National Cooperative Highway Research Program

NCHRP Synthesis 221

Assessing the Effects of Highway-Widening Improvements on Urban and Suburban Areas

A Synthesis of Highway Practice

Transportation Research Board
National Research Council

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Assessing the Effects of Highway-Widening Improvements on Urban and Suburban Areas

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

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PREFACE

A vast storehouse of information exists on nearly every subject of concern to highway administrators and engineers. Much of this information has resulted from both research and the successful application of solutions to the problems faced by practitioners in their daily work. Because previously there has been no systematic means for compiling such useful information and making it available to the entire community, the American Association of State Highway and Transportation Officials has, through the mechanism of the National Cooperative Highway Research Program, authorized the Transportation Research Board to undertake a continuing project to search out and synthesize useful knowledge from all available sources and to prepare documented reports on current practices in the subject areas of concern.

This synthesis series reports on various practices, making specific recommendations where appropriate but without the detailed directions usually found in handbooks or design manuals. Nonetheless, these documents can serve similar purposes, for each is a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems. The extent to which these reports are useful will be tempered by the user's knowledge and experience in the particular problem area.

FOREWORD

By Staff
Transportation
Research Board

This synthesis will be of interest to highway environmental specialists (particularly those concerned with assessing social and economic impacts), design engineers, planners, utility managers, and others responsible for the planning, design, and implementation of highway widening improvements. Information is presented on the reasons for highway widening projects, the nature of the projects, and the methods and practices for application of analytical techniques used to measure the potential or actual impacts of the projects on people and the physical environment. Mitigation measures are also discussed.

Administrators, engineers, and researchers are continually faced with highway problems on which much information exists, either in the form of reports or in terms of undocumented experience and practice. Unfortunately, this information often is scattered and unevaluated and, as a consequence, in seeking solutions, full information on what has been learned about a problem frequently is not assembled. Costly research findings may go unused, valuable experience may be overlooked, and full consideration may not be given to available practices for solving or alleviating the problem. In an effort to correct this situation, a continuing NCHRP project, carried out by the Transportation Research Board as the research agency, has the objective of reporting on common highway problems and synthesizing available information. The synthesis reports from this endeavor constitute an NCHRP publication series in which various forms of relevant information are assembled into single, concise documents pertaining to specific highway problems or sets of closely related problems.

This report of the Transportation Research Board describes the most recent widening projects as reported by states or other transportation agencies, as well as the most frequently encountered issues in highway widening. Selected examples of widening projects are included, as is some recognition of the need for additional information and research in the areas of social and economic impact measurement.

To develop this synthesis in a comprehensive manner and to ensure inclusion of significant knowledge, the Board analyzed available information assembled from numerous sources, including a large number of state highway and transportation departments. A topic panel of experts in the subject area was established to guide the researcher in organizing and evaluating the collected data, and to review the final synthesis report.

This synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As the processes of advancement continue, new knowledge can be expected to be added to that now at hand.

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Valuable assistance in the preparation of this synthesis was provided by the Topic Panel, consisting of Joe G. Bared, Highway Research Engineer, Federal Highway Administration; Kenneth E. Cook, Transportation Economist, Transportation Research Board (retired); David B. Foster, Director, Highway Environmental Evaluation Program, North Carolina Department of Environment, Health and Natural Resources; Gregory P. King, Chief, Social and Economics Studies Branch, California Department of Transportation; Brenda Kragh, Social Science Analyst, Federal Highway Administration; Jim McKenzie, Executive Director, MetroPlan, Little Rock, Arkansas; Gregg E. Mugele, Environmental Planner, Colorado Department of Transportation; Michael A. Perfater, Research Manager, Virginia Transportation Research Council; and Barbara H. Stevens, Socioeconomic Analyst, Bureau of Location and Environment, Illinois Department of Transportation.

The Principal Investigators responsible for the conduct of this synthesis were Sally D. Liff, Manager, Synthesis Studies, and Stephen F. Maher, Senior Program Officer. This synthesis was edited by Linda S. Mason, assisted by Rebecca B. Heaton.

Scott A. Sabol, Senior Program Officer, National Cooperative Highway Research Program, assisted the NCHRP 20-5 staff and the Topic Panel.

Information on current practice was provided by many highway and transportation agencies. Their cooperation and assistance were most helpful.

ASSESSING THE EFFECTS OF HIGHWAY-WIDENING IMPROVEMENTS ON URBAN AND SUBURBAN AREAS

SUMMARY

This synthesis presents a review of current practices by state and metropolitan government agencies for assessing the impacts of highway-widening projects in urban and suburban areas. Widening projects range from such scales as placing a two-foot strip of new pavement along one side of a two-lane roadway to adding several new lanes to an expressway. Nearly 90 percent of widening projects reported to have been undertaken in a two-year period were intended to improve capacity, improve safety, or correct design deficiencies. Widening is sometimes legislatively mandated.

While widening projects entail immediate impacts on adjacent land and subsurface conditions, a survey developed for this synthesis focused on the social, economic, and other impacts that highway widenings may have on people. A review of the research literature yielded little information on the impacts of highway widenings. A survey that was sent to all 50 states, 12 provinces and territories in Canada, and 22 metropolitan planning organizations (MPOs) elicited 46 responses. Impact assessment guidance manuals used by the states of California, Illinois, and Minnesota, and the province of Ontario, and a selection of 34 environmental impact review documents provided a representative cross-section of currently required or recommended impact assessment procedures. This synthesis reviews the scope and depth of the analyses employed, but does not consider the administrative judgments that may be based on these analyses, e.g., whether a particular element of impact is severe or if an environmental impact statement or other administrative document is required in support of decisions about a particular project.

State highway agency personnel are responsible for determining the appropriate content of required environmental assessment documents, but federal and state laws and regulations specify, for the most part, the scope and form of these documents. The National Environmental Policy Act (NEPA), Title VI of the Civil Rights Act, the Noise Control Act, the National Historic Preservation Act, the Clean Air Act and its Amendments (CAAA), Section 4(f) of the Department of Transportation (DOT) Act, and the Intermodal Surface Transportation Efficiency Act (ISTEA) are among the most significant federal laws requiring consideration of environmental impact in decisions on widening and other highway improvement projects. The Federal Highway Administration (FHWA) must review and determine that state agency actions regarding federally assisted widening projects conform to federal requirements. Other state and federal agencies, e.g., environmental agencies, may also review these documents to determine if they meet requirements.

Because some environmental issues are explicitly addressed in legislation and regulations—e.g., air quality, noise, wetlands, fish and wildlife (particularly endangered species), water quality, and parks and cultural resources—they receive substantial attention in the impact assessment process. Social and economic elements of impact typically receive significantly less coverage than do elements related to the physical environment, although provisions of the Federal-aid Highway Act (23 U.S.C. 109(h) and 23 CFR 771) explicitly

require a balance among social, economic, and environmental impacts in decision making. Individuals and public-interest groups may shift the balance by expressing their concerns during project planning and commenting on drafts of official impact review documents.

Topics covered in impact assessment documents cover a range of issues, as follows:

- Land use
- Residential impact
- Business impacts
- Relocation of residences and public facilities/services
- Location and relocation of utilities
- Employment
- Public facilities
- Public and community services
- Parking
- Property values
- Tax base
- Community cohesion
- Pedestrians and bicyclists
- Equity and environmental justice
- Changes in site accessibility
- Safety
- Aesthetics
- Air quality
- Noise
- Wetlands
- Wildlife habitat loss and endangered species
- Watershed, stormwater runoff, water quality, and water supply
- Hazardous materials and other soil contaminants
- Historic structures and archaeological sites

There is no single, generally accepted set of categories or descriptions of likely impacts of widening projects, and the variety of categories and terminology is especially broad regarding social impacts.

Highway agency officials, neighborhood business enterprises, neighborhood residents, and regulatory agency officials typically have different views regarding what may be the most significant impacts of widening projects. Right-of-way, construction time, tax base, and traffic were among the more frequently cited issues of concern to highway agency officials. Access, business revenue, and parking were understandably of concern to businesses, while residents most frequently cited noise, air quality, traffic, and access. Wetlands issues were cited as most frequently attracting the attention of regulatory agencies.

Review of guidance materials and assessment documents shows that assessment methodologies used to address elements of impact on physical environment (e.g., noise, air quality, water quality, effects on wetlands) are generally quite specific, clearly defined, concise, and quantitative. Methods suggested for assessing social and economic elements of impact (e.g., residential impact, tax base, aesthetics), on the other hand, are more abstract, vague about the nature of the impacts to be assessed, broadly described, imprecise, and qualitative. Assessment in general is focused on the immediate impacts of the proposed highway widening, with little attention to longer-term impacts.

In view of the importance accorded social and economic impacts in federal environmental regulations, research is needed to document these aspects of highway-widening projects. Improved methods of estimating these impacts are needed.

CHAPTER ONE

INTRODUCTION

BACKGROUND

Few new highways are being built today. Much of the highway construction that takes place involves the improvement of existing facilities. Improvements include adding and retiming traffic signals, applying the technology of new intelligent transportation systems (ITS), correcting alignments and other design deficiencies, and widening.

This synthesis addresses the effects of highway widening. Widening frequently requires new right-of-way and results in increased traffic volumes and higher speeds. These and other potential impacts raise concerns among affected businesses and residents. Higher traffic volumes and speeds also mean changes in the emission of air pollutants and raise concerns about meeting federal and state air quality requirements.

Highway agencies must address these concerns within the constructs of the National Environmental Policy Act of 1969 (NEPA), the Noise Control Act of 1972, the National Historic Preservation Act, the Clean Air Act Amendments (CAAA) (including 1990), the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), Title VI of the Civil Rights Act of 1964, and related federal statutes, as well as many other federal and state laws. The situation in Canada and its provinces is similar to that of the United States. Each law has generated its own set of implementing regulations that detail the procedures required for compliance.

It is beyond the scope of this synthesis to describe all the procedures applicable to assessment of the impacts of transportation projects. Highway widening, however, is covered by Federal Highway Administration (FHWA) regulations and guidelines whenever federal highway monies provide some portion of its funding. FHWA policy governing the major issues relevant to highway widening is covered in the following passage taken from the FHWA *Student Text for the Environmental Training Center:*

> NEPA calls for an examination and consideration of impacts of the proposed action on sensitive resources when we are considering a transportation facility. These resources include, but are not limited to, floodplains, wetlands, endangered species, historic and archaeological sites, parklands, air quality, wildlife habitat, etc. There also are the transportation needs that need to be fulfilled. Because of impacts to resources and needed transportation improvements, we use a balanced decision-making process that considers a range of factors of both impacts to the resources and the transportation needs. The decision of how to balance these factors rests with FHWA.
>
> It is FHWA's policy that all environmental protection and enhancement requirements, including those set out in Section 4(f) of the Department of Transportation (DOT) Act which protects historic sites and publicly owned public parks, recreation areas, wildlife and waterfowl refuges, and 23 U.S.C. 109(h), which mandates consideration of social and economic impacts to the human environment, be completed as part of the NEPA process. Evidence of this compliance must be contained in the appropriate documentation. Further, it is FHWA policy that public involvement be an essential part of this process (*1*).

Consequently, agency professional staff and their consultants are required to assess the social, economic, and natural environmental effects of proposed highway-widening projects, as well as their transportation implications.

The definition of widening employed for the purposes of this synthesis includes all scales of widening, from a two-foot strip to multiple additional lanes. Potential impacts of widening vary in significance in proportion to the scale and extent of the improvement and the nature of its surroundings, including the people who are affected. The impacts usually are classified in laws as social, economic, or environmental. Social impacts include, in part, residential relocation and disruption of community cohesion and cultural heritage, as well as reduced access to public facilities or services. Economic impacts include, in part, the loss of business and jobs and reduction of the local tax base. Environmental impacts involve, among others, noise, air pollution, and threats to water quality, endangered species, and wildlife habitat.

This synthesis covers projects in urban and suburban areas, as opposed to those in rural areas. Highway-widening impacts covered in the synthesis can and do occur in urban and suburban areas of any size. Impacts in metropolitan areas, however, tend to affect more people in many different ways because of the greater densities of residences, businesses, and public facilities, and the resulting greater volume of traffic in such areas.

SCOPE AND ORGANIZATION OF THE SYNTHESIS

As will be explained in greater detail in Chapter 2, the study that provides the basis for this synthesis included a review of current literature and a survey of U.S. and Canadian highway agency personnel. The study is unavoidably biased, in the sense that impact assessment documents and agency attention typically concentrate on the small fraction of widening projects that may involve substantial problems or especially interesting design or construction characteristics. Also, there are few studies made to determine what impacts attributable to the widening have occurred, after the widening improvement was completed.

In reviewing practices for assessing likely impacts of widening, the synthesis is focused primarily on those aspects of impact of most immediate consequence for people. These aspects tend to be classified most frequently as social or economic impacts. These categories, discussed in Chapters 3 and 4, respectively, received greater emphasis than impacts on natural environments, which are discussed in Chapter 5, with

greatest attention given to air quality and noise, again because of their more immediate consequences for people.

Chapter 6 presents conclusions drawn from the text about the status of current practice in impact review of highway-widening projects. A copy of the survey instrument used in the study, a listing of survey respondents, and other information that provides background for this synthesis are presented in Appendices A through E.

CHAPTER TWO

OVERVIEW OF HIGHWAY WIDENING AND ITS IMPACTS

Reviews of relevant research bibliographies revealed that very little documentation exists on the impacts of highway widening per se. More information is available about the impacts of highway widening on the physical or natural environment than on its economic or social impacts. Considerable research has been done over the last 30 years on the economic impacts of highway projects in general. It could be adapted to assess highway widening in particular, but little is available in that form at the present time. Even less information is readily available on the social impacts of highway widening or that could be adapted to assess those impacts.

As a consequence of this lack of research results, most of the information contained in this report has been gathered from the survey responses and project study documents provided by states, provinces, and metropolitan planning organizations (MPOs). The survey (Appendix A), which contained a request for sample documents, was sent to all 50 states and the District of Columbia, to all 12 Canadian provinces, and to a set of 22 MPOs representing all 10 federal (nine FHWA) regions of the United States. Appendix B contains a list of the 34 states, four provinces, and eight MPOs that responded.

The studies documented were instigated primarily to meet the requirements of federal or state environmental protection laws. At the federal level in the United States, the basic environmental law is the National Environmental Policy Act of 1969 (NEPA) and its requirement that affected citizens and their decision makers be fully informed of the impact of projects on the social, economic, and natural environment. Many other laws exist that cover specific components of the environment. The Federal-aid Highway Act of 1970 (which also added 23 U.S.C. 109(h)) required each state to develop an Action Plan that outlined the process by which full citizen and community involvement was to be achieved and adequate consideration given to all possible effects of proposed highway projects on the social, economic, and natural environment (*2,3*). While the Action Plan requirement was rescinded in 1982, 23 U.S.C. 109(h) remains in effect, along with Title VI of the Civil Rights Act of 1964, to require full consideration of adverse economic, social, and environmental impacts of Federal-aid highway projects. The processes of analysis, citizen participation, and interagency coordination once developed in each state's Action Plans now appear within 23 CFR Part 771 and each state's public involvement procedures (*1*).

Some of the documents published in late 1992 and after respond to the requirements of the CAAA of 1990, as well as to ISTEA. Compliance with the state improvement program (SIP) for air quality is mentioned in some cases. None mentioned the ISTEA major investment study (MIS) requirement, however, which was too new to be in place at that time.

Additional study and documentation may emerge from a 1994 Executive Order (EO) that directs federal department heads to assure that the social, economic, and natural impacts of the projects and programs of their departments on minority and low-income populations be assessed and communicated to those groups (*4*). The White House memorandum transmitting the EO states that the impacts on minority and low-income communities will be assessed (*5*). An Interdepartmental Task Force under the chairmanship of EPA was established to implement the EO. The U.S. Department of Transportation (USDOT) prepared a proposed order to address environmental justice in minority and low-income populations. The impact on the documentation required for federal projects and programs remains unclear.

State laws, such as the California Environmental Quality Act (CEQA), and national and provincial requirements in Canada contain requirements that produce study documents similar to those published under NEPA.

PURPOSES OF HIGHWAY WIDENINGS

The survey developed for this synthesis study begins by asking the purposes for which widening projects were undertaken over the previous two years. Four purposes (and an "other" category) are provided: capacity improvement, safety improvement, correct design deficiencies, and legislatively mandated. Table 1 shows the number of projects reported in each of these categories by states, provinces, and MPOs. Capacity improvement is the dominant purpose reported by the states and provinces, and it is ranked second by the MPOs. Safety ranks first among the MPOs, while it is second for the states. The correction of design deficiencies ranks second among province-reported projects and third for both the states and the MPOs. "Legislatively mandated" ranks low as a project purpose for all three classes of respondents.

A similar distribution of the purposes for highway widening emerges from the 34 study reports and four manuals received from the states and provinces. The study reports are listed among the references and in the bibliography. The manuals are also listed among the references and were provided by the Departments of Transportation of California, Illinois, Minnesota, and Ontario. The more specific purposes for capacity improvement that emerge from the reports and manuals include removal of bottlenecks, provision of access to new developments, and improvement of traffic flows over the broader network. Reduction of roadway maintenance costs was an important purpose in several of the provincial studies (*6,7*).

