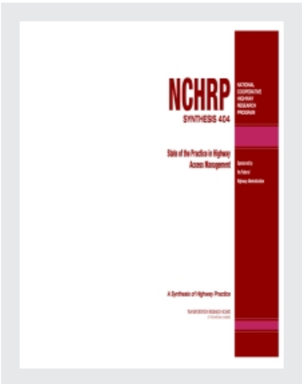

State of the Practice in Highway Access Management

DETAILS

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP SYNTHESIS 404

State of the Practice in Highway Access Management

A Synthesis of Highway Practice

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WASHINGTON, D.C.
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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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The members of the technical committee selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical committee, they are not necessarily those of the Transportation Research Board, the National Research Council, the American Association of State Highway and Transportation Officials, or the Federal Highway Administration of the U.S. Department of Transportation.

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FOREWORD

Highway administrators, engineers, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information on nearly every subject of concern to highway administrators and engineers. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the entire highway community, the American Association of State Highway and Transportation Officials—through the mechanism of the National Cooperative Highway Research Program—authorized the Transportation Research Board to undertake a continuing study. This study, NCHRP Project 20-5, "Synthesis of Information Related to Highway Problems," searches out and synthesizes useful knowledge from all available sources and prepares concise, documented reports on specific topics. Reports from this endeavor constitute an NCHRP report series, *Synthesis of Highway Practice.*

This synthesis series reports on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems.

PREFACE

By Donna L. Vlasak
Senior Program Officer
Transportation Research Board

This synthesis reports how various agencies have acted on the various components of an access management program, what have been barriers to action, and how new efforts might improve implementation of access management strategies. Primary focus areas considered are legal and legislative bases, contents of policies and programs, implementation aspects, reported effectiveness of program implementation, and profiles of contemporary practice. This synthesis reports on the state of the practice with respect to planning, highway design, development review and permitting, and other focus areas where access management is typically incorporated. The emphasis is placed on states, but counties, municipalities, and metropolitan planning organizations are also considered.

The synthesis includes a comprehensive review of existing access management-related literature. This was supplemented by an online survey questionnaire distributed to key staff with access management responsibilities identified by state departments of transportation, as well as at various participating metropolitan planning organizations, counties, and municipalities. Although 45 of 50 states initially responded to the survey, 5 additional states later provided survey responses, raising the response rate to 100%. In addition, profiles of contemporary access management practices, highlighting key aspects of how transportation agencies develop and administer their access management programs are presented.

Jerome S. Gluck and Matthew R. Lorenz, AECOM Consulting Transportation Group Inc., New York, N.Y., collected and synthesized the information and wrote the report. The members of the topic panel are acknowledged on the preceding page. This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.

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STATE OF THE PRACTICE IN HIGHWAY ACCESS MANAGEMENT

SUMMARY

Streets and highways represent major public investments and valuable resources that provide for mobility, accessibility, and economic vitality. Access to and from abutting properties must be managed to ensure that streets and highways operate safely and efficiently. Property owners have a right of reasonable access to the general system of streets and highways. Roadway users have the right to freedom of movement, safety, and efficient expenditure of public funds. The need to balance these competing rights is especially acute in cases in which significant changes in land development have occurred or are envisioned to occur. The safe and efficient operation of the roadway system calls for effectively managing the access to adjacent developments. The purpose of access management is to provide vehicular access to land development in a manner that preserves the safety and efficiency of the transportation system. Roadway access management is defined in the 2003 TRB *Access Management Manual* as follows:

> The systematic control of the location, spacing, design, and operation of driveways, median openings, interchanges, and street connections to a roadway. It also involves roadway design applications, such as median treatments and auxiliary lanes, and the appropriate spacing of traffic signals. The purpose of access management is to provide vehicular access to land development in a manner that preserves the safety and efficiency of the transportation system. (p. 3)

The objective of NCHRP Synthesis Project 40-11 is to gather and report on the state of the practice with respect to highway access management in the United States at the state and local levels. The state of the practice is identified with respect to planning, highway design, development review and permitting, and other focus areas in which access management typically is incorporated. This synthesis examines how agencies have acted on the various components of an access management program, what have been the barriers to action, and how new efforts might improve the implementation of access management strategies and treatments nationwide. The emphasis is placed on states, but counties, municipalities, and metropolitan planning organizations also are considered. The state of the practice in highway access management is identified in this report with respect to several primary focus areas, namely, the legal and legislative basis for access management, contents of policies and programs, implementation aspects, reported effectiveness of program implementation, and profiles of contemporary practice.

The synthesis includes a comprehensive review of existing access management-related literature and research that was published before and after the 2003 *Access Management Manual* became available. It addresses access classification systems, a variety of access features and techniques, access permit process, traffic impact studies, the purchase of access rights, and access design concepts.

The literature review was supplemented with an online survey distributed to key staff with access management responsibilities that were identified by state departments of transportation (DOTs), as well as at various participating metropolitan planning organizations, counties, and municipalities. The survey focused on identifying the range of current practices in administering access management programs throughout the United States.

A total of 58 separate responses were received from representatives at 45 state DOTs (a 90% response rate). These responses were compiled to develop a composite response for each state DOT to avoid overrepresenting state DOTs that had multiple respondents. For the remaining five state DOTs that did not respond to the initial online survey, a shortened version containing 14 key questions was distributed to obtain an understanding of the basic aspects of each state DOT's access management programs and practices (a 100% state DOT response rate).

The survey findings indicated that access management practices—whether part of a formal access management program or conducted informally as part of normal operations—are currently in use at all state DOTs in the United States. Approximately two-thirds of the 50 state DOTs indicated that they have a formal access management program and the remaining one-third manage access as an informal part of their normal operations.

The successful *implementation* of access management is the objective of any program. Based on the survey findings presented in this synthesis, the following topics are identified to improve the implementation and enhancement of access management programs:

- **Legislation**—Strong access management authority provides the foundation for a successful access management program.
- **Access Classification System (ACS)**—An ACS provides a framework for the comprehensive implementation of access management on a systemwide basis.
- **Institutional commitment**—Access management is most successful when the DOT has the institutional commitment to implement the program and integrate it into the daily business functions of an agency.
- **Staffing**—Implementation efforts have the most effect when state DOTs and transportation agencies can dedicate staff to access management.
- **Access champion**—Often, a person (or persons) is needed to emphasize and support the access management agenda within an agency.
- **Legal case history**—State DOTs with a strong case history of winning court cases are more empowered in making future access-related decisions.
- **Case studies**—Real-world case studies that clearly illustrate the benefits of access management are instrumental in convincing elected officials, state and local government officials, the development community, and other decision makers of its merits.
- **Education and training**—Access management training for agency staff is crucial.
- **Outreach activities**—Elected officials, the development community, and the general public need to be educated about the rationale and benefits behind access management.
- **Access committee**—Access management is best achieved when state, regional, county, and local units of government cooperate in land use and transportation management decisions.
- **Stakeholder cooperation**—The defining characteristic of a successful access management plan is the level of cooperation achieved among affected property owners and agencies involved in developing and carrying out the plan.
- **Monitoring and evaluating**—Any access management program will benefit greatly from continuous monitoring and self-evaluation to identify issues and resolve problems.

TRB's Access Management website (www.accessmanagement.info) contains a wealth of information that addresses many topics. Suggestions for future research and resources included the following:

- Identify well-documented case studies of access management successes to educate and convince stakeholders of the need for access management and the real-world benefits that can be realized.

- Prepare, in the absence of case studies of "good practice," profiles spotlighting examples of poor practice in "failed corridors" where capacity and speed reductions were related to poor access management decisions or owing to the lack of access management planning.
- Conduct additional research on the economic benefits of access management, including quantifiable cost-saving factors associated with the benefits of implementing access management techniques.
- Perform research to provide a greater understanding of the relationships between access management and other key policy objectives such as smart growth and sustainability, Transit-Oriented Development, and Context-Sensitive Solutions.
- Establish guidance for "fringe" areas. These typically are suburban or actively developing areas located between developed urban areas and undeveloped rural areas. Fringe areas present excellent opportunities to either implement access management proactively or incorporate retrofit highway improvements.
- Develop further guidance for interchange area management plans, incorporating both transportation and land use elements.
- Perform additional research into the relationship between eminent domain law and access management implementation.
- Perform safety and operational studies, under a range of traffic volumes and other considerations, to identify the situations in which road diets would be appropriate.

CHAPTER ONE

INTRODUCTION

BACKGROUND

Streets and highways represent major public investments and valuable resources that provide for mobility, accessibility, and economic vitality. Access to and from abutting properties must be managed to ensure that streets and highways operate safely and efficiently. Property owners have a right of reasonable access to the general system of streets and highways. Roadway users have the right to freedom of movement, safety, and efficient expenditure of public funds. The need to balance these competing rights is especially acute in cases in which significant changes in land development have occurred or are envisioned to occur. The safe and efficient operation of the roadway system calls for effectively managing the access to adjacent developments. Access management provides a systematic way of balancing the trade-offs between land access and through-traffic mobility functions that are implicit in the functional hierarchy of all roadways. Figure 1 illustrates a conceptual functional hierarchy of roadways, ranging from a freeway (no direct access and high mobility) to a cul-de-sac (highest level of access and no through-traffic mobility).

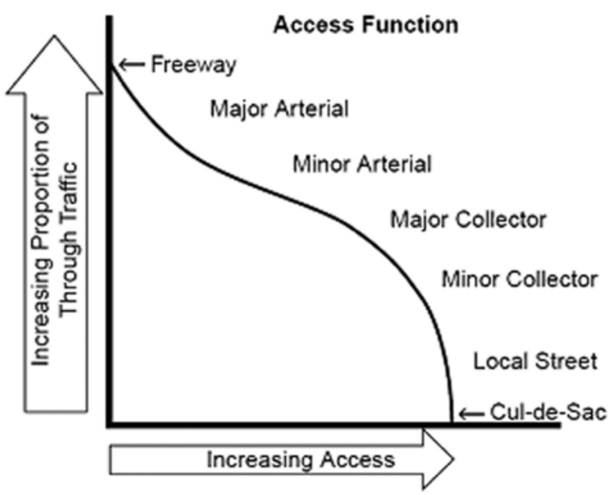


FIGURE 1 Conceptual roadway functional hierarchy. *Source: Access Management Manual* (*1*).

Roadway access management is defined in the 2003 TRB *Access Management Manual* (*1*) as follows:

> The systematic control of the location, spacing, design, and operation of driveways, median openings, interchanges, and street connections to a roadway. It also involves roadway design applications, such as median treatments and auxiliary lanes, and the appropriate spacing of traffic signals. The purpose of access management is to provide vehicular access to land development in a manner that preserves the safety and efficiency of the transportation system. (p. 3)

Williams and Levinson (*2*) noted that access management has grown dramatically in the last several decades. It has evolved steadily from its origins when it was applied on the boulevards of the late 19th century to the comprehensive systemwide programs that define contemporary practice. Throughout this evolution, states and local governments have gained more insight into the need for and the methods of coordinating transportation management and land use.

The contemporary practice of access management extends the concept of access design and location control to all roadways—not just limited-access highways or freeways. Several NCHRP research studies, work by the TRB Access Management Committee, and publications by TRB, ITE, FHWA, and others have provided information and materials to state and local agencies on access management and access control programs.

