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Final Report

Environmental Compliance Costs: Where the Rubber Meets the Road

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North Carolina State University

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Environmental Compliance Costs: Where the Rubber Meets the Road

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16. Abstract

This paper reports the results of an evaluation of the direct and indirect information on the compliance costs state departments of transportation (DOTs) experience in responding to environmental regulations.

After reviewing the statutory requirements and a series of environmental impact statements, four data sets were assembled to consider the extent of these compliance costs. The first is based on a survey of the designated environmental officials at state DOTs. Limited responses and incomplete records require that the available information from this source be treated cautiously. Based on the responding states, compliance costs range from nearly 8 to 10 percent of construction and repair expenditures for Federal-aid highway projects. The second data set compares construction expenditures for the Federal-aid highway program with construction expenditures for state roads from 1990 to 1994. Statistical analyses suggest that these expenditures for Federal-aid construction were impacted by measures of the resources or regulatory activity likely to be associated with environmental mandates. The last two data sources relate to the delays associated with the permitting requirements for some environmental impacts, related to wetlands. Both data sources provide evidence indicating that other environmental regulations increase the time required for transportation projects to obtain standard permits under Section 404 of the Water Quality Act.

These results, taken together, suggest appreciable compliance costs but also imply that standardized methods to gauge their impact are unlikely to be feasible. Instead, a modification of current practice that considers both the costs and the benefits associated with proposed changes to highway projects to meet environmental regulations would likely improve the efficiency of the process. Equally important, greater attention to the resources available to enhance inter-agency cooperation could save costs in responding to the multiple conflicting mandates.

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Environmental Compliance Costs Where the Rubber Meets the Road

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I. Introduction

Over twenty federal statutes impose different environmental mandates on the construction, repair, and maintenance activities undertaken within the federal highway system.[1] We know very little about the added costs of these requirements. Indeed, all past economic analyses of the costs of environmental regulations have completely overlooked their impacts on the construction and repair of highways.[2] This paper reports the results from the first study of these compliance costs. State transportation department engineers, who design highway projects to meet environmental restrictions, have suggested that the added costs are at least 8 to 10 percent of the construction and repair expenditures for Federal Aid projects.[3] Impacts of this scale would imply that nearly 1 billion dollars of the proposed annual appropriation for construction and repair in the ISTEA

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[1] See Smith and Von Haefen [1996] and Tarrer [1993] for a summary of the relevant statutes. We have adopted a broad description of environmental impacts to include historic and archeological effects as well as descriptions to more conventional environmental resources because this is the framework most often used in the transportation literature.

[2] Carlin et al. [1996] present a summary of the most recent EPA evaluation of the costs of environmental regulations. The economic literature has focused on three issues: welfare consistent measures of costs (Hazilla and Kopp [1990]) and general equilibrium analysis (Jorgensen and Wilcoxen [1990]); productivity impacts (Gray [1987] and Gray and Sahdbegian [1994]); and most recently plant level evaluations of the "net" costs of regulations (Morgenstern, Pizer, and Shih [1997]).

[3] This estimate is derived primarily from Novick [1995]. We also considered the findings from our survey of state DOT's described below.

reauthorization will be absorbed by environmental compliance.[4] Thus, the perceived scale of the impacts alone motivates consideration of how environmental mandates affect the resources available for enhancing public infrastructure.

Highway construction and maintenance costs have two primary components. The first arises from the expenditures to support the staff and equipment of state (and local) transportation departments. The second involves public expenditures for the private contractors involved in specific highway projects. Environmental regulations affect both sets of activities. Few states track the environmental compliance costs for construction and repair projects or for their ongoing maintenance programs for highways.[5]

To evaluate the factors influencing environmental compliance costs we assembled four data sets. The first was collected from a survey we conducted of the designated environmental officials for each of the 50 state transportation departments. The survey requested their estimates of the increases in costs due to environmental regulations and their evaluations of the primary factors

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[4] Heymann's [1997] summaries of the proposed reauthorization (HR674, S335) of the Intermodal Surface Transportation Efficiency Act (ISTEA) indicate that at least 8.8 to 10.2 billion dollars of the total proposed annual appropriations for national highways with resources totaling about 0.5 billion annually for roads in parks, Indian reservations and on public lands. Other larger components of the proposed appropriation involve highway safety and programs that also overlap with the Federal Aid system. Using the 10 percent estimate for the added costs of complying with environmental regulations to the smallest estimate for the total used for highways, this would imply at least .9 to 1.02 billion for the annual compliance costs.

[5] The General Accounting Office's 1994 review of agencies' practices preparing environmental reviews noted that:

"Although the agencies have developed the integrated processes to expedite NEPA and section 404 reviews, they have not developed a system to evaluate their success. Specifically, the agencies have not developed baseline data on the time required to complete reviews under the traditional processes, nor have they developed plans to tract projects' time frames under the integrated processes." (GAO [1994] p. 7).

In describing state's activities the same report observed that:

"FHWA and the American Association of State Highway and Transportation officials (AASHTO) do not collect or track data on all environmental costs associated with highway projects. FHWA has collected information on the costs related to noise barriers, and AASHTO has collected data on the costs of mitigating impacts on wetlands... In addition, none of 11 states we contacted routinely tracks data on all environmental costs." (p. 10)

The survey we conducted for this research (described in section III below) confirmed that this set of conditions has not changed in the two years since the GAO report was issued.

leading to these costs.[6] Nineteen states responded, five reported that they kept records on the time and costs of complying, and six were able to provide cost estimates. After describing the types of environmental regulations affecting highways in the next section, we summarize a few of the highlights of this survey in Section III.

The second data set includes states' construction and maintenance expenditures from 1990 through 1994. It was assembled using the Federal Highway Administration's (FHWA) statistics on construction and maintenance expenditures for Federal Aid highways and for state roads. The Federal Aid Highway Program is a grant-in-aid program supported by the Federal Highway Trust Fund. It allocates funds to states based on formulas that take account of population, area, mileage, relative costs, and percent of prior apportioned funds. This fund derives revenues from motor fuel taxes and federal excise taxes on highway users. Federal Aid support to state and local projects generally involves an 80/20 percent federal/state (or local) share of costs in response to specific apportionment rules.[7] States are keenly aware of "their" payments into the trust fund in relation to their receipts.[8] Thus, we should expect that project designs will be adapted for full cost-sharing.

Using these reported expenditures to gauge the effects of environmental regulations requires a behavioral model that takes account of these restrictions and acknowledges this link between funding and design. We outline such a framework in Section IV. The model describes how Federal Aid highway construction expenditures provide a "natural experiment" to evaluate the effects of environmental regulations. That is, Federal Aid projects are subject to all federal (and state)

[6] The text of the survey is reported in Appendix B. The list of designated environmental officials in state transportation departments was obtained from the report of the TRB's Committee on Environmental Analysis in Transportation [1995].
[7] Table FA-4A of the FHWA *1994 Highway Statistics* provides an example of these rules. It outlines the apportionment formulas for the Federal Aid Highway program for the 1994 fiscal year.
[8] Heymann's [1997] summary of the sources of discrepancies between the House and Senate versions of reauthorization measures of ISTEA indicates concern about an imbalance between payments into the highway trust fund versus receipts due to current formulas for funding.

environmental regulations. By contrast, state funded roads will only involve federal regulations if the road projects affect federal public lands, hazardous waste sites, or impact water quality in specific ways.[9] Thus, if these regulations affect costs we should expect to observe a distinct difference in the influence of environmental regulations on expenditures for Federal Aid highways in comparison to those for state roads.

Federal Aid highways and state roads are different for a number of other reasons aside from the effects of environmental regulations. Their roles in the transportation network are different. To account for these distinctions we analyze Federal Aid and state expenditures separately.[10] Our findings indicate that the measures of environmental resources in each state (e.g., counts of endangered species, historic sites, and National Priority List hazardous waste sites, as well as the size of coastal areas) significantly increase Federal Aid construction expenditures but have no effect on the construction expenditures with state highways. While the environmental measures are proxy measures for regulatory effects and not linked to specific Federal Aid highway projects, our findings offer consistent support for an impact of environmental regulations on costs. Moreover, the factors found to be most influential are consistent with the independently reported subjective rankings of the respondents in our survey of state transportation department staff with environmental oversight responsibilities. There is, nonetheless, the need to confirm these correlations with complementary evidence of causal relationships. To provide such support we consider a program routinely linked to highways as a persistent source of delays and increased cost. These involve impacts related to highway projects' effects on wetlands.

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[9] For further discussion see Smith and Von Haefen [1996]. Of course, where states' air quality does not meet the National Ambient Air Quality standards for the criteria air pollutants, states are required to develop an implementation plan that EPA accepts as documenting a means to bring the relevant air quality control regions into compliance. If this plan is not developed, EPA is authorized to take actions that would withhold federal funding of a wide range of programs in the relevant state. See Freeman [1978] for discussion of the early air quality legislation.

[10] We also treat the construction and maintenance costs in each category (Federal Aid versus state) separately because the activities involved are different.

Under Section 404 of the Clean Water Act any proposed activity that would impact wetlands must obtain a permit from the U.S. Army Corps of Engineers. This program has been among the most controversial sources of environmental regulations on land use (see GAO [1980, 1988, 1991] and Albrecht and Goode [1994]). Both our review of the mandates and economic model of the process suggest that environmental regulations are likely to be linked. As a result, we expect the permitting process for proposed actions related to highways to be especially complex. We assembled two data panels to evaluate whether environmental factors (in addition to mandated mitigation or restoration efforts for the affected wetlands) influence the time required to obtain decisions in applications for standard permits. The first uses the Army Corps' quarterly regulatory reports for each of ten division offices from 1994 through the second quarter of 1996.[11] The second involves individual permits issued in North Carolina. With the assistance of the Corps' Wilmington office it was possible to identify individual permits requested for transportation projects. The results support a clear role for other environmental resources (beyond wetlands) in influencing the time required to obtain 404 permits. This finding is directly confirmed for the individual permits associated with transportation projects in North Carolina. In North Carolina, Section 404 individual permits associated with DOT projects required an average of over 200 days more for decisions to be made.

Overall, our analyses support four conclusions. First, environmental regulations have a significant effect on the construction and repair costs for highways. Second, environmental regulations for highways appear to involve a different type of compliance process, that seems to require a negotiation among public agencies to meet the overlapping and conflicting requirements of different statutes. As a result, compliance costs cannot be treated as separable components of the

[11] We omitted the Pacific Division which includes Hawaii and Pacific Islands that are U.S. territories.

total costs of the highway project.[12] Moreover, judgmental estimates of costs of environmental regulations may be subject to significant error due to the complexity of the implied cost allocation task. Third, compliance costs depend on the degree of coordination. Efforts focused at enhanced funding for state or regional offices in departments that have responsibility for oversight of environmental statutes (e.g., regional offices of federal agencies such as EPA, Fish and Wildlife Service, and the Corps of Engineers, as well as state natural resource offices) may actually reduce the aggregate costs of compliance (including the expenditures required for the new staff in these resource offices). Finally, while we did not consider whether environmental regulations maintained or enhanced the resources they were intended to benefit, it is important to acknowledge that any evaluation of the desirability of the current levels of environmental regulation on Federal Aid highways cannot be based on costs alone. We must also consider the benefits derived from the services that these mandates provide consumers.

II. Background

Two statutes are especially important to understanding the effects of environmental regulations on Federal Aid highways -- Section 4f of the 1966 Department of Transportation Act and the 1970 National Environmental Policy Act (NEPA). Section 4f prohibits the use of publicly owned parks, recreation areas, wildlife areas, and historic sites of national, state, or local importance from being used in transportation projects unless the Secretary of Transportation determines there are "no feasible and prudent alternatives". A Supreme Court ruling in 1971, *Citizens to Preserve Overton Park v. Volpe*, made Section 4f and subsequent environmental laws serious concerns for Federal Aid transportation projects. Indeed, DOT's Deputy Chief Council recently noted that in the

[12] Separability has been assumed in most past analyses of the effects of environmental regulations on point sources (e.g., Hazilla and Kopp [1990]; Jorgenson and Wilcoxen [1990]; and Morgenstern, Pizer, and Shih [1997]).

initial period after this decision senior federal DOT officials felt compelled to review Section 4f provisions personally.[13] Today these reviews are delegated to FHWA field officials, but these practices have evolved to impose careful oversight to assure compliance for the Federal Aid projects.

The second key statute, NEPA, was intended to enumerate the potential environmental impacts of and mitigation for any federally funded projects before the resources for them were committed. It does not have a direct regulatory role. The Federal Highway Program has been responsible for about 10 percent of approximately 6,000 NEPA cases.[14] Three types of actions document the effects of a proposed project: environmental impact statements (EIS); findings of no significant environmental impact (FONSI); and environmental assessments.[15] An EIS is the most extensive of documentation NEPA requires. Kussy has suggested that NEPA's requirement for impact assessments has served "to discipline the project development process" in DOT. This does not mean responding to them is straightforward. Indeed, the set of regulatory mandates for Federal Aid projects is complex and overlapping. Table 1 summarizes, by type of resource, a selection of the primary statutes and Executive Orders along with the oversight agency and the regulatory

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[13] See Kussy [1996] for an interesting description of the early stages of this process.

[14] Kussy [1996] p. 12.

[15] The final product of the NEPA review process is a summary report detailing all the environmental concerns. This can be an EIS, an Environmental Assessment, or a Categorical Exclusion. The latter is associated with a finding of no significant impact. For large projects, state DOTs must prepare the EIS and may jointly file it with an interested federal agency. The standard format for an EIS includes the following components:

(a) Purpose and need for the project
(b) Alternatives considered
(c) Description of the effect of environmental resources of the project
(d) Nature of the environmental consequences
(d) Identification of irreversible commitments of resources.

After the draft EIS is circulated, a public hearing identifying concerns is held and a final EIS is distributed. A Record of Decision (ROD) issued within 30 days of the final EIS's release signifies project approval.

A final EIS is a record of the final selection and a subset of the alternatives considered along with discussion justifying the decision. Comparison of the final alternative with others reported does not reveal incremental mitigation costs to meet regulations because the EIS records the consensus that was reached, not all the alternatives avoided through the negotiation process. See Smith and Von Haefen [1996] for further discussion.

mechanism(s) used in implementation. Our summary uses a fairly broad definition of what comprises an environmental impact. Nonetheless, the table does not include additional mandates that could also be considered a part of this process. These requirements are related to preservation of private farmlands, liability related to hazardous waste sites, or requirements imposed on projects undertaken in floodplain areas which can be important to the design of highway projects.

One of the areas where this complexity is best illustrated concerns impacts on wetlands. As we noted at the outset, the Army Corps of Engineers has responsibility for the Section 404 permitting process. The set of agencies with concerns about a wetlands decision varies with each proposed action and by state. Six federal agencies have responsibilities from wetland related legislation -- the Army Corps and EPA, along with the Natural Resources Conservation Service (previously Soil Conservation Service), the Agricultural Stabilization and Conservation Service (both of the Department of Agriculture), the Fish and Wildlife Service (Department of Interior), and the National Marine Fisheries Service (Department of Commerce). Thus, substantial coordination with other federal and state agencies can be required. With this diverse group it is probably not surprising that one of the key difficulties that has arisen in this process stems from the differences across agencies in the definition of a wetland.[16]

Three types of 404 permits are available. For activities with small impacts, the Corps can issue a letter of permission and little paperwork is involved. Alternatively, there are forty national (and regional) general permits for classes of activities that are small and do not require special reviews. This group constitutes the largest number of permits and is generally handled in a

[16] After a period of considerable controversy about a proposed reconciliation of definitions, practice has reverted to the Army Corps 1987 definition for most activities that would affect highways. For a summary of this controversy and of the permitting process see Kusler [1992] and the National Research Council report on wetlands (NRC [1995]).

straightforward process.[17] When a proposed project has a significant wetlands impact, the applicant must request an "individual" (or standard) permit. These permits can require modifications in project design and involve a fairly significant review process. Indeed, the extent of delays associated with this process have been subject to considerable debate (see Albrecht and Goode [1994] and GAO [1988, 1993]).

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[17] A key distinction between the evaluation of critics of the Corps wetlands permitting process has been the treatment of general permits. Albrecht and Goode [1994] analyze them separately and find that this decision is a key reason for differences in GAO [1993] and Corps [1995a] evaluations of the permitting process.

For example, our analysis of Section 404 permits for 1994 through 1996 that varies with decision and type of permit. The table below summarizes our results in comparison with GAO [1993], Albrecht and Goode [1994] and the Corps.

	404 Individual Permits	
Source	Issued	Denied
Current Estimate (All Divisions)		
1994	137.0	303.1
1995	134.6	291.7
GAO [1993]		
Before 1989 Wetland Delineation		
(11/87 - 3/89)		
Buffalo	140	--
Huntington	98	304
Jacksonville	263	164
After 1989 Delineation		
(4/1/89-9/3089)		
Buffalo	163	--
Huntington	158	158
Jacksonville	211	143
Army Corps [1995a, 1995b]		
1994	115	161
1995	123	151
Albrecht and Good [1994]		
(time period - 1992)		
Corps Time Interval	256	133
Full Time	377	224

More details on each of these analyses is in Smith and Von Haefen [1996]. The distinction between individual and general is now likely to become more important with the Corps redefinition of general permit no. 26 making it more restrictive. Under the new rules (12/31/96), projects over 3 acres will now require a Corps standard (individual) permit. Previously, the restriction was 10 acres.

For individual permits the Corps issues a public notice of the proposed activity and allows 30 days for comments. The relevant Corps office can schedule a public hearing (if it is requested) and, then, the Corps is allowed to undertake its evaluation of the proposed action. After the Corps states its findings and decision, EPA has authority to veto an approved permit if it is judged to have unacceptable adverse effects on municipal water supplies, shellfish beds, fisheries, wildlife, or recreational areas.[18]

This brief summary suggests that two types of balancing are inherent in the ways environmental regulations impact Federal Aid highways. The first is illustrated by the provisions summarized in Table 1 and involves compromises across different types of environmental resources because highways can impact several different resources simultaneously. Here the decisions convey judgments about the relative importance of impacts across different nonmarketed resources. These tradeoffs implicitly assign values to the resources involved, such as wetlands versus historic sites or air quality. The second balancing is among the priorities as defined by the statutory mandates of the different agencies. While these can be linked to the resource balancing process they need not be. Differences in wetland definitions, for example, arise from the importance of other specific goals assigned to each agency involved.