LOCALES OF HIGHWAY-WIDENING PROJECTS AND EFFECTS

In urban areas most impacts are magnified by the density of residential, commercial, and industrial activity adjacent to existing streets. Highway traffic densities typically are higher

TABLE 1

MOST RECENT AVAILABLE 2-YEAR TOTALS OF HIGHWAY-WIDENING PROJECTS REPORTED

	By 34 States		By 4 Provinces		By 8 MPOs		
Reason	No. of Repondents	Percent	No. of Respondents	Percent	No. of Respondents	Percent	Total No. Responding
Capacity Improvement	423	46.0	20	58.8	209	32.2	652
Safety Improvement	283	30.8	6	17.7	258	39.7	547
Correct Design Deficiencies	148	16.1	8	23.5	78	12	234
Legislatively Mandated	25	2.7	0	0	20	3.0	45
Other	41	4.4	0	0	85	13.1	126
Totals	920	100	34	100	650	100	1,604

in urban areas, but this has changed somewhat as development has shifted to the suburbs over the years. Noise, air quality impacts, and relocations are higher in urban areas for comparable levels of widening. The presence of cohesive communities, affordable housing, and accessible job sites in urban areas amplifies the magnitude of impacts of widening projects there, especially for low-income and minority residents (*8*). Recent research indicates that the long-term effects of highway widening and other transportation improvements could contribute to the out-migration of middle-income families and to the isolation and disruption of low-income and minority communities (*9*). The severity of impacts on the natural environment, especially as perceived by resource and regulatory agencies, may be relatively high in suburban and exurban areas due to the existence of wetlands and endangered plant and animal species in those areas, as well as valuable agricultural land in the path of new development. The density of historically important sites is as great or greater in small urban and suburban areas as in urban ones (*10*).

CATEGORIES OF HIGHWAY-WIDENING EFFECTS

NEPA identifies the three major categories of effects requiring consideration in project development in the United States—social, economic, and environmental. Question 2 of the survey for this synthesis asked respondents to list the most frequently encountered issues or concerns expressed by each of the following groups: public officials, impacted businesses, impacted residents, regulatory and resource groups, and "other." The relative importance of various categories of effects as reported by the states, provinces, and MPOs for each of these groups is presented in Table 2.

The issues and concerns are stated essentially as reported by the respondents. Some categories the reader may consider redundant have been kept separate to preserve whatever differences may have been intended. The reader is free to aggregate them, of course. A case in point is the potential redundancy among the Environmental-General and the Noise/Air Quality and Wetlands categories.

Table 2 represents the survey respondents' view on the concerns of the four stakeholder groups. Public officials appear to the respondents to focus on proprietary issues such as right-of-way, costs, length of construction phase, and traffic impacts. Impacted businesses are seen by the respondents to be most concerned about access to their property from the street system (presumably for their customers), the impact of the project on parking (again, for customers and possibly, employees), and the volume of their business. Impacted residents are viewed by the respondents as primarily concerned about noise and air quality. They also appear to the respondents to be concerned about access to their homes, level of traffic, a number of issues involving land and property values, and relocation. Pedestrian safety also appears to the respondents to be an issue among residents. Resource and regulatory agencies appear in the view of the respondents to be concerned about the issues for which they are responsible—wetlands, historical preservation, the environment in general, noise and air quality, and land use.

The degree of assessment of the various impacts by project proponent agencies is very much governed by the significance attached to them in the environmental regulatory processes. FHWA, for example, provides extensive guidance on the level of significance of various impacts to states and other levels of government that employ Federal-aid highway funds to finance their projects. The federal 23 CFR 771 requires reports of widely differing levels of detail, depending on the expected nature and magnitude of the impacts of proposed projects. If it is unclear whether or not a project will have significant impacts, it is classified as a Class III action. An environmental assessment study (EA) is normally required at this point to determine the expected level of impacts. If a Finding of No Significant Impact (FONSI) results from the EA, a Categorical Exclusion (CE) is applied to the project. If a potentially significant impact is found to exist, the project becomes a Class I action and an Environmental Impact Statement (EIS) is required (*2*). Much greater levels of detail are expected to appear in EIS documents than in EA documents.

Caltrans uses similar guidance developed by the State Resources Agency for projects in California. Projects that will normally have a significant effect are those that:

TABLE 2

MOST FREQUENTLY ENCOUNTERED ISSUES IN HIGHWAY-WIDENING RELATIVE FREQUENCY (%) OF MENTION BY ALL RESPONDENTS*

Issues and Concerns Mentioned	By Public Officials	By Impacted Businesses	By Impacted Residents	By Reg & Resource Agencies
Cost	7			
Cost-sharing	6			
R.O.W. Issues	9	6	9	
Tax Base Impact	7			
Business Rev. Impact	2	19		
Parking Impact	2	14	1	
Traffic	7	6	15	
Construction Time	8			
Access		31	17	
Environmental-General			6	10
Noise/Air Quality		3	30	5
Wetlands				19
Relocation Rights			9	
Pedestrian Safety			8	
Land Use			7	5
Visual Impacts			7	
Historical Preservation				7
Property Value			10	

*The numbers shown for each item are the percentages of the number of states, provinces, and MPOs responding (46 in total) that mention the item as frequently a concern to the group identified in the column heading. The possible value range for each cell is 0 to 100.

- Induce substantial growth or concentration of population,
- Cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system,
- Displace a large number of people,
- Disrupt or divide the physical arrangement of an established community,
- Conflict with established recreational, educational, religious, or scientific uses of the area, or
- Convert prime agricultural land to nonagricultural use or impair the agricultural productivity of prime agricultural land (*11*).

A mandatory finding of significance is required for any project in California with environmental effects that will cause substantial adverse effects on human beings either directly or indirectly. A large number of relocations is the typical socioeconomic impact likely to fall under the mandatory finding (*11*).

Despite this type of guidance, which is provided to a greater or lesser degree in each state and province, there still appears to be room for disagreement about what level of impacts from a given highway-widening project constitutes significant effects. The degree of documentation required for a given project depends to a considerable degree, within the existing regulatory structure, on the views of the personnel of the resource, regulatory, and proponent agencies.

TIMING AND MAGNITUDE OF HIGHWAY-WIDENING EFFECTS

Tables C-1 through C-3 in Appendix C show the percentage of respondents who classified the various categories of

highway improvement impacts as primary, secondary, long-term, short-term, and/or cumulative. Representatives of 34 states (Table C-1), four provinces (Table C-2), and eight MPOs (Table C-3) responded to the questionnaire. Table C-1 shows that 12 (35 percent) of the states responding categorized land use changes caused by highway-widening projects as primary, for example, and 21 (62 percent) classified them as secondary. Twenty-two respondents (65 percent) consider these land-use change effects to be long-term while only four (12 percent) classify them as short-term, and fourteen (41 percent) think they are significantly cumulative.

Higher percentages indicate those categories considered more important by the respondents. In Table C-1, safety (as both a social and an economic impact), residential impacts, detours, business displacement, air quality impacts, utility relocation, noise, and impacts on historical and archaeological sites are considered to be important primary effects of widening projects. Detours, access problems, and business displacement are seen by a majority of state respondents to be short-term. As might be expected, these classifications are consistent with the treatment of the various effects in the sample environmental impact reports received from the states.

The magnitude of the effects of a given widening project depends on the type of project and on the characteristics of the area in which it is located. Changing a two-lane street to a four- or five-lane arterial is likely to result in greater accessibility of nearby and possibly more distant property, as well as more traffic, some temporary and permanent relocation of businesses and residences, more noise, and more air pollutant emissions. Secondary impacts, such as increased land development and changes in traffic in other parts of the street network, may occur. Other projects, depending on their proximity in space and time, may in conjunction with a project, produce substantial cumulative and synergistic effects beyond the sum of the effects of each project considered individually. Virtually any project may be part of a set of projects producing cumulative effects, such as loss of green space or reductions in air quality in a particular neighborhood (*12*).

The effects of the addition of curb and gutter to a given street, on the other hand, may be confined primarily to the right-of-way and drainage structure of the highway segment concerned, particularly if it is located in an area that is not densely developed.

MITIGATION MEASURES FOR HIGHWAY-WIDENING EFFECTS

Mitigation is simply defined for the purposes of this synthesis as an action or set of actions designed to reduce the impacts of another action. Mitigation measures are best described in terms of the categories of effects they are designed to counteract. One measure that reduces the short-term social, economic, and environmental impacts is to expedite the construction phase of the project and return the area to its normal mode of operation as quickly as possible. Another measure for mitigating short-term negative impacts, particularly traffic disruptions, is to develop and implement a comprehensive detour and traffic management plan.

Construction firms involved in roadway-widening projects have advanced the state of the art of mitigation considerably in Great Britain and France. They have been successful in urging the agencies responsible for widening freeways to include in their construction contracts provisions for extensive planning for the maintenance and management of traffic during construction. New, more compact work areas alongside active motorways, bridge construction techniques less disruptive to traffic, expedited construction cycles, and the coordinated scheduling of construction and traffic use of roadway lanes have reduced disruptions during traffic and decreased overall construction time (*13–17*). For a toll road in France, five months of traffic disruption was avoided by constructing a new overpass about 100 feet off site, instead of on the roadway, and floating it to the site on a bed of air for installation (*18*).

The Federal Uniform Relocation Assistance and Real Property Acquisition Act of 1970 and as Amended, 1987, set standards for the equitable and timely acquisition of residential and business real estate for right-of-way and for the provision of relocation assistance. This law applies to all states. However, opinions vary from case to case on the degree to which applications of the Act mitigate relocation difficulties caused by highway-widening projects.

Access, detour, safety, parking, and some nonmotorist social and economic impacts are often mitigated by careful planning and design of temporary and permanent highway facilities. Good design that integrates the physical highway into the residential and commercial areas through which it passes has been credited with reducing negative impacts on community cohesion (*11,19,20*). The practice of mitigation-sensitive design does not appear to be standard in all jurisdictions, however.

The mitigation of environmental impacts is standard practice in planning and designing highway-widening projects (*3,11,20,21*). For example, avoiding or replacing wetlands or identifying practicable measures to minimize harm to them is the standard approach in the design and implementation stages as well as in developing plans and EISs. Mitigation of noise and threats to air quality constitute the largest sections of the study reports that were reviewed. Twenty years of extensive research have been devoted to the development of mitigation measures. Emphasis on the natural environment in the United States is the result of the interpretation of NEPA and the regulatory process that has evolved from it (*1*).

ASSESSMENT METHODOLOGIES FOR ANALYZING THE EFFECTS OF HIGHWAY WIDENINGS

The status of the assessment methodologies used by highway agencies is similar to that of the mitigation measures for highway-widening effects and for the same reasons. Methods for assessing noise and air quality impacts, threats to water quality or soil, and effects on wetlands are generally quite specific, clearly defined, concise, and quantitative (*11,20,21*). They are used even when it is only to demonstrate that there is little or no impact of the type being assessed.

Methods suggested for assessing social and economic impacts, on the other hand, are abstract, somewhat vague about the nature of the impacts to be assessed, broadly described, imprecise, and qualitative (*1*). Social and economic impact assessments often lack a clear focus. Brief qualitative and subjective statements about such impacts are often the case in studies of the effects of highway-widening projects.

The training documents and manuals reviewed for this synthesis do contain guidance for the collection of relevant social and economic data (*1,11,20,21*). They also illustrate, for example, ways to estimate disruption of community cohesion, interference with the accessibility of facilities and services, and displacement of residents and businesses. The 34 environmental study reports received, however, did not contain applications of these techniques.

Furthermore, the information and techniques that are available relate essentially to the immediate impacts of highway-widening and similar projects. They do not include information on the impacts of these projects on individuals and groups over time. Consequently, there is no readily available guidance for estimating such impacts. No estimates of them were found in the review conducted for this synthesis.

It does not appear that social and economic impacts of highway widening have been the subject of well-focused research and development to the same degree that impacts on the physical environment, historical preservation, and archaeological resources have. The demand for research by national, regional, and locally based interest groups of the type that has sparked attention to the natural environment and cultural resources has not been focused on social and economic impacts (*1*). Also, the content of the studies has been shaped over the years by feedback from reviewers in the resource and regulatory agencies whose interests and skills relate to the natural environment rather than to social and economic concerns, as well as by members of the affected public who share those interests in the natural environment (*2*). Project proponents have shaped their staffs, study processes, and study reports to respond to the concerns expressed by these reviewers and the public to enable their projects to proceed (*21*).

CHAPTER THREE

SOCIAL EFFECTS OF HIGHWAY WIDENING

CATEGORIES OF SOCIAL EFFECTS

Social effects of highway widening are organized into the following categories for the purposes of this synthesis:

- Land use
- Residential impact
- Relocation of residences and public facilities/services
- Public facilities
- Public and community services
- Community cohesion
- Pedestrians and bicyclists
- Equity and environmental justice
- Changes in site accessibility
- Safety repercussions
- Aesthetics.

For each category of social effects, the relationship to highway widening, the nature of the effect, mitigation measures, and the general character of the criteria and techniques used to assess the impact are discussed. Research needs are also discussed. Much of the evidence presented is drawn from the manuals and prototypical study reports provided by the 34 states, four provinces, and eight MPOs. Material contained in the questionnaire responses is also used.

The variation in the views of social impacts is exemplified by descriptions contained in guidance manuals provided by FHWA, states, and provinces for the county and municipal governments and consultants who prepare project environmental documents.

> [Illinois] **Direct impacts** to a community include severance, access disruption, bisection, bypass, and relocation . . . **Indirect impacts**, such as those associated with the stages of project implementation, should also receive special consideration . . . . [Examples are] disruption of community cohesion, . . . changes in residential stability and tenure, . . . modified community plans and goals, plans of private interests, and changes in population characteristics (distribution and density) (*20*).

> [FHWA] Social impacts may occur at all phases of project planning and development. These impacts have been categorized into three major impact areas:
>
> - Disruption of Community Cohesion
> - Interference with the Accessibility of Facilities and Services
> - Displacement of Community Residents and Businesses (*1*).

The Caltrans manual for consultants on conducting socioeconomic analysis describes methods to estimate the following "Social Impacts" and mitigation measures for them—community cohesion, access and circulation, and parking impacts (*11*).

Creative approaches taken in urban areas around the country have produced greater clarity regarding the social impacts of highway widening and more approaches to predicting and mitigating them. Here are two cases in point. The first stems from a widening of I-5 in Anaheim, California, and the second was developed for widening I-70 and improving local streets in the area of one of its major interchanges in Denver, Colorado:

> [I-5, Anaheim, CA] Based on these goals and objectives, input from local agencies, the SATC Task Force and other sources, a comprehensive set of evaluation measures was developed. . . . Measures listed . . . can be categorized into seven general areas, as follows:
>
> - Transportation Performance and Productivity
> - Financial Feasibility
> - Cost Effectiveness
> - Socioeconomic Improvement
> - Environmental Quality
> - Energy Conservation
> - Community and Institutional Acceptance (*22*).

> [I-70, Denver, CO] The mitigation commitments outlined in this EA in Visual Impacts, Consideration Given to Pedestrians and Bicyclists, Right-of-Way and Relocation, and Noise Impacts, in addition to local street improvements identified in the Preferred Alternative, would serve to enhance the surrounding environments (*8*).

LAND USE

The land-use effects of highway widening include changes in existing land uses, likely uses of remnant parcels, effect on potential growth, effect on land value, influence on zoning changes, and consistency of changes with land-use plans. Impacts are a function of the amount of new right-of-way required, if any, and the adjacent existing uses. Impacts are also a function of the nature of any new alignment and whether roadway speed and vehicle capacity will be significantly affected. The nature and potential magnitude of other influences on land use also must be considered (*23,24*). Movements in the local economy and movements in the real estate market are important examples of other influences.

Mitigation measures include altering the location of the widening, e.g., restricting it to one side of the existing highway to avoid acquisitions or proximity impacts on certain types of land uses such as schools, parks and recreation facilities, or hospitals. In accordance with 49 U.S.C.303, (the recodified 4(f) provision), the Secretary of Transportation may approve a transportation project requiring the use of publicly owned land of a public park, recreation area, or wildlife and

waterfowl refuge, or land of an historic site of national, state, or local significance only if there is no prudent and feasible alternative and all possible planning is included to minimize harm to the land remaining in the former uses (*1*). Lowering the design speed allows for more flexible alignments that can be designed to avoid sensitive land uses and reduce the likelihood of partial takings (*24,25*). It also reduces the expected noise level, but may increase the emission levels for some pollutants and their potential impacts on land use.

Direct impacts, such as the amount of right-of-way that will be required from which parcels and the number, shape, and size of remnant parcels, can be determined from a proposed alignment. Impacts on use and growth of activity centers require estimating the effect of the widening on land access and on the volume and speed of vehicle traffic. It is necessary to make this prediction for the widened segment and for any other links in the network that might be affected, such as those connecting directly to the widened one. Significant changes in land accessibility and in the traffic volumes on adjacent roadways and streets may well cause changes in the uses of the land and the growth of activity on it.