SYNTHESIS OBJECTIVE

The objective of NCHRP Synthesis Project 40-11 is to gather and report on the state of the practice with respect to highway access management in the United States at the state and local levels. The state of the practice is identified with respect to planning, highway design, development review and permitting, and other focus areas in which access management typically is incorporated. This synthesis examines how agencies have acted on the various components of an access management program, what have been the barriers to action, and how new efforts might improve the implementation of access management strategies and treatments nationwide. The emphasis is placed on states, but counties, municipalities, and Metropolitan Planning Organizations (MPOs) also are considered.

METHODOLOGY

To identify the state of the practice in highway access management, a comprehensive review was conducted of existing access management-related literature and research that were published before or after the 2003 *Access Management Manual* (*1*). The literature review was supplemented with the results of a survey distributed to key staff with access management responsibilities that were identified at all U.S. state departments of transportation (DOTs), as well as at various participating MPOs, counties, and municipalities.

The state of the practice in highway access management as identified in this report covers several primary focus areas, namely, the following:

- The legal and legislative basis for access management
- Contents of access management programs and policies
- Implementation aspects of access management
- Results, lessons learned, and self-evaluations of access management programs and practices

In addition, a variety of profiles of contemporary practice and illustrative "sidebar" examples were developed to identify specific examples of good practice and access management successes as identified by the survey respondents.

QUESTIONNAIRE DEVELOPMENT

An online questionnaire was developed and distributed to better understand the current state of the practice. The questionnaire focused on identifying the range of current practices in administering access management programs throughout the United States. The primary candidates for completing the questionnaire were transportation agency staff, primarily at the state DOT level, but also agencies and organizations at the MPO, county, and municipal levels. Appendix A (available on web version only) of this document provides the survey questionnaire that was distributed to all state DOTs and other agencies.

To obtain as broad a representation of current access management practices as possible, the questionnaire was forwarded via e-mail to all state DOTs. The questionnaire also solicited input from the DOTs regarding any MPOs, counties, and municipalities that may have access management programs of interest. These agencies and organizations were invited to participate in the survey. In addition, the Association of Metropolitan Planning Organizations (AMPO) and the National Association of County Engineers (NACE) were requested to publicize the questionnaire and solicit voluntary participation from their membership. The survey also was publicized by means of ITE's Traffic Engineering Council and Transportation Planning Council through electronic mailing lists.

The questionnaire included a total of 69 questions and was administered in the following manner:

- A web-based survey was developed to administer the questionnaire online.
- A targeted list was developed of key individuals at state DOTs with access management responsibilities. The individuals were e-mailed a web-link and invited to complete the questionnaire online. Each recipient was asked to either complete the questionnaire or forward the web-link to another individual better suited to complete the survey for their DOT. Some recipients forwarded the web-link to individuals in multiple divisions within the DOT.
- In cases in which a key individual at a state DOT was not known, the TRB liaison was contacted to identify the person within the DOT best suited to complete the survey.
- Nonrespondents at state DOTs were contacted by e-mail and phone to encourage responses.
- Links to the web-based questionnaire were distributed to the following organizations:
  - ITE Traffic Engineering Council (via listserv),
  - ITE Transportation Planning Council (via listserv),
  - National Association of County Engineers, and
  - AMPOs.
- Participation in the survey was solicited from additional MPOs, counties, and municipalities that were suggested by the state DOTs.

A total of 58 separate responses to the survey were received from representatives at 45 state DOTs (multiple individuals within some DOTs responded to the survey). These responses were compiled to develop a composite response for each state DOT to avoid overrepresenting state DOTs that had multiple respondents. Figure 2 summarizes the distribution in primary job function among the 58 state DOT respondents.

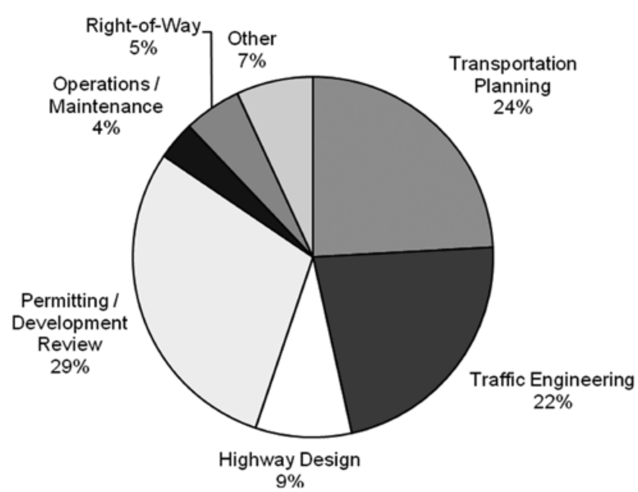


FIGURE 2 Job function of state DOT respondents (58 responses).

For the remaining five state DOTs that did not respond to the initial online survey, a shortened version, containing 14 key questions, was distributed to obtain an understanding of some of the fundamental aspects of each state DOT's access management programs and practices. In total, responses were received from 50 state DOTs, as listed in Appendix B (available on web version only).

Responses were also received from 30 counties, 10 cities, and 3 MPOs. Figure 3 summarizes the distribution in primary job function among the 43 respondents from these local agencies.

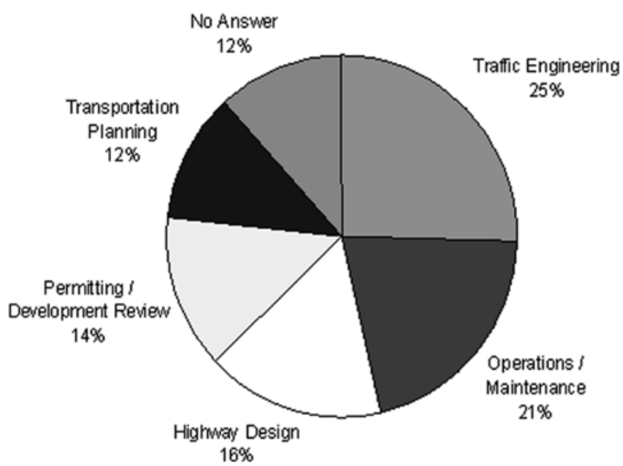


FIGURE 3 Job function of local respondents (43 responses).

Appendix B provides a list of all survey participants and agencies. Appendix C provides a summary of all survey responses (available on web version only).

REPORT ORGANIZATION

This synthesis is divided into six chapters, which are as follows:

- Chapter one provides background on the synthesis topic, a summary of the objectives, and information related to the synthesis methodology and survey development. This chapter also includes an overview of the report organization.
- Chapter two summarizes the legal and legislative basis for access management programs and policies throughout the United States, based on the survey responses obtained from state DOTs and local agencies (counties, municipalities, and MPOs).
- Chapter three includes a detailed literature search regarding the typical contents of access management policies and programs at the state DOT and local levels, including access classification systems (ACS), access features, and various key access management techniques, including traffic signal spacing, unsignalized access spacing, median treatments, interchange controls, corner clearance, and left- and right-turn lanes. Other typical program elements such as access permit processes, traffic impact studies, the purchase of access rights, and access design concepts are also discussed. The chapter includes survey results on various state DOT and local program elements, including ACS, access management techniques, access permit processes, and traffic impact studies.
- Chapter four provides an overview of the implementation aspects of the states' access management programs, including the organizational "location" of access management activities within each DOT, the types of staff members dedicated to access management, and access management–related resources typically consulted. The chapter also includes state-of-the-practice information from state DOTs and local agencies in other implementation areas, including transportation and land use coordination, access management plans (AMPs), independent studies and research, education and training activities, and community outreach.
- Chapter five presents synthesis findings related to the implementation of access management, including the results of a literature search and a summary of results and lessons learned from the survey questionnaire. This chapter includes survey findings relative to access management–related court decisions, areas for which additional information or resources are needed, and information concerning states' evaluations of their own access management programs, including the successes and strengths of these programs, barriers and difficulties encountered, and areas for improvement.
- Chapter six presents profiles of contemporary access management practices, highlighting key aspects of how transportation agencies develop and administer their access management programs. These profiles are noteworthy because they may be considered as state of the practice and have potential applicability for other agencies. They include specific examples of unique or innovative practices related to access management. A range of dimensions involved with access management are reflected, including the legal basis, policy and program elements, implementation tools, and key technical areas.
- Chapter seven provides an overview of the findings and conclusions, and sets forth suggestions for future research.

CHAPTER TWO

BASIS FOR ACCESS MANAGEMENT PROGRAMS AND POLICIES

The legal basis for managing roadway access provides the means for balancing the public interest and private property rights in making access management decisions. This chapter provides an overview of the legal and legislative basis for access management programs and policies throughout the United States, and the associated state of the practice based on the survey responses.

BACKGROUND

Access management is multifaceted, including policy, planning, design, operations, and maintenance. It is most effective when it is implemented at the system level (i.e., statewide, county, or local) and applied consistently by the different functional organizations within a transportation agency (*3*, p. 3).

Williams and Levinson (*2*) noted that the formal development of access management began around 1980. At that time, it became apparent that operational techniques alone would not be able to mitigate the adverse effects of poorly located or poorly planned access to neighboring land, that excessive traffic signals reduce travel speeds and the system effectiveness, and that the proliferation of driveways has safety, operational, and visual impacts. It also became apparent that systematic access planning is essential, especially in growing areas:

> Contemporary access management began with the Colorado State Access Code, adopted in 1981. . . . With a declaration that all state highways are controlled access highways, the Colorado legislature gave the State authority over the grant of access to state highways. This was followed by the enactment of comprehensive access management regulations in Florida, New Jersey, Oregon, and several other states.
>
> While the specifics of the regulations vary, they have several common features: (1) an access classification system that builds upon the roadway functional classification system, (2) permitted access for each access class, (3) signalized and unsignalized access spacing, (4) means of enforcement, and (5) provisions for variances. Many also include procedures for state/local adoption of corridor management plans, which replace system-wide standards as a basis for permitting. (*2*, p. 14)

Access management practices—whether part of a formal access management program, or conducted informally as part of normal business operations—currently are in use at most state DOTs in the United States. The synthesis survey revealed that 33 state DOTs (66%) indicated that they have a formal access management program, and 17 state DOTs (34%) indicated that, although they did not have a formal program, access was managed as an informal part of their normal operation.

According to the survey, 22 (51%) of the 43 local agencies responding to the survey have a formal access management program, and 16 (37%) indicated that, although their agency did not have a formal program, access was managed as an informal part of their normal operation. Three (7%) of the local respondents indicated that their agency did not consider access management and two (5%) did not respond to the question.

LEGAL BASIS FOR ACCESS MANAGEMENT

The following narrative was adapted, in part, from the legal review performed for Indiana DOT as part of the Indiana Access Management Study (*4*).

From a legal perspective, access is the right to cross public roads or highways, as well as the right to enter on or lease land abutting such roads and highways. While private property enjoys the right of access to the general system of public roadways, this is not an unlimited right. The right of access must be balanced with the needs of and potential harm to the general traveling public (*5*, p. 23). The authority of a government unit to implement an access management program involves a determination of the power of that unit to regulate an abutting property owner's right of access to a public way without compensation.

In most cases across the United States, managing vehicle access has taken the form of regulating or prohibiting the construction of driveways. Many states have statutory authority to promulgate administrative rules and regulations for driveways. They regulate the construction of driveways along the state highway system by requiring a permit from the state DOT in compliance with the agency's rules and requirements.

