmental activities that go beyond the core scope of a project. Some projects require extensive compensatory activities. Other projects require few or no compensatory activities. The primary types of compensatory activities required for a project might include some or all of the following actions:

- wetland and stream restoration[25]
- stormwater treatment[26]
- wildlife and ecosystems protective measures[27]
- noise reduction[28]
- documentation and other handling of historic and cultural resources.[29]

In addition to the cost categories described above, on a less regular basis SDOTs also may conduct a range of other compensatory activities.[30] Such undertakings include strategies to address community impacts, hazardous materials clean up, land use protection, indirect and cumulative impact mitigation, and environmental justice

[25] Most often related to CWA requirements.
[26] Most often associated with CWA requirements.
[27] Typically arise from ESA or FWCA requirements.
[28] Title 23, U.S.C., Section 109(i) requires the USDOT Secretary to adopt noise standards and to approve projects only if they include adequate noise measures. Implementing regulations for FHWA, including assessment and mitigation requirements, appear in 23 CFR Part 772.
[29] Most often linked to requirements of the NHPA and Section 4(f).
[30] For a listing of the laws that govern these areas, see Appendix B to this report.

mitigation.[31] In some cases, environmental work is performed that exceeds strictly compensatory requirements and enhances existing environmental conditions. Such work often stems from negotiations with communities or agencies. The work also may relate to State policies or requirements based on environmental or community stewardship. Regardless of the underlying cause, enhancement work often is difficult to segregate from compensatory mitigation.

Because compensatory activities usually are easily recognizable, their costs generally can be identified in an objective manner and are reasonably straightforward to compile. Often compensatory costs appear in either separate construction contracts, or as relatively easily identifiable cost components in the primary highway construction contract for a project.

Avoidance Costs

The second category of environmental costs is avoidance costs. Those costs occur when actions are taken so that a project does not create an environmental impact, or so that unavoidable impacts are reduced or minimized. Activities to avoid or minimize environmental impacts can be hard to distinguish from overall project activities because they are not discrete efforts that are readily separable from the core scope of the project. Some projects require substantial avoidance activities, while others require few or no such measures. The primary types of avoidance activities required for a project might include some or all of the following:

- preparation of environmental studies and documentation
- project design and alignment changes
- Section 4(f) assessment, to meet the requirement that special effort must be made to preserve public parks, wildlife and waterfowl refuges, and historic sites
- altered project construction practices.

In contrast to compensatory costs, avoidance-related costs often require subjective judgments and are harder to compile. Avoidance activities are not necessarily considered "environmental" activities, but might involve changes in the way non-environmental activities are carried out. Also, the discussions leading to decisions about avoidance actions are not always well documented. States with experience in estimating environmental costs raised serious concerns about attempting to quantify avoidance and minimization costs.

[31] While the displacement of residents and businesses to accommodate a project has environmental impact implications, the costs related to acquisition of required property and relocation of owners and tenants typically are not included in the environmental costs category unless the costs relate to a specific mitigation action.

As indicated above, compensatory environmental costs encompass the actual "on the ground" activities such as constructing wetland mitigation or stormwater management. The costs of the decisionmaking process that precedes project construction, including delay costs, analysis costs, and public involvement costs, are considered to be avoidance costs. While there are occasions when investment in a particular compensatory mitigation measure may be questionable, on balance it is the avoidance cost category that presents the best target for improvements in environmental cost management.

Tracking Environmental Costs

Environmental costs occur on highway projects in the planning, environmental review, design, land acquisition, project permitting, and construction phases. Efforts to identify the causes and extent of environmental costs are in early stages. The FHWA Case Studies Research identified only four States (Maryland, Montana, Oregon, and Washington) that currently have experience with extensive cost tracking efforts in the environmental area. [32] There are many reasons why efforts to identify and track environmental costs are so limited:

- Insufficient labor and financial resources are available to develop, implement, and maintain appropriate financial management information systems.

- There is inconsistency among existing State financial management information systems protocols for breaking down project costs and coding them. The methods for collecting and categorizing costs differ greatly from State to State.

- Separating environmental costs from non-environmental costs is quite difficult, especially in the avoidance costs category. Multiple project or program needs often underlie particular expenditures of time or money.

- There is no reliable means to identify the costs of "the path not taken" when design changes are made, or when other actions are taken, or not taken, for environmental reasons.

- Unique geographic, demographic, and other conditions affect each highway project. Even though the variables may fall into generally identifiable categories, such as habitat impacts, community impacts, or level of public controversy, it is difficult to extrapolate what can be considered "typical" in terms of time, costs, or impacts.