Example cases involving in-depth consideration of the land-use impacts of highway widening were provided by California, Maryland, Connecticut, and Ontario (*22–26*). Cases submitted by the province of Ontario and the state of Maryland show creative use of varying roadway design speed as a means of mitigation of adverse land-use effects. A particularly thorough overall assessment of the land-use implications is presented in the case of the widening of a major segment of I-5 in Anaheim, California:

> Each segment has been analyzed for potential effects of the new right-of-way for the following factors:
>
> - Uses affected
> - Effect of nearby freeway on adjacent uses remaining
> - Effect of loss of portion of land use district on remaining uses
> - Effect on redevelopment activities
> - Effect on major activity centers
> - Effect on property conditions
> - Effect on General Plans of Orange, Anaheim and Santa Ana.
>
> . . . [Various] growth factors documented . . . indicate [that] substantial changes to the existing land uses are occurring, regardless of the land use effects expected from the I-5 widening. These changes and the strong local economy promote new growth and reuse of existing land uses. The overall health of the local housing market and business economy afford a multitude of relocation opportunities throughout the north and central portions of the County. . . .
>
> Mitigation Measures . . . In placing cul-de-sacs and new connecting roads within existing land use districts, the integrity of each land use district shall be maintained, so as to avoid, to the greatest extent possible, potential effects on the internal circulation network of each land use district. . . . If possible within the context of local zoning codes, any remnant buildable parcels shall be utilized for relocation of displaced businesses or residences within each respective land use district, so as to maintain the current mix of uses and to avoid vacant remnant parcels (*22*).

RESIDENTIAL IMPACTS

The focus of the residential impacts category is on the cumulative effects, other than relocation, of a highway-widening project on individual residents and families. As noted in the responses to question 3 of the questionnaire as shown in Appendix C (Tables C-1 through C-3), impacts on residents are considered by a majority of respondents to be primary and by some as both long-term and short-term, and as cumulative. Of the social effects, those impacting residents were most frequently cited as key issues. The principal means of resolution of the impacts mentioned is working with neighborhood groups. Adjustment of roadway design speed is another technique employed. Other methods of resolving issues regarding residents relate to relocation and are listed in the next section.

Principal causes of these effects are roadways that carry increased traffic volumes and become more difficult to cross when widened. Jobs, schools, shopping areas, churches, and recreational facilities may become more or less accessible to residents as the result of a widening project. Cumulative effects of noise, lower air quality, reduced accessibility, and displaced facilities or services may greatly reduce the quality of life for particular individuals and families whose residences are close to the widening project. Some of these individuals and others not living so close to the widened highway may find the accessibility of their homes to work, shopping, school, and other activities improved. Attempts have been made to assess the cumulative effects of proposed widening projects on neighborhoods (*8*).

Mitigating cumulative effects is a process of separately mitigating the several effects—noise with barriers, air quality with fewer required stops and more appropriate speeds, displaced facilities with closer and more convenient new locations. Difficulties of crossing wider and more active highways may require more protected crosswalks or grade-separated walkways. Synchronized traffic signals may provide more and better opportunities to cross heavily traveled roadways. Aesthetic treatment of widened roadways can reduce their negative impact on the neighborhoods through which they pass.

The magnitude of the impact of the widening project on ease of walking and on driving could be measured for residential areas. The impacts of all the other effects of the project or projects in question, as well as other relevant forces, must be predicted for the impacted residential areas in order to include all relevant influences in the cumulative effects.

More research is needed on cumulative effects on various impacted groups. A large number of completed projects located in virtually every state, province, and metropolitan area have "before" information on a wide range of impacts as well as forecasts of the effects of proposed highway widening. Now, "after" information needs to be gathered to complete the picture. The prediction techniques employed for various effects could be evaluated along with analysis of the nature of the cumulative effects and the perceptions of the impacted residents.

RELOCATION OF RESIDENCES AND OF PUBLIC FACILITIES AND SERVICES

While questionnaire respondents frequently cited residential issues as important, impacts of highway widening on

public facilities and services were not considered key or even important. Means cited for resolving residential relocation issues include providing relocation assistance, minimizing disputes over settlements on land acquisitions and relocation, and working with local governments. Most of the studies reviewed stated that all relocation activity would be conducted in accordance with the Federal Uniform Relocation Assistance and Real Property Acquisition Act of 1970 as amended. Many also mentioned use of state or provincial manuals on land acquisition and relocation assistance.

Relocations of residences and public facilities occur when additional right-of-way is needed to accommodate the highway widening. The effects accrue to those who must move as well as to many of those who remain. Two quotes from materials reviewed summarize the impacts well. The first is from the Illinois manual on socioeconomic impact assessment; the other is from the California manual on conducting socioeconomic analysis:

> [Illinois] Both overall impacts and specific impacts must be considered. Overall impacts consist of the actual number or magnitude of relocations, which relates to which alternate is ultimately chosen. The specific impacts affect individuals and families socially, psychologically, and financially, and must be considered when assessing alternate impacts (*20*).

> [California] . . . if the community is stable and cohesive and residents have been in their homes for many years, many of those displaced may have a difficult time adjusting to new homes and neighborhoods. Certain groups such as senior citizens, low-income residents and non-English-speaking people often have strong community ties and depend upon important support networks that can be severed upon relocation. Households with school age children may consider relocation especially disruptive if school transfers would be involved. Handicapped people and those without automobile transportation often have special relocation problems. [Other issues highlighted include mobile home relocation difficulties, affordable housing, and disproportionate impacts (environmental justice)] (*11*).

The assessment of these effects is challenging. Certainly the number of residences, families, persons, and facilities affected should be known. Availability and location of replacement housing or facilities also need to be known. The number and age distribution of school-age children, presence of and impacts on particularly susceptible groups such as minority, elderly, low-income, or close-knit cultures and extended families are important, even though specific details are not always readily available during the period when environmental documents are being prepared.

The relocation laws require fair compensation for all the monetary costs of relocating. Securing appropriate replacement housing, even at greater market value than what was acquired, if necessary, is essential. Other issues are handled on a case-by-case basis. State and local policy, attitudes, and processes appear to vary greatly. For compensation beyond levels required by the Uniform Relocation Act, states can use their own funds or have additional expenditures of federal highway funds approved by FHWA. Also, some states have revamped the relocation processes to be more responsive to the needs of relocatees. This type of approach involves consultations between state agencies and groups of relocatees to reach equitable and amicable solutions, working one-on-one with relocatees, and giving more advance notice than required by law.

It is not clear how satisfactory the relocation actions have been when viewed from various perspectives, such as relocated residents and operators of public facilities, as well as the clients of relocated facilities and public services. Research on the effectiveness of various approaches could enlighten the situation for all those affected by the relocation issue. Documentation is needed of the effects of the programs in many different states on housing quality, community cohesion, and facility access.

Impacts such as disruption of community cohesion and interference with the accessibility of facilities and services need further analysis and documentation. The extent of the impact of widening projects on the various dimensions that define a community can be assessed, including geographical boundaries, ethnicity, culture, and level of interaction among residents. Impact on the degree of support for community activities and interests should be assessed as well.

Interference with the accessibility of vital community services should be measured. Time and distance between affected communities and fire and police stations, schools, churches, health care centers, and libraries are of particular importance. The results can be stratified by the number of persons or families impacted to a particular degree. The display of travel-time shifts could be an effective means of communicating changes in accessibility. Emergency response time changes are especially critical.

Relating research findings to the policies and requirements of NEPA, 23 U.S.C. 109(h), 49 U.S.C.303 (formerly section 4(f)), and 23 U.S.C.138 would assist states in preparing environmental analyses to effectively convey residential and public facility relocation impacts.

PUBLIC FACILITIES

Highway-widening projects have potentially significant impacts on the operations of those public facilities that are not affected seriously enough to require relocation. While these issues might not appear to be important by the state, province, and MPO responses to the survey questionnaire, they are treated thoroughly in many of the studies reviewed. Impacts on parks, airports, schools, churches and other community facilities are covered (*6,28–31*). The effects include increased noise, visual intrusion, loss of vegetation, interference with air navigation, and changed access to clientele. In some cases, as shown in the following report extract, the impacts are deemed to be positive:

> [Louisiana] The proposed project will increase access to the Church and School and this, in turn, should facilitate increased participation and attendance (*32*).

Some extensive mitigation measures have been employed. Several were proposed to reduce the effects on a popular rustic park totally within the city limits of St. John's, Newfoundland:

> [Newfoundland] The major potential social environmental impact would be a significant rise in noise levels through Pippy

> Park and in the area of the protected watershed. The recreational amenity value of the natural area would be significantly affected. . . . The key commitments are . . . the preparation of a rehabilitation master plan for Pippy Park addressing noise reduction measures, visual intrusion control, revegetation, and the construction of 3 walkways under the road to reconnect the present recreational trail system (*6*).

The techniques of assessment for public facilities focus on impacts on their public functions and interference with access by clientele. Widening often results in relocating streams of moving vehicles closer to parks, schools, and facilities providing administrative services to the public. Increased noise levels and visual disruption can significantly reduce the effectiveness of these facilities and need carefully considered mitigation. Noise barriers, increased vegetation, lowered roadway design speeds, and innovative use of traffic control devices have been employed for this purpose.

The additional traffic volumes that often follow roadway widening can make entering and leaving public facilities more difficult. Some additional delay and risk exposure may be experienced by patrons and employees of parks, schools, and administrative facilities. For emergency services such as police and fire protection, the impact could be more threatening to public safety. Special traffic controls are available as a technique to reduce delays in emergency response.

Management of these various risks in the location and operation of emergency response facilities has led to considerable research on the subject. A summary of findings related to highway widening would be useful.

PUBLIC AND COMMUNITY SERVICES

Public services are not rated as a key issue by states, provinces, and MPOs. They appear to be routinely covered in documentation of highway-widening impacts in the environmental study reports reviewed, however. There is general agreement on the need to maintain the effectiveness of services such as hospitals, ambulance service, and fire protection. The providers of these services are called upon early in the planning process to participate in mitigating negative impacts (*8,22,31*).

Community services such as churches, libraries and YMCA/YWCA are also routinely covered, but without the level of consistent deference given public services. Highway-widening effects on them are similar to those on public services, but these community services are treated in the planning process more like members of the affected public than insiders. This may be due to their being in the private rather than the public sector. Assessment of the impacts is focused on the connections with their clientele (*28*).

COMMUNITY COHESION

The types of communities impacted by highway-widening projects can be defined by what the members of given communities have in common. Common attributes include collocation in the same geographical area or political entity, a similar ethnic background, a common culture, a common language, membership in a given church, residing in the same school district, being served by the same recreational or community center (e.g., YMCA/YWCA), employment by the same entity or by closely located entities, or patronizing the same set of retail stores. The more of these attributes shared by a given group of people, the stronger is the sense of community and its value to the members of the group.

The cohesion of communities is affected by a highway-widening project to the degree that the project weakens or strengthens these attributes and the ability of the community to communicate and interact. A wider roadway often becomes more difficult to cross on foot or by vehicle, due just to being wider and to attracting more vehicular traffic. In such a case it becomes a physical and psychological barrier separating the parts of the community on either side of it. Any intracommunity contacts that have to cross this barrier are weakened to some degree. Assessing such an impact requires determining the particular communities and attributes that are affected and the degree to which contacts are likely to be decreased. The impact could be sufficient to threaten the viability and existence of the community.

The survey results show the belief that effects on various social groups are important impacts from highway-widening projects. As required by 23 USC 109(h), community cohesion is often singled out in project EA or EIS reports as an issue. Analyses of these impacts in the reports reviewed, while frequent, were usually quite brief and often merely qualitative. The following examples are representative:

> [California] The widening of the existing freeway will affect the edges of the existing pattern of neighborhoods and the larger community. This marginal effect occurs along existing boundaries with little or no effect on the overall land use patterns or provision of essential community services. . . . In the case of the I-5 Freeway widening project, no neighborhoods are being divided, existing travel patterns are being maintained, and improved in many cases where new overcrossings occur, maintaining existing commercial, industrial and residential relationships (*22*).

> [Nebraska] . . . proposed improvements are not expected to have an adverse effect on social and economic opportunities, nor in work, school, recreational and religious opportunities (*32*).

Prevention is the primary tool for mitigating the disruption of community cohesion. Avoidance of actions that would disrupt stable, socially valuable communities is a generally accepted first principle. When it does seem necessary to widen a roadway through such a community, other means of mitigation are available. One is the lowering of design speeds. Another is the innovative use of traffic control measures to make any barrier to cross-traffic less formidable. Lowering below grade any lanes carrying through traffic reduces noise and visual intrusion while providing opportunities for the construction of barrier-free cross access. Raising through-lanes above grade provides cross access opportunities but does increase visual and noise intrusion. Relocation of community facilities is also a possibility in many cases.

More research is needed on the effects of highway-widening projects on community cohesion. Case studies documenting the changes in the state of various communities

caused by widening highways through them could produce information very helpful to the impact estimation process. It would also be helpful to have documented evidence of the effect of various mitigation measures on the level of community disruption caused by roadway widening. This research will require comparing like situations with and without the measure in question or with measurable differing levels of the same mitigation measure.

PEDESTRIANS AND BICYCLISTS

Impacts of highway widening on nonmotorist travel is considered a key issue by a majority of the states, provinces, and MPOs responding to the questionnaire. The primary concern is to provide safety and continuity for bicycles and pedestrians where their numbers are expected to justify it or where there is a desire to encourage nonmotorist traffic. Widening can increase the difficulty of pedestrian and nonmotorized vehicular traffic in crossing a highway. Altering the roadway cross section to provide greater width for motor vehicle movement could reduce the space in the cross section currently used by bicycles or put them into the motor vehicle roadway.

Several of the study reports reviewed reveal how the issue is being treated:

> [Nebraska] Under any of the alternates, a ten-foot wide pedestrian/bikeway would be built over the mainline railroad, on the east side of 10th Street. Under the preferred alternate, 10th Street would be closed to through traffic . . . , thereby reducing bicycle and pedestrian conflicts with vehicles (*32*).

> [Denver, Colorado] Wider walkways and better lighting will be provided in the area of the new I-70 viaduct and associated connecting street improvements. A new entrance to Platte River Trail will be constructed. Consideration and encouragement of other provisions for bicycle routes is given (*8*.)

> [South Carolina] **Pedestrians and Bicyclists**—Once the BMW plant and related industries are in operation, the improved section of S.C. 101 will function as a major industrial arterial with an unusually high percentage of trucks. The widened section would be safer for pedestrians and cyclists. Incorporating special facilities into the right-of-way for cyclists and pedestrians would present an opportunity for joint development between the Department and local jurisdictions if determined to be locally desirable. Such accommodations would be at the discretion of local and county governments in conjunction with special funds allocated for those purposes under new highway legislation (*33*).

> [Maryland] There will be an eight-foot hiker/biker trail on the west side of the alignment and a five-foot sidewalk on the east side (*25*).

> [Maryland] Three types of low-cost, on-road types of improvements for bicyclists implemented in Baltimore County, Maryland are discussed: (1) wide curb lanes that provide additional width in the right-most lane by slightly narrowing adjacent lanes, (2) smooth shoulders that facilitate bicycle travel on existing roads, and (3) parking changes that provide more room on the street for bicyclists and increase sight distance for bicyclists and motorists (*34*).

Eliminating or reducing conflicts with motor vehicles and various fixed objects and providing facilities of adequate width and appropriate alignment are mitigation measures deployed in both planning and design. This level of activity is encouraged by the active interest of bicyclist and pedestrian groups in virtually every sizable community in the United States and Canada. Further evidence of this active interest is contained in the ISTEA provisions requiring the attention of states and MPOs to the provision of nonmotorist transportation facilities.

Research is needed to develop quantitative measures of the benefits of the various methods for improving nonmotorized vehicle travel. Specific attention should be paid to improving roadway planning and design techniques, as well.

EQUITY AND ENVIRONMENTAL JUSTICE

Title VI of the Civil Rights Act of 1964 originally required federal agencies to ensure that none of their programs discriminate on the basis of race, color, or national origin. Subsequent legislation has expanded the list to include age, gender, handicap/disability, and religion. A 1994 Executive Order, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* underscores this provision with respect to human health and environmental effects (*4*). The memorandum issued to all departments and agencies on that same date defines the type of action that is expected:

> [The White House] Each federal agency shall analyze the environmental effects, including human health, economic and social effects, of federal actions, including effects on minority communities and low-income communities, when such analysis is required by the National Environmental Act of 1969 (NEPA), 42 U.S.C. section 4321 et seq. Mitigation measures outlined or analyzed in an environmental assessment, environmental impact statement, or record of decision, whenever feasible, should address significant and adverse environmental effects of proposed federal actions on minority communities and low-income communities. . . . Each agency shall provide opportunities for community input in the NEPA process, including identifying potential effects and mitigation measures in consultation with affected communities and improving the accessibility of meetings, crucial documents, and notices (*5*).

Stating that human health, economic, and social effects are to be included provides further clarity on the definition of environmental effects.

The questionnaire responses did not identify Title VI-type discrimination as a key issue with respect to highway-widening projects. However, in many of the study reports reviewed, the number of residences or businesses to be relocated that were owned or occupied by minority or elderly persons was set forth. The proportion of relocations required, which was documented to be in one or the other of these categories, lay in the 10 to 30 percent range. No mention of disproportionate impacts on these groups or of mitigating the impacts on them per se was found (*10,22*).

Two more general forms of mitigation appeared most frequently in the study reports. The first and most frequent is the commitment on the part of the project proponent to compliance

with the Uniform Relocation and Real Property Acquisition Act of 1970, as amended. Explicit assurance is often given that its provisions will be applied without discrimination. The second is to demonstrate that the number of dislocations required has been minimized through a thorough consideration of the alternatives to the chosen approach.