The legal authority of a state DOT to regulate access to the state highway system is conferred in the police powers of the state and the state's right of eminent domain. *Police power* confers authority on a government unit to control access for public health, welfare, and safety. Police power is a construct of statute, rules, and regulations. When access rights are controlled under police power, the impact of the regulation on the property holder is not compensable.

Eminent domain is the right of a government unit to take private property for a public or semipublic use. Under a recognized rule in the law of eminent domain, when access regulations are characterized as a taking of property for a public purpose by government authorities, payment of just compensation is necessary.

Types of traffic regulations that have tended to be upheld by courts under police power include one-way streets, traffic signals, stop lines, and prohibitions against certain turns. Courts consistently have upheld as reasonable divided highways on which U-turns and left turns are permitted only at designated points by either physical dividers (including median strips) or regulations. This decision is based on the principle that an abutting property has no right to the continuance or maintenance of traffic flow past that property.

The nature of the right to access varies among the states. Whether the right of access has been regulated merely for the public safety or welfare by the exercise of police power, or whether the regulation amounts to a compensable taking under eminent domain, is a question courts have had great difficulty in resolving. It appears that no strict, generally accepted definition of what constitutes "deprival" of a right of access to and from a public highway has been developed. When a court seeks to determine whether a property holder has been granted "reasonable" access or deprived of a right of access, the court balances the abutter's rights against public health, welfare, and safety. As indicated in the 2003 TRB *Access Management Manual* (*1*),

> State courts frequently inquire whether access has been substantially diminished or impaired when defining whether access is reasonable. Whether access has been substantially diminished is evaluated on a continuum from relatively minor route changes, which are not usually compensable, to extremely circuitous rerouting of access, or complete denial of access to a public street, which are compensable. Because circumstances of individual properties vary widely, the availability of reasonable access must be determined on a case-by-case basis. (p. 272)

Resolving issues of the power of a government unit to regulate access involves recognizing the right of access and balancing that right against particular public and private rights. Statutory authorization for action by a government unit regulating access is essential; but that statutory authorization does not always have to specifically address access rights. Courts have found justification for reasonable regulation of access among general charter or enabling provisions.

In some states, the courts have held that access points can be regulated because a property owner is not entitled to unlimited access at all points along a highway. In addition, ingress and egress generally can be made more circuitous and difficult for an abutting property holder without constituting a taking of private property. Traffic regulations that provide access only at designated points are almost universally regarded as reasonable.

The abutting property owner also may have no right to the continuance or maintenance of the free flow of traffic past his property, and thus, no compensation may be required if traffic is diverted from an abutter's premises or made to travel a more circuitous route. Establishing divided highways on which U-turns and left turns are permitted only at designated points (by either physical dividers or regulations) has been consistently upheld as reasonable based on this principle.

Courts across the country, however, have not given broad general police powers to highway authorities to exert police power to eliminate or reduce access rights without paying compensation to abutting property owners. Instead, individual courts have made determinations on police power and eminent domain based on the specific facts of the particular case. This makes it difficult to draw broad conclusions regarding the ability of any given highway authority to implement new methods of access regulation.

States with access management–related statutory authority or administrative rules have the strongest legal backing for their access management programs and policies. Figure 4 identifies the percentage of responding DOTs that have statutory authority or administrative rules related to access management.

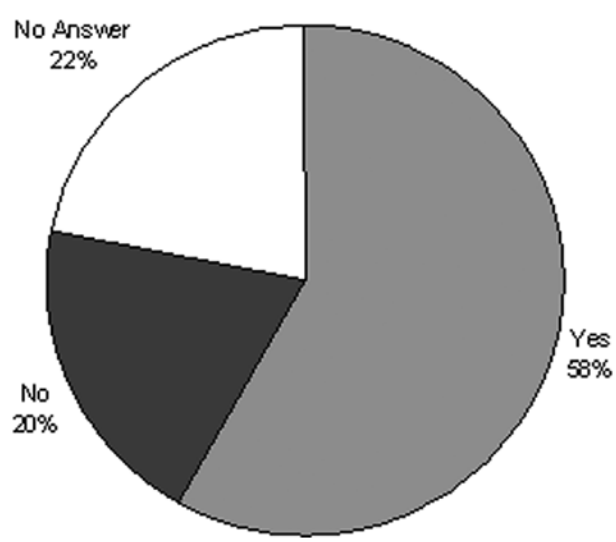


FIGURE 4 State DOTs with statutory authority or administrative rules related to access management (50 responses).

As shown in Figure 4, 29 (58%) of the 50 state DOTs indicated that they have statutory authority or administrative rules related to access management. These states are as follows:

- California
- Colorado
- Florida
- Georgia
- Idaho
- Illinois
- Indiana
- Iowa
- Kansas
- Maine
- Maryland
- Massachusetts
- Mississippi
- Montana
- Nebraska
- New Jersey
- New Mexico
- Ohio
- Oregon
- Pennsylvania
- South Carolina
- South Dakota
- Texas
- Utah
- Virginia
- Vermont
- Washington
- Wisconsin
- West Virginia

In comparison, 21 (49%) of the 43 local agencies responding indicated they have statutory authority or administrative rules related to access management. Chapter six presents a description of the Virginia DOT efforts to establish legislative authority for their access management program.

CHAPTER THREE

CONTENTS OF POLICIES AND PROGRAMS

This chapter includes a detailed literature search regarding the typical contents of access management policies and programs at the state DOT and local levels, including ACS and various key access management features, including the following:

- Spacing for traffic signals
- Spacing for unsignalized driveways and street connections
- Corner clearance
- Median treatments
- Median openings
- Access management on interchange crossroads

Also discussed are other typical program elements such as the following:

- Access permit processes (including access denial)
- Traffic impact studies
- Purchase of access rights
- Access design concepts (including frontage roads, right- and left-turn lanes, and alternative left-turn treatments)

The chapter concludes with the survey results concerning various state DOT and local agency program elements, including a general overview of access management programs, ACS, access management techniques, access permit processes, and traffic impact studies.

BACKGROUND

The scope and content of access management programs in the United States vary widely. Some agencies have a comprehensive code that establishes a sound legal basis for access management decisions. Other agencies establish guidelines or desirable practices as a step in the process of developing a more extensive program. Formal agency regulations, however, are more legally defensible and ultimately more effective in implementing an access management program (*1*, pp. 40–41).

All programs need to address a variety of technical and administrative factors. These factors range from the type of access features that will be managed, to the appropriate staffing and organizational structure for administering the program. *NCHRP Report 348* (*6*, p. 9) identifies key components of an access management program as follows:

- Classifying road systems, based on their areawide importance, into a logical functional hierarchy
- Planning, designing, and maintaining roadway systems based on criteria, such as road geometry, and functional or access classification
- Defining allowable access levels and spacing for each roadway class that do not degrade its function in the hierarchy (this involves identifying when and where access can be permitted and setting appropriate criteria for the spacing of access points)
- Applying appropriate geometric design criteria and traffic engineering analysis to each allowable access
- Using driveway permit procedures and regulations to ensure that decisions are reasonably enforceable and that the government agency can manage effectively roadway design and operation
- Providing a mechanism for granting variances when reasonable access cannot be provided
- Establishing a means for enforcing criteria. Each agency has unique circumstances to address

LITERATURE SEARCH

The TRB *Access Management Manual* indicates that access management includes both systemwide and corridor-based programs. Systemwide programs involve the development and implementation of a comprehensive access management program for all roadways under state or local jurisdiction. Corridor-based programs focus on the development and implementation of corridor AMPs. Corridor-based programs are useful for retrofitting problem areas or addressing the needs of high-priority corridors and often are combined with a systemwide approach. Some systemwide programs, for example, contain or authorize corridor-based solutions (*1*, p. 7). (Corridor AMPs are discussed in more detail in chapter four.)

The following elements of a comprehensive, systemwide access management program are described in this section:

- ACS (access classification system)

- Access features
- Access management techniques
- Access permit process
- Traffic impact studies
- Purchase of access rights
- Access design concepts

Access Classification System

An ACS typically is used to establish the level of allowable access for roadways of varying levels of importance in a state highway system. As stated in the *Access Management Manual* (*1*, p. 72), an ACS is a hierarchy of access categories that forms the basis for the application of access management. Although the structure of an ACS may vary widely among different agencies, establishing an ACS involves three basic actions:

- Defining access management categories
- Establishing whether access should be permitted, and related access spacing and design criteria for each category
- Assigning an access management category to each roadway or roadway segment

Each access category sets forth criteria governing the access-related standards and characteristics for corresponding roadways. These access categories ultimately define areas where access can be allowed between private developments and the roadway system, and where it should be denied or discouraged. The categories also define spacing standards for signalized and unsignalized intersections, and where turning movements should be restricted. Defining access categories typically involves consideration of the following factors:

- *Level of importance of the roadways within the overall network hierarchy*—The foundation of an ACS may be the functional classification system (i.e., arterial, collector, and so on) or another similar hierarchy that reflects the general purpose of each roadway within the transportation system.
- *Roadway characteristics*—Roadway characteristics associated with geometric design (e.g., number of lanes, design speed, and median treatment) and traffic operations (e.g., volume and speed) may be considered in defining access categories.
- *Degree of urbanization and land use controls*—Factors such as the intensity of existing and planned development, intersection frequency, parcel size, and need for a supporting circulation system can be used to help define the degree of urbanization and could be considered in defining access categories.

Typically, direct property access is prohibited from freeways and expressways. Direct property access typically is denied (or highly restricted) for higher-level arterial class roadways, although access may be provided where no reasonable alternative access is available. Direct property access often is permitted for lower-level arterials and collectors, although the number and location of access points may be limited. Direct property access typically is allowed on local roadways and frontage roads, subject to safety considerations, such as maintaining proper sight distances.

Transportation agencies use a range of ACSs. Two ACSs—North Carolina DOT's Strategic Highway Corridors initiative and Indiana DOT's ACS development—are highlighted in chapter six as profiles of contemporary practice.

Access Features

For each roadway classification that is established, an agency must determine the access features that will be managed and how they will be managed. Access management standards for these features are assigned to roadways through the access categories (although access in the vicinity of interchanges typically is addressed through statewide standards, AMPs, or interchange areas management plans) (*1*, p. 42). Access features to manage include the following:

- Traffic signals (minimum spacing distances or through bandwidth)
- Driveway and street connections, and corner clearance (minimum spacing distances, location, allowable movements, and design)
- Medians (to manage left turns and direct access) and median openings (minimum spacing distances and design)
- Interchanges and access in the vicinity of interchanges

The following section provides an overview of each of these access features. The access management techniques that are related to these features are presented in the *Access Management Techniques* section.

Spacing for Traffic Signals

Establishing traffic signal spacing criteria for arterial roadways is one of the most important and basic access management techniques. The same criteria for signal spacing apply to both signalized driveways and signalized public roadway intersections.

Effects of Signal Spacing

The spacing of traffic signals, in terms of frequency and uniformity, governs the performance of urban and suburban highways. Traffic signals account for most of the delays that motorists experience. Closely or irregularly spaced signals reduce arterial travel speeds, thereby resulting in an excessive number of stops even under moderate traffic volume conditions. Signals also can increase crash frequency (*7*, p. 22).