For these reasons, many States still question the benefits of tracking environmental costs. However, FHWA and the States that are working to track environmental costs believe that there are benefits to doing so. Greater program accountability, better data to support policy-level decisions, and improved project cost estimating and project decisionmaking

[32] States contacted as part of the FHWA Case Studies Research included: Arizona, California, Florida, Illinois, Kansas, Kentucky, North Carolina, Maryland, Maine, Minnesota, Mississippi, Missouri, Montana, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, Texas, Utah, Washington, West Virginia, and Wisconsin.

are among the perceived benefits. While cost tracking efforts continue to expand, the challenges are significant and impede progress.

Case Studies Costs Results

The FHWA Case Studies Research report was based on extensive discussions with numerous SDOT staff, and a review of data taken from multiple sources provided by the SDOTs. The small sample size prevents any statistical use of the data. However, the data can be viewed as indicative of the ranges of various types of environmental costs. Detailed presentations of the case study projects, including cost tables, appear in Section 4.3 of the FHWA Case Studies Research (Appendix A). The overall costs results for all six case studies, displayed by project phases, appear in Figure 2.1. Highlights from the research data in Figure 2.1 include:

- Environmental costs for the case study projects averaged about 8 percent of total project costs, with a range from 2 percent (12300/12600 S, Utah) to 12 percent (US 113, Maryland; Bob Creek Bridge, Oregon). These estimates do not include categories of costs that the research was not able to address, including costs associated with air quality activities prior to the environmental review process, costs of delay, costs borne by Federal agencies and State resource and regulatory agencies, environmental costs arising during facility operations and maintenance, and costs specifically attributed to the use of CSS.

- Environmental costs incurred during preconstruction planning, environmental review, and design phases averaged about 23 percent of the total costs for those developmental phases of the project. The range was from 8 percent (U.S. 113, Maryland) to 41 percent (Alexauken Bridge, New Jersey).

- For the three case study projects that required land acquisition for environmental purposes, the costs represented from 1 percent (12300/12600 S, Utah) to 55 percent (I-90 Sunset Way, Washington) of all acquisition and relocation costs for the project. The additional land was for mitigation or stormwater management. Because the only real estate cost data the SDOTs could provide was for the total project acquisition and relocation costs, the reported environmental-related costs in this category were an apportioned share of that total.[33] That methodology is likely to result in overstating or understating actual costs for environmental-related acquisitions and relocations.

- The environmental costs for construction engineering ranged from 1 percent (MT-84, Montana) to 10 percent (12300/12600 S, Utah) of total construction engineering costs, with an average of 5 percent.

[33] Parcel-specific acquisition data exists at the State level, but the State effort required to extract such data was determined to be greater than the relative benefit of the more accurate information.

Figure 2.1
Summary of Case Study Projects' Costs Results

Overview				**Detailed Breakdown**										
Project (State) (NEPA Class)	**Overall Costs**			**Environmental Review and Design**			**Land Acquisition**			**Construction Engineering**			**Construction**		
	Environmental-Related Costs (000s)	Total Project Costs (000s)	%	Environmental-Related Costs (000s)	Total Env. Review/ Design Phase Costs (000s)	%	Environmental-Related Costs (000s)	Total Land Acquisition Phase Costs (000s)	%	Environmental-Related Costs (000s)	Total Construction Engineering Phase Costs (000s)	%	Environmental-Related Costs (000s)	Total Construction Phase Costs (000s)	%
US-113 (MD) (EIS)	$21,915	$181,126	12%	$1,103	$14,455	8%	$2,264	$15,680	14%	$325	$6,300	5%	$18,223	$144,690	13%
MT-84 (MT) (EA)	$282	$10,291	3%	$44	$452	10%	NA	NA	NA	$12	$903	1%	$226	$7,751	3%
Alexauken Bridge (NJ) (CE)	$240	$1,980	12%	$206	$498	41%	NA	NA	NA	$8	$196	4%	$26	$1,286	2%
Bob Creek Bridge (OR) (CE)	$166	$1,701	10%	$141	$394	36%	NA	NA	NA	$5	$139	4%	$20	$1,168	2%
12300/ 12600S (UT) (EA)	$2,405	$132,292	2%	$964	$3,576	27%	$500	$39,918	1%	$294	$2,942	10%	$647	$85,855	1%
I-90 Sunset Way (WA) (EIS)	$12,202	$112,800	11%	$2,350	$13,730	17%	$6,020	$10,919	55%	$380	$8,816	4%	$3,452	$79,344	4%
Average			8%			23%			18%			5%			4%