Illinois DOT in its socioeconomic impact assessment manual notes the importance of identifying special groups, such as elderly, handicapped, ethnic and racial minorities, low-income families or individuals, and religious minorities. It is suggested that assessments include impacts such as barriers, accessibility of jobs and services, land values, and relocations of residences. It is also recommended that negative impacts on these groups be mitigated and favorable ones be enhanced (*17*). This approach is the one that has been taken in most localities and jurisdictions of the reports covered in our review. The thoroughness of the coverage given in the various cases could not be assessed in the review because other sources of information on the projects were lacking.

The Executive Order on Environmental Justice has caused the creation of an interdepartmental task force led by EPA. Greater emphasis will be given this issue in federal transportation programs, including those supporting highway-widening projects. What form it will take is not clear.

What research will be undertaken, if any, is not clear either. However, research on the distribution of all the various impacts of highway widening among groups classed by household income, race, ethnic origin, and possibly age, gender, handicap/disability, and religion would be very useful in bracketing the size of the issue and supporting the development of solutions to it.

CHANGES IN SITE ACCESSIBILITY

Changes in access to residential areas and to public facilities such as local schools, universities, museums, and libraries often constitute an important social issue. Access control has become a major issue in many states (*35*). The controversy, however, is frequently over the number of driveways or curb-cuts allowed in shopping areas and other business strips. The negative long-term economic impact that roadside businesses feel they suffer from not having their own individual curb-cuts must be weighed against the increased traffic safety and reduced traffic delays that result from limiting the number of curb-cuts. Economic impacts are covered more fully in the next chapter, but the social impact in such a case is any long-term reduction of access to retail businesses. A similar trade-off also exists regarding access to residential areas on the one hand and traffic safety and delays on the other. These tradeoffs must be made in assessing the effects of the introduction of nonaccessible medians. The type of trade-off expressed in the following report excerpt is typical:

> [Nebraska] Traffic patterns for area residents will be significantly changed by the selected build alternative through the introduction of mainline medians, limited access points to the mainline, and "U" turns for use by residents needing roadway crossovers. While there will be an initial adjustment to this changed traffic pattern, the long-term benefits of improved traffic flow and reduced accident rates outweigh the short-term effects (*36*).

Not only are the long-term, permanent impacts of highway widening of concern, but short-term, temporary ones are, as well. Short-term social impacts include those stemming from the nature of the provisions for temporary access to residences and public facilities and those involving detours that bypass the widening project site. In either case, access may be made difficult or even impossible by the nature of the temporary access facility or by the route of the detour.

Taken singly or in the aggregate, access related impacts are frequently mentioned in the survey results and in the reports reviewed as being of concern. Site-bypassing detours are frequently mentioned, but temporary access restriction is most often mentioned as a key issue.

Mitigation measures reported to be in use include early and unusually extensive community involvement in the project development process, performing construction and restricting access only at night, providing advance notice of work zones and detours, as well as times of restrictions, and special signing. One of the most effective strategies for reducing the impacts of temporary access restrictions has been expediting construction while maintaining traffic during construction (*14,16*). In North Carolina, bonuses of up to 30 percent of project construction cost are awarded to contractors for timeliness (personal communication, David Foster, Director, Highway Environmental Evaluation Program, North Carolina Dept. Environment, Health, and Natural Resources, November 15, 1994).

Over the years, a great deal of research has been done on effective traffic management during construction of highway-widening projects. More research is needed on the impacts of temporary or permanent access restrictions of various kinds. The knowledge gained would enable project proponents to develop implementation processes that significantly reduce access problems (*12,25,32*).

SAFETY NEEDS AND REPERCUSSIONS

Highway safety continues to be a major social issue. More than 39,000 motor vehicle fatalities occurred in the United States in 1992 and more than 300,000 severe injuries were caused by motor vehicle accidents (*37*). Safety, as reported by questionnaire respondents and as noted in the reports reviewed, is a key issue in the selection and development of highway-widening projects. Research in the mid 1970s indicated that highway-widening projects had a positive effect on safety, reducing accidents at all levels of severity (*38–40*). Current research by FHWA integrates safety considerations regarding roadway width and other geometric design variables into the roadway design process. A related effort will result in a capability to predict accident rates as a function of proposed highway width and other design features. This model will be able to be used in integrated planning and design processes to evaluate the trade-off between safety and other impacts (*41*).

Mitigation of safety problems begins by examining accident records to identify dangerous sections of highway and causative factors. A comparison of accident rates for the section concerned is made with regionwide or statewide rates for similar type facilities. A relatively high number or rate for collisions involving turning movements is considered a

good reason to consider highway widening as a safety improvement measure (*26,31,42*).

A substantial body of literature exists that indicates that various types of highway-widening projects, in both urban and rural areas, have resulted in fewer and less severe accidents. In Los Angeles, the overall rate of improvement was about 20 percent (*38,39*). Rural road widening projects in Kentucky produced reductions in accidents ranging from 10 to 39 percent for lane widening and 6 to 21 percent for shoulder widening (*43*). A TRB study on the cost and safety effectiveness of highway design elements showed no significant difference in accident rate between 22-foot and 24-foot pavement widths. However, there was a measurable difference between the 18-, 20-, and 22-foot pavements, indicating that the narrower widths below 22 feet are more dangerous. Wider shoulders and paved shoulders were also found to have lower accident rates (*40*).

The improved sight distances for both vehicle drivers and pedestrians that often result from highway-widening projects reduce the risk of vehicle-pedestrian accidents. Concurrent improvement of pedestrian crossings of the wider highway through the use of better marking and signing of crosswalks and improved traffic signals also has a positive effect on safety.

The safety impacts of carefully planned and designed highway-widening projects are primarily positive—fewer and less severe accidents.

AESTHETICS

Aesthetics was not included as a survey item. However, it was mentioned in several of the reports reviewed as being a concern. The concern is related to the prevention of visual intrusion, which is domination by highways and highway traffic of the view from residences, certain businesses, and public facilities. For example, a particular alternative for improving the capacity of a railroad crossing in Lincoln, Nebraska, provided the greatest opportunity to enhance the aesthetics of the University of Nebraska campus there with street closings, plantings, and wider, winding walkways. The proposed expansion of an expressway in California uses aesthetics as an integrating theme:

> The proposed improved roadway, landscape treatment, bicycle and pedestrian paths, and unified treatment of soundwalls would upgrade the aesthetic quality of the area from the existing transitional rural character to a suburban character consistent with adjacent residential areas (*12*).

For a roadway being expanded at the edge of a major park in St. John's, Newfoundland, assessment of the change in the visual environment was extensive and included analyses of the view from the road as well as development of ways to mitigate the appearance of the road from the park (*6*).

Favorable aesthetic treatment of expressway interchange elements in Denver was promoted as a means not only of integrating the expressway more compatibly into the neighborhood, but also of promoting the economic growth of the area (*8*).

Mitigation measures employed to improve the aesthetics of highway-widening projects include involving the affected community with aesthetics in the planning and design phases. Use of landscape architects early in the planning process as well as in design has also been an effective way to improve aesthetics. Landscape architects have been successfully employed as resource persons in support of community involvement with aesthetics.

In summary, examples have been found from various states, provinces, and MPOs of the considerable importance attached to all 10 social impact categories reviewed. While FHWA has no formal guidelines for social impacts, FHWA requirements are based on 23 USC 109(h), 23 CFR 771, Executive Order 12898 (Environmental Justice), Title VI of the Civil Rights Act, and related statutes. FHWA Technical Advisory TA 6640.8A also contains relevant information. Guidelines available from several states and provinces help analysts determine which social impacts might be expected from given widening projects. They also list appropriate criteria for measuring the impacts and suggest available data sources that might prove useful. Available guidance is less thorough on ways to estimate values for the criteria or to mitigate negative social impacts. The reporting of social impacts of highway-widening projects and expected levels of mitigation in environmental documents is often quite brief.

Research on the actual social impacts and the relative effectiveness of various mitigation measures would be quite useful. The forthcoming book by Myron Orfield of the University of Minnesota makes a strong case for research on the cumulative social impacts over time of various public investment policies, including expenditures on highway widening (*9*).

CHAPTER FOUR

ECONOMIC EFFECTS OF HIGHWAY WIDENING

CATEGORIES OF ECONOMIC EFFECTS

Economic effects of highway widening are organized into the following categories for the purposes of this synthesis:

- Land use
- Business impacts
- Location and relocation of utilities
- Employment
- Property values
- Tax base
- Parking
- Safety.

For each of these categories, the following are addressed: its relationship to highway widening, the nature of the effect, appropriate measures for mitigating negative impacts, the general character of the criteria and techniques used to assess the impact, and research needs and activities related to the category. The information presented comes in part from the manuals and study reports provided by the states, provinces, and MPOs. Responses to the questionnaire also contain a great deal of information on the views and practices of the states, provinces, and MPOs. Results of recent research are presented where appropriate.

Current procedures for estimating economic impacts were developed during the 1960s and 1970s to assess the impacts of new Interstate highways on the communities they bypassed and served. In the early stages, they overlapped work done in various states to estimate the economic impacts on communities of new bypasses built to remove growing intercity traffic from community centers. The emphasis was on determining the net economic effect of the bypasses on the communities, as well as the distribution of economic impacts among various groups such as retail businesses serving the traveling public (*19*).

Much was learned about the economic effects of highways and how to measure them. Pennsylvania State University, for example, developed a model for predicting the primary and secondary impacts on local areas caused by highway improvements within a corridor (*19*). This model required easily obtainable information including travel time to the nearest Interstate highway, labor market and population accessibility, ratio of highway mileage to total land area, average daily traffic on the new highway, and access to rail facilities.

The techniques and findings of the studies of this era have applicability to the assessment of the economic impacts of highway-widening projects. While the scales of the projects of this earlier time are typically greater than widening efforts today, the methods and findings still apply.

Recent work by the Texas Transportation Institute and the Texas Department of Transportation builds on the earlier studies. The purpose of the work is to estimate the economic impacts of highway improvements. The widening of existing highways is one of the classes of improvements being evaluated. Effects estimated in two cases include the following:

> The effects estimated are (a) impact on businesses, distinguishing between traffic-serving and other types of businesses; (b) impact on property values; (c) impact on new development; (d) impact on relocation and employment, including that caused by construction expenditures and loss of clientele; (e) impact on municipal tax revenues, and (f) impact on highway users (*44*).

Economists and highway planners performing the work in Texas have provided the following guidelines for assessing economic impacts:

> Collect sufficient data on the characteristics of the proposed highway improvements to use in selecting the most comparable findings of prior studies to estimate economic effects. At a minimum, data from previous studies must be comparable in the following ways:
>
> - Type of highway improvement (design and route location)
> - Dominant abutting land use, and
> - Stage of land development in area (percent developed).
>
> When ideally comparable case study findings can't be found, the highway planner is forced to use subjective judgment in adjusting the impact estimates based on the findings of available studies.
>
> Adjust the findings of previous case studies to fit the proposed improvement area and route characteristics (*44*).

Today, there is greater focus on the distribution of impacts among different groups in the affected population. The concern for defining and including direct or primary, indirect or secondary, and cumulative effects is also more important today. Illinois DOT provides its project proponents the following guidance:

> Economic impacts pertaining to transportation projects are generally captured in the public or private sector as net losses or gains. From an economic standpoint, the impacts of a highway improvement can be classified in terms of direct, indirect, or induced impacts. . . . Direct impacts are those which produce immediate measurable changes such as increases in the number of on-site jobs available. Indirect impacts are those that result in some measurable net change in economic activity over time in a given community, which can be reasonably attributed to the development of the new highway improvements such as increases in the number of jobs available at local material suppliers off-site. Induced impacts occur as a result of direct and indirect impacts of new employment and income resulting from successive rounds of spending. . . . Economic impacts also occur on a secondary level; for example, in property value changes which may or may not be beneficial to the owner(s) or the community. . . . The distribution effects of highway improvements should also be considered (*20*).

It is also important to recognize that the widening of highways in urban and suburban areas today often takes place in the presence of other significant forces stimulating economic change. Examples of these other forces are continuation of suburbanization, international and interregional economic competition, the rise of rail-truck intermodal transportation, foreign trade zones, local zoning ordinances, and availability of water and sewer lines. The following assessment of a project to widen a two-lane bottleneck to match the four- or five-lane abutting sections in the far eastern suburbs of the San Francisco Bay metropolitan area describes such a case:

> The widening of this one-mile stretch of Highway 156 would have no significant growth-inducing effects. It would relieve traffic congestion and improve safety conditions within the project limits. San Juan Bautista's recent slow rate of growth is very likely to continue because of a number of factors, including the moratorium on sewer hookups, the City's Development Control Ordinance, policies in place to protect prime agricultural land from encroachment by residential development, and the limited local employment base (*12*).

Review of the studies submitted by the states shows that the economic impact sections of environmental impact assessment documents are usually quite brief in comparison with other sections of the document. The following excerpt of the total coverage of the expected economic impacts of a North Carolina Interstate highway-widening project is a typical example of the level of coverage given:

> [Durham, NC] B. Economic Impacts The project will not adversely affect local government finances. The additional right-of-way required will not result in any substantial lowering of property tax assessments. Economic trends will probably maintain their current physical growth rate with few modifications along the proposed project's location. A small percentage of commercial establishments will be negatively impacted as a result of the proposed project. However, in some cases, local commercial establishments will probably benefit economically from the widening of Interstate 85 by realizing increased visibility and improved access. Moreover, increased accessibility and improved traffic service provided by the proposed project should result in making the region more attractive to new industries. The reduction in travel time for commuting workers, plus the reduced road user costs for industry will be direct economic benefits to the region (*45*).

The following review of the major categories of economic impact shows that coverage is usually brief and more frequently qualitative than quantitative. Knowledge of the state of the art does not appear to be widespread among analysts or reviewers. Pressure for more thorough treatment of economic impacts has been weak in the past, but concerns about them are raised in a number of the reports reviewed, particularly more recent ones.

LAND USE

Highway-widening projects generally increase the accessibility of affected parcels and areas. The strategic location of the widened section within the urban transportation system and the relative increase in highway capacity determine how extensive the impact may be. New businesses or residential development may be attracted to the more accessible land, or existing land uses may grow in intensity or extent. Urban land use and transportation planning models are normally used to estimate the impacts of the more extensive projects. Often, the state DOT makes the model runs for the metropolitan planning organization (*11*). In other locations, it is normal for the MPO to do the model runs.

Simpler methods are used for the less extensive projects that are expected to have only local accessibility effects. The level of additional traffic that can be accommodated and might be expected to materialize due to the widening project can be estimated from the *Highway Capacity Manual* and allocated to various current or future land uses, for example (*46*).

Efforts have been made over the years to reduce the negative impacts on land use of expanded highway systems. Urban sprawl has been widely condemned as the result of unbridled highway expansion. Furthermore, it is claimed by Morefield and others that the use of investment in highways and other infrastructure to support exclusionary development in outlying portions of metropolitan areas is wasteful, inequitable, and promotes social blight (*9*). Perhaps the most significant and widespread effort today is the alteration of the metropolitan transportation system as a means or tool to manage growth and land use. The Growth Management Act enacted in 1990 in the State of Washington embodies this approach. Caltrans employs the same sort of policy for California:

> Caltrans projects are designed to facilitate planned growth in accordance with local and regional plans and policies [and]. . . are designed to accommodate existing traffic and traffic projected to be generated by planned growth. . . . A socioeconomic impact analysis prepared for an environmental document must assess growth inducement . . . defined as the relationship between the proposed transportation project and [economic or population] growth within the project area (*11*).

> The expansion of the freeway is seen as accommodating the region's projected growth, but not inducing the growth. The projected land uses are being planned regardless of freeway expansion plans. . . . (However,) when cumulatively considered with other transportation improvements, (the proposed project) could serve as one of the factors that influence and facilitate planned population and employment growth in the corridor (*22*).

South Carolina has applied this philosophy of matching the transportation system to the growth plan in developing the widened roadways and new bikeway and pedestrian facilities to serve the new BMW plant there (*33*).

While some connection between land use, growth, and widened highways is broadly discussed today, the published information about the actual effects of highway widening on land use seems very thin. This area is a worthy candidate for further research to understand this relationship. The information developed 20 to 30 years ago on the impacts of the new Interstate highways may or may not be useful in this regard. There are enough widening projects taking place today, however, to provide sufficient information for a definitive study.

BUSINESS IMPACTS

The impacts of highway widening on business can be substantial. They can result in manifold increases in business

volume or in decreases so severe that they cause firms to fail. Firms that depend on passing traffic for their business are particularly susceptible, such as service stations, fast-food outlets, and convenience stores. Long-range impacts are caused primarily by the effect of the widening on the relative accessibility of the affected locations to particular markets. Short-term impacts are caused by the widening construction process itself. They accrue from temporary changes in accessibility to the affected businesses as exemplified by roadway closures, lane restrictions, temporary driveways, and detours.

Long Range

The long-range impacts on business of highway-widening projects are, in essence, the land use effects described in the previous section. Consequently, the relationships, means of measurement, criteria, and mitigation actions are essentially as described earlier. Lack of available information on the impacts of highway widening on business is a problem. Impact assessments are often succinct and similar to the following one from Louisiana:

> [Baton Rouge, LA] . . . [U]sers will benefit from the traffic condition improvements . . . reduced travel times, reduced costs, and increased safety. . . . The widening of Siegen Lane will definitely increase the development potential in the area. The development would probably be mostly commercial. . . . Industriplex [existing industrial park] businesses will benefit from the increased access. . . . Shoppers will be more likely to patronize establishments that are easier to get to (*30*).