NCHRP Report 420 identified that each traffic signal added per mile to a roadway reduces travel speed by about 2 to 3 mph. Table 1 shows the percentage increases in travel times as signal density increases, using two traffic signals per mile as a base.

TABLE 1
PERCENTAGE INCREASES IN TRAVEL TIMES AS SIGNAL DENSITY INCREASES

Signals per Mile	Percent Increase in Travel Time (compared with 2 Signals per mile)
2	0
3	9
4	16
5	23
6	29
7	34
8	39

Source: Gluck et al. (*7*, p. 28).

Signal Spacing Criteria

Signal spacing is a function of progression speed and signal cycle lengths. The spacing distances for various combinations of progression speeds and cycle lengths are shown in Table 2.

TABLE 2
SIGNALIZED INTERSECTION SPACING FOR VARIOUS PROGRESSION SPEEDS AND CYCLE LENGTHS

Cycle length(s)	Speed (mph)						
	25	30	35	40	45	50	55
60	1,100	1,320	1,540	1,760	1,980	2,200	2,420
70	1,280	1,540	1,800	2,050	2,310	2,570	2,820
80	1,470	1,760	2,050	2,350	2,640	2,640	2,640
90	1,630	1,980	2,310	2,640	2,640	2,640	2,640
120	2,200	2,640	2,640	2,640	2,640	2,640	2,640

Source: Adapted from Gluck et al. (*7*).
Note: Spacing distances are in feet.
A spacing of 2,640 ft is shown where the computed spacing in the table exceeds 2,640 ft.

When signalized driveways and intersections are placed at these distances, signal progression can be maintained and green bandwidth (through bandwidth) is not lost. Small deviations in the signal location (e.g., less than 10%) will have minimal negative effects on the progression. The through bandwidth measures how large a platoon of vehicles can pass through a series of traffic signals without stopping for a red light. Bandwidth may be expressed in terms of the number of seconds per cycle or the percent of cycle length that the traffic could flow within a platoon. Further guidelines for through bandwidth are contained in *NCHRP Report 348* (*6*, pp. 56–58) and in the *Access Management Manual* (*1*, pp. 140–149).

For efficient traffic flow, *NCHRP Report 348* indicates that new signals should be limited to locations where the progressive movement of traffic will not be impeded significantly. The "optimum" distance between signals depends on the cycle length and the prevailing progression speed. At the optimum distance, bandwidth is not lost. When signals are placed at nonoptimal locations, bandwidth is lost and delay increases (*6*, p. 58).

Spacing for Unsignalized Driveways and Street Connections

Access points—commonly referred to as driveways or street connections—introduce conflicts and friction into the traffic stream. They are, in effect, intersections and should be designed consistent with their intended use. *A Policy on Geometric Design of Highways and Streets* (i.e., AASHTO's "Green Book") indicates that the number of crashes is disproportionately higher at driveways than at other intersections. Therefore, driveway design and location merit special consideration (*8*, pp. 729–731).

Effects of Unsignalized Access Spacing

Nearly 50 years of research efforts have documented the basic relationships between access frequency and safety. The methods of analyses and the resulting relationships among individual studies vary, but the patterns are generally similar. Roadways with properly managed access have lower crash rates than other roadways. Arterial roadways with many driveways and signals often have double or triple the crash rates of roadways with wide spacing between access points or of roadways where access is fully controlled. Crash rates generally increase with greater frequencies of intersections and driveways. Table 3 lists a sample of the many studies that have considered how crash rates are related to spacing (*9*).

NCHRP Report 420 presented information that had been synthesized from other studies to arrive at the composite predictors of crash rates for ranges of unsignalized and signalized access densities. The report presented the results of an analysis of crash data from around the nation, including a series of three graphs for quantifying the relationship between crash rates and signalized and unsignalized access densities. All three figures have been incorporated into the 2004 AASHTO *A Policy on Geometric Design of Highways and Streets* (*8*).

TABLE 3
SAFETY EFFECTS OF ACCESS

Context	Result	Year and Source
Minnesota—about 4/5 of the segments in the study were two-lane highways	Greater access densities were accompanied by lower speeds and higher crash rates.	late 1940s Kipp (*10*, pp. 33–37)
Oregon—426 sections of urban state routes, all with parallel parking	Excepting low volume two-lane roadways, increasing commercial driveways per mile or increasing signal density was correlated with increasing crash rates.	1959 Head (*11*, pp. 45–63)
California—closing median openings at selected intersections in a corridor	Resulted in lower numbers of total crashes in the corridor.	1967 Wilson (*12*)
North Carolina—92 homogeneous urban and rural multilane divided highway sections with posted speed limits ranging from 35 to 60 mph	• For most crash types, the crash rate tended to increase as the number of median openings (excluding intersections) increased. • Excepting crashes at night on unlit sections, crash rate increase associated with an increase in the frequency of signalized intersections. • Crash rates increased as access points increased.	1967 Cribbins et al. (*13*, pp. 8–25) 1967 Cribbins et al. (*14*, pp. 140–157)
Indiana—examined 100 urban arterial sections, and also compared 15 pairs of similar sections (the majority were two-lane sections)	The crash rate would likely decrease when the number of access points or the number of traffic signals per mile was reduced.	1967 Mulinazzi and Michael (*15*, pp. 150–173)
Indiana—examined 100 urban arterial sections in cities with populations more than 30,000	The driveway crash rate decreased as spacing between driveways or between driveways and street intersections increased.	1976 McGuirk et al. (*16*, pp. 66–72)
North Carolina—6-year study of 57 undivided urban four-lane sections	Crash rate increased as access density increased.	1983 Heimbach et al. (*17*)
Wisconsin—referenced a regional planning commission study of both county and state trunk highways	Crashes per mile dramatically increased when the average spacing between access connections was less than 300 ft.	1993 McGee and Hughes (*18*, pp. 287–291)
Florida—median modifications on 5.1-mi section of a four-lane divided arterial Before: 77 full median openings After: closed 16 openings and converted 42 full openings to directional openings	• Collision rates decreased by 15% • Injury rates decreased by 24%	1997 Wu (*19*)
Minnesota—432 rural and urban segments from the state network	• Both urban two-lane and urban four-lane roadways, crash rates increased as either public street or commercial access density increased. • Rural areas, the crash rate increased as access density increased.	1998 Preston et al. (*20*)
Arkansas—3 years of crash data from all rural and suburban four-lane highways (excluding freeways) on the state system	• The crash rate increased as access density increased.	2005 Gattis et al. (*21*)

Source: Gattis (*9*).

Figures 5 and 6 present crash rates by median type and total access density (both directions) for urban-suburban and rural roadways, respectively. In urban and suburban areas, the addition of each driveway would increase the annual crash rate by 0.11 to 0.18 crashes per million vehicle-miles traveled (MVMT) on undivided highways, and by 0.09 to 0.13 crashes per MVMT on highways with two-way left-turn lanes (TWLTLs) or nontraversable medians. In rural areas, each driveway added would increase the annual crash rate by 0.07 crashes per MVMT on undivided highways and by 0.02 crashes per MVMT on highways with TWLTLs or nontraversable medians (*7*, p. 55).

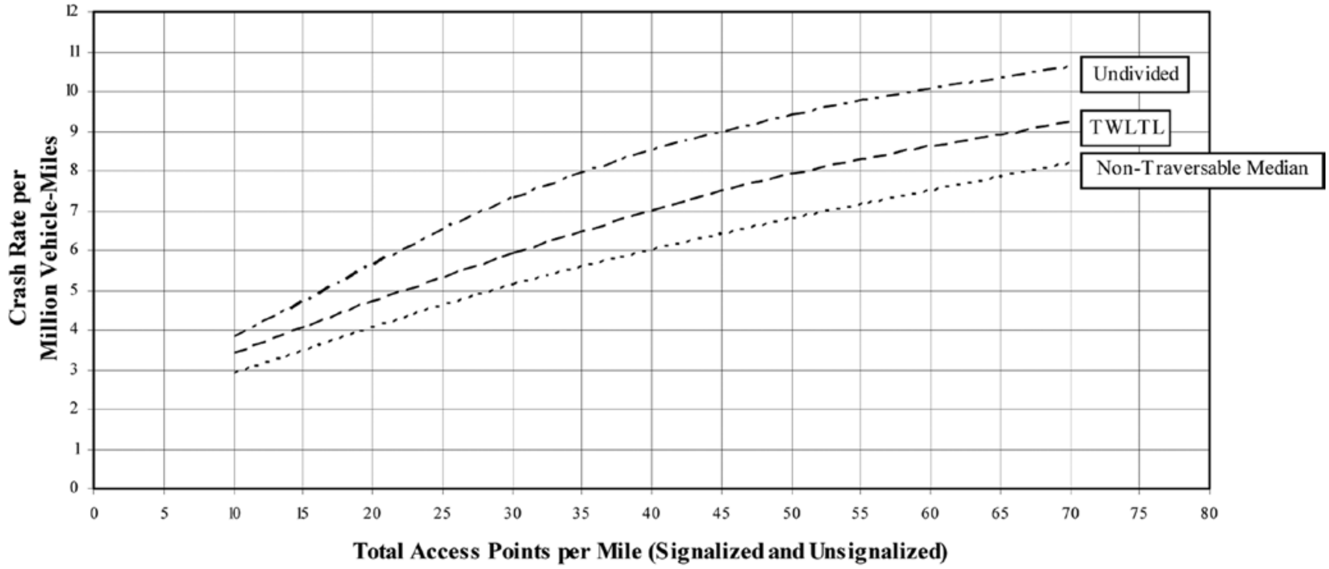


FIGURE 5 Estimated crash rate by type of median—Urban and suburban areas. *Source:* Gluck et al. (*7*, p. 57).

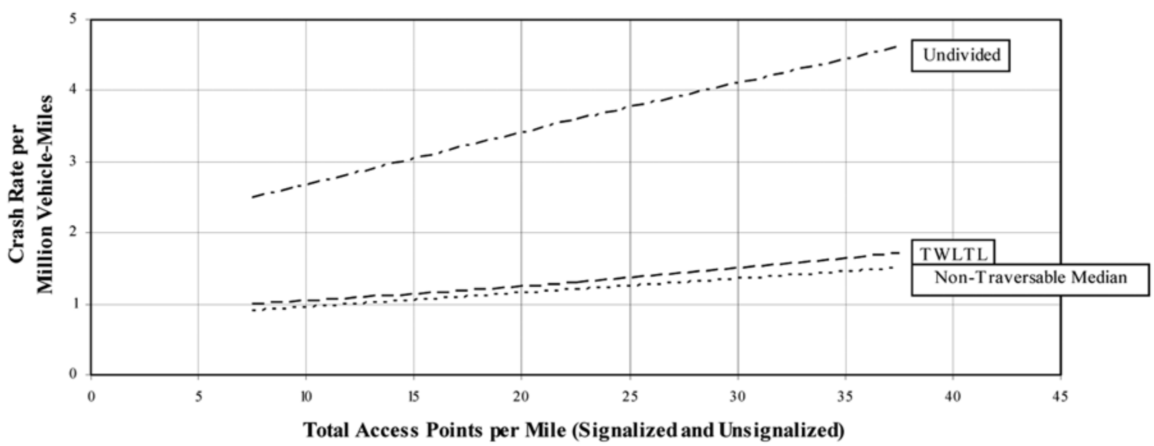


FIGURE 6 Estimated crash rate by type of median—Rural areas. *Source:* Gluck et al. (*7*, p. 57).