Source: FHWA Case Studies Research (2006)

- Construction costs typically are the largest element of total project costs (ranging from 65 percent to 80 percent in the case study projects). Environmental costs typically represent a small percentage of construction costs, although the dollar costs for such work may be substantial. The case study projects experienced environmental-related construction costs that averaged 4 percent of total construction costs for the projects, with a range of 1 percent ($640,040 for 12300/12600 S, Utah) to 13 percent ($18,223,080 for US 113, Maryland) across the projects. However, where mitigation construction was required, the construction-related environmental costs constituted the largest portion of the project's total environmental costs. For example, Oregon DOT estimated that noise mitigation accounts for about 19 percent of its total environmental compliance costs.

The FHWA Case Studies Research demonstrated that the Case Studies States are able to identify the costs for environmental staff and consultants fairly easily, but are less able to identify the costs for non-environmental staff and consultant work that is a part of the environmental process. Only Oregon DOT had a methodology for estimating this latter type of cost. All six States indicated, however, that the costs for non-environmental staff and consultants to perform environmental-related work were likely a small part of the total environmental costs for preliminary engineering and a very small part of total environmental costs on a project-wide basis.

A number of additional findings from the FHWA Case Studies Research may further inform the topic of environmental costs in the Federal-aid highway program. Those points are outlined below.[34]

- *Environmental costs increase with project costs*. For the projects studied, absolute environmental costs are lower on smaller projects and higher on larger projects. For the small projects studied, environmental costs for preconstruction activities outweighed environmental costs incurred during construction. The reverse was true for larger projects.

- *Expenditures on stormwater, landscaping, and wetlands during construction are large environmental cost drivers*. For the case study projects, the cost to construct stormwater management structures,[35] replace wetlands, [36] control erosion, and

[34] For a more detailed discussion, see Section 4.4 of the FHWA Case Studies Research Report (Appendix A).

[35] In separate research, a Washington DOT study in 2003 found that the average cost of stormwater treatment within the State was $1.81 per square foot of impervious surface constructed. See "WSDOT Project Mitigation Costs Case Studies," WSDOT (2003).

[36] FHWA data published in 2001 shows a nationwide average wetland mitigation cost of $16,000 per acre. Anecdotal information gathered by FHWA indicates that states are experiencing cost ranges from $4,000 per acre to $100,000 per acre, depending on location and type. (Communication from Carol Adkins, FHWA Office of Natural and Human Environment, June 29, 2006). An April 2006 study published by the Environmental Law Institute, titled "2005 Status Report on Compensatory Mitigation in the United States," examined wetland and stream mitigation across the CWA Section 404 program, which is administered by USACE. That report found that wetland and stream mitigation costs varied widely, depending on type of mitigation, location, required land acquisition, and the party that provided the mitigation (the permittee, a wetland bank, or other party). The lowest reported wetland mitigation cost was $3,000-$4,000 per acre

conduct landscaping have a much bigger impact on total project costs than staff and consultant time spent on project studies and construction engineering. For example, on the Maryland US 113 case study, the expenditures to prepare the EIS ($1,103,252) and oversee environmental issues during construction ($325,000) were only 6 percent of the project's total environmental costs ($21,915,152), and less than one percent of total project costs of $181,125,760. In addition, State or local environmental mitigation requirements may exceed Federal requirements. The I-90 Sunset Way project in Washington incurred substantial stormwater mitigation costs in order to meet State law and local ordinance requirements.[37] Case study projects that did not require extensive wetlands mitigation and stormwater treatment, such as the Utah 12300/12600 S case study, featured much lower environmental costs.

- *Environmental costs are a significant proportion of total preconstruction costs (excluding land acquisition).* Environmental costs are incurred during preconstruction for NEPA document preparation, other environmental studies, and coordination with resource agencies. They averaged 23 percent of total preconstruction costs in the case study projects. The range was from 8 percent (U.S. 113, Maryland) to 41 percent (Alexauken Bridge, New Jersey). The costs usually included a mix of in-house costs and consultant costs, which the case studies SDOTs had little trouble identifying. Several SDOTs had trouble identifying environmental costs attributable to non-environmental bureau staff or consultants, but were confident those costs accounted for a small share of total environmental costs.

- *Environmental-related land acquisition costs vary among projects, but can be a significant cost driver*. Environmental costs are not always incurred during the land acquisition phase of a project. Three out of the six case study projects did not involve land acquisition due to environmental requirements. In projects where additional land is required, the affiliated costs can be substantial. All the case study projects indicated that the methodologies for apportioning environmental-related land acquisition costs could be improved.