These long-range impacts on business are considered by many analysts to be secondary or indirect because it takes some time for them to develop fully after completion of the widening project. From the studies and questionnaire responses, it does not appear that long-range impacts constitute a key issue.

Short Range

Short-range business impacts of highway-widening projects do constitute a key issue in the United States. Business displacement was most frequently mentioned among both social and economic effects as a key issue by states and MPOs. It ranks only marginally behind noise and wetlands, which are most frequently mentioned as key issues among all the categories. It is classified by survey respondents as a primary short-range impact. It ranked low and medium, respectively, for amount of time and amount of data required.

The key impact of concern is reduction in the volume of business caused by restricted access to business sites during the time required to construct the widening. This impact can be great enough to put a firm out of business, so it is taken seriously by all concerned. Restrictions include closed driveways or highways, temporarily reduced capacity of driveways or highways, intermittent blockage of driveways or highways, reduced number of parking spaces, and the confusion or uncertainty of customers about how to reach the business site during construction. A close second concern by respondents is the acquisition or relocation of the business site.

Respondents have suggested a number of ways to resolve these issues. They suggest most frequently the provision of relocation assistance. Various means of handling purchase or relocation are suggested: appraisal, negotiation, condemnation, compensation, and purchase of the property. Early identification of impacts and meetings with business owners to present issues and design alternatives are also mentioned, as is working with local government.

Communicating the specifics of process and construction events to affected businesses that are not relocated is a form of mitigation that states report is much appreciated. Provided with this type of information, managers can plan their own activities around access difficulties to minimize the negative economic impacts on their businesses and the social impacts on the communities they serve.

The mitigation measures suggested include expediting the construction process, thorough planning for traffic management during construction, improved signing to guide customers to the businesses during construction and to guide bypassers through the detours, and temporary access or parking facilities. Expediting construction and providing convenient temporary access constitute a preferred approach.

The study reports contain these and other mitigation measures:

> [Lansing, MI] Reduction of lanes open to traffic during construction will cause delays to residents and customers of businesses. Access will be maintained to each commercial location to the extent possible (*42*).

> [The general state of the highway paving industry as reported in *Engineering News-Record*, January 1992.] To maintain productivity under the prevailing conditions, contractors and highway departments have found ways to speed the return of pavements to traffic by developing equipment geared to working in tight spaces, and by finessing the way they approach traffic management (*47*).

> [Houston, TX] Maintaining existing traffic within the freeway right-of-way is proposed. There are two major shopping centers along the route plus numerous other traffic-dependent shopping and business enterprises for which access will have to be maintained. Proposed traffic handling schemes for each of the three segments have been planned to conform with adjacent segments so that the construction work causes minimum inconvenience to the traveling public passing along and across the freeway (*48*).

Nebraska is but one state in which it is standard policy to maintain access to businesses throughout construction by project phasing and other means (*36,49*).

Advice is given to consultants by Caltrans on what data to collect. Note that they include information that is important to Title VI concerns regarding social and economic impacts of proposed projects:

> Describe the number, size, and types of businesses within the affected environment. Indicate if they are established, new, or deteriorating. Determine if they are highly dependent upon a highway location for profitability. Note if any businesses are highly dependent on on/off ramps. Describe the clientele served by the firms. For instance, do they primarily serve local customers, minority groups, senior citizens, etc.? (*11*)

Proprietors of impacted businesses necessarily have great concerns about the impacts of highway-widening project

implementation on their businesses and livelihoods. A compilation of the effects of various types and durations of projects and access restrictions on businesses of various types would be a great aid to the planning and negotiation process.

LOCATION AND RELOCATION OF UTILITIES

Widening projects often encounter telephone, TV cable, electric power, gas, sewer, or water lines in the old or the new highway right-of-way. Even the prospect of such an encounter requires coordination with the utility or utilities concerned. An accidental encounter with a utility line can be a costly and/or dangerous experience. These accidents are so costly and disruptive to the utilities and the services they provide that they constantly monitor the neighborhoods of their lines for construction activities. Utilities maintain user-friendly ("one-call") systems to encourage calls from construction agencies or firms as early in the project development process as possible. A widening project might also provide a utility with a good opportunity to place a new line in or near the highway right-of-way with a minimum of cost and additional disruption to traffic or to the neighborhood.

Protection, location, relocation, or avoidance of utility lines during the planning, design, and construction of a widening project require the scheduling of utility contacts and construction activities as items in the project schedule. States and provinces responding to the questionnaire rated utility relocation as a key issue and a primary short-term effect. Means of resolving this issue listed by respondents include early coordination and negotiation with the utilities concerned, management by the right-of-way section of coordination with utilities, and determining the most economic means of relocation, subject to appropriate safety standards. Some MPO responders noted the intractability of utility negotiations and recommended buying the utility's interest in the area of the widening project and encouraging them to locate their line elsewhere.

Question 7 asks the responder to list any special problems of utility relocation and how they were resolved in the reporting jurisdiction. Fifty responses were received. They are shown in Appendix D. The problems were grouped into the following seven categories:

- Space limitations and utility placement in the highway right-of-way,
- Cost of utility relocation and allocation of cost responsibility,
- Planning and coordination,
- Safety and removal of hazardous materials,
- Mitigation of impacts on the natural environment,
- Problems peculiar to buried utility lines, and
- Drainage.

Utility relocation was not a topic mentioned very frequently in the study reports reviewed. The following excerpt from the environmental analysis of the widening of I-5 in California represents the type of coverage given this topic:

> . . . a method of procedure for assuring the relocation and continued maintenance of the water facilities, sewage collection system, electrical and natural gas transmission lines, and telephone lines shall be submitted for approval to the respective service agencies impacted by project construction. . . . Where possible, utilities will be relocated prior to project construction (*22*).

EMPLOYMENT

The impacts of highway-widening projects on employment can be either negative or positive. There is a direct relationship with the impacts on business described earlier. Widening projects that take business sites for which there are no alternatives result in loss of those businesses and the jobs they provided. It is possible for access to be so restricted that business and jobs are lost for the duration of project construction. Such an impact that is severe and lasts long enough can push the affected firms out of business.

In the longer run, the wider highway can reduce congestion and improve access to remaining businesses for customers and suppliers as well as employees. The effect on business and employment under these circumstances is positive (*44*). Widening projects are often only one of several forces influencing economic activity and the availability of jobs in a given area. The situation surrounding the widening and reconfiguring of ramps and streets associated with a major interchange on I-70 in Denver, Colorado, is a case in point:

> The relatively high unemployment rate and below-average earnings in the Globeville, Swansea, and Elyria neighborhoods might be affected positively if this roadway improvement project spurs economic redevelopment, and if the new or revitalized businesses employ people from the neighborhoods. A roadway improvement project which improves access to . . . the local street system, which this project would, is one of the many factors which can contribute to economic redevelopment (*8*).

Other possible negative quantifiable employment impacts include loss of income, multiplier effects on the tax base, increased need for social services due to unemployment, and the costs of moving should reemployment within the community not be available (*50*).

Mitigation of negative impacts on employment are the same as those for negative business impacts. The most important mitigation measures for the short run are to maintain continuous customer access to the business during construction and to complete the project as quickly as possible. The overall longer-run impacts can be positive if they are combined with other measures to promote growth in business and employment in the affected area.

Research documenting the results of case studies on employment impacts of various types of highway widening would be valuable to the assessment of alternative proposed highway-widening projects. Recent work done by the Texas Department of Transportation and the Texas Transportation Institute provides examples of research of this kind (*44*).

PROPERTY VALUES

The impacts of highway-widening projects on property values are considered by survey respondents to be indirect or secondary, of moderate importance, and long-term. They can

be traced to increases in noise and emissions from traffic. Partial acquisition of real estate parcels to accommodate the wider highway results in remainder parcels with changed values, usually lower ones, as well.

On the positive side, property that becomes more accessible because of the widening project may increase in desirability and value. Whether the net effect is positive or not depends on the type of land use (commercial, industrial, residential, recreational) as well as on the relative changes in accessibility, noise, and air quality.

Estimating these direct impacts and tracing their influence on land value requires comparison of the situation in question with similar situations for which the impacts on land value are known. Changes in land value that are the result of increased noise and air pollution have been studied. The impacts of changes in accessibility on land values at various locations around the country have been measured and are known. Changes in value of remainder parcels of various sizes have also been studied. Some inference of the expected change in property value can be made by examining these sources and estimating their individual and combined effects. The expected changes in noise, air quality, and accessibility must be made first, of course.

A number of studies of the effects of these changes on property values have been made by various states and by FHWA. Many are part of studies of the socioeconomic impacts of freeways and widenings of arterial highways in urban areas. Others are the result of studies of the impacts of freeways on land use. A comprehensive review of the effects of highway proximity and accessibility on property values was compiled for FHWA in 1976 (*19*).

The nature of the type of information available is given in an internal Caltrans report. The report is a survey of literature on the impact of urban freeways on residential property values. It reveals that increased noise tends to reduce values up to 16 percent for homes abutting the freeway (adjacent to two blocks away) while increased accessibility tends to increase values up to 17 percent for homes up to eight blocks away, higher increases accruing to homes where the increased accessibility is put to use for commuter and shopping trips. Freeways with landscaping, alignment, and placement designed to fit into neighborhoods and settlement patterns had the more positive effects on residential property values (*51*).

It is also possible to review the sale prices of various properties in the affected zone of a change similar to the one being assessed, before and after the change occurred. Types of land uses as well as the types and levels of direct impacts known to have taken place must also be taken into account.

Much research, dating from the 1960s through the early 1990s exists. Some is quoted in the article on two Texas case studies of economic impact cited earlier (*44*). An in-depth analysis of the available literature on the economic impacts of highway widening could be valuable to highway planning practitioners.

TAX BASE

Impacts of highway-widening projects on the tax base are not deemed either significant impacts or key issues by the states, provinces, and MPOs participating in the survey. The amounts of land converted to public highway use and taken off the tax rolls are generally small. Other impacts on the tax base are derived from the effects of the projects on the amount of business, both short- and long-run, (sales tax) and on property values (property tax). These effects are described in earlier sections of this chapter. One respondent noted the impacts on tax revenues deriving from loss of jobs caused by widening projects.

Standards for estimating this category of impact are illustrated in this quote from the Caltrans manual on conducting socioeconomic analyses:

> . . . [A]nalysis of the impact on local tax revenue, both property and sales taxes, should be done if a sizable portion of a community's residences and/or businesses will be removed. . . . [The] tax revenue lost should be calculated as a percentage of total local tax revenue and not just presented as a total amount (*11*).

Inference of a potentially positive impact on the tax base of Denver was noted in the study of the effects of changes to a major I-70 interchange there:

> There would be some minor impact to the tax base of Denver due to the loss of property taxes on privately-held lands and the losses of other business-generated taxes. On the other hand, revenues for Denver could increase due to the actions of this project if the redevelopment of the I-70/Washington Street and Brighton Boulevard interchanges spurs an increase in land values and in the use of the Washington Street corridor and the Denver Coliseum and its revenue-generating parking lot. Likewise, the redevelopment of this interchange could be a catalyst for additional utilization of the NWSS [Northwest Stock Show] facilities and Brighton Boulevard business sites (*8*).

Mitigation measures suggested include reducing budgeted public expenditures to match the expected revenue decline and designating a base for taxation other than real property (*50*).

The research results available from existing sources on the subject of the impact of highway widening on the tax base, similar to the situation for property values, would be valuable in a compendium of economic impacts.

BUSINESS PARKING

Parking impacts of highway-widening projects are felt by the states to be important to businesses. However, the states rank the impact as of only moderate importance and do not rank it explicitly as a key issue. Provinces and MPOs give parking a low ranking.

On the other hand, the provision of too much parking has been viewed by critics as having negative environmental effects due to the encouraging effect it has on automobile use (*52*).

Projects that reduce the number of parking spaces available to a given business constitute the major problem in this category. Parking spaces partially or wholly on land that might be acquired for the widening of the highway are at risk. These problems are sometimes mitigated by reducing the amount of land acquired on a particular side of the highway. This is done by shifting the roadway alignment to the opposite side of the

right-of-way or by reducing the amount of widening in that particular segment. Replacement space for parking might be found adjacent to or near the business affected. Rearranging or resizing the spaces in the impacted lot may also be a way of recovering lost spaces (*8*). One respondent noted that in some localities building codes requiring businesses to have a specified number of parking spaces mandate the mitigation of loss of parking spaces.

SAFETY

Safety as an economic impact of highway widening was identified as a primary effect by three-fourths of the states and MPOs and by all of the provinces. It is infrequently mentioned as a key issue, however. The cost savings from reduced accidents are occasionally mentioned as benefits of widening in the studies reviewed. For a South Carolina project report published in 1993, accident cost savings were estimated using the AASHTO *Manual of User Benefit Analysis on Highway and Bus Transit Improvements*, published in 1977 (*28*). The National Safety Council was the source of accident cost estimates used in a Finding of No Significant Impact for a Lincoln, Nebraska project, according to a report published in 1991 (*32*). Respondents have noted that safety cost estimates developed by FHWA and the National Safety Council since 1990 have been significantly higher than those published in 1977 (*50*).

Safety improvement measures suggested in the questionnaire responses include more interaction with the public to seek community support for safety-enhancing measures, accident analysis, and improved facility design.

OVERVIEW

The manuals, study reports, questionnaires, and research results reviewed show that the economic impacts of highway-widening projects can be quite substantial. Under certain circumstances, the effects could be great enough to cause firms to go out of business. Methods for making both short-range and long-range impact assessments were developed in the 1960s and 1970s, primarily to assess alternative Interstate highway route locations (*19*). The results of extensive research done on economic impacts in that same era are still available and generally relevant. However, most of the studies reviewed gave only brief and perfunctory treatment to economic effects. Mitigation of negative impacts is also typically given only brief coverage.

CHAPTER FIVE

ENVIRONMENTAL EFFECTS OF HIGHWAY WIDENING

CATEGORIES EFFECTS OF HIGHWAY WIDENING

The category of environmental effects has been restricted to impacts on the physical environment. For the purpose of this synthesis, environmental effects have been grouped into the following areas :

- Air quality
- Noise
- Wetlands
- Wildlife habitat loss and endangered species
- Watershed, stormwater runoff, water quality, and water supply issues
- Hazardous materials and other soil contaminants
- Historic structures and archaeological sites.

In all the documents reviewed for this synthesis, effects on the physical or natural environment are covered far more thoroughly than social or economic effects. Emphasis on the natural environment is a direct result of the increasing concerns about highway projects expressed by regulatory agencies and specialized public-interest groups over the last 30 years or more. The massive scale of the Interstate highway program was the major stimulus for action.

Concern for the way public-works projects, including highways, were being planned, designed, built, and operated, among other issues, brought on the National Environmental Policy Act (NEPA) of 1969. It created the Council on Environmental Quality (CEQ). The Environmental Protection Agency (EPA) was empowered by the Clean Air Act Amendments of 1970 to set and enforce air pollutant emission standards. Compliance with NEPA as administered by these agencies, and with companion laws passed by many states, has required federal, state, regional, and local governments to focus a great deal of effort on analysis of the effects of proposed highway projects on the natural environment.

The Federal-aid Highway Act of 1970 and subsequent federal highway legislation up through the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) have resulted in the establishment of planning, design, and review procedures that reinforce the focus on the natural environment to satisfy NEPA requirements as administered by EPA and allow highway projects to proceed. The focus on the natural environment is also reflected in the experience and interests of the employees of federal and state resource and regulatory agencies who administer the laws and regulations, such as EPA and the U.S. Army Corps of Engineers. Their reviews of environmental impact assessment documents require project proponents to spend most of their efforts estimating effects on noise, air quality, wildlife, water quality, habitat loss—the effects covered in this chapter.

Analyses performed in Canada are governed by provincial laws such as the Ontario Environmental Assessment Act of 1980. Environmental effects include the natural, social, economic, and cultural categories. Component studies that may be required of the natural environment include fisheries and aquatic biota, wetlands, vegetation, wildlife, surface water, ground water, soils, air, and stormwater. Estimates of project impacts during and after construction may be required, as well as a mitigation and monitoring program that contains an environmental protection plan (*6,27*).

Survey respondents listed a number of issues that relate to the overall process of estimating effects on the natural environment. These are areas of potential improvements in the efficiency and effectiveness of the process. Foremost is the nature and extent of negotiations. States and MPOs are concerned about the uncertainty surrounding the requirements and extent of the process that results from the way the process is conducted. The particular need may be for permitting and for proponent agencies to obtain very early in the project development process an understanding of the nature and depth of the concerns of the resource and regulatory agencies regarding that particular project (personal communication, David Foster). Scoping sessions, presentation of data to resource and regulatory agencies, and mitigation negotiation are all mentioned as concerns. Requirements may vary significantly from case to case. More effective partnering among the involved agencies has been suggested as one approach to mitigate this type of issue.

AIR QUALITY

The stringency of the laws and regulations governing air quality assessment has had a profound effect on the degree to which the various types of highway-widening impacts are covered in system and project analyses today. This section begins by reviewing the development of these laws to illustrate the amount and type of effort that was expended.

Efforts to improve air quality through control of motor vehicle emissions has a history predating NEPA (*53*). California pioneered in regulating permissible automobile emissions, setting standards for the 1967 model year. The California standards were adopted at the national level for the 1968 model year in the Clean Air Act of 1965. Clean Air Act Amendments beginning in 1970 and continuing periodically to 1990 have forced down the allowable levels of carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NOx) emitted by new vehicles manufactured for the U.S. market.