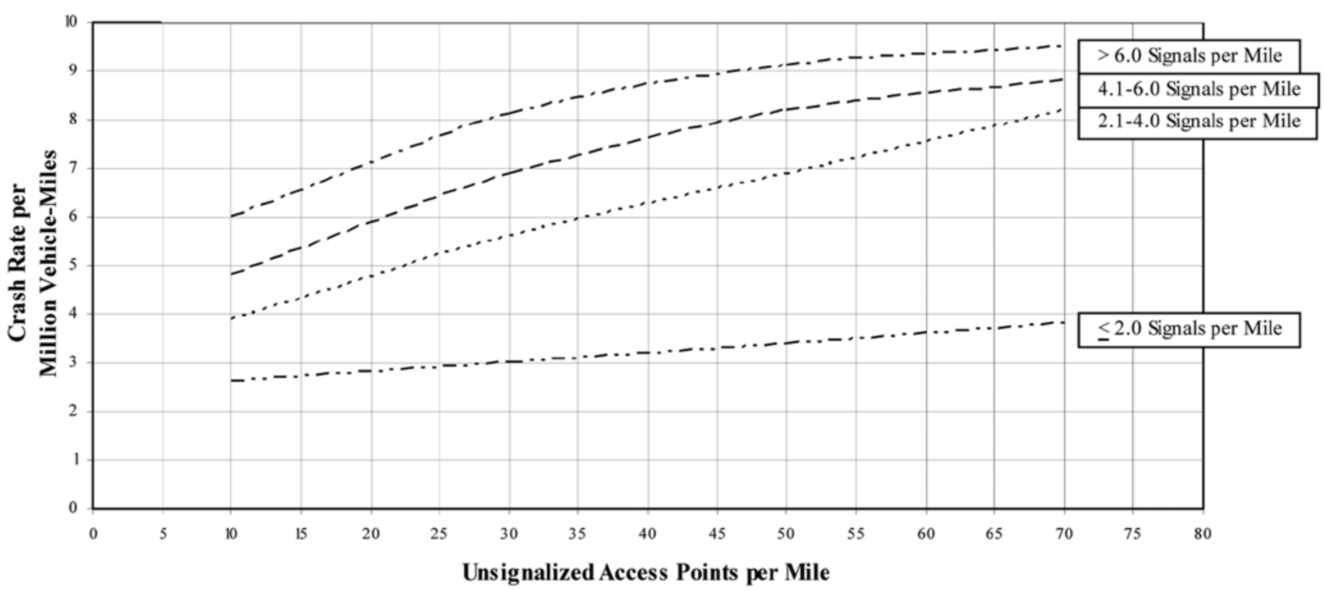


FIGURE 7 Estimated crash rate by access density—Urban and suburban areas. *Source:* Gluck et al. (*7*, p. 58).

Figure 7 presents crash rates by driveway density and signal density. Each unsignalized driveway may increase the crash rate by approximately 0.02 crashes per MVMT at low signal densities. At higher signal densities, each unsignalized driveway may increase the crash rate from 0.06 to 0.11 crashes per MVMT.

NCHRP Research Results Digest 247 (*35*) compares the crashes per MVMT found in *NCHRP Report 420* (*7*) with research results from Minnesota. It also compares safety indices set forth in *NCHRP Report 420* and derived from the Minnesota data. Both sets of results confirm that driveways merit special consideration.

Research by Levinson (*36*) explored estimating the safety of arterial roads based on traffic volumes, access road (i.e., driveways and intersecting streets) volumes, and access density. The research applied the relationship between intersection crashes and the product of conflicting traffic volumes to estimate safety. A simplifying assumption—that access roads have roughly equivalent volumes—made it possible to identify safety indexes that relate only to the change in access density; these indexes generally are consistent with those reported in *NCHRP Report 420*. These indexes estimate that the increase in crashes is roughly equal to the square root of the increase in access density (*36*) (e.g., a doubling in driveway density would increase the crash rate by more than 40%). This is known as the "square root rule."

Unsignalized Access Spacing Criteria Transportation Research Circular Number 456 (*37*) provides information on the basic considerations that may be applied in the development of sound unsignalized access spacing criteria. The report provides an overview of selected spacing guidelines at the state and local levels of government. It indicates that jurisdictions that have adopted access management regulations have used different approaches for establishing unsignalized access spacing criteria. *The Access Management Manual* (*1*, p. 150) lists the following possible approaches for establishing unsignalized connection spacing criteria:

- Safety
- Stopping sight distance
- Intersection sight distance
- Functional area
- Right-turn conflict overlap
- Influence distance
- Egress capacity

As noted in *A Policy on Geometric Design of Highways and Streets* (*8*), driveways should not be located within the functional area of an intersection, or within the influence area of an adjacent driveway. The functional area extends both upstream and downstream from the physical intersection area and includes the longitudinal limits of auxiliary lanes. As defined in *NCHRP Report 420*, the influence area associated with a driveway includes (1) impact length (the distance back from a driveway that vehicles begin to be affected by driveway traffic), (2) perception-reaction distance, and (3) vehicle length.

The spacing of driveways should reflect the impact lengths and influence areas associated with motorists entering or leaving a driveway. The impact length represents the distance upstream when the brake lights of through vehicles are activated or when one vehicle changes lane because of a turning vehicle ahead.

The impact lengths associated with motorists entering or leaving a driveway should be considered in establishing driveway separation distances. *A Policy on Geometric Design of Highways and Streets* includes a figure (see Exhibit 9-101) derived from *NCHRP Report 420* that identifies impact lengths relating to vehicles making right turns into driveways (*8*, p. 730). For example, at 30 mph speed, 20% of the right-lane through vehicles was affected at an approximate distance of 172 ft or more in advance of a driveway. At 50 mph, 20% of the right-lane through vehicles was affected a distance of 345 ft or more in advance of a right-turn location. Influence areas can be obtained by adding the perception-reaction distance and vehicle length to the distance shown in the AASHTO exhibit. The functional area of an intersection should reflect these influence areas.

NCHRP Report 420 provides the series of tables from which the AASHTO exhibit was derived, and these tables can be used to establish connection spacing guidelines based on the spillback expected to occur along a roadway section. (The report includes five tables, one each for posted speeds of 35 mph to 55 mph, in 5-mph increments.) Spillback occurs when a through vehicle must brake in response to another vehicle making a right turn at an access connection. The spillback rate represents the percentage of through vehicles experiencing such an event. Table 4 presents, as an example, the table for a 35-mph roadway.

As noted in the *Access Management Manual*, the higher the roadway functional classification, the lower the acceptable spillback rate. The acceptable rate on a major roadway may be no more than 2%. A spillback rate of 5% may be acceptable on a major collector serving commercial, industrial, or large mixed-use areas, whereas 15% or more may be acceptable on major collectors in residential areas. For example, the minimum access connection spacing on a 45-mph major urban arterial, assuming a 2% spillback rate, would be at least 530 ft. The minimum spacing on a 35-mph major collector (right-turn-in driveway volume of between 30 and 60 vehicles per hour) would be 355 ft if a 5% spillback rate is acceptable, and 280 ft if a 15% spillback rate is acceptable (*1*, pp. 153–154).

TABLE 4

PERCENTAGE OF RIGHT-LANE THROUGH VEHICLES INFLUENCED AT OR BEYOND ANOTHER DRIVEWAY: POSTED SPEED = 35 MPH

		Right-Turn-In Volume per Driveway, R (vph)							
		R < 30		30 < R < 60		60 < R < 90		R > 90	
Driveway Spacing (ft)	No. Driveways per 1/4 Mi., n	Single Driveway P_2	Multiple Driveways, At Least Once per 1/4 Mi., $1-(1-P_2)^n$	Single Driveway, P_2	Multiple Driveways, At Least Once per 1/4 Mi., $1-(1-P_2)^n$	Single Driveway, P_2	Multiple Driveways, At Least Once per 1/4 Mi., $1-(1-P_2)^n$	Single Driveway, P_2	Multiple Driveways, At Least Once per 1/4 Mi., $1-(1-P_2)^n$
100	13.2	2.4%	27.3%	7.5%	65.2%	12.2%	82.1%	21.8%	96.1%
125	10.6	2.4%	22.5%	7.5%	56.0%	12.2%	74.7%	21.8%	92.5%
150	8.8	2.4%	19.1%	7.5%	49.5%	12.2%	68.2%	21.8%	88.5%
175	7.5	2.4%	16.4%	7.4%	44.0%	12.1%	62.1%	21.8%	84.0%
200	6.6	2.2%	13.9%	7.1%	38.3%	11.5%	55.4%	20.6%	78.1%
225	5.9	2.0%	11.2%	6.3%	31.8%	10.3%	47.2%	18.4%	69.7%
250	5.3	1.5%	7.7%	4.8%	22.7%	7.8%	34.7%	13.8%	54.5%
275	4.8	1.1%	5.3%	3.5%	15.9%	5.8%	24.8%	10.3%	40.7%
300	4.4	0.8%	3.6%	2.6%	11.1%	4.3%	17.6%	7.7%	29.6%
325	4.1	0.6%	2.6%	2.0%	8.0%	3.3%	12.8%	5.9%	22.0%
350	3.8	0.5%	1.8%	1.5%	5.6%	2.5%	9.0%	4.4%	15.6%
375	3.5	0.3%	1.2%	1.1%	3.7%	1.7%	6.0%	3.1%	10.5%
400	3.3	0.2%	0.7%	0.7%	2.3%	1.1%	3.7%	2.0%	6.6%
425	3.1	0.1%	0.5%	0.5%	1.4%	0.8%	2.4%	1.4%	4.2%
450	2.9	0.1%	0.3%	0.3%	0.9%	0.5%	1.5%	0.9%	2.6%
475	2.8	0.1%	0.2%	0.2%	0.5%	0.3%	0.8%	0.5%	1.4%
500	2.6	0.0%	0.1%	0.1%	0.2%	0.1%	0.4%	0.3%	0.7%
525	2.5	0.0%	0.0%	0.0%	0.1%	0.1%	0.2%	0.1%	0.3%

Source: Gluck et al. (*7*, p.140).

The *Access Management Manual* offers the following guidance in selecting and applying unsignalized access spacing (*1*, p. 155):

- Longer spacing standards are generally applied to roadways of a higher functional classification.
- Higher classifications of roadways typically have higher speeds than roadways of a lower classification.
- Higher classifications of roadways tend to carry higher traffic volumes than roadways of lower classification.
- The interference with through traffic increases as traffic volume increases. A small number of turning vehicles can interfere with a large number of through vehicles on high-speed, high-volume suburban-urban roadways—especially during peak periods. A single vehicle turning from a through lane can disrupt platooned flow and traffic progression.
- Roadways with speeds ≥45 mph are typically more critical than those with speeds ≤40 mph.

Gattis et al. performed *NCHRP Project 15-35: Geometric Design of Driveways* (*5*) to develop a driveway design guide that addresses the needs of the various users in the driveway, roadway, and sidewalk area and reflects the requirements of the Americans with Disabilities Act (ADA). As part of this effort, the authors completed a literature search and review, compiled transportation agency design documents, and documented state of the practice. This led to the identification of research needs, some of which were addressed in *NCHRP Project 15-35*. The recommendations for the geometric design of driveways will be useful to state DOTs, local governments, and consultants in preparing driveway design standards and practices that consider standard engineering practice and accessibility needs, and that provide for safe and efficient travel by motorists, pedestrians, bicyclists, and transit users on and in proximity to the affected roadway.