A review of several final EIS's confirmed these conjectures in that the alternatives described in each EIS include a range of different types of resource effects. One example of this process can be found in a 1991 EIS for a project involving a six mile roadway through downtown Wilmington, NC (see Federal Highway Administration [1991]). The project had wetlands impacts (about 23.1 acres), encountered two landfills with hazardous substances, and had a potential water supply

[18] An EPA veto of a Corps approved permit has been rare. There have been under twenty cases involving vetos. See Smith and Von Haefen [1996] for a listing of the cases of EPA vetoes.

impact due to the possibility of releasing hazardous substances into nearby aquifer from proposed bridge pilings required to avoid one of the waste sites.[19] Air quality was likely to be an issue for the Wilmington project as well but was not discussed in the supplementary EIS we reviewed. Finally the project was in the 100 year floodplain for the Northeast Cape Fear River and three large creeks. This feature alone required elevating the roadway above the 100 year flood level. It also impacted four areas of environmental concern identified in North Carolina's Coastal Management Plan (a requirement of the Coastal Zone Management Act (CZMA)).

Resolving these issues involved compromises among the agencies charged with responsibility for the resources affected by the project. This cross agency negotiation process is the second type of balancing. The details of each type of balancing can be expected to differ with each project considered. As a result, the exact mix of participants (i.e., federal and state agencies) and resources will be defined in an iterative process as the project's design is structured and evaluated.

This format has important implications for any attempt to estimate the compliance costs of these regulations. Past economic models of the process of regulation envision a regulatory decision process that is largely exogenous to the firm's activities and that firms "respond to" the rules after they have been defined.[20] By contrast, this summary suggests it will be hard to identify external standards that define the required response of Federal Aid projects to specific environmental resources. Our model, developed in Section IV treats state transportation departments (or their private contractors) as cost minimizing "firms" facing both environmental mandates and the restrictions arising from the cost sharing provisions of the Federal Aid system.

[19] See Smith and Von Haefen [1996] for a more detailed summary and NC DOT [1991] for the original source.
[20] Most environmental economics texts present regulation in this way. A recent example is Hanely, Shogren and White [1997].

III. States' Perspectives on Environmental Compliance Costs

In July 1996 with the assistance of the Center for Transportation and the Environment (CTE) and Secretary Charles Thompson of the Wisconsin Transportation Department, we conducted a mail survey of the designated environmental officials of the 50 state DOTs about their environmental compliance activities during the 1995 fiscal year.[21] After follow-up mailings and telephone calls, we received 19 responses. The survey's six page questionnaire requests disaggregated information about expenditures for Federal Aid and state projects for new construction and repair along with the percentages of each attributed to the compliance activities required to meet environmental regulations. We also asked about the transportation staff's ratings of the important environmental impacts on their highway projects, the personnel used in response to environmental regulations, and other aspects of their experience with environmental regulations.

Most survey respondents were unable to complete the requested environmental compliance cost questions. Of those states reporting that they kept records on the staff time and added costs of compliance, the added compliance costs were reported to be under 10 percent in each category of expense. Table 2 summarizes the results for this small sample. This range is consistent with the only other estimate developed for environmental compliance costs of about 8 percent of total design, planning, and construction costs.[22] However, these results should be considered speculative. Both the nature of the task (e.g., separating the compliance costs from environmental regulations) and the sample sizes suggest that this survey does not provide an adequate basis for gauging the magnitude of these costs.

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[21] The Center is a part of the Institute for Transportation Research and Education (ITRE). See Appendix B for the text of Secretary Charles Thompson's supporting letter and our survey. The mean responses and standard deviations by variable are also given in this Appendix.

[22] This other estimate was for 1993 and is based on a delphi process conducted by the engineering staff of Wisconsin's DOT. (See Novick 1995])

Responses to questions requesting judgmental evaluations of the important environmental factors influencing these costs were more informative. Table 3 summarizes the mean score for each of 18 factors presented to survey respondents for ratings on the Likert scale from 0 to 4 with a response of 0 labeled as "usually of no concern" and 4 "extremely important" in terms of the staff time and additional resources required to deal with them for ongoing and new highway projects. The rankings of resource and related impacts of highways derived from the survey agree with informal judgments offered in our discussions with key transportation planning personnel in North Carolina, Pennsylvania, and Wisconsin. The survey also suggests that Section 404 permits are a large part of their activities. The average number requested in 1995 for all respondents was 126.

Overall, a survey approach to collecting environmental compliance information, comparable to what was used in collecting the Pollution Abatement and Control Expenditures (PACE), was not successful. As noted in the GAO [1994] report on environmental compliance costs, few states keep records.

IV. An Economic Model for Negotiated Regulations

As we have noted, a model characterizing environmental compliance costs for highways must incorporate several differences in regulatory processes. The first arises from the way in which these regulations create links across resources. While interdependency among resources was recognized in the earliest discussions of environmental management (e.g., Kneese and Bower [1968]), these linkages involved using materials and heat balance conditions to estimate the residuals from production activities.[23] By contrast, in the case of highways, a dependency in the

[23] Indeed, these physical linkages were important to establishing that the tendency of regulations to focus on individual media was shortsighted. By treating air pollution regulations on a plant in isolation from water quality and other forms of pollution, this work argued that firms' responses to regulation could generate more serious environmental

regulations is also created by the construction of the roadway. That is, highway projects connect locations in space and, as a result, create links in the policies associated with managing environmental resources in those locations. These interconnections arise even when the underlying ecosystems involved may not be subject to significant natural interactions.

A second distinction arises from the assumption that environmental restrictions are usually treated as being exogenous to the firm. In the case of highway projects the interactions are among public agencies arise from what is more likely to be a negotiated decision process. The statutes appear to include several conflicting mandates to avoid impacts on different types of resources. Adjustments must take place. Thus, a hierarchy of impacts must be negotiated to identify which mandate is most important and which is least. When we try to represent these decisions the process implies that the unit assumed to have responsibility for the highway project is also a part of the negotiation process that defines the regulations it must meet. Finally, the regulations often require a change in the highway's path, associated land areas, construction mode, or materials. These types of changes are incompatible with the end-of-pipe orientation that is adopted in many production models used to describe pollution regulation of point sources. To take account of features, we treat the regulations as restricting the inputs used by a cost minimizing firm.

To illustrate how this approach works in practice, consider some examples. Our earlier discussion of the Wilmington EIS suggested that the required response to 100 year floodplain restrictions in the Wilmington project involved elevating the roadway, thereby changing the requirements for pilings, steel, and other materials. This modification may also change the amount of land adjoining the roadway. We model this response to the flood plain requirements as a constraint that the input ratios required to meet this mandate are different from what would be

externalities. The physical linkages implied the residuals would not "go away". Policies created incentives to change their form (e.g., concentrate or dilute them) and to alter the media used for disposal.

implied by a cost minimizing design without them. Thus, if two inputs (designated here as X_i and X_j) are involved in this process we assume their ratio, X_i/X_j, must exceed the ratio when the regulation is not present, *(e.g.,* X_i^0 / X_j^0*)*.[24] In our Wilmington example, this requirement does not appear to change the output of the roadway. Of course, in a general sense one could argue that it does change one type of output. That is, the design change "protects" the infrastructure from the damage that might be caused by specific types of storms. To interpret the regulation in this way would require a re-specification of the production process with each environmental mandate assumed to change some output. In our example we would need to describe the avoided flood damage to the highway, and to specify how it related to the other outputs being produced.

Another example can be found in the typical response to wetland impacts. As a rule the project is required to avoid wetland areas or to purchase, or restore other compensating wetlands. Usually, these adaptations require greater than a one-to-one trade in terms of acres of wetland.[25] Thus, the total land required for the project relative to other inputs is now different. Both examples illustrate a situation where regulations require that best practice be adjusted to meet some other objective. We represent that change here as requiring the new input ratio exceed previous practice by a pre-defined amount, say β_{ij}. Equation (1) describes this type of input restriction in general terms.

(1) $$\frac{X_i}{X_j} - \frac{X_i^0}{X_j^0} \geq \beta_{ij} > 0 \text{ for } i \neq j$$

[24] Changes that reduce X_i to X_j can be inverted to fit this form.
[25] Table 5 below summarizes the results from AASHTO's wetlands mitigation survey for 1995. In all cases but West Virginia the compensating wetlands exceeded those filled from the projects involved.

The ratio, $\frac{X_i^0}{X_j^0}$, is assumed to be defined exogenously to the current process. β_{ij} is assumed to be a policy parameter also set independent of the process. By re-writing equation (1) in a form that resembles a physical content requirement, as in equation (2), it is possible to use earlier work (see Färe, Logan, and Lovell [1989]) to describe how these restrictions influence the properties of neoclassical cost functions.

(2) $$X_i \geq (\beta_{ij} + \alpha_{ij}^0) X_j \quad with\ \alpha_{ij}^0 = \frac{X_i^0}{X_j^0}$$

Input demand functions can be derived from the cost function using the derivative properties of the function. However, these input demands will reflect both the features of the technology and the content constraints. Thus, while Shephard's lemma applies in the presence of physical content requirements, input demands do <u>not</u> describe features of the production technology. To illustrate this point consider a two input example. Equation (3) defines the cost function with the content requirement assumed for simplicity to hold as an equality. λ and τ are lagrangian multipliers and $\gamma = \beta - \alpha^0$ (from our earlier notation).

(3) $$\overline{C} = p_1 x_1 + p_2 x_2 + \lambda\left[q - f(x_1, x_2)\right] + \tau\left[x_1 - \gamma x_2\right]$$

The envelop condition establishes the duality conditions in equation (4)

(4) $$\frac{\partial \overline{C}}{\partial p_1} = x_1^* \qquad \frac{\partial \overline{C}}{\partial p_2} = x_2^* \qquad \frac{\partial \overline{C}}{\partial \gamma} = -\tau x_2^*$$

The asterisks designated the constrained cost minimizing demands. This formulation implies that using observations that describe differences in regulatory practice as variations in γ we can recover an estimate of the incremental costs, τ, due to the regulatory constraint $(e.g., \ \tau = -\overline{C}_{\gamma} / \overline{C}_{p_2})$. Of course, the cost function is different from what would describe input responses in the absence of the content constraint on these inputs.

To illustrate the argument suppose we assume that the production function, $f(x_1, x_2)$ is Cobb Douglas with constant returns to scale $(e.g., \ q = x_1^{\alpha} x_2^{1-\alpha})$. Solving the constrained cost minimization subject to the Cobb Douglas technology <u>and</u> the physical content requirement yields a cost function that describes input inter-relationships as if they were the result of a Leontief or fixed coefficient technology not the Cobb Douglas. This result follows because the content requirement maintains that the only two inputs must be used in fixed proportion. Hence the cost function is given by equation (5a) and not (5b) the usual Cobb Douglas form for this case (without the content requirement).

(5a)
$$\overline{C} = \frac{(p_1\gamma + p_2)q}{\gamma^{\alpha}}$$

(5b)
$$\widetilde{C} = p_1^{\alpha} \cdot p_2^{1-\alpha} \cdot q$$

with α = elasticity of productivity for x_1.

While this is a simple example, it does illustrate a more general point. The restrictions do not, as a rule, lead to a cost function with a separable component attributable to environmental compliance. As the number of these restrictions increase and/or the production technology becomes more complex the nature of the interactions change, but this general conclusion remains.[26]

[26] To our knowledge, Lave [1984] appears to be the first to recognize the potential cost implications for contradictions in the regulations administered under different federal statutes by different agencies. The sequential approach to responding to externalities is cited as a cause for this phenomenon. He used the fuel economy, air pollution and safety regulations imposed on the automobile industry.

Our situation is different in that the process forces some compromise. The Environmental Impact Statements and permitting requirements of regulations as well as Section 4f requirements serve to identify the conflicting effects. They do <u>not</u> provide a means for resolving them. Nor do they assure that identification will take place early in the design process.

A second characteristic of our proposed strategy for testing the effects of environmental regulations arises from the link between federal highway funding and the regulations. With a few exceptions, most of the regulations are relevant for all Federal Aid projects and not for state funded activities. Thus, the cost function that the analyst can observe is different from the function resulting from the minimization given by equation (3). It involves an implicit comparison of the costs of a project funded exclusively through state sources versus one that seeks the federal cost sharing but, to obtain the federal funds, must meet environmental regulations. This is represented by equation (6).

$$(6) \qquad C^R = Min\left[\tilde{C}(p_1, p_2, p_3, \ldots, p_n, q),\ (1-k)\overline{C}(p_1, p_2, \ldots, p_n, \gamma_1, \gamma_2, \ldots, \gamma_e, q)\right]$$

γ_j's represent the individual environmental regulations for each of the set of resources impacted by the highway project. k responds to the federal cost sharing rate. Thus, in this simplified view of the process, states will pursue the Federal Aid strategy only if the net cost they incur, after including the requirements of complying with environmental regulations (i.e., the second function on the right side of equation (6)), is less than what could be derived by paying all the costs using state funds but avoiding the environmental regulations (i.e., the first function on the right side of (6)). This formulation implies that the cost sharing rate, k, provides an upper bound on environmental compliance costs. That is $\left(\overline{C}(\cdot) - \tilde{C}(\cdot)\right) / \overline{C}(\cdot) \leq k$ for all the Federal Aid highway projects. Otherwise, they would not have been agreed to by the states involved. Of course, with a current cost sharing rate of about 80 percent this upper bound is not especially useful as a gauge of the actual impact of the environmental regulations on costs.

Thus, as in other situations where there are conflicting mandates that must somehow be negotiated (e.g., among trustees for different resources in natural resource damage assessments, see Hanemann [1992] or the cleanup of contaminated Superfund sites, see Dixon et al. [1993]) there exists opportunities for substantial cost savings with their introduction of a coordinating mechanism or agency.

Even with this consideration of the effects of cost sharing our description of the role of environmental regulations for the costs of constructing, repairing and maintaining highways simplifies the process. The model assumes that the stringency of the constraints (i.e., the values of the γ's) used to represent environmental mandates are exogenous to the "firms". In fact, as we already noted, they are likely to be endogenous to the planning and design activities. They are outputs of an inter-agency negotiation. Thus, even if we could identify the standards that applied to all projects within a given jurisdiction, they should not be treated as completely exogenous parameters.

Finally, there remains a further complication. Because the resources used to support the Federal Aid system come from the Federal Highway Trust Fund, projects are not funded exclusively at the state's discretion. There is a set of formulas governing eligibility and cost sharing rate. These rules change periodically with the enabling legislation but have included recognition of: past funding; the extent of the existing Federal Aid system and miles traveled (for maintenance); the costs of responding to deficient bridges; population in Non-Attainment areas defined under the Clean Air Act; measures of the urbanized and the total state populations; and overall public road mileage.[27] Each factor has a different weight and apportionment factor. In principle, this scheme offers the opportunity for some behavioral adjustment in the proposed projects by the states applying for funds. That is, we should expect that projects will be adapted in response to the rules in order to maximize the k that can be obtained. From the perspective of estimation this feature of the system implies that k should also be regarded as endogenous, along with the effective γ's.[28]

[27] See Table FA-4a in the FHWA *Highway Statistics* for 1994, as examples.

[28] The logic of this argument follows one developed by Seig [1996] in estimating the effects of changes in the tax system for Germany and contrasts with attempts to "second guess" how states might respond to the schedule of incentives. This effort is beyond the scope of this research but with sufficient variation in the schedule of incentives, a comparable approach could be estimated from the FHWA data.

Overall, then, the model suggests that the effects of environmental regulations can be detected by considering Federal Aid projects. The analysis must control for two sets of influences. The first describes the factors that influence how states can respond to the cost sharing formulas (represented by k in the model). These comprise the characteristics of each state's current system of Federal Aid roadways and bridges. The second involves the set of environmental resources or conditions exogenous to the negotiating process hypothesized to determine the final form of the regulations in each project. These measures include variables such as measures for the count of Endangered Species, extent of wetlands, number of historic sites, etc., that condition the ultimate form of γ's.[29]

We assume factor prices do not vary across states and evaluate environmental regulations by comparing the effects of these exogenous descriptions of environmental resources on the expenditures for Federal Aid construction and repair that our hypothesis suggests would be determined by a process defined by $C^R(\cdot)$ in equation (6) (with recognition of the potential to adjust k as well) versus the costs for a fully state funded approach where costs would be more likely to respond to a function like $\widetilde{C}(\cdot)$. We expect that if environmental compliance costs are important then we should observe their effects through the influence of these exogenous environmental variables on $C^R(\cdot)$ and not on $\widetilde{C}(\cdot)$.