Attempts have been made since the early 1970s to develop federal regulations that result in lower emission levels in metropolitan areas. State vehicle monitoring programs and transportation facility investment and operating programs have been mandated. State vehicle emission control inspection programs

were mandated in 1977, to be implemented in 1982 for areas likely to be in noncompliance in one or more of the regulated pollutant classes in 1983.

As a result of the Clean Air Act Amendments of 1977, states were required to develop implementation programs (state implementation program (SIP)) that identified areas in nonattainment with respect to one or more of the regulated pollutant standards (National Ambient Air Quality Standards (NAAQS)). Transportation control measures had to be applied that would result in progress toward attainment acceptable to EPA. State and local highway-widening projects developed under Federal-aid programs within nonattainment areas were required to include estimates of the net pollutant burden resulting from the project and to identify applicable mitigation in support of the transportation control measures of the SIP.

With the Clean Air Act Amendments of 1990 and ISTEA of 1991, more definite and enforceable transportation air quality planning requirements were established for states and MPOs. They include firm deadlines and meaningful penalties for noncompliance.

Air quality impact has been classified by survey respondents as primary and both short-term (during construction) and long-term. It is tied for third place with historic structures and archaeological sites for most frequent mention as a key issue, behind wetlands and noise. Environmental effects were mentioned as key issues 148 times by survey respondents, while social effects were mentioned 79 times, and economic effects, 63 times.

The reports reviewed were published as early as 1986 (*2*) and as late as 1994 (*1*). Over 60 percent of them postdate ISTEA, and more than 75 percent of them came out after enactment of the CAAA of 1990. Consequently, many of the reports respond to the more exacting air quality requirements. A sophisticated and reasonably well-organized practice of estimating the air quality impacts of proposed transportation facilities has grown up over the past 25 years or so. It is based on models developed by EPA and Caltrans. A large part of the Caltrans modeling capability was transferred to the California Air Resources Board during the late 1970s. Reviews performed by personnel of these agencies have shaped the process and the content of environmental impact reports quite significantly.

The following passages selected from an Environmental Impact Statement for the widening of I-5 in Orange County, California, present in capsule form a description of the air quality impact estimation process. These passages show the depth of detailed analysis contained in the process. The description applies to a greater or lesser extent to the process as followed in all the states and provinces:

> Changes in travel efficiency can be determined by summing the air pollution burden of the existing and selected future improvement alternatives. This burden calculation is made by combining traffic volumes with speed dependent emission factors. Traffic data from the Caltrans Transportation Analysis Section and LARTS Branch were combined with the latest emissions data from the Air Resource Board (ARB) EMFAC7C computer model to calculate total emissions on the I-5 segment from Chapman to Magnolia. The burden calculations were performed for existing traffic, and for year 2010 for [all options] . . [The calculations] show that the future system for all alternatives [including the No Project Alternative] will transport more cars than the existing configuration, with fewer air emissions.
>
> . . . The HOV lanes on I-5 result in a benefit of 160,000 fewer miles traveled, over 75,000 travel hours and 25,000 gallons of fuel saved, and reduce air emissions by ten tons of CO, one ton of total organic gases (TOG) and a negligible increase in NOx emissions.
>
> . . . [T]he California line source roadway dispersion model (CALINE4) was run [for all scenarios] . . . to determine existing roadway air pollution distributions, and to evaluate any changes due to project implementation. Input parameters included very restrictive dispersion conditions and congested rush hour traffic in order to generate the worst-case impact assessment. Light winds almost parallel to the roadway were used to estimate pollutant exposure at twenty-three receptor sites . . . within the area of potential I-5 traffic pollution influence.
>
> . . . Ramp metering and ramp HOV bypass lanes shall be incorporated into the final design of the project in accordance with the Air Quality Management Plan, Control Measure 4, traffic improvements.
>
> . . . Due to a lower level achieved through emission reductions incorporated into new car design, the No Project Alternative condition will experience a reduction of daily and peak hour emissions . . . (*22*).

The reports reviewed often identified the publications used as guidelines and the models employed to estimate the air quality impacts of the highway-widening projects concerned. They are listed here to make the picture of air quality impact assessment more complete.

FHWA's Federal Highway Program Manual (FHPM) 7-7-9, "Air Quality Guidelines," is most often mentioned as the authoritative guide for analysis. The air quality impact section of the FHWA Technical Advisory T 6640.8A, "Guidance for Preparing and Processing Environmental and Section 4(F) Documents," is frequently mentioned. The only air quality regulation referred to in any of the reports is 23 CFR 770, "Rule on Air Quality Conformity and Priority," issued by FHWA. The EPA technical publication, "Mobile Source Emission Factors," is referenced in one 1987 report.

Emissions and dispersion models developed by EPA, Caltrans, and the California Air Resources Board constitute the generally accepted set of analytical procedures. These models have been criticized for relying on average vehicle speeds and not reflecting the speed profiles of vehicles. It is well known that the rate of pollutant emissions varies with vehicle speed. The rate for some pollutants increases with speed, while for others it decreases. Consequently, it is claimed that the air quality impacts of contemporary traffic control systems and other measures that influence vehicle speeds cannot be adequately estimated. The same criticism has been leveled at traditional transportation planning models, as well. It is claimed that conformity to standards required under the CAAA cannot be determined with the available models, including MOBILE 4.1, which is currently being used. Efforts are under way in FHWA and EPA to develop new travel demand estimation and emissions models to correct these shortcomings.

NOISE

The process of regulating noise from highway motor vehicles began with the Federal Noise Control Act of 1972. The Act directed EPA to develop and promulgate noise standards. The first standards, issued in 1976, applied to medium and heavy trucks. Those for buses and motorcycles followed in 1977 and 1978, respectively (*53*). Standards were issued by FHWA in 1972 for maximum permissible noise levels from new or modified highways. Levels are established by type of receptor such as residence, recreational facility, office, and commercial facility. They are published in 23 CFR Part 772, *Procedures for Abatement of Highway Traffic Noise and Construction Noise.*

Noise ranks evenly with wetlands as the impact category most frequently considered a key issue by the states, provinces, and MPOs responding to the questionnaire. It was classified by these respondents as a primary long-term impact. A significant number classified noise as a short-term impact, referring to the construction phase.

Three phenomena emerge from the review of the study reports. The first is that noise analyses are performed for virtually every project, even to show that noise does not exceed the maximums set in the standards for the receptors concerned. The second is that the methods of analysis used are reasonably straight-forward and not complex. Virtually all the guidance and models were created by FHWA or by Canadian highway agencies. The third phenomenon evident in the reports is that the project proponents, particularly the state or provincial DOT personnel involved, understand the mitigation measures and have them well under control.

FHWA has provided both the guidance and the models used by states and other project proponents in the United States to assess the noise impacts of highway-widening projects and to develop noise-mitigating measures. The prime authority for all analyses is 23 CFR Part 772, which contains noise abatement criteria (NAC). The model commonly employed is described in FHWA Report RD-77-108, *FHWA Highway Noise Prediction Model,* by T.M. Barry and J.A. Reagan. Noise levels are predicted by the STAMINA 2 program and estimation of the effectiveness of noise barrier walls of varying designs is done using the program called OPTIMA.

In Canada the agency responsible for legislation and policy on noise is the provincial Ministry of Environment. Guiding documents are issued by the respective Ministries of Transportation of the provinces (*27*).

Noise barriers are the most prominent mitigation measure. They are used predominantly to protect residential areas from noise incursion. States have established cost-per-residence as one of the factors for a barrier to be considered to be reasonable in a given situation. Figures from $25,000 to $40,000 per household were mentioned in various reports (*24,54*). Other considerations governing noise barriers include number and spatial distribution of structures, the predominant activities carried on in the area, the visual impact of the barrier, and practicality of construction (*23*). Cost varies among different regions of the country, but total installed cost in 1992 was generally in the neighborhood of $15 to $20 a square foot, with $16.50 used in many jurisdictions as a rule of thumb (*23*). Mitigation fairly typical of a highway-widening project was developed for the expansion of a 1-mile section from two-lanes to a four-lane divided cross-section. Six barriers ranging in height from 10 to 14 feet and up to 387 feet (average of 254 feet) in length will be installed to protect a school, an inn, and residences. The level of mitigation for these receptors averages 5 dB (*51*).

Other noise mitigation measures employed include restricting trucks and buses from the widened segment, alterations of vertical and horizontal alignment, acquiring property to serve as a buffer zone, and constructing earth berms. In one case, the use of exposed aggregate concrete pavement surface, which is expected to produce less noise interacting with vehicle tires, was used as a mitigation technique.

In summary, the highway-design professionals in state and local government agencies and their consultants have followed the guidance provided to them by FHWA. They have been thorough and creative in identifying and mitigating traffic noise associated with highway-widening projects.

WETLANDS

Wetlands tie with noise as the impact category most often considered by the survey respondents as a key issue. It ranks slightly higher than historic structures and archaeological sites as the category requiring the most time and is tied with that category for second, behind noise, as the category requiring the most data. Actions most often suggested by the respondents for resolving wetlands issues are to avoid wetlands altogether, to provide replacement wetlands, or to provide highway alignments and designs that minimize the impacts on given wetland areas. Other measures suggested for resolving wetlands issues include working closely with resource and regulatory agencies and the affected public from inception at the planning stage through implementation. As mentioned in the section on air quality, it has been suggested that an early understanding on the part of project proponents of the nature and depth of the concerns of resource and regulatory agencies can remove much uncertainty, focus analysis and planning efforts, and reduce the time and cost of the overall planning and implementation task. Proponents should seek to obtain buy-in on the part of the resource and regulatory agencies at the time of the issuance of the planning systems letter (*37*). More thorough field studies, especially the mapping of wetlands, and feasibility assessment during the planning stages have also been suggested as means to reduce uncertainty on the part of the reviewer and increase the efficiency of the process.

Survey respondents also indicated that wetlands impacts need improved mitigation measures. Concern was expressed for having measures that result in conditions as good in type and quality, as well as in quantity, as what is taken for highway purposes. Greater flexibility in the acceptability of measures by regulatory and resource agencies has also been recommended. While these two concerns may appear antithetical, they both indicate a need for in-depth knowledge of the function and value of wetlands, how they are impacted by highways, and how they can be restored or replaced. Once again, an early mutual understanding of the concerns of the regulatory agencies should enable project proponents to develop

the needed in-depth assessments more directly and with less uncertainty.

A study performed for adding lanes to an arterial street on the west edge of the Omaha, Nebraska metropolitan area describes the typical activities and concerns associated with wetlands in suburban highway-widening projects:

> The purpose of performing the wetlands study was to identify jurisdictional wetlands according to the Army Corps of Engineers (ACOE) guidelines . . . . The wetlands determination used technical criteria, field indicators and other sources of information to determine whether the area has jurisdictional wetlands or not and delineated the boundary of the wetland areas. The methods used generally followed the Federal Manual for Identifying and Delineating Jurisdictional Wetlands, January, 1989 . . . . The value of the four wetland areas should be reviewed for their role in flood mitigation, storm abatement, aquifer recharge, water quality improvement and their aesthetic qualities. If portions of the wetlands are altered or destroyed it is our intent to mitigate these wetlands (i.e., no net loss of wetland area) (*49*).

Wetlands issues are also touched on in the sections on wildlife habitat loss and watersheds, which follow.

WILDLIFE HABITAT LOSS, ENDANGERED SPECIES

Impacts on wildlife habitats and endangered species are perhaps not as great in urban and suburban areas as in rural, and highway widening may not produce as extensive effects as new facilities. Survey respondents classify these impact categories as primary and long-term, however, with some votes for secondary. Some classified them as short-term impacts during construction. Endangered species are mentioned with moderate frequency and often as a key issue.

The greatest efforts found for these two areas in the studies reviewed were devoted to the survey and identification of plants and animals living on lands that would be impacted by alternative highway-widening proposals. While only one mention (habitat fragmentation) was made of these areas for research needs, several states nominated wildlife habitat loss and endangered species as good topics for further research.

WATERSHED, STORMWATER RUNOFF, WATER QUALITY, AND WATER SUPPLY ISSUES

Protecting surface and ground water quality and preventing soil erosion and soil loss are the major concerns with these four categories of highway-widening impacts. Watershed and water supply were infrequently classified as primary impacts, but about 40 percent of the survey respondents classified them as secondary. They were mentioned only very few times as key issues by the states, provinces, and MPOs responding to the survey. Stormwater runoff and water quality, on the other hand, received a moderate number of mentions as key issues in highway widening. They were classified as primary by over half the survey respondents and as secondary by 40 percent.

The studies reviewed emphasize attention to these impacts in project design and in construction planning and implementation as the best means of mitigation (*52*). Some of the measures taken are described in these report excerpts:

> [I-5, Orange County, CA] Effective methods for controlling erosion and sedimentation as a result of grading and construction include: 1) leave the soil exposed for the shortest time possible; 2) provide a protective cover for exposed soils; 3) reduce and/or control the velocity or flow of potential runoff and; 4) detain runoff on-site to trap sediment. . . . The various local storm drains and freeway drainage structures shall be preserved in place, extended or replaced to Caltrans standards. . . . Compensatory retarding capacity shall be provided [at other sites in the affected creek system to compensate for any encroachment on a retarding basin] (*22*).

> [I-70, Denver, CO] Construction of short flood levee on west bank of South Platte River will be part of the project. Also, (a) new stormwater system would be built to reduce flooding of underpasses (*8*).

> [State Route 66, Middlefield, CT] There are three primary means to reduce the risk of pollution from highway spills:
>
> - Reduce accidents that would cause spills . . .
> - Incorporate physical containment structures in roadway design . . .
> - Respond rapidly to spills . . . Per Section 22A-450 of the Connecticut General Statues, failure to immediately report a spill is punishable by a fine of up to $5,000 . . . . The CTDOT is considering the installation of an emergency telephone . . . to facilitate an immediate response (*26*).

> [IL 59, Plainfield, IL] The collected runoff from IL 59 will be directed into adjacent agricultural fields and will drain as sheet flow. Sheet flow across vegetated areas has been found to be effective at removing most pollutants from highway runoff (*56*).

HAZARDOUS MATERIALS AND OTHER SOIL CONTAMINANTS

Hazardous waste in the proposed right-of-way is classified as a primary impact by approximately 60 percent of the states, provinces, and MPOs responding to the survey. It is of moderate importance as a key issue. Research on analysis methods and allowable thresholds of various materials has been suggested by a number of the states responding. Hazardous materials rank second only to wetlands as an impact needing better mitigation techniques. A common complaint is the lack of flexibility with respect to the amounts of various materials allowed to remain in the soil under different successor land uses, whether or not the materials are classified as hazardous.

Another key issue is the uncertainty regarding the nature and extent of the risks and liabilities associated with contaminants in soil. A large number of variables must be considered, including toxicity and worker safety, as well as longer-term health and safety implications. The bottom line for many highway agencies is succinctly stated in an Illinois report: "Any future investigations will insure that contaminated property will not be acquired until all risks and liabilities of such acquisition can be justified" (*56*).

Two NCHRP projects directed at assisting states and other agencies with these problems have been completed. The first publication focused on the identification and remediation of

hazardous waste sites (*57*). The second is a follow-up study and deals more extensively with the topic (*58*).

Research on case studies of risks encountered and how they were dealt with in various cases involving contaminants in the soil would be quite helpful to proponent agencies.

CULTURAL RESOURCES

Identifying potentially impacted historic structures and archaeological sites and determining appropriate mitigations are considered to be primary impacts by some 60 percent of responding states, provinces, and MPOs. This category of impacts ranks fifth as the most frequently mentioned key issue. Highway-widening project proponents normally address the issue through the state historic preservation office and the state archaeological staff. These two groups or their counterparts in each state are well-versed in their respective subjects. They are able to provide valuable advice and recommendations on qualified consultants.

The National Historic Preservation Act mandates the required consultation process. Site identification and categorization as well as mitigation measures are approved by the state historical preservation office. Effects on significant cultural resources also involve the Advisory Council on Historic Preservation.

Several of the reports reviewed contain records of historic structure and archeology site assessment and mitigation. The following record of a South Carolina highway-widening project describes a typical process:

> Historic and archaeological information was gathered through archival research, and archaeological and architectural field surveys . . . .Seven archaeological sites (five prehistoric and two historic) were discovered during the field surveys . . . All seven sites are considered ineligible for the NRHP [National Register of Historic Places], due to the degree of erosion and construction activities along the study corridor . . . .The architectural field survey evaluated all sites and historic structures 50 years or older . . . .Only the historic structure presently being used as the Smugglers Cove Restaurant, located near the intersection of S.C. 161 [subject of widening project] and S-961 is recommended eligible for the NRHP. The structure is in good condition and exhibits good architectural integrity by retaining the majority of its original construction materials, as well as a sense of historic setting. The S.C. State Historic Preservation Office (SHPO) concurs that this structure is NRHP eligible . . . .During the Letter of Intent response period, SHPO concurred with the use of the archaeological firm engaged to conduct the archaeological and architectural surveys. The results of the . . . surveys were submitted to SHPO and the Advisory Council on Historic Preservation (ACHP), in accordance with the section 106 (National Historic Preservation Act) consultation process. Both . . . concur with the findings of no adverse effect . . . (*28*).

Accepted practice in assessing the impacts of a proposed highway-widening project on historical structures or archaeological sites is clearly defined. There are experts in state agencies who serve as resources for project proponents as well as regulators. Qualified consultants are available to perform analyses. Project impacts are thoroughly researched, analyzed, and communicated to those with a need or a desire to know.