Corner Clearance

As noted in *A Policy on Geometric Design of Highways and Streets* (*8*, p. 729), driveways should not be located within the functional area of an intersection or in the influence area of an adjacent driveway. The functional area extends both upstream and downstream from the physical intersection area on both the major roadway and the intersecting cross street, and includes the longitudinal limits of auxiliary lanes. As a result, the functional area encompasses the area where motorists are responding to the intersection, decelerating, and maneuvering into the appropriate lane to stop or complete a turn.

Additional guidance related to the computation of the driveway influence area is available in *NCHRP Report 420*, and was presented in the *Spacing for Unsignalized Driveways and Street Connections* section of this report. Another general guideline that applies to driveway location is that sight distance must be sufficient. AASHTO's "Green Book" (*8*, pp. 651–677) contains detailed guidance related to the purpose and computation of sight distance. In addition, driveways must be located so that they are conspicuous and clearly delineated for the various users.

Gattis et al. noted in *NCHRP Project 15-35* (*5*) that one major objective of access management is avoiding driveway queuing that backs up into a public roadway. This is accomplished through design of the throat length, internal circulation, and traffic control within a site. Queuing of traffic exiting a site does not affect the operation of the public roadway, but it could affect site circulation and parking lot operations. This internal queuing is affected by the throat length, number of egress lanes, and traffic control at the intersection with the public roadway.

In *Transportation and Land Development*, Stover and Koepke (*38*) provide extensive guidance on criteria to use to provide sufficient corner clearance at intersections both on the upstream and downstream sides of the major roadway and intersecting cross street. This guidance is summarized as follows:

- **Upstream clearance on major roadway**—This distance is calculated as follows:

  Upstream clearance = (PIEV distance + Maneuver distance) + Queue

  Where:

  PIEV distance = Distance traveled during Perception-Identification-Evaluation-Volition (commonly referred to as "Perception-Reaction distance").

  Maneuver distance = Distance traveled while maneuvering and decelerating to a stop.

  Queue = Maximum back-of-queue length.

The PIEV + Maneuver distances for various speeds are tabulated in Table 5-13 of *Transportation and Land Development*. As an example, the desirable PIEV + Maneuver distance for a speed of 30 mph would be 250 ft, whereas for a speed of 50 mph, the PIEV + Maneuver distance would be 570 ft.

- **Downstream clearance on major roadway**—This distance is calculated as the greater of the upstream clearance distance (see "Upstream clearance on major roadway") or the AASHTO stopping sight distance, based on speed.
- **Upstream clearance on minor crossroad**—The maximum back-of-queue length.
- **Downstream clearance on minor crossroad**—Allow drivers to clear the major road–minor road intersection (see Figure 6-23 of *Transportation and Land Development*).

Median Treatments

Left turns increase vehicular conflicts, as well as conflicts with pedestrians and bicyclists. They also result in increased crashes and delays, and complicate the signal timing and phasing parameters at signalized intersections. These problems are especially acute on major roadways (*7*). Therefore, the presence (or absence) of a median has a substantial impact on roadway operations and safety, and on the provision of left-turn access to abutting properties (*1*, p. 199).

Effects of Median Treatments

As noted in *NCHRP Report 420* (*7*, p. 68), the treatment of roadway medians has an important bearing on how well roadways operate, their crash experience, and the access they provide to adjacent developments. The basic choices for designing medians are as follows:

- Whether to install a continuous TWLTL
- Whether to install a nontraversable (physical) median on an undivided roadway
- Whether and when to replace a TWLTL with a nontraversable median

The *Access Management Manual* contains definitions of these three cross-section types (*1*). An undivided roadway offers no control of, or refuge for, turning and crossing vehicles. A TWLTL has a flush-center lane that serves as refuge for left-turning vehicles. A nontraversable median is depressed or raised, and actively prohibits crossing and turning movements. Although a traversable (or flush) paved median is not intended to be crossed, it does not actively restrict left-turn and crossing movements.

Table 5 presents a selection of studies compiled by Gattis that together span half a century. Some of the studies compared vehicular crash rates among all three cross-section types, while others compared two of them. The general trend is that nontraversable medians are associated with lower crash frequency. Continuous two-way left-turn lanes generally are preferable to undivided roadways, but generally are not preferable to nontraversable medians (*9*).

NCHRP Report 395 compared the different outcomes from a number of crash prediction models developed by different researchers. A composite finding suggested that, as traffic volumes exceed approximately 15,000 Average Daily Traffic (ADT), a raised median is safer than a two-way left-turn lane. Both are safer than no median (i.e., an undivided roadway) for volumes at least as low as 10,000 ADT (*30*).

TABLE 5

RELATIVE SAFETY OF CROSS-SECTION DESIGN ALTERNATIVES

Context		Relative Safety of Median Treatment (1 = best, 3 = worst)			Year and source
		Undivided	TWLTL	Restrictive (e.g., raised, depressed)	
California—563 miles of 4-lane					1953, Telford et al. (*22*, pp. 208–231)
without speed zones, development, or intersections	ADT 5,000–9,000	3	-	1	
	ADT 10,000–14,999	1	-	3	
	ADT 15,000–25,000	3	-	1	
with speed zones, roadside development	ADT 5,000–9,999	1	-	3	
	ADT 20,000–29,000	3	-	1	
Illinois—Compare two suburban roadways		3	-	1	1968, Frick (*23*, pp. 14–20)
Nebraska—urban 4-lane		3	1	-	1986, McCoy et al. (*24*, pp. 11–19)
Georgia—82 urban 4- or 6-lane sections		-	3	1	1989, Squires et al. (*25*)
Florida—4-lane arterials					1993, Long et al. (*26*)
	urban	3	2	1	
	rural	1	3	2	
4 cities, 15 sites, 145.9 miles					1994, Bowman/Vecellio (*27*, pp. 169–179)
central business district	vehicular crashes	3	1	2	
	pedestrian crashes	3	2	1	
suburban - vehicular crashes		2	3	1	
Rural and urban; 4- and 6-lane		-	3	1	1995 Hadi (*28*, pp. 169–177)
4-lane suburban commercial with ADT < 32,500; compare 11 TWLTL with 11 median		-	3	1	1995, Marigiotta/ Chatterjee (*29*)
Phoenix, Omaha—urban, suburban					1997, Bonneson/McCoy (*30*)
	Business or office; ADT > 10,000	2.5	2.5	1	
Residential or Industrial	ADT 15,000–25,000	2	3	1	
	ADT > 25,000	3	2	1	
4 states; 4-lane		3	-	1	1999, Council/Stewart (*31*)
5 states; 264 urban segments					1999, Papayannoulis et al. (*32*)
	signalized and unsignalized	3	2	1	
	signalized density > 2/mile	3	2	1	
	signalized density < 2/mile	2	3	1	
Springfield, MO—compare 3 multilane commercial arterial sections		-	3	1	2000, Gattis/Hutchinson (*33*)
Georgia—all divided highways		-	3	1	2000, Parsonson (*34*)
Overall Rankings (1 = best, 3 = worst)		worst	better	best	

Source: Gattis (*9*).

Schultz et al. (*39*, pp. 11–15) applied stepwise linear regression analysis to identify correlations between access management techniques and crash patterns. Their research indicated that the presence of a raised median corresponded to a reduction of 1.23 crashes per MVMT. In addition, raised medians were negatively correlated with right-angle collisions, while TWLTLs were positively correlated with opposite-direction collisions.

A more recent median treatment option is to apply a "road diet" that converts a four-lane undivided roadway into three lanes (one through lane in each direction and a TWLTL). The fourth lane may be converted to bicycle lanes, sidewalks, or on-street parking. *The Road Diet Handbook: Setting Trends for Livable Streets* (*40*) is a practitioner's guidebook for more information.

Huang et al. (*41*, p. 1) performed safety research related to road diets and found the following:

- Crash rates did not change significantly from the period before the road diet to the period after the road diet. Although crash rates were lower at road diets than at comparison sites, road diets did not perform better or worse (from the before period to the after period) relative to the comparison sites.
- Road diet conversion did not affect crash severity.
- Road diet conversion did not result in a significant change in crash types.

In their conclusions and recommendations, the researchers indicated a need for future safety and operational studies, under a range of traffic volumes and other considerations, to identify the situations in which road diets would be appropriate. They also noted that traffic operations and capacity must be considered fully at a given site before implementing a road diet or other lane reduction measures (*41*, p. 6).

Selecting a Median Type

The basic decision process with respect to median type is illustrated in Figure 8. TWLTLs and medians improve traffic operations and safety by removing left turns from the through-traffic lanes. TWLTLs provide more access and maximize operational flexibility. Medians physically separate opposing traffic, limit access and conflicts, and provide a better pedestrian refuge. Median design requires adequate provisions for left turns and U-turns to avoid problems associated with concentrating these movements at other locations (*7*, p. 68). Table 6 from the *Access Management Manual*, based on research conducted for *NCHRP Report 395*, provides a comparative evaluation of median treatments (*1*, p. 203).

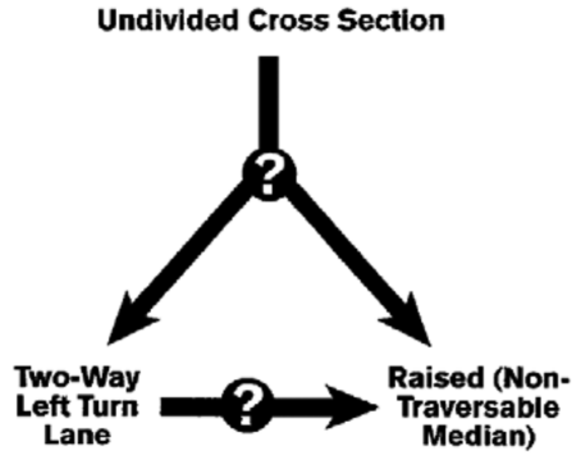


FIGURE 8 Median decision choices. *Source:* Gluck et al. (*7*, p. 69).

Selecting a median alternative will depend on many policy, land use, and traffic factors. Factors identified in *NCHRP Report 420* include the following:

- Access management policy and access class for the roadway under consideration
- Types and intensities of the adjacent land use
- Supporting street system and the opportunities for rerouting left turns
- Existing driveway spacing
- Existing geometric design and traffic control features (e.g., left-turn provisions and proximity of traffic signals)
- Traffic volumes, speeds, and crash patterns
- Costs associated with roadway widening and reconstruction (*7*, p. 85)

Table 7 from *NCHRP Report 420*, based on the research performed for *NCHRP Report 395*, provides a comparative analysis of the three midblock treatments, citing the strengths and weaknesses of each. *NCHRP Report 395* contains more detailed guidelines for selecting the midblock left-turn treatment based on benefit-cost comparisons for roadways serving various land uses (either business and office land use or residential and industrial land use). A series of tables in *NCHRP Report 395* may be used to help identify the following situations:

- When an undivided cross-section should be converted to a nontraversable median
- When an undivided cross-section should be converted to a TWLTL
- When a TWLTL should be converted to a nontraversable median

The Florida Department of Transportation (FDOT) considers its median policy—which requires a restrictive median on new and reconstructed multilane highways—one of the more effective elements of its access management program (*1*, p. 42). The FDOT *Median Handbook* indicates that the department has a 1993 Multi-lane Facility Policy that essentially directs all department multilane projects over 40 mph in design speed to have a restrictive median. It also directs designers to find ways to use restrictive medians in all multilane projects, even those below the 40 mph design speed (*42*, ch. 1, p. 9).