V. Federal Aid Construction Costs as the Source for a "Natural Experiment"

Our proposed test of the effects of environmental regulations is an effort to gauge whether there is a difference in the cost functions that arise from a process where, from the analyst's

[29] Thus, we are implicitly assuming there are other processes that define $\gamma_j = g_j(N_1, N_2, \ldots, N_s)$ and $k_r = k_r(h_1, h_2, \ldots, h_m)$ where $N_\ell = \ell$ th exogenous natural resource measures relevant to j th environmental restriction and h_r is r th Federal highway characteristic.

perspective, both the extent of the environmental regulations faced by states in each project and the cost sharing rule for Federal Aid projects are determined simultaneously with these costs. We proceed by assuming the extent of the Federal Aid roadway system in existence for each year, measured by center lane miles, lane mileage (i.e., the sum of the products of center lane mileage and lanes for each roadway in the Federal Aid system in the state), and a count of Federal Aid bridges is given and exogenous each year.[30] New construction (which arguably is endogenous) is a small fraction of this base.[31]

If environmental regulations impact highway construction costs then we should expect that after controlling for the exogenous system characteristics of the Federal Aid roadway (and bridges), then variables describing the exogenous influences to the environmental regulations, the resources available for the implementation process, and the experience states have had with the process should influence Federal Aid expenditures. Factors likely to enhance the stringency of environmental regulations would be expected to increase costs and those related to experience and resources available for facilitating negotiations would reduce them. The latter arises because the costs due to delay and staff time are reduced. As noted earlier, we should <u>not</u> expect to detect these effects with state funded highways because they are less subject to the federal environmental statutes. Based on Tarrer's [1993] review of the effects of environmental regulations on routine

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[30] There is some changes in the Federal Aid system year to year as existing roadways are removed or upgraded. Because of differences in states' reporting practices it is difficult to distinguish changes due to status of the roads from reporting corrections. Moreover in 1991, ISTEA changed the Federal Aid system replacing it with the National Highway System (NHS) that consists of the entire principal arterial system. Further additions to the NHS after September 30, 1995 would require congressional action. This does not affect our analysis because it ends in 1994. The year to year changes in the Federal Aid system are quite small whether measured using miles or lane miles. The statistics for the average and median indicate that the yearly change was 1 percent or under for lane miles and only over 1 percent for the 91-92 period with miles the years the ISTEA legislation changed the system designating miles in the National Highway system. See Table 4A in Appendix A for a summary.

[31] While it is not reported in FHWA statistical reports we solicited this information by telephone from all state DOT offices. Twenty-five states provided some information for some of the years in our sample. The new miles added average from 88.1 (in 1990) to 61.2 miles (in 1994). It is not clear whether these estimates are included in the total mileage reported for the Federal Aid system each year. Because it is about a half percent of the existing system in the average state, we have assumed it has inconsequential effects on our results.

highway maintenance practices, these differences seem less likely to be detectable (with the variables available using aggregate data) for Federal Aid maintenance expenditures.[32] Nonetheless, we report models for all four expenditure categories.

Our analysis exploits the ability to construct a panel data set using the FHWA Highway Statistics from 1990 to 1994, along with variables designed to represent changes in key environmental resources over this time in each state. The latter data were assembled from a diverse array of sources documented in Appendix A. Because our focus is on the annual Federal Aid construction expenditures in each state as the source of our "experiment", we developed our models using this variable and then treated state construction expenditures as a control (i.e., where the regulations are not as likely to be important).[33] Maintenance expenditures are presented for comparative purposes.

The statistical model used to evaluate a panel of states reported experience over the period 1990-1994 assumes there are two errors. We follow the simplest form of the random effects framework as in equation (7):

$$y_{jt} = a + b^T Z_{jt} + u_j + \varepsilon_{jt} \tag{7}$$

a is the intercept, b is a $K \times 1$ parameter vector for the determinants of the dependent variable y_{jt} (in our case an expenditure measure) is assumed constant across the j and t dimensions and with the levels of the $K \times 1$ vector, Z_{jt} of independent variables. u_j is constant over the t dimension and

[32] Weather conditions alone are likely to be important to our ability to detect some effects. Consider for example the case of the deicing and the effects of environmental regulations on storage and runoff of chemical based deicing materials. Differences in weather conditions across states and time are likely to impact the influence of these regulations. See Tarrer [1993] for further discussion.

[33] This approach follows the logic used in a growing literature offering statistical alternatives to social experiments that exploit existing variations in rules of programs influence the behavior of economic agents. See Heckman [1992] for a discussion of the two approaches.

varies with j. In the analysis of Federal Aid expenditures j will be states.[34] ϵ_{jt} varies with both j and t. The time subscript, t, in this case will be years. Both u_j and ϵ_{jt} are assumed to be classically well behaved. The composite error does yield a non-spherical covariance matrix, because the covariance for different time periods in the same state is not zero, $E\left((u_j + \varepsilon_{jt})(u_j + \varepsilon_{js})\right) \neq 0$. One common measure of the importance of u_j is defined as by equation (8)

$$\theta = 1 - \frac{\sigma_\varepsilon}{\sqrt{T\sigma_u^2 + \sigma_\varepsilon^2}} \tag{8}$$

Where σ_ϵ = Standard deviation for ϵ_{jt}

σ_u = Standard deviation for u_j

T = The number of time periods observed for each cross sectional unit.

Equation (8) assumes balanced samples. When they are not, θ will vary with the available sample of time periods for each state, so T would be replaced by T_j in (8). The random effects estimator uses the structure assumed for u_j and ϵ_{jt} to construct feasible generalized least squares (FGLS). Estimates using FGLS are reported for most of the random effects models. The Hausman [1978] specification test compares the ordinary least squares fixed effects format with the GLS estimator associated with the random effects error structure.[35]

Consider first the effects of differences in the characteristics of the existing system, on Federal Aid construction costs, assuming states have responded to the inherent incentives created by the cost sharing formulas. Equation (9) reports estimates of a random effects model applied to the

[34] Later with the Army Corps permits it will correspond to Divisions for the aggregate analysis and ultimately counties with our analysis of individual permits for North Carolina (see Baltagi [1995] chapters 2 and 4 for an overview).
[35] Both are consistent estimates under the null hypothesis and OLS is inefficient. Under the alternative OLS is consistent and GLS is not. Thus, a failure to reject the null hypothesis provides support for the random effects formulation of the model.

panel. Federal Aid construction costs are deflated to 1994 dollars using the Producers Price Index (adccf) and the dependent variable is expressed in logarithmic form.[36] A semi-log model was adopted after plotting the deflated Federal Aid construction costs by year. These plots are reported as figures 1a and b in Appendix A and suggest that the log transformation appears appropriate for these data, especially since our statistical tests rely on the assumption of normally distributed errors. The panel is unbalanced because of missing data for some states.[37]

(9) $$\ln(\text{adccf}) = \underset{(96.18)}{12.179} + \underset{(3.74)}{.021}\ \text{lane miles} + \underset{(1.51)}{.031}\ \text{count of bridges (measured in 1000s)} - \underset{(-1.80)}{.020}\ \text{center lane mileage}$$

$\hat{\theta}$ (median) = .800
[.75 - .80]

Hausman test
$\chi^2(3) = 6.51$
(0.09)
Breusch - Pagan
$\chi^2(1) = 304.6$
(0.00)

R^2

within	.005
between	.514
overall	.483
Number of Obs. =	238
n =	50
$\bar{T}$ =	4.66

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36 With a neoclassical cost function including factor prices, there would be no need to deflate. Because such cost functions are homogeneous of degree one in factor prices, adjustment for inflation that affects all factor prices equal is unnecessary.

One interpretation of our deflator is as an attempt to use the price index as a control for factor prices over time. This follows because our deflated cost is expressed in logarithmic terms (i.e., ln(adccf) = ln(ccf/PI) = ln(ccf) - ln(PI)). Ideally, one would like to account for differences in factor costs by state but the required factor price indexes were not available.

37 The data reporting system is voluntary so that in some years states failed to report some key variables for the model. Rather than impute the missing values for construction cost, maintenance, or the mileage variables we deleted the observations from the panel. Missing values for a large number of the independent variables in 1989 and the dependent and independent variables for 1995 limited our time span to the 1990-94 period.

The numbers below the coefficients are *t* ratios for the FGLS estimator. The bracketed interval for $\hat{\theta}$ is the range of values for the estimates. Recall each $\hat{\theta}$ varies with the number of time periods available for each state. All of the highway characteristics in this model relate to Federal Aid highways.

The Breusch-Pagan [1980] statistic tests the null hypothesis that the variance in the state effect error is zero and is rejected.[38] The Hausman [1978] specification test is used to test for orthogonality of the random effects to the independent variables. Testing this hypothesis is one way to evaluate whether a random effects is superior to a fixed effects approach to taking account of differences in states. At a p-value of .05 we would not reject the null hypothesis and therefore conclude a random effects framework adequately deals with the different sources of error over time and states. Of course, we should acknowledge that a slightly higher p-value would change this verdict. The signs for our highway system variables are consistent with what might be expected based on the characteristics of highway construction and repair. That is, we expect center lane mileage to reflect the effects of economies of scale in the repair and modernization projects for existing Federal Aid highways. It seems clear from the R^2 that there is substantial unexplained variation in construction costs between states.

The first column in Table 4 reports a model that evaluates whether compliance costs due to environmental regulations can account for the unexplained variation with the simple specification given in (9). We test this hypothesis by including measures that in most cases vary by state and year of the environmental resources likely to influence the stringency of regulations. That is, these factors are hypothesized to be exogenous influences to the negotiated form of the regulations. We

[38] The Breuch - Pagan test was complemented using the Baltagi - Li [1990] adjustment for incomplete panels as developed in STATA.

also include measures of the physical characteristics of resources in the state likely to be related to coastal zone management plans, private farmland, and measures of the level of activity (and experience) in preparing environmental impact statements under NEPA.

Most of the hypothesized impacts are consistent with the conclusion that environmental regulations do increase Federal Aid construction costs. A count of the Federal Endangered or Threatened Species with habitat in each state (which changes over time), a count of sites in the state on the National Registry of Historic Sites (which also changes over time), and measures of federal land in the state relative to the Federal Endangered/Threatened Species count are all statistically significant and plausible influences on the real Federal Aid Construction expenditures. The last of these variables has a negative influence, and is consistent with interpreting federal land as both a restriction on new highways (that are a small fraction of current activity see note 31) and a potential source of habitat for the species that might compensate for any project related effects.

The count of Federal National Priority List sites with hazardous waste in each state is also a positive significant influence. A count of the EIS issued by FHWA in each state by year measures the level of activity involving environmental impacts in the Federal Aid construction budget. This variable is also a positive influence on costs, but is insignificant. A count of overall EIS's in the state is negative, and significant with a p-value of .10, perhaps reflecting ongoing experience with the process. Our measure of coastline (which includes the Great Lakes, takes a value of zero for non-coastal states) is positive and consistent with increased expenditures.

Unfortunately, we were not able to develop measures of wetlands by state that varied over time. Most of the other measures we considered had incorrect signs, limited the available sample, or were highly correlated with other variables. Overall, it was not possible to separate these problems from a judgment about whether the wetland measures could be interpreted as adequate indexes of the effect of wetland restrictions. None were statistically significant determinants of Federal Aid construction costs. Aside from this measure our results are striking, given the aggregate nature of the information available. The Breusch-Pagan and Hausman tests support the random effects framework. The model does a better job of "explaining" variation in real construction costs. It is also reassuring that, with the exception of measures of wetlands, the variables with clearest link to increased expenditures for Federal Aid construction correspond to the environmental impact areas independently identified by state environmental officials in our survey (see Table 2).

Of course, association does not establish causation. Thus, it is important to consider a control to offer some evidence in support of our interpretation for the Federal Aid results. This control is through the models for expenditures on state funded roads. The deflated construction costs for these activities are reported in the second column of Table 4 with the roadway mileage and bridge measures corresponding to the state system. Only the count of the National Registry Sites was found to be a significant determinant of these costs. The Hausman test would imply the model is not mis-specified. Only one of the variables used to represent the potential impact of the negotiated form of the environmental restrictions from federal statutes was found to have an impact. Thus, the contrast in findings further reinforces our interpretation of the Federal Aid results. As expected, Federal Aid maintenance expenditures are not especially well suited to the framework. Thus our results comparing models for these expenditures with those for the state given in the second and fourth columns of Table 4, are not informative.

One final "test" of our approach uses the Federal Aid construction cost model in the first column of Table 4 to estimate the residual in the log of deflated costs that is not explained by state specific system and land characteristics. That is, we predict ln(adccf) using Federal Aid lane mileage, the center lane miles, the count of Federal Aid bridges, miles of coastline, and acres of farmland and then compute the residual $(e.g., \; ln(adccf) - ln(adccf^{P}))$. This is an estimate of the proportional increase in costs this framework would attribute to omitted environmental variables. We now ask if the measures of environmental activism and state resources devoted to environmental enforcement (as an index for the available staff to facilitate coordination in meeting federal and state regulations) influences this residual in a plausible way. These factors were considered separately from our panel model because we could only obtain measures for 1991. Using this single cross-section for observations with complete data (n=48) we have equation (10). The numbers in parentheses below the estimated coefficients are t ratios for the null hypothesis of no association using a robust variance covariance estimator.[39]

(10) $ln(adccf) - ln(adccf^{P})$ = .895 + .452 Conservation Group Membership
(5.00) (2.49)

-30.709 Percent of state budget
(-3.13) Spent of Environmental Programs

$R^2 = .086$

Once again the results support our interpretation. The unexplained residual in Federal Aid construction costs is significantly higher where environmental activism is likely to be more pronounced as measured by the conservation group membership variable and lower if the state is allocating more resources to environmental expenditures.

Thus, our statistical experiment supports the conclusion that the compliance activities of state DOTs to meet environmental regulations on Federal Aid highways increase their costs.

[39] The robust estimator uses the White [1980] consistent covariance matrix to this application. It allows for the fact that the dependent variable is likely to be heteroscedastic.

Because we do not know the specific environmental resources affected by individual projects, this conclusion does not provide a basis for measuring the size of the cost increment. Moreover, it results from our statistical experiment and not a documented linkage that isolates how specific regulations affected individual highway projects. Our estimated models describe how expenditures seemed to change with these environmental resource measures. They are not the constrained cost functions used in describing our hypotheses. Finally, we were not able to include what states rated as the most important environmental factor -- wetland impacts. Thus, in the next two empirical analyses we attempt to refine what can be learned about the potential effects of regulations on highways that arise through their impacts on wetlands. Our focus is on whether delays associated with wetland impacts are likely to be affected by the same interactions among diverse regulatory mandates noted in our discussion of the Federal Aid expenditures.

VI. Delay and Compliance Costs: The Aggregate Record

Environmental regulations to protect wetlands have been among the most controversial of the statutes affecting the highway construction and repair costs. Therefore, they may well be one of the largest impacts on the compliance costs in our summary of expenditures on construction and repair under the Federal Aid highway system. However, inadequate data prevented consideration of whether differences in the wetland areas available by state or over time affected these expenditures. The costs of wetland regulations fall in three general categories -- direct costs associated with wetlands restoration, enhancement, or creation; added re-design and construction costs to avoid or mitigate impacts on wetlands; and the delay costs associated with obtaining the required 404 (and state) permits for each project.

AASHTO conducts a periodic survey of state DOTs to assemble information on the direct wetland costs. Table 5 summarizes these results from the 1993 summary, indicating states and the number of projects with cost information as well as the average and range in the per acre costs of wetland mitigation, and the average ratio of preserved, restored, enhanced, or created wetland acres to the filled wetland acres. These reports suggest that the per acre costs have been specific to the location and context for each project. Thus, average costs per acre cannot be routinely applied to new projects. Without linking them to the other land related costs of these projects it is hard to gauge, based on these estimates alone, the importance of wetland mitigation as a component of environmental compliance costs.

The processing time for permits and associated project delays have been a central focus of reviewers of the wetlands programs. There are substantial differences in the time required for "standard" (also designated as individual) permits in comparison of national permits. The latter are processed quickly and the former can require substantial time periods. Indeed, the first General Accounting Office's (GAO) review of this program concluded that:

> "Dredging permits (including Section 404 permits affecting wetlands) are not being processed within the time frames specified by law and Corps regulations. The responsibility for lengthy processing time is shared by the Corps, other Federal agencies, and the applicants. The Corps district offices do not summarize permit processing data and consequently do not know how much time it is taking to send out public notices and issue final dredging permits" (GAO [1980] p. 26 parenthetical comments added).

As a result of this report and subsequent reviews, the Army Corps introduced its system of Regulatory Quarterly Reports by district.[40] We used these data from the first quarter of 1994 to the second quarter of 1996 to evaluate time required to process individual permits.

[40] Based on discussions with the staff of the Corps headquarters office, the data system provided reliable records of processing time after about 1993. To account for potential reporting errors we indicated over analysis with 1994 to the last available quarter at the time our empirical analysis was completed (second quarter 1996).

The first step in our analysis is a process of aggregation to concatenate the Army Corps records reported by district and Division with the state level information on environmental resources used to evaluate the Federal Aid construction, repair and maintenance expenditures. We aggregated the Corps district level data to 10 Divisions because the Divisions generally include complete states. Districts relate to sections of different states and would require information on our environmental resources with a spatial resolution that is not available. Figure 3 in Appendix A provides a map that indicates the states included in each Division. The Corps' quarterly reports summarize permits issued and denials based on the days for evaluation and group the data in three categories. Our analysis focuses on three measures of processing time -- the fraction of standard permits that are evaluated in 60 days or less, the fraction requiring greater than 120 days to process, and a measure of the lower bound mean (LBM) processing time defined below:

$$(11) \qquad LBM = 0 \cdot (Share \leq 60) + 61 \cdot (Share\ 61\ to\ 120) + 121 \cdot (Share > 120)$$

The LBM estimator is simply an alternative to the unweighted sum of the shares of individual permits in the highest two classes based on the number of days required for a decision.

Table 6 reports some summary statistics by Corps Division. These data relate to an average quarter within the 10 quarter period in our sample. The first three columns report the average and minimum and maximum values for the number of standard permits processed. The remaining columns report the minimum and maximum values for the shares associated with the two processing time intervals we have analyzed.

Our hypothesis is straightforward. Section 404 permits involve projects that impact wetlands. If the interactions across environmental regulations and agencies are present, we should expect that our measures of environmental resources and of regulatory activities should affect the two share variables in opposite ways -- reducing the number of standard permits that could be processed in under 60 days and increasing the number requiring more than 120. Moreover, because our LBM measure emphasizes the contribution of the middle and upper tail shares we would also expect this estimator of average processing time to increase.

Our models include other measures that could make the permitting process more complex -- such as population density and a count of the number of National Pollution Discharge Elimination System Permits (NPDES) issued. The latter variable is intended to gauge the extent of point source activity that is likely to have impacts on water quality. Therefore this variable provides a crude proxy for the effects these other sources' pollution can impose on the process indirectly by increasing the need to maintain the natural resources such as wetlands that mitigate their pollution. Because the permits involve wetlands we include an index of the acreage of wetlands across states. We used Dahl et al. [1991] estimate for the mid-1980, recognizing it is inadequate. Our sample period is about a decade after the time period the estimate is intended to represent. One might argue that a more recent (to our sample) estimate of the stock prior to the decisions would indicate the effect of available substitutes. In this case, we are at best controlling for states likely to have conditions that are consistent with large amounts of wetland resources. Unfortunately, we cannot control for the effects of regulations on the conversion and development of these resources over the period from 1980 to the outset of our sample. We considered a variety of alternative measures.[41] None of the available measures seemed to offer distinct advantages over the Dahl estimate.