CURRENT PRACTICE IN ASSESSING IMPACTS ON THE PHYSICAL ENVIRONMENT

Public concern for the natural environment and cultural resources has resulted in laws and requirements that exact a great deal of effort from transportation agencies. Meeting these requirements has focused the efforts and concerns of project proponents on this area. Social and economic impacts of highway-widening projects are covered far less thoroughly in all but a fraction of the proponent jurisdictions.

CHAPTER SIX

CONCLUSIONS

The current practice of assessing the effects of highway-widening improvements on urban and suburban areas is at three different levels of development. The reasons for this conclusion lie in the forces that have shaped the implementation of NEPA and related laws in the United States and Canada.

Effects on the physical environment are at the first level. They are quantitative to a considerable degree and are done in great detail. Generally accepted practices are clearly defined and well-known. This does not preclude disagreements in the interpretation of the results, however.

Economic effects are at the second level. Being in the human dimension and having the common denominator of money, there is a generally accepted set of important economic impacts. Plausible qualitative arguments often comprise their analyses, however. Quantitative methods of estimating economic impacts exist, but they are not in a form easily accessible to the analyst nor are they well-known. Surrogate measures are often employed. There are few, if any, generally accepted practices.

Social effects are at a third level. There is general agreement that impacts on the quality of life enjoyed by individuals and groups are important. There is not yet any generally accepted classification of important impacts despite the requirements of 23 USC 109(h). Methods of measuring impacts are just now evolving toward those that will allow more discrimination among alternative widening schemes. Beyond simple accounting of relocation requirements, there are no generally accepted practices.

Meeting public concerns about the effects of proposed highway-widening projects requires a great deal of effort from the professional staff of federal, state, provincial, and local transportation agencies. The information gathered for this synthesis shows that the guidance and models provided by FHWA, EPA, AASHTO, and the individual states and provinces has been quite valuable. Knowledge and approaches gained from new research focused on certain specific needs would also be quite valuable.

NEPA calls for informing the affected public of the social, economic, and environmental effects of public works projects, including highway widening. It is focused, however, on impacts on the physical environment and the social and economic impacts stemming from them. FHWA requires the more balanced assessment of social, economic, and environmental impacts mandated by 23 U.S.C. 109(h). Most of the documents reviewed for this synthesis are heavily weighted toward estimation of the impacts on the physical or natural environment.

More research and development is needed to define and deploy improved practices in the assessment of the social effects of highway widening. A classification of important impacts is the first need. Community cohesion, relocation, access to public facilities and services, safety, and equity should all be considered. Reliable data and methods for measuring these impacts need to be found or developed and put in a form available to the analysts who need them.

Currently available methods of estimating the important direct economic impacts, including needed data, can be put in a form readily available to analysts. Impacts on businesses, classified as to whether they are traffic-serving or not, on property values and new development, relocation, employment, tax revenues, and highway users should be covered. Better estimation techniques need to be developed and widely disseminated.

Research directed toward updating and reissuing the publication, *Social and Economic Effects of Highways,* produced by FHWA in 1976 would be very useful to the field. Guidance could be given to highway agencies on successful approaches to the estimation and management of social and economic impacts of many types of highway projects, including various levels of highway widening. The approaches could include developing new institutional relationships as well as categorizing, estimating, promoting, and mitigating the various types of social and economic impacts.

There is a need in several areas of the physical environment for reducing the uncertainty regarding what are serious impacts of highway-widening (and other) projects and what are not. This need extends to hazardous materials, wetlands, wildlife, and air quality. The development by proponent agencies of a better understanding of the perspectives of resource and regulatory agencies on the key issues and concerns regarding particular projects should substantially reduce that uncertainty. Some respondents have suggested that these efforts begin as early as possible in the development of individual projects.

Research is needed that articulates the levels of impact and cause-effect relationships between highways and the environment in ways that the affected public can appreciate. A common level of knowledge is needed that allows more effective communication among highway project proponents, resource and regulatory agency personnel, and the affected public.

Well-focused research on the impacts of highway widening can improve the understanding of these impacts. Furthermore, the improved understanding will give highway agencies the opportunity to manage the impacts more effectively through improved methods of planning, design, operations, and maintenance. As a result, these agencies will be able to serve better the users and neighbors of their highway systems.

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52. From an address at the October, 1994, four-state conference of the American Planning Association in Little Rock, AR, by Frank Kent, Executive Director, Partners for Livable Places, cited by James McKenzie, Executive Director, Metroplan, Little Rock, AR, November 15, 1994. Saying "traffic engineers are evil," Kent felt that they often tend to plan for too much parking to the extent that it has a negative influence on the desirable goal of encouraging people to leave their cars at home and seek alternative modes of transportation.
53. Altshuler, A., with J.P. Womack and J.R. Pucher, *The Urban Transportation System,* MIT Press, Cambridge, MA, 1981.
54. *Draft Environmental Assessment S.C. Route 700,* South Carolina Department of Transportation, Federal Highway Administration, January 1994.
55. *Initial Study/Environmental Assessment for State Route 156,* California Department of Transportation, Federal Highway Administration, September 1992.
56. *Environmental Assessment and Section 4(f) Evaluation for FAP 338,Illinois Route 59,* Illinois Department of Transportation, October 1993.
57. Friend, D., and J. Connery, *NCHRP Report 310: Factors to be Considered by Highway Agencies in the Identification and Remediation of Hazardous Waste Sites,* Transportation Research Board, National Research Council, Washington, D.C., 1988.
58. *NCHRP Report 351: Hazardous Wastes in Highway Rights of-Way,* Transportation Research Board, National Research Council, Washington, D.C., 1992.

APPENDIX A

Survey Instrument

EFFECTS OF HIGHWAY WIDENING IMPROVEMENTS ON URBAN AND SUBURBAN AREAS

NCHRP PROJECT 20-5
Synthesis Topic 24-13

Name of Respondent: _____
Title: _____
Name of Agency: _____
Phone Number: _____

A. EXISTING ISSUES AND PRACTICES IN ASSESSING HIGHWAY WIDENING EFFECTS
(If you need more space, please use back or separate page.)

1. Please indicate the approximate number of widening projects undertaken in your jurisdiction in the past two years.

	Reason	Number	Comment
a. Capacity Improvement	_____		
b. Safety Improvement	_____		
c. Correct Design Deficiencies	_____		
d. Legislatively Mandated	_____		
e. Others (please specify)	_____		

2. What are the most frequently encountered issues or concerns regarding highway widenings expressed by:

a. Public Officials _____
b. Impacted Businesses _____
c. Impacted Residents _____
e. Regulatory & Resource Agencies _____
f. Other (please specify) _____

3. Following is a list of the impacts, by category, often identified as "highway improvement impacts." From your experience and observation, please **place a check mark** to show whether you consider each impact as usually being: (1) a primary effect of widening; (2) a secondary effect; (3) a long-term effect; (4) a short-term (temporary) effect; or (5) a cumulative effect. **More than one category may be checked.** Please add any additional effects that you observe to be substantial. Also, put a 0 for any impact category rarely or never found significant in a highway widening assessment.

Category	(1) Primary	(2) Secondary	(3) Long-term	(4) Short-term	(5) Cumulative
a. Social					
1) Land Use Changes					
2) Residential					
3) Public Facilities					
4) Green Space/ recreational loss					
5) Safety					
6) Street Closures					
7) Public Services					

Category	(1) Primary	(2) Secondary	(3) Long-term	(4) Short-term	(5) Cumulative
8) Community Cohesion					
9) Non-Motorist (Pedestrians, Bicyclists)					
10) Transit-Dependent					
11) Emergency Access					
12) Detours					
13) Title VI Discrimination					
14) Temporary Access/Construction Impacts					
15) Other (Specify) _____					
b. Economic					
1) Business Displacem't					
2) Jobs					
3) Utility Relocation					
4) Access/Circuitous Routing					
5) Property Values Gain/Loss					
6) Tax Base (Short-term/Long-term)					
7) Parking					
8) Safety					
9) Other (Specify) _____					
c. Environmental					
1) Air Quality					
2) Noise					
3) Wetlands					
4) Endangered Species					
5) Watershed					
6) Wildlife Habitat Loss					
7) Stormwater Runoff					
8) Water Quality					
9) Water Supply					
10) Hazardous Mat'ls					
11) Historic Structures & Archeology Sites					
12) Other (Specify) _____					

APPENDIX A (Continued)

4. Which of the above impacts tend to: (a) emerge most often as key issues in highway widening assessments; (b) require the most analysis time; and (c) require the most data? (Please indicate in order of priority by use of identifying letter/numeral from the above list, e.g., a3, c2, etc.)

a. Key issues: _____

b. Most Time: _____

c. Most Data: _____

5. How are the key issues cited in question 4. most often resolved?

	Key Issue	How Resolved
a.	_____	_____
b.	_____	_____
c.	_____	_____
d.	_____	_____

6. What major alternatives to highway widening (signal timing; signs; HOV lanes; TDM; loss of parking, curb, and gutter) are usually considered in impact assessments or in state or federal EIS-type reports other than the "no build" option? (Please list in approximately the frequency order that the alternatives are included in highway widening assessments. Please also indicate approximately how often each alternative is chosen over the widening option: often, sometimes, rarely.)

		How Often Adopted		
	Alternative	Often	Sometimes	Rarely
a.	_____	_____	_____	_____
b.	_____	_____	_____	_____
c.	_____	_____	_____	_____
d.	_____	_____	_____	_____

7. What special problems have resulted from utility location and relocation, and how have they usually been resolved?

	Problems	How Resolved
a.	_____	_____
b.	_____	_____
c.	_____	_____
d.	_____	_____

8. What sources does your agency most often use on assessment criteria, approaches, methodologies, and techniques in highway widening assessments?

	Source	Publisher	Year
a.	_____	_____	_____
b.	_____	_____	_____
c.	_____	_____	_____
d.	_____	_____	_____

9. For which impacts do you feel current assessment techniques and/or criteria are limited or inadequate, needing further research?

a. _____

b. _____

c. _____

d. _____

10. For which widening impacts are better mitigation measures needed?

a. _____

b. _____

c. _____

d. _____

11. What other problems are typically encountered in assessing the social, economic, and environmental impacts of proposed roadway widenings?

a. _____

b. _____

c. _____

d. _____

B. RESEARCH CONCERNING HIGHWAY WIDENING EFFECTS

1. Assessment Techniques

Please provide copies of up to 3 of the most useful in-house documents you know of or use that provide guidance on social, economic, or environmental impact assessment and mitigation techniques applicable to highway widening projects. Completed before-and-after studies are especially desirable. Any out-of-print documents that you furnish will be returned after rapid review.

2. Assessment Documents

Please provide copies of up to 3 highway-widening assessment studies performed for or by your agency that best document the potential impacts of such an improvement.

3. Current or Future Research

Please provide a list of significant past, current, or planned research on highway widening assessment techniques or mitigation measures you are familiar with, giving project title, author(s), research organization, sponsor, location, and start/end date of each study.

THANK YOU FOR YOUR COOPERATION AND ASSISTANCE. WE LOOK FORWARD TO HEARING FROM YOU.

PLEASE MAIL THE COMPLETED SURVEY FORM, ATTACHMENTS, AND DOCUMENTS TO THE FOLLOWING ADDRESS:

Thomas N. Harvey
Harvey Consultants, Inc.
111 Temple Road
Concord, MA 01742-1514
Telephone: 508-371-0928

APPENDIX B

Respondents to Survey

STATES

Arizona Dept. of Transportation
Transportation Planning Division
206 S. 17th Avenue
Phoenix, AZ 85007-3213

California Dept. of Transportation
Environmental Division
650 Howe Avenue, Suite 400
Sacramento, CA 95825

Colorado Dept. of Transportation
Research Coordination
4201 E. Arkansas Avenue
Denver, CO 80222

Connecticut Dept. of Transportation
Environmental Planning
2800 Berlin Turnpike
PO Box 317546
Wethersfield, CT 06131-7546

Delaware Dept. of Transportation
Location Studies & Environmental Engrg
PO Box 778
Dover, DE 19903

Florida Dept. of Transportation
Transportation Planning
605 Suwannee Street, MS 57
Tallahassee, FL 32399-0450

Georgia Dept. of Transportation
Planning and Programming
2 Capitol Square
Atlanta, GA 30334

STATES (continued)

Illinois Dept. of Transportation
Planning and Programming
2300 S. Dirksen Parkway
Springfield, IL 62764

Kansas Dept. of Transportation
Regional and Urban Planning
Docking State Office Bldg, 8th Fl.
Topeka, KS 66612

Louisiana Dept. of Transportation &
Development – Planning Division
PO Box 94245
Baton Rouge, LA 70804-9245

Maine Dept. of Transportation
Bureau of Planning
Transp. Bldg., State House Sta. 16
Child Street
Augusta, ME 04333-0016

Maryland Dept. of Transportation
State Highway Administration
Office of Planning and Preliminary
Engineering
707 North Calvert Street
Baltimore, MD 21202

Massachusetts Executive Office of
Transportation and Construction
Bureau of Planning
10 Park Plaza, Room 4150
Boston, MA 02116-3973

Michigan Dept. of Transportation
Bur. of Trans Plng, Environmental Sect.
PO Box 30050
425 West Ottawa
Lansing, MI 48909

STATES (continued)

Minnesota Dept. of Transportation
Intermodal Programs
Transportation Building
395 John Ireland Blvd
St. Paul, MN 55155

Missouri Highway & Transportation
Department – Urban Planning
PO Box 270
Jefferson City, MO 65102

Montana Dept. of Transportation
Data Collection & Analysis Section
2701 Prospect Avenue
PO Box 201001
Helena, MT 59620-1001

Nebraska Dept. of Roads
Environmental Studies
PO Box 94759
Lincoln, NE 68509-4759

Nevada Dept. of Transportation
Road Design
1263 S. Stewart Street
Carson City, NV 89712

New Jersey Turnpike Authority
Planning Division
PO Box 1121
New Brunswick, NJ 08903

New York Dept. of Transportation
Planning Division
State Campus, Bldg 4, Rm 206
Albany, NY 12232

STATES (continued)

North Carolina Dept. of Transportation
Operations Research
PO Box 25201
Raleigh, NC 27611-5201

North Dakota Dept. of Transportation
Planning Division
608 East Boulevard Avenue
Bismarck, ND 58505-0700

Oklahoma Dept. of Transportation
Transportation Planning Branch
200 N.E. 21st Street
Oklahoma City, OK 73105

Oregon Dept. of Transportation
Environmental Services
1158 Chemeketa Street, N.E.
Salem, OR 97310

Pennsylvania Dept. of Transportation
Bureau of Design
1113 Transportation & Safety Bldg
Harrisburg, PA 17120

South Carolina Dept. of Highways and
Public Transportation
Preconstruction Division
PO Box 191
Columbia, SC 29202

South Dakota Dept. of Transportation
Transportation Plng & Programs Div.
700 East Broadway Avenue
Pierre, SD 57501-2586

APPENDIX B (Continued)

STATES (continued)

Texas Dept. of Transportation
Environmental Affairs
125 East 11th Street
Austin, TX 78701-2483

Utah Dept. of Transportation
Engineer for Programming
4501 South 2700 West
Salt Lake City, UT 84119-5998

Vermont Agency of Transportation
Transportation Program Specialist
State Adm Bldg - 133 State Street
Montpelier, VT 05633

Virginia Dept. of Transportation
Transportation Engineering
1401 East Broad Street
Richmond, VA 23219

Washington State Dept. of Transportation
Transit, Research, & Intermodal Planning
PO Box 47300
Olympia, WA 98504-7300

Wisconsin Dept. of Transportation
Division of Planning and Budget
Bureau of System Planning
PO Box 7913
Madison, WI 53707-7913

PROVINCES

Alberta Transportation & Utilities
Planning Branch
4999 - 98 Avenue
Edmonton, Alberta T6B 2X3

PROVINCES (continued)

Newfoundland Dept. of Works, Services and Transportation
Policy and Planning
PO Box 8700
St. Johns, Newfoundland A1B 4J6

Ontario Ministry of Transportation
Highway System Planning
1201 Wilson Ave., 3rd Fl, W. Tower
Downsview, Ontario M3M 1J8

Saskatchewan Highways and Transportation
Transportation Planning Engineer
1855 Victoria Avenue
Regina, Saskatchewan S4P 3V5

METROPOLITAN PLANNING ORGANIZATIONS

Metroplan
Executive Director
201 E. Markham, Suite 450
Little Rock, AR 72201

Denver Regional Council of Governments
Transportation Services
2480 West 26th Ave., Suite B-200
Denver, CO 80211

Naples (Collier Co.) Metropolitan Planning Organization
MPO Coordinator
Development Services Center
Courthouse Complex
2800 N. Horseshoe Drive
Naples, FL 33942

MPOs (continued)

Atlanta Regional Commission
Senior Transportation Planner
200 Northcreek, Suite 300
3715 Northside Parkway
Atlanta, GA 30327-2809

Northeastern Indiana Regional Coordinating Council
Transportation Planning
City-County Building, Rm 640
One Main Street
Ft. Wayne, IN 46802

Northwestern Indiana Regional Planning Commission
Transportation Planner
6100 Southport Road
Portage, IN 46368

Southeast Michigan Council of Governments
Transportation Programs
660 Plaza Drive, Suite 1900
Detroit, MI 48226

East-West Gateway Coordinating Council
Transportation Planning
911 Washington Avenue
St. Louis, MO 63101-1295

APPENDIX C

Highway-Widening Impact Categories Identified by Survey Respondents

The following five tables represent the responses to questions 3, 4, and 6 on the survey.