- *Project design and construction changes can add costs, but the costs are hard to identify, segregate, and measure*. For five of the six case study projects, modifications to the project's design and construction were attributable at least in part to environmental issues. In the Oregon case study, a one-lane temporary bridge was constructed instead of a two-lane bridge to avoid impacts to cultural resources and Federal lands. Those changes generated an unquantified amount of cost savings.[38] Similarly, in the New Jersey case study, a simpler bridge design that involved

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(excluding land costs) for non-tidal wetland restoration. The highest reported cost was $350,000 for an acre of credit from a wetland mitigation bank. The reported wetland mitigation costs were derived from data submitted by 15 of 38 USACE Districts. Fewer USACE districts offered stream mitigation costs. Those reported costs similarly varied by location and other factors. The "per linear foot" reported costs range was $75-$400, while two districts gave costs of $57,000 and $68,000 based on acreage or combined acreage/linear foot measures.

[37] See Section 4.3 of the FHWA Case Studies Research.

[38] The effects on highway users, if any, from the reduced capacity of the temporary single lane bridge are not included in the Oregon cost estimates.

replacement of the superstructure only was selected in part to avoid a complicated environmental process. The choice also saved overall construction costs and time, but the amount of the savings was not provided. By comparison, in three case studies, larger bridges or culverts were built to avoid sensitive wetlands (Maryland), improve fish passage (Montana), and accommodate a bike trail (Utah). In each of those cases, the changes added costs to the projects, ranging from $23,545 in Montana to $4.5 million in Maryland.[39]

[39] Washington DOT reported in its 2003 costs study that the use of bridge crossings rather than culverts on two of its study projects, in order to avoid environmental impacts, generated an additional $1.05 to $3.33 million in costs. "WSDOT Project Mitigation Costs Case Studies," WSDOT (2003).

CHAPTER III: CONCLUSION

Determining the Federal-aid highway program costs attributable to Federal environmental requirements is important for many reasons, including program accountability and effectiveness. The FHWA Case Studies Research contributes valuable information that will help advance the effort by expanding the industry's understanding of the probable ranges of environmental costs, and by identifying the knowledge and structural gaps that remain. In the future, FHWA will utilize the knowledge gained from the research as the agency develops and evaluates environmental procedures and policies.

The results of the FHWA Case Studies Research suggest that the range of environmental costs at the project level, including all phases of project work, is from two percent to 12 percent of all project costs, with an eight percent average. These estimates do not include categories of costs that the research was not able to address, including costs associated with air quality activities prior to the environmental review process, costs of delay, costs borne by Federal agencies and State resource and regulatory agencies, environmental costs arising during facility operations and maintenance, and costs specifically attributed to the use of CSS. These estimates apply to "typical" projects as defined in the research scope of work, and do not capture the costs for projects that are unusually complex or controversial.

The FHWA results echo earlier studies in Washington[40] and Montana.[41] Those State studies also estimated costs using a "total project costs" framework, albeit using slightly different cost components. Washington found environmental cost ranges of 4 percent to 34 percent, with an average of 15 percent and a median of 12 percent. Montana reported a range of zero percent to 23 percent, with a median of 1.7 percent. The results of all three of these studies compare favorably to professional estimates developed in Wisconsin in 1993 that suggested that environmental compliance costs constitute approximately 8 percent of total planning, design, and construction costs.[42]

It is important to reemphasize that there are many limitations inherent in environmental cost estimates and that it is problematic to use these percentages to extrapolate nationwide costs of meeting Federal environmental requirements. Among the limitations, and perhaps the most important one, is that the environmental costs studies developed to date all rely on very limited data and are not statistically reliable for determining nationwide general compliance costs. In addition, each project used in the environmental costs studies represents a set of unique conditions and events. Generalizing across programs, or even by project type, can provide at best an order of magnitude figure. Finally, to some extent the costs of meeting State environmental requirements are

[40] "WSDOT Project Mitigation Costs Case Studies," WSDOT (2003).
[41] "Project Cost Case Study-Environmental Mitigation and Context Sensitive Design," Montana Department of Transportation (October 2004).
[42] See "An Evaluation of Major Highway Program," Wisconsin Legislative Audit Bureau (2003), cited at page 12 of the research report titled "Environmental Compliance Costs: Where the Rubber Meets the Road, published by The Center for Transportation and the Environment, North Carolina State University, Raleigh, NC (1997).

inextricably embedded in the cost figures, thereby making it virtually impossible to segregate fully the costs driven by Federal versus State requirements. Accordingly, any statewide or nationwide environmental costs estimate may over or understate the actual costs of meeting Federal environmental requirements.