[41] These variables included measures of coastal wetlands from Field et al.'s [1991] summary of coastal resources; the estimates of hydric soils and wetland acres reported in Parks and Kramer [1995]; and wetland estimates for the conservation reserve program.

Before discussing our specific results, it is also important to recognize that these models describe activities of the Army Corps. They relate to all requests for individual permits aggregated by Division in each quarter. Our model and discussion to this point has argued that applications for 404 permits associated with highway projects are likely to be more complex than other applications for individual permits. There may well be more balancing of the conflicting mandates of other environmental regulations. For large projects, often the materials prepared as part of the EIS process become part of the documentation used in the application for a 404 permit. An example of this linking of documentation can be found in the final EIS for the Mon/Fayette project (FHWA [1994]) providing an expanded highway link between West Virginia and Pennsylvania. This type of linkage has encouraged by Federal agencies in an effort to reduce the time required for compliance (GAO [1994]).

In this case, then, we are not arguing that the highway projects' permit applications are like the "average" or representative individual permit received by the Corps. Instead, we are hypothesizing that transportation projects account for a disproportionate share of the outliers with greater than average processing time for individual permits. For this reason, a key variable in our model is the share of EIS prepared by the FHWA.

Table 7 reports random effects models using all three dependent variables. This is a balanced panel. Our estimates of σ_ϵ and σ_u suggested that the variance of the effects due to the cross-sectional effects, the Corps Division, (σ_u) was zero (and therefore $\hat{\theta} = 0$). As a result, the estimate models in Table 7 are based on a maximum likelihood estimator for the random effects model, allowing for the possibility that $\sigma_u \neq 0$. As σ_u approaches zero, this estimator will be equivalent to ordinary least squares (OLS). A further potential complication arises because the share variables fall in the zero to one interval. The assumption of normality underlying these estimators would not be correct. We considered a log-odds formulation for each of these models instead of using the shares directly. Use of a log-odds specification for the (share < 60) or the (share > 120) does not alter our overall conclusions. We report the linear form because the shares' values generally fall in a range where apparent violation of the normality assumption due to the truncation (and corresponding sensitivity of the estimates) is not likely to be an issue (see Wales and Woodland [1983] as an example). Greater variability in the dependent variable in this linear form than in the log odds format also provides a wider set of statistically significant effects.

As we noted earlier, the only variable in our model directly related to transportation projects is the count of Environmental Impact Statements issued by FHWA for each region. Preparation of an EIS implies a large scale project, one that leads to involvement of more resource agencies and thus greater delay. With aggregate data we have hypothesized that this variable reflects the time demands of these projects. The measures for the count of Federal Endangered /Threatened species, and federal land relative this count are also consistent with the pattern expected in our hypothesis. The count of National Registry Sites and the count NPL sites are not. All these variables are statistically significant.

The counterintuitive estimates for the National Registry and NPL counts are maintained for all specifications in which they are included. These results are difficult to "explain". They do reinforce our earlier concerns with exclusive reliance on aggregate data for isolating the underlying causal effects of regulations. In this case we do not know that the projects summarized in these quarterly statistics involve any of these resources beyond the wetlands that the permits are intended to address. Thus, while the results are not as clear-cut as with the statistical models for the Federal Aid expenditures, we do find that delays are linked to measures of the resource stocks in ways that are consistent with our hypothesis.

Two other results in the model should be noted. The first involves the farmland preservation restrictions. The acres of farmland variable is consistent with a delaying effect due to this mandate. However, this result should be interpreted cautiously, given state DOT officials' low rating for this source of environmental concerns. The finding is consistent with concerns identified in some of the final EIS documents we reviewed (see Smith and Von Haefen [1996]). Finally, the variable reflecting membership levels in conservation groups which does not change over the time span of our sample is consistent with the concerns identified in our survey of state officials about public participation processes and with the analysis of residuals from our models for Federal Aid construction costs. Such membership variables are commonly used as indexes for environmental activism in the public participation process.

Thus, these results add support for interaction effects across environmental resources and regulatory agencies. They are clearly not decisive. The seemingly implausible effects for two key variables found to be important to both the Federal Aid construction costs and to state DOT officials, in our survey, raises the need for caution in relying on these results alone to judge the effects of wetland policies. Our last empirical analysis seeks to investigate the wetland permitting process further to attempt to resolve some of these uncertainties.

VII. Delay and Compliance Cost: The North Carolina Experience

Establishing an unambiguous link between increased processing time for Section 404 permits and other environmental resources affected by highway projects requires information on the individual permit applications. With the cooperation of the Wilmington office of the Army Corps we obtained the permit records for over 1300 permit applications for projects in North Carolina with decisions that were made in 1994 and 1995. 1088 of these qualified for general permits and 97 percent of these were Section 404 permits. Of the remainder, 237 were individual permits and 78 percent of these were Section 404 permits. Table 8 compares the average time for a permit decision for the general and individual permits that had decisions in these years. This record is consistent with all evaluations of this program.[42] On average, in North Carolina individual permits required nearly four times as much time as the general permits for decisions in 1994. In 1995 this average approached five times. Moreover, these estimates may well understate the total time required. They do not consistently include any time involved in pre-application meetings with Corps personnel or the time-out interval from the date of a decision to the date a permit is issued (see Albrecht and Goode [1994] for discussion of these added time intervals).[43] Nonetheless, by assembling a record of all permits with the same identification codes we were able to take account of the increased time due to incomplete applications.[44]

While the recorded information on the individual application forms made available to us was limited, the Corps staff did identify whether the permits were requested as part of the NC DOT projects. Thus, using this identification alone it is possible to formulate a direct test for the interaction effects due to transportation projects. The time required to process Section 404 individual permits requested for transportation projects should be longer. This conclusion follows because the DOT projects generally must meet a larger set of environmental requirements in

[42] See note 17 for related discussion of the average processing time for individual permits.
[43] This same limitation applies to the aggregate data on processing time and to the means, aside from Albrecht and Goode, that we report in note 17.
[44] Based on discussions with staff in the Army Corps' Wilmington Office it appears that the Corps' data bases retains separate records each time a Section 404 permit application is made. Where the same activity has involved several applications with each version progressively more complete, the separate applications are assigned the same identification number. Thus, by searching within this ID it was possible to reconstruct the full time span from first application to permit decision.

comparison to other applications. To associate this hypothesis with environmental regulations alone assumes that other factors do not account for the delay. Failure to coordinate other aspects of the process could be an alternative explanation. As we discuss below, this explanation was explored with local Army Corps and DOT staff (see also note 46). Equation (12) reports our estimated random effects model with these data. The numbers in parentheses below the estimated coefficients are the *t* ratios for the null hypothesis of no association. We distinguish the time effects associated with each year and identify the NC counties for the projects as the cross-sectional unit.

$$\text{(12)} \quad \text{Processing Time} = \underset{(17.14)}{119.08} + \underset{(5.84)}{215.06}\ \text{DOT}$$

$\hat{\theta} = .241$
[.145 - .707]

R^2	
within	.136
between	.259
overall	.160

This is an unbalanced panel so that $\hat{\theta}$ is again the median estimate and the bracketed values correspond to the estimates at the minimum and maximum values. The logic of the application process seems to fit the assumptions of the random effects model in that it assumes the cross-section distinctions arises with individual specific shifts that are randomly distributed across the cross-sectional units. In this case the cross-section units are counties and the model's error assumptions treat each permit applications as the realization drawn from a large population. The Breusch-Pagan test supports the use of a random effects framework $\chi^2(1) = 7.79$ (p-value = .005) and the Hausman specification error test cannot reject the null hypothesis that the DOT identification is independent of the errors (i.e., $\chi^2(1) = 1.84$, p-value = .175).[45]

[45] Our overall conclusion is not affected if the model is estimated as a fixed effects framework (with counties designating the sources of cross-sectional variation in the processing time)

The model implies that DOT projects in North Carolina requesting a Section 404 individual permit required about 215 more days to complete than those that did not arise from DOT. Because these results are for individual projects and focus directly on a requirement of the environmental regulations related to wetlands, they offer the most direct evidence of interaction effects in the delay related compliance costs. Of course, we should acknowledge that the delay could well be associated with agency interactions -- the Corps and NC DOT -- and not the result of other environmental mandates. While this issue cannot be directly answered with the permit data available, private discussions with Corps and DOT staff suggest that a system of monthly meetings to coordinate highway projects introduced several years ago has served to reduce coordination problems between the Corps, DOT, and other resource agencies identified some years earlier.[46] Thus, non-environmental factors are unlikely to be the sole sources for the substantial added time to obtain decisions for DOT's Section 404 permit applications.

Before closing this discussion of the factors influencing the time required to process individual permits we should also note that it is possible to use the individual permit records to consider an issue that has confounded discussions of the costs of wetland regulations. Critics have suggested that the delays to obtain permits have been excessive, while the Army Corps has argued it has had an improving performance record. The distinction arises because the Corps usually includes general and individual permits in its summary evaluation of permit processing time and the critics do not. Information on individual and general permits for North Carolina allows us to consider whether the interaction effects we argue explain, in part, the increased delays would have

[46] Early analysis of the processing time results for the 404 permits were discussed with staff of the Wilmington Office of the Corps and NC DOT staff. Both confirmed the important role of these coordination sessions in processing 404 applications. They did acknowledge that the time available for such activity was limited due to staff cutbacks at the regional offices of the federal agencies charged with aspects of the regulatory program.

been detected in a sample composed of both types of permits. The models in Table 9 address this issue.

The first column reports the random effects estimator and the second provides the results using a fixed effect model with counties as the cross-sectional units. The Breusch-Pagan test would imply that the fixed effects method provides an adequate description of the factors influencing delay. To evaluate the effects of environmental resources we developed <u>county specific</u> measures for protected species (based on state records for one year, not the Federal Endangered Species count used earlier), a count of National Registry sites, NPL sites (for 1993) the total wetland acres by county, and a count of Environmental Impact Statements prepared for projects in each county. All the environmental variables (including the EIS and National Registry counts) are included as interaction terms with the variable identifying an application as one for an individual permit, because these are the cases in which we would expect these environmental resource impacts to have an impact on the process.

These results confirm the difference in time required for individual and general permits with the statistically significant estimated coefficient for the variable identifying individual permits. Equally important, they illustrate the difficulties posed in isolating the effects of DOT applications when general and individual permits are combined in a single analysis. The estimated effect of DOT applications is negative and insignificant when the model treats the source as having equal impact for both general and individual permits. However the interaction term (i.e., INDIV * DOT), isolating its effect on individual permits, confirms our findings with the simple model, given in equation (12) earlier. Individual permit applications submitted by DOT require significantly longer processing times. This result is unaffected by our treatment of the cross-sectional dimension of the data.

The other environmental factors included in interaction terms do not seem to reflect how these influences would explain processing delays. Here we are using county measures in an attempt to explain the delays in permit decisions. The county level information does not influence processing time and this should not be surprising. Such findings do not contradict our earlier analyses because in those cases our dependent variable was an aggregate. Here the dependent variable relates to an individual permit and we do not know whether the applications actually raised the issues being represented by these aggregate, county level, measures for the environmental variables.

We expect with the aggregate analysis that some of the projects (for the Federal Aid construction cost) or individual permit applications (for the share models) would be affected by the environmental regulations whose effects are proxied by these resource measures. In the case of the applications for individual projects, the effects are either present or not and we should expect the county statistics would not be relevant to processing time unless the specific environmental resources are related to some aspect of the project associated with the permit application. Only the effect of total wetland acres in the county appears to be a stable and plausible influence on processing time. Since all applications by definition involve some disruption to wetlands, this is consistent with our approach.

Thus, we can conclude from this multivariate analysis that our identification of the transportation project applications does not appear to be serving as a proxy measure for some other county specific effect. As a result, the findings do provide strong evidence of interaction effect among the environmental resources generally involved in transportation projects. These effects appear to lead to significant delays in obtaining Section 404 permits.

VIII. Conclusions

A. Findings

This paper has assembled a "patchwork quilt" of information in order to evaluate whether environmental regulations impose significant compliance costs on highway construction and repair. The Federal Aid system is subject to over 20 different statutes. Activities funded by this program may encounter subsets of the nearly 30 different federal agencies with some oversight responsibilities for the environmental resources covered by these statutes. We have argued the resulting system is one that has public agencies negotiating with other public agencies about the exact nature of compliance on multiple environmental mandates. These negotiations can entail different federal agencies as well as state agencies in addition to the state DOT's initiating the specific highway projects.

This process has implications for defining and measuring of environmental compliance costs. Our theoretical analysis suggested that they are unlikely to fit the view of environmental compliance costs commonly adopted for point sources. The response to the regulations appears to be a change in relative input usage. This is akin to a physical content requirement. In these cases compliance costs will not be separable components of total production costs. This means that efforts to solicit experts' judgments about the extent of the costs may be subject to greater error than one might expect with the PACE survey of manufacturing firms. Our survey of the environmental officials at the state transportation departments provides some informal support for this conclusion. It is a task they describe as difficult or impossible. For example, an official from Alaska's DOT suggested best practice was now different and the components due to the difference could not be disentangled.[47] Despite these difficulties most perceived environmental compliance costs to be

[47] This example is based on private correspondence with the first author. It was the explanation offered by a staff member from the Alaska DOT to indicate why the CERE/CTE survey could not be answered.

serious issues. In qualitative terms, their ratings of the important impacts were consistent with the patterns that emerged from a review of environmental impact statements for three states (North Carolina, Pennsylvania, and Wisconsin; see Smith and Von Haefen [1996]).

Using aggregate information about the likely extent of specific environmental resources (or problems) by state, our analysis of the Federal Aid construction expenditures across states suggests that environmental resources (and therefore the regulations) do have significant effects on these expenditures. These same impacts were not found with state funded construction costs, where the federal environmental mandates are less likely to be relevant. No significant, stable parameter estimates for these types of impacts were detected with either the Federal Aid or the state maintenance expenditures.

Our estimation strategy relies on treating the Federal Aid program as the source of a natural experiment. Our results document a statistical association. They do not provide a test of the separability conclusion implied by our theoretical model.[48] Because we do not have records of the specific resources involved in the individual projects, we cannot isolate how specific environmental regulations contribute to increased expenditures. Moreover, we were unable to detect a significant effect for wetland regulations, the environmental requirement rated as most important in our survey of state DOT staff.

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[48] To explain why requires a description of the analytical form of our hypothesis. The separability we argue is precluded by our description of the regulations between the factor inputs and the environmental regulations. This conclusion follows because treating the regulations as comparable to physical content requirements alters the technological relationship we can observe from reduced form cost functions. In the absence of the effects of the cost sharing rule, weak separability of γ_s, s = 1, ..., e) would imply that

$$\overline{C}_{p_i} \cdot \overline{C}_{p_j \gamma_s} - \overline{C}_{p_j} \cdot \overline{C}_{p_i \gamma_s} = 0$$

$$\overline{C}_{\gamma_s} \cdot \overline{C}_{\gamma_r p_k} - \overline{C}_{\gamma_r} \cdot \overline{C}_{\gamma_s p_k} = 0$$

for all i, j that are inputs to production of the highway project and γ_s defining the separable incremental restrictions. Basically what is at issue is whether the restrictions on ratios of inputs affect the demands for other inputs. See Brendt and Christensen [1973] for an outline of the conventional neoclassical argument with simple neoclassical cost functions. Hazilla and Kopp [1986] provided a detailed example of the process of testing separability when a subset of the inputs involved are quasi-fixed. This is not exactly the same issue as we considered, but it is closely related.

To offer further perspective on the effects of regulations related to wetlands we considered the Clean Water Act's Section 404 permits. Two data sets were assembled. The first used aggregate records for 10 of the Corps' 11 divisions. The second focused on individual permits for actions undertaken in North Carolina. Both analyses confirm that the 404 permitting program is likely to be significantly affected by the other environmental mandates imposed on highway projects. The most direct evidence of a differential processing time for the Section 404 individual, permits was found using the 184 such applications in North Carolina with decisions made during 1994 and 1995. DOT projects took an average of about 215 days longer to receive a decision on their permit applications. Past experience with delays has led to considerable effort at coordination across environmental and transportation agencies with the Army Corps staff. Thus, it seems reasonable to attribute a substantial portion of this greater processing time to the number and complexity of the other regulations such projects must address. The aggregate analysis of individual permits supports this conclusion, but must rely on relating differences in distribution of processing times by Division and quarter to aggregate measures of environmental resources in the states within each Division.

Overall, then, we believe our "quilt" reveals a clear and consistent pattern. Regulations protecting wetlands, historic sites, and endangered species appear to be the most important influences on the processing time (and hence delays) for permits as well as for the increased expenditures required to construct and repair Federal Aid highways. At this point we do not know the extent of the full compliance costs and believe it would be difficult, if not impossible, to isolate them as separable percentages that could be applied uniformly to all projects. Indeed, based on the informal record presented in GAO evaluations, selected EIS reports, and discussions with DOT staff in several states, it would appear that the extent of processing time and the compliance cost can depend on the efforts to coordinate among agencies and the designation and effectiveness of a lead agency with responsibility for facilitating these interactions.