The FDOT *Median Handbook* (*42*) is a valuable resource to guide decisions related to the design of medians and the location of median openings. It indicates that:

> Full median openings serve a "Major" transition function. This means that on arterial roads they should only be provided at arterial junctures of the road system as defined for the public street or internal circulation systems. (ch. 2, p. 2)

Median Openings

Figure 9, from FDOT's *Median Handbook* (*42*, ch. 2, p. 19), illustrates components in the spacing of median openings, including deceleration length, queue storage, perception-reaction distance or full width of median, and turn radius.

The research for *NCHRP Report 524* investigated the safety and operational effect of U-turns at unsignalized median openings. The safety performance of typical median opening designs was documented, and guidelines for the use, location, and design of unsignalized median openings were developed. The research included unsignalized median openings on all types of divided highways, but the focus was on urban-suburban arterials because these present the greatest current challenge to highway agencies in access management. Among the research conclusions were the following (*43*):

- For urban arterial corridors, average median opening accident rates are slightly lower for conventional three-leg median openings than for conventional four-leg median openings.
- For urban arterial corridors, average median opening accident rates for directional three-leg median openings are about 48% lower than the accident rates for conventional three-leg median openings.
- For urban arterial corridors, average median opening accident rates for directional four-leg median openings

TABLE 6
COMPARISON OF TYPES OF MIDBLOCK LEFT-TURN TREATMENTS

Comparison	Nontraversable Median	TWLTL	Undivided
Operational effects			
1. Reduced delay to major roadway traffic	●	●	○
2. Enhanced capacity	●	●	○
3. Reduced delay to major roadway left turns	●	●	○
4. Reduced delay to minor roadway left turns			
a. Low-volume major roadway	◒	●	○
b. Highway-volume major roadway[a]	○	○	○
Safety effects			
1. Reduced vehicular crashes	●	◒	○
2. Pedestrian refuge	●	○	○
3. Positive guidance[b]	●	○	○
Other effects			
1. Aesthetics	●	○	○
2. Snow removal	○	●	●
3. Construction cost[c]	◒	◒	●

Source: Access Management Manual (*1*, p. 203).
Note: ● = most effective/preferable; ◒ = somewhat effective/somewhat preferable; ○ = least effective/ least desirable.
[a] Very low capacity for direct left turns due to an absence of gaps in traffic on the major roadway. A nontraversable median has a relatively high capacity for "left turns" that can be made by a right-turn followed by a U-turn.
[b] Effective communication to motorist.
[c] *NCHRP Project 3-49* concluded that the difference between a raised, curbed median and a TWLTL is negligible. Florida DOT reports a slightly lower cost for a "flush grass" median (exclusive of landscaping) than for a TWLTL.

are about 15% lower than for conventional four-leg intersections.

- Analysis of field data found that, for most types of median openings, most observed traffic conflicts involved major-road through vehicles having to brake for vehicles turning from the median opening onto the major road.
- For median openings at four-leg intersections without left-turn lanes on the major road, most of the observed traffic conflicts involved major-road through vehicles having to brake for vehicles turning left into the median opening.
- The minimum spacing between median openings currently used by highway agencies in rural areas ranges from 152 to 805 m (500 to 2,640 ft). In urban areas, the minimum spacing between median openings ranges from 91 to 805 m (300 to 2,640 ft) in highway agency policies. In most cases, highway agencies use spacings between median openings in the upper end of these ranges, but occasional use of median opening spacings as short as 91 to 152 m (300 to 500 ft) do not indicate safety problems.

TABLE 7
COMPARISON OF THREE MIDBLOCK LEFT-TURN TREATMENTS TYPES

Comparison Factor	"Preferred" Midblock Left-Turn Treatment [1]		
	Raised-Curb vs. TWLTL	Raised-Curb vs. Undivided	TWLTL vs. Undivided
Operational Effects			
1. Major-street through movement delay	n.d.[2]	Raised-Curb	TWLTL
2. Major-street left-turn movement delay	n.d.	Raised-Curb	TWLTL
3. Minor-street left & through delay (two-stage entry)	n.d.	Raised-Curb	TWLTL
4. Pedestrian refuge area	Raised-Curb	Raised-Curb	n.d.
5. Operational flexibility	TWLTL	Undivided	n.d.
Safety Effects			
1. Vehicle accident frequency	Raised-Curb	Raised-Curb	TWLTL
2. Pedestrian accident frequency	Raised-Curb	Raised-Curb	n.d.
3. Turning driver misuse/misunderstanding of markings	Raised-Curb	Raised-Curb	Undivided
4. Design variations can minimize conflicts (e.g., islands)	Raised-Curb	Raised-Curb	TWLTL
5. Positive guidance (communication to motorist)	Raised-Curb	Raised-Curb	n.d.
Other Effects			
1. Cost of access (access management tool)	Raised-Curb	Raised-Curb	n.d.
2. Direct access to all properties along the arterial	TWLTL	Undivided	n.d.
Access Effects			
1. Cost of maintaining delineation	n.d.	Undivided	Undivided
2. Median reconstruction cost	TWLTL	Undivided	Undivided
3. Facilitate snow removal (i.e., impediment to plowing)	TWLTL	Undivided	n.d.
4. Visibility of delineation	Raised-Curb	Raised-Curb	n.d.
5. Aesthetic potential	Raised-Curb	Raised-Curb	n.d.
6. Location for signs and signal poles	Raised-Curb	Raised-Curb	n.d.

Source: Bonneson and McCoy (*30*).
Note: [1] The "Preferred" left-turn treatment is based on the findings of this research and the more commonly found opinion during a review of the literature.
[2] n.d. = negligible difference or lack of a consensus of opinion on this factor.

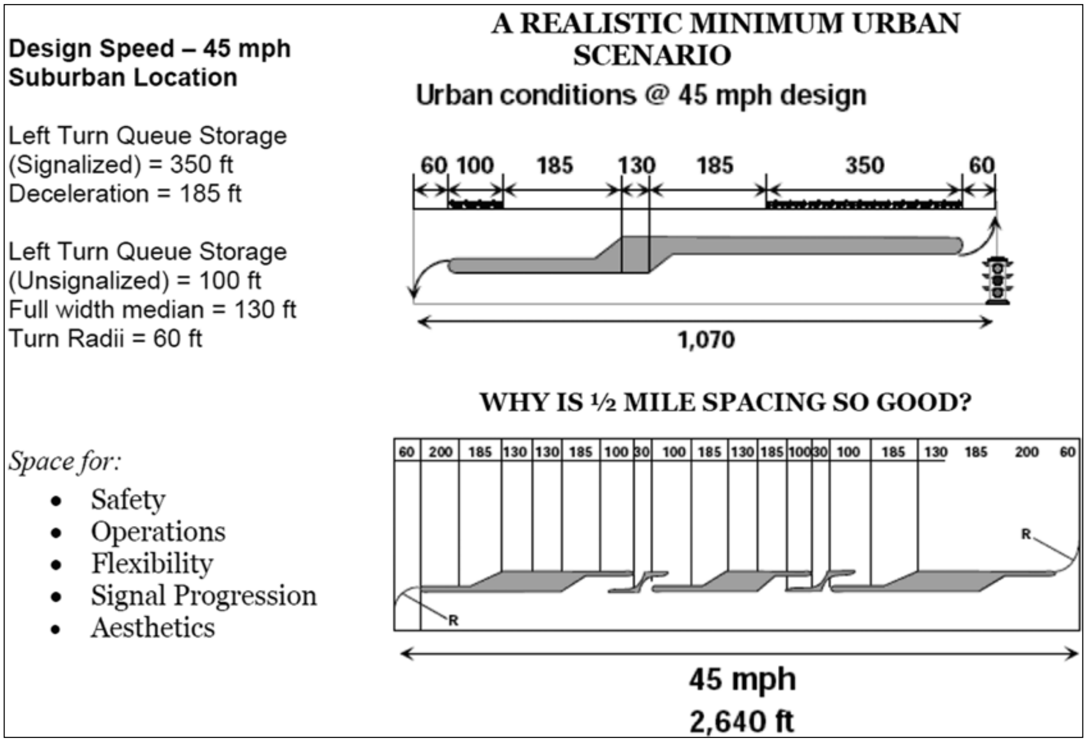


FIGURE 9 Component lengths for median opening spacing. *Source: Median Handbook* (*42*).

Guidelines for the use, location, and design of unsignalized median openings are included in Appendix C of *NCHRP Report 524*. The guidelines include tables presenting the advantages and disadvantages of typical median opening designs. These tables are a resource for designers to use when considering alternative median opening designs (*43*).

Access Management on Interchange Crossroads

Interchanges have become more than the means to move traffic between freeways and arterial streets. An interchange area attracts much land development activity because of the traffic volumes in the vicinity. Although access is managed along the entire length of a freeway, including the interchange area, many transportation agencies apply little, if any, access management along the crossroad (*7*, p. 113).

Intersections that are too close to the ramp termini of the arterial-freeway interchange often develop heavy weaving volumes, complex traffic signal operations, frequent accidents, and recurrent congestion. Therefore, land development at interchanges should be sufficiently separated from ramp terminals. However, street intersections along the arterial often are spaced too close to interchanges. In addition, driveways and median breaks for private developments compound the problem. As a result, many transportation agencies have a growing recognition that access separation distances and roadway geometry should be improved from an access management perspective. *NCHRP Synthesis 332* was prepared to document and summarize practices relating to access location and design in the vicinity of interchanges. It identifies standards and strategies used on new interchanges and on the retrofit of existing interchanges (*44*). *NCHRP Project 3-47: Capacity Analysis of Interchange Ramp Terminals* developed and validated a methodology to determine capacity and level-of-service at signalized interchanges (*45*).

Interchange Area Management

NCHRP Synthesis 332 provides a comprehensive summary of the strategies employed by various state DOTs and other agencies to manage access to and from crossroads in the vicinity of interchanges. The summary is based on survey responses received from the various agencies, a review of additional materials provided by the agencies, and follow-up with the respective agency contacts (*44*, p. 17) (see Figure 10, text box).