Because the ultimate goal is to better recognize and manage environmental cost and time requirements, FHWA is pursuing several key initiatives along with its State partners:

- *Implementation of the environmental provisions SAFETEA-LU.*[43] Section 6002 of SAFETEA-LU creates a series of coordination, scheduling, dispute resolution, and project management tools for the environmental review process. Those measures should help resolve a number of traditional uncertainties in the environmental review process. Other environmental provisions in SAFETEA-LU create opportunities to test whether delegation of FHWA's environmental review responsibilities to the States can expedite the review process. Sections 6003 (transportation enhancements and recreational trails), 6004 (CEs), and 6005 (all types of projects, limited to five pilot States) authorize the delegations. FHWA continues to coordinate with the States and with other Federal agencies on the implementation of the new law.

- *Development of new or modified mechanisms that will help reduce the time and cost for the environmental review process*. Efficient project delivery without compromising environmental protection is the primary objective of FHWA's "Vital Few" goal of environmental stewardship and streamlining.[44] Strategies for achieving the goal include requiring a negotiated project schedule for all EIS and EA projects, promoting corridor-based or watershed-based approaches to mitigation, developing efficiency measures for the environmental process, tracking EIS and EA time requirements, and promoting eco-system conservation. The initiatives most directly related to the timeliness of EIS and EA projects are FHWA's Environmental Document Tracking System, and FHWA's work with the Executive Order 13274 Task Force to improve the environmental review process and to expedite completion of reviews for certain critical projects.[45]

- *Promotion of improved approaches to project planning, development, and construction*. FHWA believes that improved coordination and communication are critical challenges in the effort to improve environmental decisionmaking. CSS and integrated planning are two closely related initiatives designed to achieve progress in these areas. Both involve collaborative decisionmaking, the use of interdisciplinary teams, sensitivity to effects of highway projects on the human and natural environment, and maintenance of operations safety and mobility. CSS focuses on

[43] *"Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users"* (SAFETEA-LU), P.L. 109-59 (2005), is the most recent congressional reauthorization of the Federal-aid highway program.
[44] The Vital Few goals, adopted by FHWA in 2002, are safety, congestion mitigation and environmental stewardship and streamlining.
[45] President George W. Bush signed Executive Order 13274, titled "Environmental Stewardship and Transportation Infrastructure Project Reviews," on September 18, 2002. The order emphasizes the importance of expedited project delivery and stewardship of the environment.

methods SDOTs can use to balance the multiple objectives and stakeholder desires that come into play during the typical transportation decisionmaking process. Integrated planning promotes processes, systems, and specific methods that incorporate environmental and community values into transportation decisions at an early point in planning, and all the way through project design and construction. The goals of integrated planning include early identification and resolution of project issues; early and consistent involvement of affected Federal and State agencies; recognition of community needs; fair assessment of the burdens and benefits to the environment; and strong interagency coordination and communication practices that include interdisciplinary staff involvement and commitment from both staff and management levels. CSS and integrated planning both acknowledge that partnering with affected agencies and stakeholders, and ensuring objective consideration of the environment, are good business practices that can save time and money for a project. FHWA promotes these initiatives as a part of its Strategic Plan and the FHWA Vital Few goal of environmental stewardship and streamlining. In addition, these efforts support the implementation of the new SAFETEA-LU statewide and metropolitan planning provisions, which include requirements for the coordination of transportation plans with inventories of natural and historic resources to improve the planning process and support the early development of mitigation strategies.

- *Support for State efforts to identify and track project costs, including environmental costs*. FHWA is convinced that there is value in the better identification and tracking of environmental and other project cost components. The benefits include more program-wide accountability for performance, better supporting information for policy decisions and investment decisions, stronger tools for program and project management, and identification of options for programmatic mitigation and landscape-scale mitigation that can provide costs savings and better environmental results. FHWA supports efforts by the States to develop cost identification and tracking methods through its research and technology transfer activities.

FHWA expects these initiatives to continue to produce benefits for the Federal-aid highway program by improving environmental, financial, and operational performance.

LIST OF FIGURES

APPENDIX A: COSTS RELATED TO COMPLIANCE WITH FEDERAL ENVIRONMENTAL LAWS: CASE STUDIES IN THE FEDERAL-AID HIGHWAY PROGRAM

APPENDIX B: FEDERAL ENVIRONMENTAL LAWS AND EXECUTIVE ORDERS APPLICABLE TO THE DEVELOPMENT AND REVIEW OF TRANSPORTATION INFRASTRUCTURE PROJECTS