B. Next Steps for Measuring Environmental Compliance Costs

A key implication of our overview and statistical analyses is that environmental compliance costs are specific to each highway project. This conclusion implies that further progress in evaluating how the environmental mandates imposed Federal Aid highways have impacted costs will require a detailed study of individual projects -- either reconstructing ex post the adjustments made to accommodate the relevant environmental requirements, or estimating ex ante what appears to be their likely consequences for a specific set of projects. This would be a significant venture that would require both engineers and economists to design and evaluate the information assembled from past project records or to construct cost estimates based on proposed future actions. In either case, an important omitted consideration in all the discussions of the costs imposed by these mandates is what the regulations have in fact accomplished. The real concern with these programs is if the modifications to what was best practice in the planning, design, and construction (or repair) of highways prior to the introduction of these regulations have raised costs without delivering services from highways and the other environmental resources that are worth at least the added costs. To address this question requires consideration of the net benefits of these modifications. While including benefits involves another significant set of complexities (see Scodari [1997] for a summary of wetland benefit estimates), evaluating what is delivered from these programs and whether it is worth the effort are essential steps in any effort to address the issue that motivates attention to environmental compliance costs, namely -- are they worth it?

C. General Implications

There are some general lessons from our review and statistical analysis of environmental regulations impacting highways. Two seem especially relevant. With progressive increases in the stringency of environmental regulations there is greater recognition of the implications of the spatial distribution of residuals. Evaluations of the cost savings due to replacing command and control with incentive based policies were among the first to highlight this issue.[49] EPA's newly announced standards for ozone and particulate matter may well generate a regulatory process that specifically acknowledges these spatial interconnections by distinguishing areas of influence and areas of violation. The former can cause a separate location to fail to comply with the ambient standard but are outside the jurisdiction for regulation. Once this is recognized explicitly, compliance will become a negotiated process and subject to the generic issues involved in how environmental regulations affect highways.

Moreover, the relevance is not limited to this case. The current EPA process has evolved to assembling "stakeholders" and negotiating an assignment of responsibilities. Our analysis of negotiated regulations (in highways) suggests these approaches are time consuming and increase costs. Moreover, the informal evidence from our research (assembled from interviews with state personnel, past GAO reports on the wetlands program, and EIS documents for highway projects) also indicates that this approach requires substantial resources devoted to coordination and the designation of someone (e.g., an agency) with responsibility to see that it takes place.

Second, the economic model of the regulatory process associated with an increasing number of environmental programs needs to be amended. Early research focused on the agency defining regulations exogenously to the firms affect by these mandates. More recently, theory has

[49] See Oates, Portney and McGartland [1989], Schwabe [1996] and Smith, Schwabe and Mansfield [1997] for discussions of this issue in the context of air and water quality issues.

considered interactions between the agency and the firm in the presence of incomplete information about the costs of residual control, the emissions from individual firms, or both.[50] Our analysis suggests that this process ignores another source of interaction -- among environmental agencies with diverse mandates. In several large programs (e.g., cleanup under Superfund, restoration under the Oil Pollution Act and natural resource damage liabilities, and Federal Aid highway construction activities) the outcome of the regulatory process may have more to do with interagency interactions than the relationship between any one of these "regulators" and the firms comprising the regulated community. To our knowledge, these complexities have been overlooked in the "new" literature on environmental regulations and firm behavior.

[50] See Lewis [1996] for an overview of this recent literature.

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Table 1: Selected Environmental Statutes Impacting Highways by Resource[a]

Resource	Statute/Executive Order	Agency	Regulatory Mechanisr
.ll Resources	NEPA (1970)	Council on Environmental Quality	EIS
and Public Parks Wildlands Historic Sites Coastal Areas	Section f, DOT (1966)	FHWA	Documentation and permi
	Wilderness Act (1988)	U.S. Forest Service	Land-use restrictions
	National Historic Preservation Act (1966)	State Historic Preservation Office	Cultural Resource Assessment
	National Wildlife Refuge Administration Act (1988)	Department of Interior	Land-use restrictions
	National Forest Management Act (1988, 1993)	Department of Agriculture	Land-use restrictions
	Endangered Species Act (1973) - Habitat	Department of Interior and Department of Commerce	Conservation Plan listing
	Coastal Zone Management Act (1988, 1991) Coastal Barrier Act (1982)	Department of Commerce	Coastal Zone Management Plan Certification; funding restrictions
'etlands	Clean Water Act Section 404 (1972)	Corps of Engineers EPA	404 permits
	Executive Order (1977)	FHWA	EIS
	DOT Order 5660.1A (1978)		Public Review
avigable Water	Rivers and Harbors Act (1899)	Corps of Engineers	Sec. 10 Permits

[a] This table is based on a detailed summary in Smith and Von Haefen [1996] and Tarrer [1993]. It does not include Executive Orders and statutes governing farmland, floodplains, Superfund and other hazardous waste sites.

Fish and Wildlife Including Endangered Species	Fish and Wildlife Coordination Act (1988)	Fish and Wildlife Service	NEPA Provisions
	Migratory Bird Treaty Act (1918)	Fish and Wildlife Service	Permits
	Endangered Species Act (1973)	Department of Interior; Department of Commerce	Biological Assessme Conservation Plan
	National Wildlife Refuge Administration Act (1988)	Department of Interior	Land Use Res.
Rivers	Wild and Scenic Rivers Act (1988, 1993)	Department of Interior	Prohibit Developme
Water	Clean Water Act (1972); Clean Water Act Section 208 319 (1978) Safe Drinking Water Act (1988)	EPA State Water Quality Agencies	NPDES permit for p source management Memorandums of Understanding
Air	Clean Air Act (1970, 1977, 1990)	EPA	National Ambient Ai Quality Standards fo Criteria Air Pollutant State Implementatior Plans; Restrictions imposed on activities non-attainment areas
Noise	Noise Control Act (1972)	EPA	Standards on Constru

Table 2: Reported Environmental Compliance Costs by Activity[a]

	New Construction		Repair	
	%	n	%	n
Planning	7.6	5	1.0	2
Design	7.75	4	13.0	2
Construction	6.33	3	---	---
Materials/Labor	---	---	4.0	1

Source: 1996 CERE/CTE survey of state DOT environmental officials, see Appendix B.

[a] These statistics are simple averages of the responses for survey indicating records were kept for survey indicating records were kept and a specific percentage was reported. n designates the number of observations used to compute the percentage estimate.

Table 3: Ratings of Important Environmental Factors
By State Transportation Officials[a]

Type of Impact	Average Importance Score
Wetlands	3.67
Historic Sites	3.39
Archeological Sites	3.33
Public Involvement	3.27
Endangered Species	3.00
Public Lands - Federal Aid Projects	3.00
Hazardous Waste	2.70
Fish and Wildlife	2.61
Water Quality	2.50
Noise	2.33
Air Quality	2.12
Flood Plains	2.11
Public Lands - 100 % State Projects	1.89
Coastal Impacts	1.50
Wild and Scenic Rivers	1.44
Compliance with Land Use Plans	1.28
Aesthetics	1.11
Farmlands	1.06

Source: 1996 CERE/CTE survey of state DOT environmental officials, see Appendix B.

[a] The text of the question used to collect these ratings was: "Based on your best professional judgment, please indicate the importance of these types of environmental impacts in terms of the staff time and additional resources required to deal with them for all the highway projects underway as well as those undertaken for the first time in your state during the 1995 fiscal year." A linear scale was displayed below the question with ratings and key words from 0 to 4. 0 was labeled "usually of no concern" and 4 "extremely important". The number of observations = 18.

Table 4: Federal Aid Versus State Funded Expenditures on Highway Construction and Maintenance (1994 dollars)[a]

	Federal Aid		State Funded	
	Construction Cost	Maintenance Cost	Construction Cost	Maintenance Cost
Lane Mileage	.017*** (2.86)	.019 (1.42)	-.027 (-1.32)	-.029 (-0.86)
Public Road and Street Mileage	-.026** (-2.45)	-.021 (-0.80)	.045 (1.26)	.060 (0.97)
Number of Bridges (scaled by 1000)	.026 (1.34)	.088** (2.11)	-.010 (-0.58)	-.005 (-0.16)
Count of EIS draft, final and supplemental issued by FHWA	.010 (1.17)	.001 (0.04)	.011 (0.44)	-.021 (-0.46)
Count of Federal Endangered/Threatened Species	.004* (1.72)	-.003 (-0.64)	.008 (1.22)	.005 (0.41)
Count of Proposed and Final National Priority List Sites	.009*** (3.05)	.008* (1.84)	.002 (0.18)	-.030 (-1.50)
Count of National Registry Sites, Objects, Structures and Districts (scaled by 10)	.003*** (3.18)	.002 (1.29)	.008** (2.01)	.001* (1.91)
Miles of Coastline	.046** (2.01)	-.037 (-0.92)	.057 (0.63)	.080 (0.46)
Acres of federal land relative to count of endangered or threatened species	-.039* (-1.81)	.051 (1.29)	-.047 (-0.59)	-.041 (-0.23)

*** p-value of .01
** p-value of .05
* p-value of .10

[a] The numbers in parentheses below the estimated parameters are the t ratios for the null hypothesis of no association. Appendix A describes the sources of definitions of each variable in detail.

Estimated acres of farm land	-.002 (-0.43)	-.013* (-1.88)	.015 (0.72)	-.029 (-0.90)
Count of all environmental impact statements by all federal agencies	-.004* (-1.90)	.003 (0.72)	-.003 (-0.43)	.013 (1.18)
Intercept	11.845*** (90.59)	10.240*** (48.74)	8.95*** (14.55)	7.510** (7.97)
$\hat{\theta}$	.726	.497	.824	.806
R^2 within	.054	.000	.027	.002
between	.778	.705	.091	.180
overall	.727	.522	.090	.140
Number of observations	238	229	235	224
Hausman Test (p-value)	11.85 (0.295)	18.87 (0.042)	7.69 (0.659)	20.30 (0.027)
Breusch-Pagan Test (p-value)	209.38 (0.000)	35.05 (0.000)	186.84 (0.000)	138.14 (0.000)

Table 5: AASHTO Wetland Mitigation Cost Survey 1993[a]

State	No. of Projects	Average Mitigation Cost per Filled Acre of Wetlands			Acres of Replacement Wetlands/Acre Filled Wetlands
		Mean	Min	Max	
Alabama	7	10,000	4,000	20,000	2.00
Arizona	1	20,000	--	--	2.80
Arkansas	9	2,432	279	5,375	1.48
California	13	102,413	8,273	600,000	2.71
Connecticut	4	58,193	24,625	78,410	1.03
Delaware	6	72,423	5,000	314,641	1.34
Florida	25	112,384	964	629,969	33.78
Georgia	13	27,124	17,857	44,720	1.07
Illinois	1	53,750	--	--	2.98
Iowa	3	2,222	1,364	3,636	1.13
Kansas	2	10,277	10,231	10,323	1.06
Louisiana	8	1,510	384	3,437	1.06
Maine	8	195,401	4,074	998,325	3.64
Michigan	1	9,006	--	--	2.27
Mississippi	16	630	524	1,185	1.06
Nebraska	13	16,946	1,627	84,207	1.09
New Jersey	7	1,055,978	114,942	5,000,000	1.32
Oklahoma	3	27,722	1,161	80,000	3.40
Pennsylvania	7	116,628	34,400	168,750	1.48
Virginia	22	77,733	216	336,186	2.00
Washington	1	53,333	--	--	1.44
West Virginia	2	729	625	833	0.27
Wyoming	4	11,497	4,000	21,333	1.90

[a] These results were developed with the assistance of the Georgia Department of Transportation. Bill Phillips and Brandon Daniels provided tabular data with each state's response to the AASHTO survey conducted by Georgia's Department of Transportation.

Table 6: Number and Processing Time for Section 404 Permits by Army Corp Division: 1994Q1 - 1996Q2[a]

U.S. Army Corps Division[b]	Number of Standard Permits			LBM		Share ≤ 60		Share > 120	
	Average (Quarterly)	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
Lower Mississippi	214.7	184	265	47.9	60.4	.26	.43	.19	.30
Ohio River	99.1	79	127	49.8	65.3	.16	.32	.14	.28
North Atlantic	197.8	171	234	23.6	50.9	.41	.65	.04	.24
South Atlantic	294.7	232	400	45.6	58.1	.30	.43	.17	.28
North Central	188.7	131	230	52.8	68.1	.27	.36	.19	.44
Southwestern	107.9	77	129	41.8	59.9	.30	.48	.17	.29
New England	29.8	14	50	28.7	65.5	.11	.56	.03	.30
South Pacific	60.1	39	97	54.1	81.3	.14	.37	.22	.48
North Pacific	124.1	94	152	46.1	63.2	.22	.41	.17	.26
Missouri River	84.7	43	115	52.7	90.1	.08	.36	.17	.57

[a] These statistics were developed from data provided by the U.S. Army Corps headquarters from their Regulatory Quarterly Reports.
[b] Figure 3 and Table 5A in Appendix A defines these Divisions in terms of the states.

Table 7: Share Models for Processing Time for
Section 404 Individual Permits: 1994Q1 - 1996Q2[a]

Independent Variables	Share ≤ 60	Share > 120	Average Time (LBM)
Count of Federal Endangered/Threatened Species (scaled by 100)	-.088*** (-3.84)	.048** (2.32)	8.280*** (3.66)
Dahl's Estimate of Wetland Acres 1980	-.003** (-2.26)	.002* (1.84)	.333** (2.42)
Membership - Conservation Groups	-6.103*** (-4.73)	3.543** (3.02)	548.862*** (4.59)
National Pollution Discharge Elimination Permits 1993 (scaled by 100)	-.015*** (-4.70)	.010*** (3.43)	1.547*** (4.81)
Count of Proposed and Final National Priority List Sites	.002*** (4.19)	-.001* (-1.90)	-.149*** (-3.65)
Population Density	-.548 (-1.49)	.505 (1.51)	63.758* (1.75)
Count of National Registry Sites, Objects. Structures and Districts (scaled 1000)	.067*** (3.84)	-.065*** (-4.08)	-8.029*** (-4.63)
Count of EIS draft, final, and supplemental issued by FHWA	-.002** (-2.01)	.003*** (2.82)	.342*** (2.80)
Estimated acres of farm land	-.001*** (-3.12)	.001*** (2.87)	.137*** (3.52)
Share of standard and regional permits that are regional	-.140* (-1.66)	.020 (0.25)	9.738 (1.17)
Acres of federal land reliable to count of federal endangered or threatened species	.088* (1.88)	-.089** (-2.11)	-10.709** (-2.33)
Intercept	1.016*** (5.67)	-.057 (-0.35)	-4.417 (-0.25)
σ_u	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)
σ_ε	0.068*** (14.14)	0.062*** (14.14)	6.742*** (14.14)
χ^2 (p-value)	102.5 (0.00)	72.69 (0.00)	99.68 (0.00)
Number of observations	100	100	100

*** p-value of .01
** p-value of .05
* p-value of .10

[a] The numbers in parentheses below the estimated coefficients are the asymptotic Z statistics for the null hypothesis of no association. These estimates are based on the maximum likelihood estimator for the random effects model.

Table 8: Average Processing Time (days)
Section 404 Permits for Activities in N.C.

Date of Final Permit Decision	Individual				General			
	n	Mean	Min	Max	n	Mean	Min	Max
1994	99	84.02 (114.79)	1	748	454	22.46 (17.17)	1	145
1995	85	152.47 (182.27)	22	1054	444	31.90 (15.17)	1	59

Source: This summary was developed from a data file provided by the Wilmington, N.C. office of the U.S. Army Corps of Engineers. Small values for the processing time may well reflect coding errors. These summary statistics dropped a small number of observations with obvious processing errors (e.g., negative processing time). Eliminating observations with under 10 days of processing time does not alter the overall conclusions from this comparison. Numbers in parentheses are the standard errors for processing time.

Table 9: Processing Time for Individual and General Section 404 Permits in North Carolina[a]

Independent Variables	Random Effects	Fixed Effects
DOT Application (=1)	-6.164	-2.655
	(-1.36)	(-0.47)
Individual Permit (=1)	130.311***	130.980***
	(10.94)	(9.04)
Count of Protected Species[b]	2.467	1.966
	(1.59)	(0.95)
Total Wetlands Acres[b]	-0.062***	-0.069***
(in 100's)	(-8.83)	(-7.32)
Count of NPL sites[b]	-17.125*	-17.419
(in 1993)	(-1.66)	(-1.42)
Count of National Registry Sites[b]	-0.921***	-0.758*
	(-2.67)	(-1.93)
Count of EIS prepared[b]	-1.688	-6.468
	(-0.21)	(-0.68)
Individual Permit * DOT	210.457***	191.647***
	(11.96)	(10.18)
Intercept	30.285**	31.131***
	(12.41)	(12.13)
R^2		
within	.283	.286
between	.760	.754
overall	.348	.343
Number of observations	1090	1090
n	99	99
$\bar{T}$	3.74	11.01
Breusch-Pagan	1.75	--
(p-value)	(0.186)	--
Fixed Effect	--	1.506
F (98,983)	--	(0.002)

*** p-value of .01
** p-value of .05
* p-value of .10

[a] The values in parentheses below the estimated coefficients are the t-ratios for the null hypothesis of no association. The values below test statistics, Breusch-Pagan and the Fixed effect F-test are p -values.

[b] These variables are interacted with a dummy variable identifying individual permits.

Appendices: Environmental Compliance Costs Where the Rubber Meets the Road

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Appendix A: Data Description

Appendix A: Data

This appendix describes the basic format for each of the data sets assembled from public sources or based on requests to public agencies. Each set of data is discussed according to the type of analysis undertaken: Federal Aid Expenditure Analysis, Aggregate Section 404 Processing Time, and the North Carolina Section 404 Permit Processing Time. The survey of designated state environmental officials is described in Appendix B.

I. Federal Aid Expenditure Analysis

The sample contains three categories of variables at the state level for 1990 to 1994. First, variables that reflect highway characteristics were assembled to control for roadway characteristics in the Federal Aid system as well as for state roads. These variables serve as controls for the factors influencing cost sharing. Second, a set of environmental variables serve as proxies for the effects of environmental regulations on highway construction and expenditures. Table 1A summarizes the variables' definitions. Table 2A provides means and variances for selected environmental variables by year.

All data concerning roadway extent and characteristics of both Federal Aid highways and non Federal Aid highways are from *Highway Statistics*. The Federal Aid highways are segments of public roads that are eligible for federal funding. Only a fraction of the public roads are Federal Aid highways. In 1994, there are 947,895 center-lane miles of Federal Aid highways and 2,958,649 miles of non-Federal Aid highways in the U.S., excluding Washington D.C. Federal Aid highways contain the entire interstate highway system, principal arterials and major collectors, which usually have more lanes than the local roads. 27 percent of total lane-mileage are on the Federal Aid highway system.