Tables C-1, C-2, and C-3 summarize *by percent* the responses by (1) states, (2) provinces, and (3) metropolitan planning organizations (MPOs) to question 3's request for the categorization of a given list of impacts often identified as "highway improvement impacts" as primary, secondary, long-term, short-term, or cumulative. The most frequently reported resolutions of the designated key issues (as requested in question #5 of the survey) are discussed in the text of the report.

Table C-4 summarizes *by number of mentions* how the states, provinces, and MPOs combined responded to the request to indicate which of the impacts in Table C-1 to C-3 are key issues, which require the most analysis time; and which require the most data.

Table C-5 presents a summary *of number of mentions* by the combined three types of jurisdictions in response to question #6 regarding alternatives (other than the "No build" option) to highway widening which are "often," "sometimes," or "rarely" considered in impact assessments or in state or federal EIS-type reports.

APPENDIX C (Continued)

TABLE C-1
34-STATE CLASSIFICATION OF HIGHWAY WIDENING IMPACT CATEGORIES
In Percent

IMPACT CATEGORIES	PRIMARY	SECONDARY	LONG-TERM	SHORT-TERM	CUMULATIVE
A. Social					
1) Land Use Changes	35	62	65	12	41
2) Residential	68	29	47	41	24
3) Public Facilities	41	35	26	38	9
4) Green Sp/Recr Loss	56	35	32	18	32
5) Safety	76	18	47	6	3
6) Street Closures	44	32	24	53	3
7) Public Services	35	41	18	32	15
8) Community Cohesion	32	62	53	32	32
9) Non-Motor(Ped,Bicycles)	62	29	50	41	21
10) Transit-Dependent	9	41	6	53	6
11) Emergency Access	50	6	29	44	12
12) Detours	68	24	0	79	0
13) Title VI Discrimination	24	29	12	21	12
14) Temp Access/Construct	47	26	0	79	3
B. Economic					
1) Business Displacement	68	29	24	56	15
2) Jobs	35	35	18	47	12
3) Utility Relocation	65	24	32	44	12
4) Access/Circuitous Routing	50	35	24	53	15
5) Property Vals-Gain/Loss	32	53	56	26	26
6) Tx Base-Sht/Long Term	26	32	26	38	18
7) Parking	50	29	32	32	26
8) Safety	76	21	32	21	15
C. Environmental					
1) Air Quality	68	41	59	24	6
2) Noise	65	35	53	6	29
3) Wetlands	62	35	38	26	29
4) Endangered Species	56	41	35	29	26
5) Watershed	26	41	18	18	24
6) Wildlife Hab. Loss	47	41	38	24	41
7) Stormwater Runoff	56	38	41	24	26
8) Water Quality	53	41	26	32	24
9) Water Supply	26	18	18	21	9
10) Hazardous Materials	59	32	21	44	12
11) Histor Struc, Arch. Sites	65	53	56	35	

TABLE C-2
4-PROVINCE CLASSIFICATION OF HIGHWAY WIDENING IMPACT CATEGORIES
In Percent

IMPACT CATEGORIES	PRIMARY	SECONDARY	LONG-TERM	SHORT-TERM	CUMULATIVE
A. Social					
1) Land Use Changes	50	75	100	25	50
2) Residential	100	0	50	50	25
3) Public Facilities	100	25	75	50	25
4) Green Sp/Recr Loss	75	50	50	50	25
5) Safety	100	0	100	25	50
6) Street Closures	50	50	75	50	25
7) Public Services	50	75	75	50	50
8) Community Cohesion	25	100	50	50	25
9) Non-Motor(Ped,Bicycles)	50	50	50	25	0
10) Transit-Dependent	25	75	50	25	50
11) Emergency Access	100	0	100	25	0
12) Detours	100	0	0	100	0
13) Title VI Discrimination	NA	NA	NA	NA	NA
14) Temp Access/Construct	50	50	0	100	0
B. Economic					
1) Business Displacement	100	25	75	50	25
2) Jobs	25	50	50	50	25
3) Utility Relocation	100	0	0	75	0
4) Access/Circuitous Routing	75	25	50	50	25
5) Property Vals-Gain/Loss	50	75	75	50	25
6) Tx Base-Sht/Long Term	50	75	50	25	50
7) Parking	50	75	75	25	50
8) Safety	100	25	75	50	50
C. Environmental					
1) Air Quality	50	50	50	25	50
2) Noise	75	50	50	25	50
3) Wetlands	75	25	25	25	25
4) Endangered Species	75	25	25	0	25
5) Watershed	50	50	50	50	50
6) Wildlife Hab. Loss	75	50	25	25	50
7) Stormwater Runoff	50	50	25	25	50
8) Water Quality	50	25	25	25	25
9) Water Supply	50	25	25	25	25
10) Hazardous Materials	75	50	25	25	25
11) Histor Struc, Arch. Sites	100	0	50	0	50

APPENDIX C (Continued)

TABLE C-3
8-MPO CLASSIFICATION OF HIGHWAY WIDENING IMPACT CATEGORIES
In Percent

IMPACT CATEGORIES	PRIMARY	SECONDARY	LONG-TERM	SHORT-TERM	CUMULATIVE
A. Social					
1) Land Use Changes	50	50	100	13	50
2) Residential	50	38	63	13	88
3) Public Facilities	0	75	50	38	38
4) Green Sp/Recr Loss	25	50	25	13	38
5) Safety	63	38	50	50	25
6) Street Closures	38	38	13	50	0
7) Public Services	25	63	0	50	0
8) Community Cohesion	25	63	75	0	63
9) Non-Motor(Ped,Bicycles)	38	50	38	38	25
10) Transit-Dependent	13	50	13	38	0
11) Emergency Access	63	25	38	63	0
12) Detours	63	25	0	88	0
13) Title VI Discrimination	0	38	0	25	0
14) Temp Access/Construct	75	25	0	88	13
B. Economic					
1) Business Displacement	63	38	38	75	13
2) Jobs	38	50	63	38	38
3) Utility Relocation	63	25	13	63	0
4) Access/Circuitous Routing	88	13	50	75	13
5) Property Vals-Gain/Loss	50	50	88	38	50
6) Tx Base-Sht/Long Term	13	63	38	25	38
7) Parking	38	63	38	63	13
8) Safety	75	25	75	50	13
C. Environmental					
1) Air Quality	38	63	38	25	25
2) Noise	63	38	63	38	50
3) Wetlands	63	38	50	25	25
4) Endangered Species	25	63	50	25	25
5) Watershed	25	63	50	0	25
6) Wildlife Hab. Loss	25	63	50	0	25
7) Stormwater Runoff	63	38	38	13	25
8) Water Quality	13	75	38	13	25
9) Water Supply	0	63	13	13	13
10) Hazardous Materials	0	88	0	25	0
11) Histor Struc, Arch. Sites	38	75	38	13	13

TABLE C-4
ASPECTS OF HIGHWAY WIDENING IMPACTS
NUMBER OF MENTIONS BY STATES, PROVINCES, & MPOs (COMBINED)

IMPACT CATEGORIES	KEY ISSUES	REQUIRE MOST TIME	REQUIRE MOST DATA
A. Social			
1) Land Use Changes	11	5	5
2) Residential	13	7	3
3) Public Facilities	3	1	1
4) Green Sp/Recr Loss	5	3	2
5) Safety	15	5	8
6) Street Closures	2	1	1
7) Public Services	2	1	1
8) Community Cohesion	6	4	1
9) Non-Motor(Ped,Bicycles)	8	5	3
10) Transit-Dependent	1	2	1
11) Emergency Access	3	1	1
12) Detours	0	2	1
13) Title VI Discrimination	0	0	0
14) Temp Access/Construct	0	1	1
B. Economic			
1) Business Displacement	21	2	7
2) Jobs	2	1	1
3) Utility Relocation	9	3	5
4) Access/Circuitous Routing	7	2	1
5) Property Vals-Gain/Loss	8	1	3
6) Tx Base-Sht/Long Term	1	0	1
7) Parking	4	1	1
8) Safety	6	1	4
C. Environmental			
1) Air Quality	19	7	17
2) Noise	25	8	23
3) Wetlands	25	12	17
4) Endangered Species	9	4	12
5) Watershed	6	2	4
6) Wildlife Hab. Loss	8	2	5
7) Stormwater Runoff	11	2	9
8) Water Quality	11	3	8
9) Water Supply	6	3	8
10) Hazardous Materials	11	9	13
11) Histor Struc, Arch. Sites	16	11	17

APPENDIX C (Continued)

TABLE C-5
MAJOR ALTERNATIVES TO HIGHWAY WIDENING
CONSIDERED BY STATES, PROVINCES, AND MPOs (COMBINED)

	FREQUENCY OF CONSIDERATION		
	OFTEN	*SOMETIMES*	*RARELY*
ALTERNATIVE			
Traffic Signal Timing	4	4	7
High Occupancy Vehicle Lanes (HOV)	1	6	7
Loss of Parking Spaces	3	9	1
Transportation Demand Mgt (TDM)	3	5	1
Addition of Curb and Gutter	2	5	2
Traffic Systems Management (TSM)	5	2	0
Improved Signing	1	1	3
Restriping for More Lanes	1	2	0
Augmented Public Transit	0	0	3

APPENDIX D

Utility Location and Relocation in Highway-Widening Issues Identified by Survey Respondents

PROBLEMS CITED	RESOLUTIONS OFFERED
1. Space limitations and utility placement in the highway right-of-way	
• Need for additional right-of-way easements	Buy r.o.w.; bury utility lines; work with local businesses; negotiate with landowners; get permit for utilities to be on r.o.w.; treat case by case; forced relocation; coordinate locations with meetings and on-site visits
• Highway and railroad rights-of-way parallel utility relocation	Move relocation to other side of the r.o.w.
• No room for utilities	Treat case by case; stack utilities in the same trench; obtain joint agreement; early planning
• Limited room for relocation	Retain under pavement; use minimum pavement offsets
• Utility conflicts	Move, or provide separate r.o.w.
2. Cost of relocation and allocation of cost responsibility	
• Cost to cities	Develop special assessment district
• Expense, high cost	Assist utility with funding; place within r.o.w.; negotiate with utility; seek alternate, less costly, design; limit number of relocations; share cost between state and city (small towns pay less); look for other options
• Upgrading	State pays fair share of utility relocation; upgrading paid by utility
• Balancing relocation costs with safety	Use of control zone guidelines
• Question of who pays for relocation	Negotiation or legislation
• Additional cost	Innovative financing; delay of project; build project in phases
3. Planning and coordination	
• Timing of relocation	Negotiate with contractors; early coordination; include work in D.O.T. contract
• Late discovery or short notice to utility	Better effort to identify utilities EARLY in planning process
• Construction schedule delay	Contractor modifies work schedule; stage utility work to fit contract schedule
• Timing/construction	Usually solved by advancing the utility project and getting it done before construction starts
• Coordination	Meet with all affected utilities at once
• Delay to prime contractor	Partnering with utilities to resolve issues
• Utility relocation done prematurely	Mitigate/coordinate – very difficult
• Coordination of utility modifications	Include within project
4. Safety and removing hazardous materials	
• Encountering hazardous or solid wastes	Coordinate testing with regulatory agency

APPENDIX D (Continued)

PROBLEMS CITED (cont'd)	RESOLUTIONS OFFERED (cont'd)
• Hazardous materials / pipeline ruptures	Clean up and remove
• Leaking underground tanks	Remove and clean up, or avoid
• State and local regulations	Negotiation of issues
• Uncovering contaminated soil	A real problem; negotiate with regulatory agency; relocate project; investigate and test in planning stage prior to construction
• Objection by utility to safety regulations	Compliance with department's control zone objective required
• Safety issues	Safety devices
5. Mitigation of impact on the natural environment	
• Easement protection vs. wetlands	Move utility easement to other side of highway from wetlands
• Electric sub-station historic protection	Recordation of structure prior to demolition
• Tree removal	Minimize or avoid
6. Problems peculiar to buried utility lines	
• Leaving utilities in roadway	Buy out and relocate utility
• Items in the way	Re-routing or buying out

PROBLEMS CITED (cont'd)	RESOLUTIONS OFFERED (cont'd)
• Fiber optics	Avoid
• Unknown or imprecise locations	Contact utility to locate line through construction site
• Location of guardrail	Dig by hand
• Non RCP pipe	Replace with RCP
• Covering buried lines	Allow to remain, subject to several conditions
• Buried facilities vs. utility line	Obtain early and accurate information on buried location
• Utility is within clear zone	Move outside clear zone; relocate, steepend slopes, guardrail, or barrier deviation
• Control zone compliance	Undergrounding of aerial lines
• Sewer line protection	Encase in concrete
• Natural gas-line crossings	Encase in concrete
• Undergrounding of overhead utilities	Project picks up cost

(continued)

(Appendix C ends on next page)

APPENDIX D (Continued)

PROBLEMS CITED (cont'd)	RESOLUTIONS OFFERED (cont'd)
7. Drainage	
• Drainage conflict	Relocate utilities; redesign drainage (often the two are in the same place)
• Irrigation dry-up (seasonal)	Construct in allowable dry-up period
• Storm drainage run-off	Provide interception system, or relocate utility
• Down-stream improvement of stormwater capacity	Project picks up cost

APPENDIX E

Highway-Widening Issues Identified by Survey Respondents

The following tables (E-1 through E-3) represent the responses to questions 9, 10, and 11 of the survey for this synthesis.

TABLE E-1

IMPACTS OF HIGHWAY WIDENING WHERE CURRENT ASSESSMENT TECHNIQUES AND/OR CRITERIA MENTIONED AS LIMITED, INADEQUATE, NEEDING FURTHER RESEARCH
(Those Receiving Three or More Mentions by States, Provinces, and MPOs, Combined)

Number of Mentions	Specific or Generic Type of Impact
12	Air Quality
6	Social/Economic
6	Hazardous Materials and Waste
6	Changes in Property Value (Gain or Loss)
5	Wetlands
3	Land Use Change
3	Noise
3	Environmental

TABLE E-2

IMPACTS OF HIGHWAY WIDENING FOR WHICH BETTER MITIGATION MEASURES ARE NEEDED
(Those Receiving Three or More Mentions by States, Provinces, and MPOs, Combined)

Number of Mentions	SPECIFIC OR GENERIC TYPE OF IMPACT
12	*Wetlands*
9	*Noise*
8	*Hazardous Materials*
6	*Air Quality*
4	*Wildlife Habitat Loss*

APPENDIX E (Continued)

TABLE E-3

"OTHER" PROBLEMS TYPICALLY ENCOUNTERED IN ASSESSING SOCIAL, ECONOMIC, AND ENVIRONMENTAL IMPACTS OF PROPOSED HIGHWAY WIDENINGS

As Mentioned by States, Provinces, and MPOs (combined)

PEOPLE ISSUES
• *Cultural resources*
• *Public involvement*
• *Local opposition (N.I.M.B.Y.s)*
• *Minority community impacts*
• *Determining TRUE social impacts*
• *Defining measures of community cohesion*
• *Controversy related to need for project and public acceptance of it*
• *Public opposition due to perceptions and emotional issues*
• *Impact on low-cost housing availability*
• *Inability to distinguish between natural social trends vs. those induced by widening*
• *Public and Native American involvement / participation*
$$ ISSUES
• *Construction equipment needs*
• *Staying within budget*
• *Better balance in considering, affording, maintaining, better visual improvements*
• *Business takes and relocations*
• *Financial value*
• *Inability to forecast effect on tax base*
• *Cost / benefit determinations*
THE PROCESS
• *Need for construction impacts to be accurately defined EARLY*
• *Lack of appropriate level of economic data*
• *Inability to ignore small, inconsequential environmental impacts*
• *Overlapping / conflicting regulatory agencies*
• *Level of detail required to identify and document impacts*
• *Statistical data not available for non-standard situations (and there are many)*
• *Difference in perception of same impact by different individuals (or organizations)*
(continued)

TABLE E-3

"OTHER" PROBLEMS TYPICALLY ENCOUNTERED IN ASSESSING SOCIAL, ECONOMIC, AND ENVIRONMENTAL IMPACTS OF PROPOSED HIGHWAY WIDENINGS

As Mentioned by States, Provinces, and MPOs (combined)

• *Relative weighting of various types of impacts when choosing alternatives*
• *Typical assessment focuses on the very narrow roadway corridor*
• *Long range considerations (i.e. 20+ years) of any of the impacts*
• *Comparing construction costs to environmental impacts*
• *Retaining wall vs. 1/4-acre pristine wetland*
• *Validity of long-range projections*
• *Accuracy of traffic projections*
• *Quantifying impacts*
• *Qualitative assessment too subjective*
• *Cost effectiveness of environmental mitigation*
• *Transportation / environmental tradeoffs*
• *Evaluation methodologies*
LAND USE
• *Land use / zoning changes*
• *Defining values of green space / recreational loss*
• *Prediction of future development*
• *Residential takes or encroachments*
• *Access changes and land-use changes*
• *Inability to forecast small scale land-use changes*
PHYSICAL
• *Safety issues in crossing roads on main high speed arterials*
• *Controversy over practicality of mass transit*
• *Visual impacts*
• *Re-routing local traffic patterns*
• *Drainage facilities*
• *Need for new sidewalks and bike paths*

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