Including all states in the sample, an average of 15,372 miles of roadways were under construction annually. System preservation and capacity addition constitutes over 70 percent of all highway projects, with system preservation an ever increasing component of the total. There are substantial fluctuations in the construction of new routes annually. The low mileage of new construction was confirmed by telephone contacts with the individual states. Most states reported that their roadway systems was complete, or almost completed. New roads added are due primarily to the addition of new turns and intersections, which add few new miles.[1] Table 3A summarizes the data assembled from phone contacts with states about new mileage. Table 4A summarizes the average proportionate change in the miles and lane miles for the states in our data panel for each of the pairs of years in our panel.

Data on highway expenditures include capital outlay and maintenance cost of both Federal Aid and state highways. Capital outlay includes land acquisition and other right of way costs, engineering, construction and reconstruction, resurfacing, rehabilitation, restoration costs, and installation of traffic service facilities. Total Federal Aid expenditures in 1994 involved over 27 billion dollars in construction. This is approximately 9 times the total capital outlay of non-Federal Aid highways.

Maintenance costs are incurred from work done to keep roadways in usable condition, such as routine patching repairs, bridge painting. Unlike construction/reconstruction of roadways, maintenance is not intended to extend the service life of a highway, only to preserve it. Total maintenance of federal aid highways amounts to about 5 billion dollars in 1994, about 3 times as much as that of the non-federal aid highways.

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[1]From Trend Chart, Miles of roadway projects underway, *Highway Statistics*, 1993, 1994.

The remaining component of this sub-section includes notes on specific assumptions associated with the construction of each variable.

II. Aggregate Section 404 Processing Time

Figure 3 reproduces the annual summary of the quarterly reports prepared by the U.S. Army Corps of Engineers for its permit activities. Our analysis of the aggregation Section 404 permits assembled these data for each of 10 Divisions by quarter from the first quarter of 1994 to the second quarter of 1996. Beginning in the late 1980s, these reports have been maintained as computer-based data files, and, have undergone substantial upgrades with resulting improvement in data integrity. Private correspondence with multiple Corps staff suggest that by the early 1990s, the data accurately reflected the experience of regional and district offices.

Figure 3 identifies the link between states and Divisions. The environmental measures used in this analysis are aggregates of the state level information described in Table 1A with the measures for the relevant states aggregated to match the Divisions. Table 5A identifies the Division acronym, name and states used in constructing the environmental measures.

III. North Carolina Section 404 Processing Time

The data for the analysis of the Army Corps' processing time for Section 404 and 10 permits was obtained with the assistance of Wayne Wright from the Corps' Wilmington Office. It covers individual permits with decisions over the period 1994 to 1995. Using the earliest date on the permit application that was submitted to the Corps along with the date a final decision was made, the type of permit (e.g., Section 404 individual, general, etc.), and information specifically added to each record by Corps staff indicating whether it was a DOT project we are able to estimate the processing time for each permit. Nine of the 1,338 permits in our file had negative estimates for processing time. These likely reflect coding errors in the original data and were deleted from our sample used for analysis.[2]

Information on a wide range of environmental variables were assembled for our analysis of the state and division panels and for the analysis using North Carolina county variation in these measures to describe the cross-sectional environmental effects for analysis of individual permits. Table 6A identifies the source and definition for each of these supplementary variables.

[2] Our efforts to assemble the data set, with DOT identification and resolve issues with multiple applications required considerable time for Corps staff. This issue was such a minor one in terms of the other demands for their time we were unable to resolve the source of the mistake.

Table 1A: Federal Aid and State Funded Highway Expenditure Analysis: Data Description & Documentation

Variable	Description	Documentation	Comments
ccaf	Capital outlays on the federal aid highway system.	From Table SF-12 series, *Highway Statistics*, published annually by the Federal Highway Administration, Department of Transportation.	Costs associated with highway improvements, including land acquisition and other right of way costs, engineering, construction and reconstruction, resurfacing, rehabilitation, restoration costs of roadway and structure, and installation of traffic service facilities.
ccnf	Capital outlays on the non-federal aid highway system.	See ccaf documentation.	
mcf	Maintenance costs on the federal aid highway system.	See ccaf documentation.	Costs required to keep highways in usable condition, such as routine patching repairs, bridge painting. Maintenance does not extend the service life of a highway, only preserves it.
mcnf	Maintenance costs on the non federal aid highway system.	See ccaf documentation.	
[ad]varname	Varname in constant dollars (1994), adjusted by producer price indexes.	Data from Producer Price Indexes, for intermediate materials, supplies, and components-materials and components for construction. Published by Bureau of Labor Statistics, Department of Labor.	
ba	number of bridges on the federal aid highway system.	Table HM41, *Highway Statistics.*	A continuously updated inventory of vehicle bridges greater than or equal to 20 feet.
bna	number of bridges on the non federal aid highway system.	see ba for documentation.	
milea	public road and street mileage on the federal aid highway system.	Tables HM-10, HM-14, HM-15, *Highway Statistics.*	Center-lane mileage on the existing roads.
milena	public road and street mileage on the non federal aid highway system.	see milea for documentation.	
lma	Estimated lane mileage on the federal aid highway system.	Calculated from Table HM-60, *Highway Statistics.*	The sum of the product of the number of lanes and center-lane mileage on the existing roads.
lmna	Estimated lane mileage on the non federal aid highway system.	see lma documentation.	
eis[a]	Counts of all EISs (draft, final, supplemental, etc.) issued to all federal agencies for each year, 1990-1995.	These counts were constructed from a computer printout of all EISs issued in the period January 1, 1990 to December 31, 1995. This printout was generated by the EPA Office of Federal Activities' Environmental Review Tracking System.	
fhw[a]	Counts of all EISs (drafts, final, supplemental, etc.) issued to the FHWA for each year, 1990-1995.	See documentation for eis.	

spec[a]	Count of Federal Endangered/Threatened Species	A February 29, 1996 snapshot of the counts of endangered species for each of the 50 States was obtained from the Endangered Species Program's Web Page, http://www.fws.gov/~r9endspp/ listmap.html. This information was combined with a chronological listing of species obtained from the ESP to construct the ES List for the years 1990-95.	
hist[a]	Count of National Register Sites, Objects, Structures, and Districts in each state for the years 1989 to present	Obtained from John Byrne, Database Manager at the National Register of Historic Places, Department of the Interior, a dataset consisting of all National Register Sites as of July, 1996 that allowed us to construct these yearly counts.	These data are cumulative counts for each of the years.
npl[a]	Count of Proposed & Final National Priority List Sites for the years, 1989-1995	This data is annually compiled *in The Statistical Abstract of the United States*, Bureau of the Census, from EPA press releases and proposed rules. Also, *The World Almanac & Book of Facts*, World Almanac Books, compiles the same information from similar EPA documents.	
wet1980[a]	Estimated wetland acreage in the 1980s from the National Wetlands Inventory Report	Dahl, T.E. et al. 1990. *Wetlands Losses in the United States 1880's to 1980's*. US Department of the Interior, Fish and Wildlife Service, Washington, DC.	These acreage estimates were assumed constant across the 1990-94 panel.
fed[a]	Estimated acres of all federally owned lands, 1989-1993	For years 1989-91, the annually published Public Land Statistics, a US Department of the Interior, Bureau of Land Management document. For 1992-93, the publication, *Summary Report of Real Property Owned by the United States Throughout the World*. US General Services Administration, Washington, DC, was used.	Inspection of the data suggests that the two data sources are consistent. were available for 1994, so 1993 values were substituted for the missing data.
farm[a]	Estimated acres of farm lands where a farm is defined as any establishment from which $1000 or more of agricultural products are sold or would normally be sold during the year.	This data is annually published in *Farm Numbers and Land in Farms*, US Department of Agriculture, National Agricultural Statistics Service.	

[a] More detailed documentation on these variables is also reported in Table 6A below.

Table 2A: Summary Characteristics for Selected State Level Environmental Variables

Environmental Variables						
mean (std. dev)	1990	1991	1992	1993	1994	across years
npl	23.94 (25.5)	24.03 (25.9)	24.48 (26.1)	25.16 (26.21)	25.66 (26.39)	24.57 (25.80)
fhw-eis	2.42 (2.83)	1.88 (2.76)	2.6 (3.58)	1.74 (2.16)	3 (3.88)	2.35 (3.04)
hist	1117 (717)	1156 (733)	1193.9 (747.7)	1225.6 (754)	1257 (765)	1170 (731)
spec	23.58 (18.29)	25.46 (19.4)	27.72 (22.78)	29.86 (26.9)	32.04 (29.11)	27.04 (22.90)
fed	.01299 (.036)	.01298 (.036)	.0130 (.036)	.0130 (.036)	.0131 (.036)	.0130 (.036)
farm	19.75 (22.39)	19.65 (22.28)	19.59 (22.17)	19.55 (22.17)	19.5 (22.1)	19.65 (22.07)

Table 3A: New Federal Aid Highway Miles by Year and State

New Miles Constructed	1989	1990	1991	1992	1993	199
Alabama	NA	NA	NA	NA	NA	NA
Alaska	NA	NA	NA	NA	NA	NA
Arizona	0	0	0	0	0	0
Arkansas	7.91	14.52	11.53	14.61	15.54	17.54
California	NA	NA	NA	NA	NA	NA
Colorado	NA	NA	NA	NA	NA	NA
Connecticut	0	0	0	0	0	0
Delaware	NA	NA	NA	NA	NA	NA
Florida	NA	NA	NA	NA	NA	NA
Georgia	32.37	29.21	28.63	32.69	44.02	50.96
Hawaii	NA	NA	NA	NA	NA	NA
Idaho	5.375	7.54	11.204	15.854	8.361	3.46
Illinois	18.42	79.05	42.43	19.46	23.79	11.08
Indiana	16.515	26.593	15.223	5.514	0	1.75
Iowa	12	4	18	16	32	32
Kansas	0	0	7	8.4	0	10.5
Kentucky	NA	NA	76.002	49.724	124.233	178.33
Louisiana	NA	NA	NA	NA	NA	NA
Maine	1.5	0	0	0	0	0
Maryland	53.27	221.24	308.35	138.63	80.05	33.75
Massachusetts	NA	NA	NA	NA	NA	NA
Michigan	NA	NA	NA	NA	NA	NA
Minnesota	6	8	33	16	20	10
Mississippi	NA	NA	NA	NA	NA	NA
Missouri						
Montana	0.2	0	0	0	0	0
Nebraska	539.7	970.4	580.1	1054.1	685.5	514
Nevada						
New Hampshire	2 miles during 1989 to 1994					
New Jersey	9.46	0	0	0	21.4	6.32
New Mexico	NA	NA	NA	NA	NA	NA
New York	NA	NA	NA	NA	NA	NA
North Carolina						
North Dakota	0	0	0	0	0	0
Ohio						
Oklahoma						
Oregon	92.02	184.87	24.45	81.8	37.9	76.24
Pennsylvania	49	8	25	12	8	19

Rhode Island	NA	NA	NA	NA	NA	NA
South Carolina	NA	NA	NA	NA	NA	NA
South Dakota	157.6	115.2	116.2	196.9	166.1	180
Tennessee	NA	NA	NA	NA	NA	NA
Texas	NA	NA	NA	NA	NA	NA
Utah	0	0	20.5	0.9	7.4	16.6`
Vermont	1.998	4.737	0	0	0	4.069
Virginia	NA	NA	NA	NA	NA	NA
Washington						
West Virginia	0	0	0	0	0	1.08
Wisconsin	367.07	529.379	439.921	474.825	587.305	420.047
Wyoming	0	0	0	0.16	2.339	0.424

Table 4A: Proportionate Change in Miles and Lane Miles

Miles (measured at center lane)	94-93	93-92	92-91	91-90
Mean	.00155	.01088	.08900	.00105
Median	.00016	.00486	.0553	.00047
<u>Lane Miles</u>				
Mean	.00533	.00866	.01123	.00279
Median	.00287	.00286	.00658	.00195

Table 5A: Composition of Corps Division[a]

Division	Abbreviation	States Included
Lower Mississippi	LMD	Arkansas, Illinois, Louisiana, Mississippi, Missouri, Tennessee
Ohio River	ORD	Alabama, Illinois, Indiana, Kentucky, Mississippi, New York, Ohio, Pennsylvania, Tennessee, West Virginia
North Atlantic	NAD	Delaware Maryland, New Jersey, New York, Pennsylvania, Virginia
South Atlantic	SAD	Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina
North Central	NCD	Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, New York, Ohio, Wisconsin
Southwestern	SWD	Arkansas, Colorado, Louisiana, Missouri, New Mexico, Oklahoma
New England	NED	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
South Pacific	SPD	Arizona, California, Colorado, Nevada, Utah
North Pacific	NPD	Alaska, Idaho, Oregon, Washington
Missouri River	MRD	Colorado, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota, Wyoming

[a] States are included in more than one division in aggregating the independent variable describing environmental resources. The permit share measures do not overlap. A unique value of each share is associated with each division.

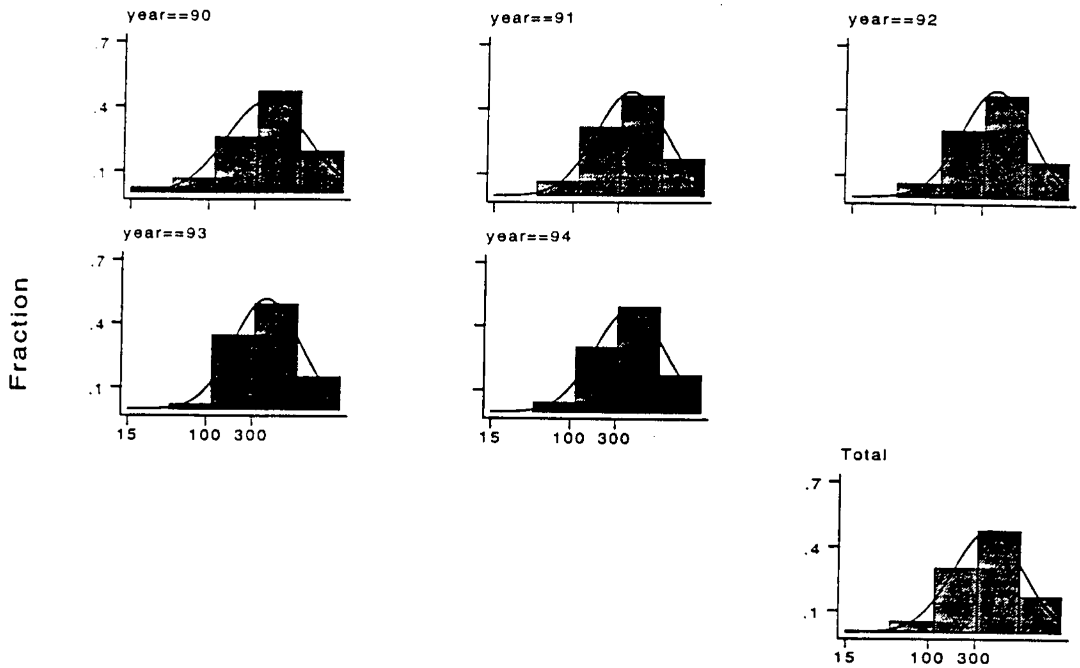
Table 6A: Supplementary Environmental Variables for State and NC County Analyses

Variable	Description	Documentation	Comments
hydric82	Cropland acres, excluding land in hay, on hydric soils that required drainage but had not been drained in 1982.	Calculated from 1987 National Resources Inventory (NRI) data tapes by aggregating sample plots to the state level. See US Department of Agriculture Soil Conservation Service's "1987 National Resources Inventory: Summary Report," Soil Conservation Service Statistical Bulletin 790, US Dept. of Agriculture, Washington, DC (1989), for details on the NRI. The state estimates are reported in Parks, Peter J. & Randall A. Kramer, "A Policy Simulation of the Wetlands Reserve Program," *Journal of Environmental Economics & Management*. 28; 223-240 (1995).	No estimates for the states CO, CT, ID, ME, MT, NE, RI, WA and WY. These estimates were assumed constant across the panel years.
wet82_pk	Cropland acres classified as either a wetland system or type in 1982.	See documentation for hydric82.	No estimates for the states DE, NH, and OK. These estimates were assumed constant across the panel years.
conserve	Acres of restored wetlands enrolled in Conservation Reserve Program's CP 14 initiative.	Calculated from individual CRP contract data, Signups 8 & 9. The state estimates are reported in Parks, Peter J. & Randall A. Kramer, "A Policy Simulation of the Wetlands Reserve Program," *Journal of Environmental Economics & Management*. 28; 223-240 (1995).	These estimates were assumed constant across the panel years.
wetcrp	Acres of wetlands enrolled in the Conservation Reserve Program, but not CP 14. These wetlands are not restored wetlands, but are wetlands serving as buffer strips for rivers, streams, and newly restored wetlands.	See documentation for conserve.	These estimates were assumed constant across the panel years.
eis	Counts of all EISs (draft, final, supplemental, etc.) issued to all federal agencies for each year, 1990-1995.	These counts were constructed from a computer printout of all EISs issued in the period January 1, 1990 to December 31, 1995. This printout was generated by the EPA Office of Federal Activities' Environmental Review Tracking System.	1995 values inserted for missing 1996 values, and 1990 values inserted for missing 1989 values.
eis_fhw	Counts of all EISs (drafts, final, supplemental, etc.) issued to the FHWA for each year, 1990-1995.	See documentation for eis.	1995 values inserted for missing 1996 values, and 1990 values inserted for missing 1989 values.
czmpelig	1 if state is eligible for Coastal Zone Management Program	Obtained from NOAA's CZM Plan Web Page, http://wave.nos.noaa.gov/ocrm/czm/welcome.html.	Five of the six states eligible but not currently enlisted in the CZM Plan are developing plans. Only Illinois is not.
czmpl	1 if Coastal Zone Management Plan in place	See czmpelig for documentation.	See czmpelig for comments.
coastmi	Miles of coast (counting barrier islands) for each state	See documentation for czmpelig.	These estimates were assumed constant across the panel years.
coastpop	Population in designated CZM counties	See documentation for czmpelig.	YEAR???
spec	Count of Federal Endangered/Threatened Species	A February 29, 1996 snapshot of the counts of endangered species for each of the 50 States was obtained from the Endangered Species Program's Web Page, http://www.fws.gov/~r9endspp/ listmap.html. This information was combined with a chronological listing of species obtained from the ESP to construct the ES List for the years 1990-95.	
hist	Count of National Register Sites, Objects, Structures, and Districts in each state for the years 1989 to present	Obtained from John Byme, Database Manager at the National Register of Historic Places, Department of the Interior, a dataset consisting of all National Register Sites as of July, 1996 that allowed us to construct these yearly counts.	These data are cumulative counts for each of the years.
npl	Count of Proposed & Final National Priority List Sites for the years, 1989-1995	This data is annually compiled *in The Statistical Abstract of the United States*, Bureau of the Census, from EPA press releases and proposed rules. Also, *The World Almanac & Book of Facts*, World Almanac Books, compiles the same information from similar EPA documents.	1995 counts were inserted for 1996 missing values.
conmem	Percentage of residents in 1990 who are members of one of three conservation organizations: Sierra Club, Greenpeace, and	Compiled in Hall, Bob & Mary Lee Kerr. 1991. *The 1991-92 Green Index*, Island Press, Washington, DC, from Names in the	Because data was not readily available for other years, 1990 values were inserted for all years.

	National Wildlife Federation	News, 1 Bush Street, San Francisco, CA 94104.	
landacre	Surface acres of land	Dahl, T.E. 1990. *Wetlands Losses in the United States 1980's to 1980's*. US Department of the Interior, Fish and Wildlife Service, Washington, DC.	These acreage estimates were assumed constant across the 1989-96 panel.
h20acre	Surface area of water	See documentation for landacre.	These acreage estimates were assumed constant across the 1989-96 panel.
wet1980	Estimated wetland acreage in the 1980s from the National Wetlands Inventory Report	See documentation for landacre.	These acreage estimates were assumed constant across the 1989-96 panel.
voter[yr]	Voter turnout in the November Elections	Scammon, Richard &Alice V. McGillivray. 1991-1995. *America Votes 19, 20, &21: A Handbook of Contemporary American Election Statistics*. Election Research Center, Congressional Quarterly, Washington DC.	1992 Voting data was not used because of the dramatic increase in turnout. 1990 data was plugged in for 1989 &1991-92, and 1994 data was plugged in for 1993 & 1995-96.
vpop[yr]	Estimated eligible voter population	See voter[yr] documentation.	See voter[yr] comments.
pop	Population estimates, 1989-94	This data is annually reported in *The Statistical Abstract of the United States*, Bureau of the Census, and is compiled from US Bureau of the Census, *1990 Census of Population and Housing, Population and Housing Unit Counts* (CPH-2); *Current Population Reports*, pp. 25-1106; press releases CB94-204; and unpublished data.	Because no estimates were available for 1995-96, 1994 values were inserted for later years.
fedland	Estimated acres of all federally owned lands, 1989-1993	For years 1989-91, the annually published Public Land Statistics, a US Department of the Interior, Bureau of Land Management document. For 1992-93, the publication, *Summary Report of Real Property Owned by the United States Throughout the World*. US General Services Administration, Washington, DC, was used.	A visual inspection of the data suggests that the two data sources are consistent. No estimates were available for 1994-96, so 1993 values were substituted for the missing data.
farm	Estimated acres of farm lands where a farm is defined as any establishment from which $1000 or more of agricultural products are sold or would normally be sold during the year.	This data is annually published in *Farm Numbers and Land in Farms*, US Department of Agriculture, National Agricultural Statistics Service.	No estimates were available for the years 1995-96, so 1994 values were used for these years.
envexp91	Total environmental expenditures by state and federal agencies in 1991.	Brown, R. Steven, et.al. 1993. *Resource Guide to State Environmental Management, Third Edition*. Lexington, KY, The Council of State Governments.	Because expenditure estimates were available only for 1991, these values are assumed constant over the panel years.
sttoex91	Total state expenditures, 1991.	See envexp91 for documentation.	See envexp91 for comments.
nnpl1993	All non-NPL sites tracked in the CERCLIS database at the EPA in 1993.	This information is stored in electronic format on the LandView II CD-ROM (1994) published jointly by the EPA and the Department of Commerce. Landview II contains selected information from the Comprehensive, Environmental Response, Compensation and Liability Information System (CERCLIS), a database maintained by EPA's Office of Solid Waste and Emergency Response that inventories abandoned, inactive, or uncontrolled hazardous waste sites.	Only 1993 data was readily available, so 1993 values are assumed fixed across the panel years.
npdes93	Count of the number of National Pollution Discharge Elimination System permitted sites in 1993.	This information is stored in electronic format on the LandView II CD-ROM (1994) published jointly by the EPA and the Department of Commerce. Landview II contains selected information from the Permit Compliance System (PCS), a computerized management information system for EPA and State use in tracking permit, compliance, and enforcement status for the National Pollution Discharge Elimination System (NPDES) program under the Clean Water Act.	Only 1993 data was readily available, so 1993 values are assumed fixed across the panel years.
eis[yr]	Counts of all EISs (draft, final, supplemental, etc.) issued to all federal agencies for each year, 1990-1995.	These counts were constructed from a computer printout of all EISs issued in the period January 1, 1990 to December 31, 1995. This printout was generated by the EPA Office of Federal Activities' Environmental Review Tracking System.	1995 values inserted for missing 1996 values,.
npl93	Count of Final National Priority List Sites for 1993.	This information is stored in electronic format on the LandView II CD-ROM (1994) published jointly by the EPA and the	

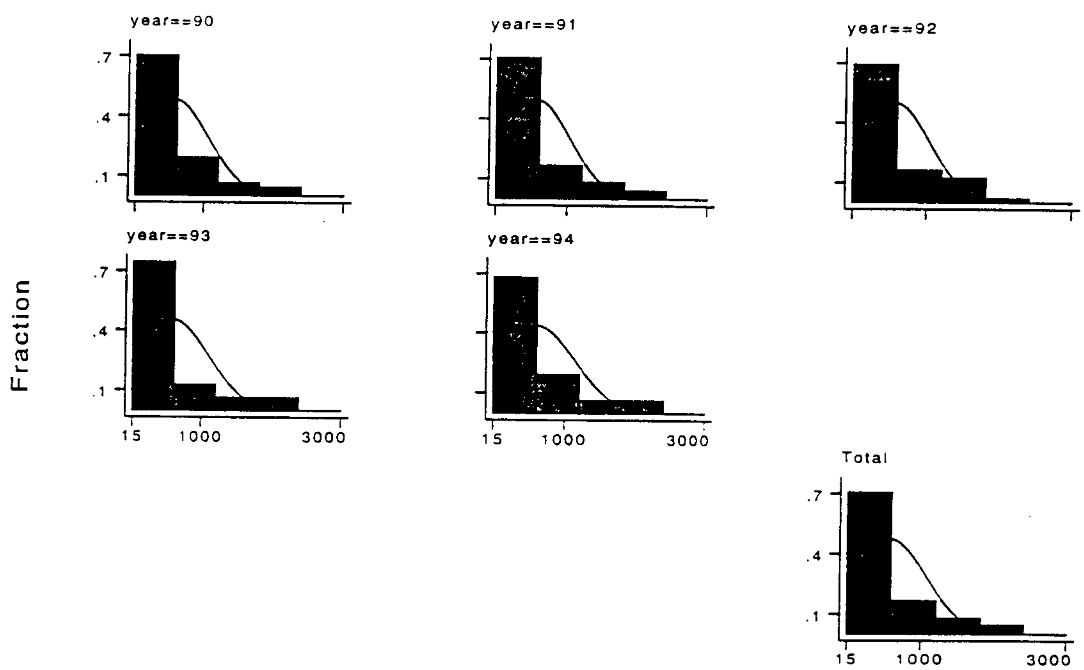
		Department of Commerce. Landview II contains selected information from the Comprehensive, Environmental Response, Compensation and Liability Information System (CERCLIS), a database maintained by EPA's Office of Solid Waste and Emergency Response that inventories abandoned, inactive, or uncontrolled hazardous waste sites.	
nnpl93	Count of Non-NPL Sites for 1993	See npl93 for documentation.	1993 counts were inserted for all years.
hist[yr]	Count of National Register Sites, Objects, Structures, and Districts in each state for the years 1994 to present	Obtained from Michael Southern, Research Historian at the NC State Historic Preservation Office, a dataset consisting of the entire National Register as of July, 1996 that allowed us to construct these yearly counts.	These data are cumulative counts for each of the years.
cwettot	Estimated coastal wetlands (saltwater, freshwater, forested, and tidal) acres	Field, Donald W., et.al. 1991. *Coastal Wetlands of the United States*: An Accounting of a Valuable National Resource, National Oceanic and Atmospheric Administration, National Ocean Service, Rockville, MD.	Neither estimates for the Great Lakes surrounding wetlands exist nor for Alaska. These acreage estimates were assumed constant across the 1989-96 panel.
cwetsalt	Estimated saltwater coastal wetlands	See cwettot for documentation.	See cwettot for comments.
cwetfres	Estimated freshwater coastal wetlands	See cwettot for documentation.	See cwettot for comments.
cwetfore	Estimated forested coastal wetlands	See cwettot for documentation.	See cwettot for comments.
cwettide	Estimated tidal coastal wetlands	See cwettot for documentation.	See cwettot for comments.
steandt	Endangered & threatened species receiving State protection	The North Carolina Natural Heritage Program, which is a quasi-public organization funded by the NC Department of Environmental Health, and Natural Resources and the NC Nature Conservancy, maintains a database that tracks by county information on endangered and threatened species and significant natural areas. This dataset is not an entirely complete inventory of endangered and threatened species, but are the best available estimates. Inge Smith, Informational Specialist at the Natural Heritage Program, generated the county level estimates that are used in this report.	This information is a single snapshot as of July, 1996 and therefore is fixed across panel years.
fedeandt	Endangered and threatened species recieving Federal protection	See steandt for documentation.	See steandt for documentation.

Figure 1A



Real Construction Costs Federal Aid Projects -Log Normal Scale

Figure 1B



Real Construction Costs Federal Aid Projects - Normal Scale

Figure 2: Example of Army Corps Reports On Processing Time for Permits

REGULATORY QUARTERLY REPORT	DISTRICT/DIVISION		QTR	FY
OFFICE OF CHIEF	OCE	OCE	5	1995

EVALUATION WORKLOAD

LAWS SEC	CARRY OVER	REC-IEVED	WITH DRAWN	STAN-DARD	LOP	DENIAL W/P	DENIAL WO/P	PEND-ING	REG-IONAL	NWP
10	940	4918	903	1291	2768	5	57	834	15519	2746
404	3548	5659	4031	2110	188	41	137	2700	8268	30415
10/404	1876	3264	1062	2141	254	29	77	1577	6473	6516
10/103	31	15	13	14	XXXXX	0	1	18	XXXXX	XXXXX
TOTAL	6395	13856	6009	5556	3210	75	272	5129	30260	39677

EVALUATION DAYS

LAWS SEC	STANDARD	LOP	DENY W/P	DENY WO/P	REGIONAL	NWP
10	97389	88564	1280	6126	*****	47546
404	*****	6381	11958	13822	*****	*****
10/404	*****	13419	8231	7324	81503	*****
10/103	1330	XXXXX	0	89	XXXXX	XXXXX
TOTAL	*****	*****	21469	27361	*****	*****

DAYS OF EVALUATION	STANDARD & DENIAL	LOP	REGIONAL	NATIONWID
0-60	2052	2887	29894	3868
61-120	2551	257	304	67
OVER 120	1300	66	62	32
TOTAL	5903	3210	30260	3967

% OF ALL ACTIONS < 60 DAYS 93%
TOTAL NO. ALL ACTIONS 79050

% OF STD ACTIONS < 120 DAYS 78%
TOTAL ALL ACTIONS < 60 DAYS 73513

##

PRIMARY CAUSE FOR DELAY FOR STANDARD & DENIAL ACTIONS COMPLETED > 120 DAYS

APPL	401 CERT	CZM	HIST	404Q/INF	404Q/FORMAL	INTERNAL	TOTA
491	213	76	66	105	0	318	130

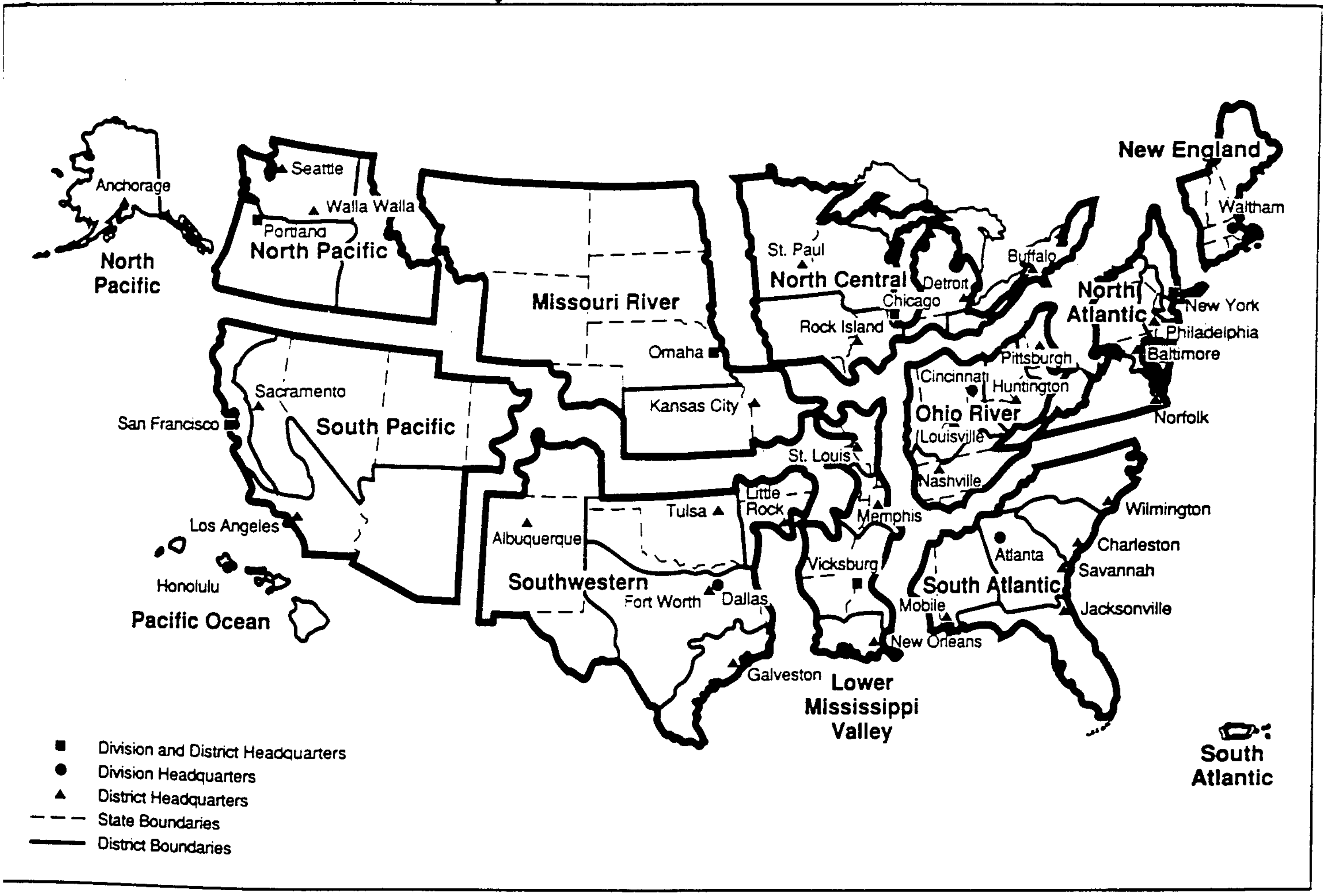
OTHER WORKLOAD ITEMS

NO PERMIT REQD	16950	EIS PENDING	322	PUBLIC HEARINGS	4
APPL MODIFIED	1171	EIS COMMENTED ON	250	PUBLIC INFO MEETINGS	264
PERMITS MODIFIED	3001	JUR. DET. OFFICE	35543	PREAPP. CONSULTATIONS	519
SITE VISITS	20985	JUR. DET. FIELD	18439		

STAFFING

FTE'S ALLOCATED 0.0 FTE'S EXPENDED 0.0

igure 3 **Offices of the U.S. Army Corps of Engineers**



Note: In Iowa the eastern bank of the Missouri River is regulated by the Omaha office.

Source: Corps of Engineers.

Notes on Variables

1. Federal-Aid Expenditures Analysis

a. Highway Characteristics - Federal Aid

Mileage and Lane Mileage Measures:

From table HM-14, *Highway Statistics*. Federal Highway Administration, U.S. Department of Transportation, 1990-1994. Includes all existing (completed) mileage open to the public and carrying traffic under local, state, and federal control, for all urban and rural areas. Eligibility for federal aid funds is based on functional classifications. All public roads and streets except rural minor collectors and roads on urban and rural local system are eligible for federal funding. They include the interstate highway system, other principal arterials, minor arterials, and local roads for rural, small urban and urban areas, other freeways and expressways in small urban and urban areas, rural major and minor collectors, small urban collectors and urban collectors. Eligibility for federal aid funds are not based on jurisdiction. These two classifications are independent. Designation of roads and streets as federal aid highways does not affect them being under federal, state, and local control. County roads, town and township roads may be included in or excluded from the federal aid highway system depending on their service value and importance.

From table HM-60. A lane mile is defined to be the number of lanes times its mileage. For example, a 100 mile, 2-lane road equals 200 lane miles. Minimum lane widths are required for interstate highways, principal arterials, freeways and expressways, and collectors. Each state reports the number of lanes on these highways to FHWA and FHWA calculates their lane mileage. No uniform minimum lane width are required on local roads.

They are determined by the local authorities. FHWA assumes 2 lanes for local roads for all states in the calculation of lane mileages. Reports of lane miles are not consistent across years. For 1990-1994, data are reported for rural and urban areas, broken by functional system, including estimates of local lane miles. For 1990-1994, lane mileage for non-federal aid highways is calculated by aggregating lane mileage of rural minor collector, rural local and urban local roads. Federal aid highways are calculated as total lane miles minus that of non-federal aid highways.

Count of Bridges

From table HM-41. Data aggregated for rural and urban areas. Only structures greater than or equal to 20 feet classify as a bridge. There are two kinds of bridges, pedestrian bridge and vehicle bridge. Only vehicle bridges are included in Highway statistics. The number of bridges in the Highway statistics comes from a continuously updated inventory of bridges. It is not an exhaustive account of number of bridges on roads and highways. An increase in the number of bridges does not necessarily mean new bridges are built. For example, a bridge in a remote area can be neglected for a period of time and therefore not counted in the inventory until it is rediscovered. Once it is found, it remains in the inventory until it is taken out for various reasons. Every bridge is inspected at least once every two years. If the inspector finds the conditions of the bridge deteriorated to a certain point, a low rating is given to the bridge. A bridge receiving 3 low ratings will be closed to the public and taken out of the inventory. Other possible reasons for the decrease in the number of bridges include reclassification, shortening of the structure (e.g. installation of drainage pipe on bridge) so it no longer qualifies as a bridge and taking it out of service because it is no longer needed in service.

Construction and Maintenance Expenditures

Capital expenditures in current dollars reported in Highway Statistics include costs for land acquisition, other right of way costs, preliminary and construction engineering, construction and reconstruction costs, resurfacing, rehabilitation, restoration costs of roadways, and cost of installation of traffic service facilities such as guardrails, fencing, signs and signals.

The definition of maintenance cost changed in 1993. For the years prior to 1993, maintenance cost includes costs to preserve highways in usable condition, such as routine patching repairs and bridge painting. It also includes traffic service costs, such as snow and ice removal, pavement markings, signs, signals, litter cleaning, and toll collection expenses.

In the last 1980's, the concept of physical maintenance came in. It is realized that there is an operational aspect of highways, for example, keeping traffic flowing, avoiding congestion, using surveillance cameras and other monitoring systems. Maintenance cost should then only refer to the physical maintenance of highways, aimed entirely at preservation of the present conditions of the roads, not at extending their service life. It would include, for instance, minor resurfacing, bridge painting, small pot hole patching. However, once the pot holes became so large that the structure of the roads is damaged, repair work would no longer be considered as maintenance but as construction, which aims at making roads better and extending their service life. Also, since snow and ice removal cannot be considered as preservation of road conditions, it no longer belongs to the maintenance category. These operations are classified as traffic service costs since 1993.

For 1992-1994, capital outlay and maintenance costs are reported in table SF-12B for federal-aid highways and non-federal-aid highways. For 1990 to 1991, cost data for federal-aid highways and non-federal aid highways are not readily available. Instead, they are classified in table SF-12 by functional systems and by region into (a) for rural areas: interstate. other principal arterials, minor arterial, major collector, and minor collector. (b)for small urban areas and urban areas: interstate, other freeways, and expressways, other principal arterial, minor arterial and collector. The data for local roads are not available for 1989 to 1991. Since only rural minor collectors and urban and rural local roads are not eligible for federal aid fundes, the capital outlay and maintenance costs for federal-aid highways can be calculated by aggregating each category for all areas except the rural minor collector. They are reasonable approximations since they should not be affected by local data. To approximate the costs for state highways, local costs for 1992 are added to costs for rural minor collector for 1990 to 1991 since the local data are not available for those three years. This assumption is somewhat arbitrary.

Due to definition change in maintenance cost in 1993, further adjustment of data is required so that measurement of maintenance cost would be consistent across time. Highway Statistics reports capital outlay, (physical) maintenance cost and highway service costs for state administered highways in table SF-4, and corresponding expenditures of the state on local roads in table SF-6. State highway agency capital outlay and maintenance cost, excluding traffice service cost, i.e., (physical) maintenance, are reported in table SF-12B. Since total capital outlay by state on both state (SF-4) and local (SF-6) administered roads and highways sums up to corresponding total capital outlay in table SF-12B, we assume that total (physical) maintenance cost and traffic service cost in SF-4 and SF-6 tables would sum up to corresponding (physical) maintenance cost and traffic service costs in SF-12B if traffic service costs were included. Since table SF-12B is the only table that breaks down costs by federal aid and non federal aid highways , we can use the percentage of maintenance cost for federal aid and non federal aid highways in table SF-12B to approximate the breakdown of total (physical) maintenance cost and traffic service costs by federal aid and non federal aid highways. That is, we assume the percentage spent on physical maintenance is the same as assume the percentage spent on physical maintenance and traffic service costs.

Maintenance cost in table SF-12B are of three types: (1) data exist for both federal aid and non-federal aid highways, (2) data exist for either federal aid or non federal aid highways, including states IA, ID, LA, MD, MI, SD, TN, WA, and (3) data do not exist for either federal aid or non federal aid highways. It is easy to calculate the percentages in case (1). For case (2) total physical maintenance and traffic service costs can be assigned to the category which data exist, either federal aid or non federal aid highways. For case (3), we can assign national average of expenditure shares of (physical) maintenance cost on federal aid and non federal aid highways to total maintenance costs.

FHWA sends each state each year form 532 and form 534 each year on state expenditures on highways, classified by functional form and improvement types. Form 532 includes all functional forms while form 534 does not include the local system. These forms are used to produce the SF-12B tables. For some states, data are missing for each functional system in the federal aid highway system. This is because the states did not segregate data in their reports to the FHWA. When data are missing for non-federal aid highway system. it is an indication that the local roads are not under state jurisdiction so the state could not provide any data on them.

Appendix B

1996 CERE/CTE Survey of Designated Environmental Officials at State DOTs

Attached are:

(1) sample letters from V. Kerry Smith and Charles H. Thompson requesting states to provide the information in the survey

(2) questionnaire along with means and standard deviations for returned surveys with responses

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July 12, 1996

Mr. William L. Taylor, Environmental Program Manager
New Mexico State Highway & Transportation Department
Environmental Section, Room 213
P.O. Box 1149
Santa Fe, New Mexico 87504-1149

Dear Mr. Taylor:

I am writing to ask for your assistance in providing information about your experience with the expenses and tin complying with environmental regulations. As you know, the FHWA and American Association of State Highv and Transportation Officials have very little information on states' experiences in meeting federal environmenta regulations.

With the support of the Center for Transportation and the Environment we are preparing a report summarizing w is known about this topic. A key aspect of our report is a summary of states' experiences. A questionnaire askir about your experience with these regulations is enclosed. To maintain the scientific credibility of our study it is essential to have all states included.

Our project has been endorsed by the Center's Board which includes the Secretaries for North Carolina and Wisconsin's Transportation Departments. Secretary Charles Thompson's supporting letter is enclosed and expla how the project relates to Wisconsin's experience with their own study.

I know from discussions with Charles and other members of the Board that staff time for these types of requests very short supply. Nonetheless, the limitations in available information need to be addressed. An important rea for our study is to understand the situations where meeting the regulations has worked so they can be shared witl others.

I have enclosed a postage paid envelope and request that you return the questionnaire by August 15th so we can include your responses in our summary. We will be happy to provide a summary of our findings. If you have ar questions or would like more information about any aspect of the study, please do not hesitate to contact me.

Thank you for your assistance.

With best wishes,

V. Kerry Smith

V. Kerry Smith
Arts and Sciences Professor
of Environmental Economics

Wisconsin Department of Transportation

Tommy G. Thompson
Governor

Charles H. Thompson
Secretary

OFFICE OF THE SECRETARY
P. O. Box 7910
Madison, WI 53707-7910

July 12, 1996

Mr. William L. Taylor, Environmental Program Manager
New Mexico State Highway & Transportation Department
Environmental Section, Room 213
P.O. Box 1149
Santa Fe, New Mexico 87504-1149

Dear Mr. Taylor:

The purpose of this letter is to urge you to complete the enclosed survey. We are requesting information about the time and resources used in your state to meet the obligations of regulations intended to maintain or improve the quality of environmental resources. To improve the ways we meet these objectives it's important to share information about our experiences in responding to these mandates.

Unfortunately, this type of information is not collected systematically. Because of the limited information available in Wisconsin, a few years ago, we initiated on internal review of the expenditures and time required in Wisconsin. The resulting information has been exceptionally helpful.

As you may know, under the 1991 federal transportation legislation (ISTEA), several research institutes were established across the U.S. One of them, the Center for Transportation and the Environment in NC State's Institute for Transportation Research and Education, has supported researchers at Duke in the process of assembling a summary of what is known about the compliance costs experienced by transportation departments around the U.S. in meeting environmental rules. This survey is part of that effort.

At the end of the project, Duke's research team will distribute a summary of results to all participants. I am convinced this information will help all of us do our jobs better. It is especially important to do our collective best in answering the survey questions. No one's interests is served by exaggerating the costs resource requirements or by avoiding the issues due to the conflicting nature of the demands on our time.

I urge you to help by completing the survey and sending any supplemental information that you think would help in understanding your local conditions.

Thank you in advance for your cooperation.

Sincerely,

Charles H. Thompson

Charles H. Thompson
Secretary

Hill Farms State Transportation Building, Room 120B
DT81
4802 Sheboygan Avenue, Madison, Wisconsin
Telephone (608) 266-1113
FAX (608) 266-9912

Environmental Policy and Highways: A Survey on States' Responses*

This survey is being conducted for the ITRE's# Center for Transportation and the Environment by Duke University's Center for Environmental and Resource Economics. As Secretary Thompson of Wisconsin's Department of Transportation suggests in his letter, this information will help all state level agencies understand each department's experiences in meeting environmental regulations. We hope this information can make everyone's jobs easier by understanding what has worked and what has not.

Please provide the information we have requested as completely as possible. If you have questions or can explain special circumstances relevant to how you assembled information to provide these answers, please write this description on the back of the last page using the question number to identify how it is relevant to your answers (or enclose extra pages if you wish). Thank you for taking the time to help us.

---

* If you have any questions, please contact V. Kerry Smith, Director, (919-613-8052) Center for Environmental and Resource Economics, or Roger von Haefen, Research Associate (919-660-1854).
# ITRE is the Institute for Transportation Research and Education at North Carolina State University.

1. We are interested in how the amounts of your 1995 expenditures for *100% State* and *Federal Aid* Projects for New Construction and all other activities (i.e., repair, reconstruction, rehabilitation and resurfacing of existing roads. general maintenance, etc.) was divided among the categories listed under each heading. That is, for new construction expenditures how much of this total amount would be associated with planning activities. design activities, etc. Similarly in the case of repair. reconstruction, general maintenance, etc., how much was in each category? If it is not possible to provide the dollar amounts for each category, please indicate the dollar amount for total budget and the approximate percentages in each category.

TYPE OF PROJECT						
	100% State Projects			**Federal Aid Projects**		
Activity	Amount	Percent of expendi-tures for each activity	Number of projects	Amount	Percent of expendi-tures for each activity	Number of projects
I. New Construction	Mean (# Obs.) Standard Dev.					
Total Budget	14567.43 (12) 19805.53	100%	71.89 (9) 117.53	26200.00 (11) 24200.00	100%	95.57 (7) 135.43
Planning	320.17 (7) 455.60	2.99 (8) 2.38		819.58 (6) 859.77	3.72 (7) 2.09	
Design	3084.98 (6) 5121.43	12.49 (8) 12.38		3385.47 (6) 3622.07	8.68 (8) 4.76	
Construction Costs	7325.91 (9) 10586.31	69.88 (9) 30.58		24130.94 (7) 21937.16	84.54 (8) 9.16	
Other (please indicate most appropriate category)	782.53 (9) 1560.534	7.16 (8) 8.66		2367.46 (8) 3537.07	6.17 (7) 6.29	
II. Repair, Reconstruction etc.						
Total Budget	18300.00 (13) 16000.00	100%	366.14 (7) 366.15	13999.18 (10) 8568.05	100%	188.00 (5) 97.22
Planning	357.81 (8) 461.7	2.05 (8) 1.98		622.88 (7) 524.814	2.69 (7) 2.13	
Design	1896.27 (7) 2521.35	7.41 (9) 8.69		1163.71 (7) 723.11	7.27 (9) 2.76	
Materials and Labor Costs	15189.51 (9) 13754.69	84.24 (11) 17.15		12600.00 (8) 4920.00	85.96 (10) 7.38	
Other	2320.00 (9) 4540.00	10.08 (7) 16.66		550.89 (10) 857.95	5.35 (8) 5.16	

2. Recognizing that the planning, design, and construction activities in these highway projects are integrated activities, please try to approximate the percentage of the 100% State and the Federal projects' costs for each category that you would directly attribute to meeting environmental regulations.

TYPE OF PROJECT		
	100% State Projects	**Federal Aid Projects**
Activity	Percent of expenditures **in each category** due primarily to environmental regulations	Percent of expenditures **in each catgegory** due primarily to environmental regulations
I. New Construction Mean (# Obs.) Standard Dev.	1.75 (2) 1.06	1.75 (2) 1.06
Planning	16.22 (9) 28.81	18.8 (10) 30.23
Design	12.06 (8) 14.75	6.83 (9) 9.19
Construction Costs	5.44 (8) 4.65	6.05 (9) 5.51
Other (please indicate most appropriate category)	2.92 (3) 2.51	29.19 (4) 47.35
II. Repair, Reconstruction etc.		
Planning	2.71 (7) 3.59	14.43 (7) 31.29
Design	7.05 (9) 8.44	8.00 (8) 9. 58
Materials and Labor Costs	3.71 (7) 3.30	5.83 (6) 7.25
Other	5.50 (4) 3.70	26.4 (5) 41.76

3. Does your department keep records on the activities, staff time, private consultants and additional costs associated with complying with environmental regulations?

26.32% Yes 73.68% No 19 observations

4. Has your department developed a set of procedures or working agreements for coordinating the activities across state and federal agencies to comply with federal and state environment regulations?

78.95% Yes 21.05% No 19 observations

If your answer is yes, is it possible to send something describing these agreements to us (even if it has been informally prepared; please send it to our address on the enclosed envelop)?

66.67% Yes 33.33% No 15 observations

5. Based on your best professional judgment, please indicate the importance of these types of environmental impacts in terms of the staff time and additional resources required to deal with them, for all the highway projects underway as well as those undertaken for the first time in your state during the 1995 fiscal year.

usually of no concern	somewhat important	average importance	very important	extremely important
0	1	2	3	4

Types of Impacts	Importance Score				
	0	1	2	3	4
Farmlands	1.06	1.09	17		
Public Lands: 100% State Projects	1.89	1.02	18		
Public Lands: Federal Aid Projects	3.00	.77	18		
Fish and Wildlife	2.61	.85	18		
Historic Sites	3.39	.61	18		
Noise	2.33	.97	18		
Wetlands	3.67	.48	18		
Archeological Sites	3.33	.48	18		
Hazardous Waste	2.70	.92	17		
Air Quality	2.12	.93	17		
Water Quality	2.50	1.29	18		
Endangered Species	3.00	1.03	18		
Coastal Resources	1.50	1.37	16		
Floodplains	2.11	1.13	18		
Wild/Scenic Rivers	1.44	1.20	18		
Public Involvement	3.28	.83	18		
Aesthetics	1.11	.83	18		
Compliance with land use plans	1.28	1.23	18		
	Mean	Std. Dev	# Obs.		

6. The preparation of environmental reports for transportation projects can be handled in different ways. We recognize that each project may involve input from several sources including in-house staff and external support. Our goal is to try to characterize how environmental reports are generally completed and about how much resources are required. Please indicate what best describes the procedures used in your department.

Environmental Reports for Transportation Projects Completed By:	**Percent of Time**	**FY95 cost ($)**
In-house staff (mean/Std. Dev./# Obs.)	54.53 / 32.79 / 14	258.85 / 295.90 / 10
Outside consultants on project-by-project contract	34.98 / 28.67 / 14	1300.00 / 2040.00 / 10
Outside consultants on retainer/standing contract	18.73 / 21.40 / 11	294.86 / 358.30 / 7
Resource agency staff	10.98 / 29.61 / 11	28.63 / 31.19 / 5
University staff	.91 / 2.02 / 11	0.00 / 0.00 / 3
Other (please specify)	1.25 / 3.53 / 8	100.00 / 200.00 / 4

7. Based on your experience in **a typical year**, about what fraction of the highway budget is required over and above the direct costs associated with the planning, construction, and maintenance costs for highway projects in order to comply with all environmental regulations?

Expenditures and Time for Meeting Environmental Standards	**Percent Added**
Internal expenditures (mean/Std.Dev./# Obs.)	5.90 / 7.24 / 10
Contracting expenditures	5.75 / 5.23 / 10
Staff time	9.28 / 15.73 / 9

Our remaining questions concern the specific features of your activities.

8. What are the beginning and ending dates for your fiscal year? ______to______

9. We are interested in the miles of roadway that are under your department's jurisdiction.

As of 1995, what were:		Mean	Std.Dev.	#Obs.
a.	Miles of State roadway under your authority	22728.04	23790.28	19
b.	Miles of Interstate	939.06	726.93	19
c.	Miles added in 1995 *100% State*	11.34	39.44	16
d.	Miles added in 1995 *Federal Assistance*	4.79	8.98	15

10. How many permits related to highway projects underway or initiated in 1995 were requested?

	Mean	Std. Dev.	# Obs.
Total	233.5	211.76	14
404	126.39	125.82	18
401	80.73	143.19	11
Coastal Zone Management (if relevant)	17.50	30.84	8
Other (please describe)	75.56	109.28	6

Thank you very much for your assistance. Please indicate if you would like a summary of our findings.

Yes, please send a summary. ______