According to *NCHRP Synthesis 332*, most agencies use access spacing criteria based on one or more of the following five types of access connections upstream and downstream of the interchange terminus:

- Nearest access (all types)
- Right-in/right-out access
- Left-in/right-in/right-out access
- Unsignalized, full access
- Signalized, full access

Many factors are evaluated by agencies when determining the required or recommended distance downstream of an interchange terminal at which an access location can be

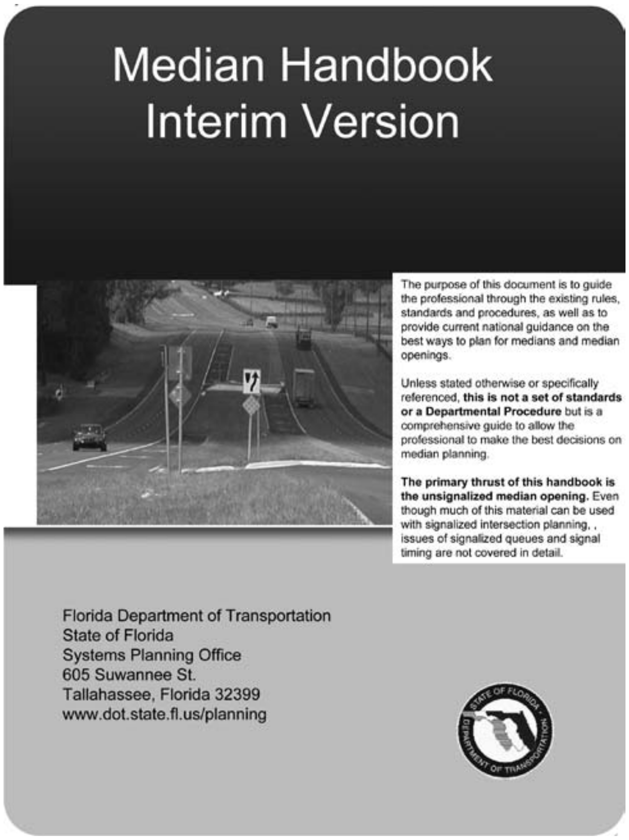


FIGURE 10 Florida DOT Median Handbook. *Source: Median Handbook—Interim Version* (*46*).

permitted. The *NCHRP Synthesis 332* (*44*, pp. 19–20) survey questionnaire identified the following 13 factors that the 36 responding agencies use to determine their respective access management criteria:

- Surrounding land use and environment
- Roadway classification
- Interchange form
- Public and private accesses
- Type of downstream access point
- Downstream storage requirements
- Cross-section
- Design speed
- Volume
- Signal cycle length
- Cost and economic impacts
- Level of interchange importance
- Crossroad jurisdiction

NCHRP Synthesis 332 contains a description of each of these factors as well as further information related to access management on crossroads in the vicinity of interchanges. From the survey results, it identifies lessons learned relating to new interchanges, as well as retrofits of existing interchanges. The lessons learned concerning planning, operation, and design practices for new interchanges include the following (*44*, p. 32):

- Access management techniques should be considered in the earliest planning stages of the interchange project. Considering access management early in the project allows for better planning and education of the public on access management issues.
- Although the standards and guidelines for design should be followed, the design also should incorporate some level of flexibility.
- Intergovernmental coordination is extremely beneficial in planning for the future functionality of the crossroad. The various levels of government need to work together to review and mitigate public and private development actions that otherwise might have affected the crossroad.
- Access management policies and criteria should be defensible. Defensible standards allowed the closure of access points and ultimately provided for a safer and more efficient transportation system.
- Sufficient funding is needed for interchange access management techniques to be applied. Proper funding also allows for the future preservation of the interchange crossroad and vicinity. Inadequate funding can limit the extent of access control and could compromise the future operations and safety of the interchange area.

The lessons learned concerning planning, operation, and design practices for retrofit of existing interchanges include the following (*44*, p. 33):

- The responding agencies generally had the same experiences for both new and retrofit projects. The major difference between new and retrofit interchanges, as noted among respondents, was the importance of community and stakeholder support for the retrofit interchange project.
- Involving the public early on in the retrofit interchange planning process was beneficial. Because there may be adjacent developments, acquiring access can be a challenge. Therefore, community support is important. In contrast, new interchanges typically are built in less constrained areas, where acquiring access may raise fewer objections and, therefore, may be more feasible.
- Early public involvement allowed for the education process and provided an opportunity for feedback from the community. When using such public involvement, it was important to have access management criteria that are easy to explain to the community, to gain local support for the project.
- Establishing access management guidelines before beginning the project would have been beneficial. If there is no formal guidance for access management around an interchange before the start of a retrofit interchange project, additional time is needed to achieve municipal consent on access spacing.
- According to the survey responses about the planning, operation, and design of new and retrofit interchanges,

retrofit interchange projects that involved the public early in the planning stages were successful in achieving the desired access control.

The lessons learned are consistent with the following finding in the report by Williams and Sokolow (*47*):

> Because interchanges invite development and traffic, it is essential to have regulations in place that address issues of compatibility and function. Access management plans and regulations help to preserve the safety and efficiency of interchange areas as development occurs. Although the need for improved access management is clear, the separation of state and local jurisdiction has made it difficult to accomplish. No single technique or governmental entity can achieve the desired results. Effective interchange area management requires a combination of techniques involving land use planning, zoning, subdivision regulation, signage, access management, and intergovernmental coordination. (p. 3)

Land and Williams (*48*) note the importance of access management to the economic development potential of an interchange area, in addition to its traffic function and safety:

> A concern that often arises at the local level is that access controls could impede economic development. It is understandable that local governments are interested in increasing their tax base through development. What is often not understood is that not managing access can have long-term adverse impacts on both the transportation function *and* economic development potential of interchanges. For example, shared access roads open up more land for development on the interior of interchange areas, thereby increasing their development potential and allowing more efficient use of land. Access management plans and requirements can also help to discourage the division of roadway frontage into small lots with constrained development potential, and help to preserve larger parcels for higher quality development with good internal circulation and access design. (p. 3)

Access management in interchange areas can be accomplished through planning and a range of regulatory and nonregulatory techniques identified by Land and Williams. It also requires cooperation with property owners, developers, and local governments. Regulatory methods require certain actions, while nonregulatory methods encourage or drive desired actions. Nonregulatory techniques are more subtle in their direction of development. They often are in the form of agreements or incentives (*48*, p. 38).

Spacing on Crossroads at Freeway Interchanges

Access separation policies are contained in various AASHTO publications and in state DOT design policies. The booklet, *A Policy on Design Standards—Interstate System* (*49*), for example, states that the following:

> Control should extend beyond the ramp terminal at least 100 feet in urban areas and 300 feet in rural areas. These distances should usually satisfy congestion concerns. However, in areas where the potential exists which would create traffic problems, it may be appropriate to consider longer lengths of access control.

Many states have established more stringent policies that reflect the importance of providing sufficient access control lengths or separation distances along crossroads (arterials) at interchanges.

Table 8 from *NCHRP Synthesis 332* summarizes the spacing reported by state DOTs and provincial transportation agencies. The majority of state DOTs rely on the 100-ft urban and 300-ft rural spacing guidelines provided in AASHTO's *A Policy on Design Standards—Interstate System* when acquiring access rights, managing public and private access to the crossroad, and constructing new interchanges or retrofitting existing ones (*44*, p. 18).

The AASHTO guidelines generally are shorter than some of the access spacing requirements that ensure good arterial traffic signal progression and provide adequate weaving and storage for turning traffic, left turns in particular (*7*, p. 113). Figure 11, adapted from *NCHRP 420* (*7*, p. 118), illustrates the access spacing needed.

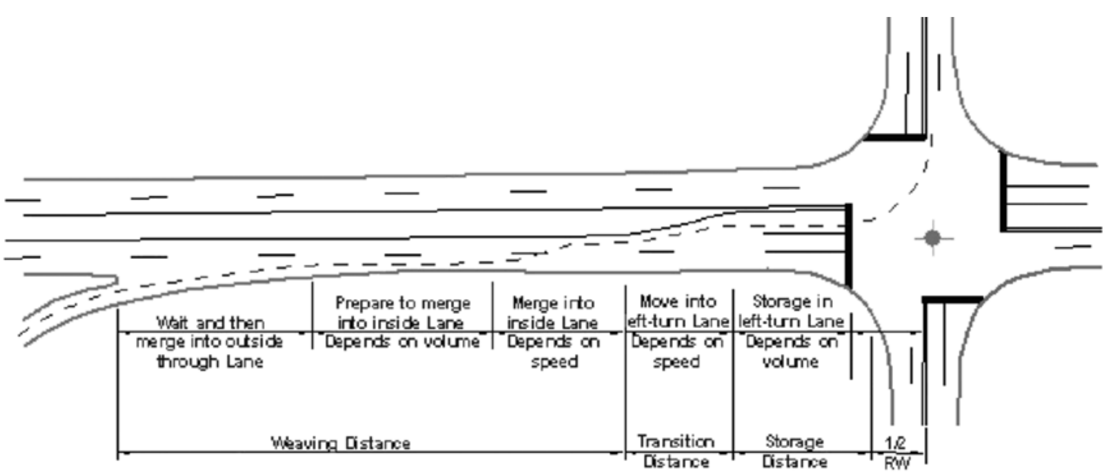


FIGURE 11 Factors influencing access spacing distance. *Source*: Gluck et al. (*7*).

TABLE 8
SUMMARY OF MINIMUM ACCESS SPACING STANDARDS OR GUIDELINES IN INTERCHANGE AREAS, BY RESPONDING AGENCY

Agency	Minimum Spacing Requirement or Guideline: Stated Distance
Alberta Transportation	660 ft (200 m)
Arizona Transportation Research Center	300 ft (90 m)
Arkansas State Highway and Transportation Department	150 ft (45 m)
California DOT	415 ft (125 m)
Colorado DOT	350 ft (105 m)
Connecticut DOT	None
E-470 Authority (Colorado)	600 ft (180 m)
Florida DOT	440 ft (135 m)
Georgia DOT	100 ft (30 m)
Illinois DOT	150 ft (45 m)
Indiana DOT	100 ft (30 m)
Iowa DOT	100 ft (30 m)
Kansas DOT	None
Louisiana DOT and Development	100 ft (30 m)
Maine DOT	500 ft (150 m)
Maryland State Highway Administration	100 ft (30 m)
Michigan DOT	100 ft (30 m)
Ministère des Transports du Québec	None
Minnesota DOT	Developing guidelines
Mississippi DOT	100 ft (30 m)
Nebraska Department of Roads	660 ft (200 m)
Nevada DOT	300 ft (90 m)
New Brunswick DOT	215 ft (65 m)
New Jersey DOT	Varies
New York DOT	100 ft (30 m)
Nova Scotia DOT and Public Works	200 ft (60 m)
Ohio DOT	600 ft (180 m)
Oregon DOT	750 ft (230 m)
South Carolina DOT	100 ft (30 m)
South Dakota DOT	660 ft (200 m)
Texas DOT	460 ft (140 m)
Utah DOT	165 ft (50 m)
Virginia Transportation Research Council	100 ft (30 m)
Washington State DOT	130 ft (40 m)
West Virginia DOT	100 ft (30 m)
Wyoming DOT	150 ft (45 m)

Source: Butorac and Wen (*44*, p. 18).

The purposes of the research performed by Rakha et al. (*50*, p. iii) were to (1) provide a synthesis on state of practice with regard to interchange access control, (2) investigate the safety impact of varying access arrangements and spacing, and (3) develop regression models that relate crashes to roadway and geometric variables.

Rakha et al. (*50*, p. 1) developed a methodology to evaluate the safety impacts of different access spacing standards on crossroads at interchanges. The analysis results demonstrate the shortcomings of the 100-ft urban and 300-ft rural spacing guidelines.

NCHRP Report 420 provides guidance for estimating the necessary access spacing along an interchange crossroad. Although there are many different interchange types, from an access management perspective, they can be categorized as those with free-flowing entrance and exit ramps, and those for which ramp entrances and exit ramps are controlled by traffic signals or stop signs. These types and their access management and spacing implications are shown in Figure 12 and described as follows:

- **Ramp Intersections Controlled by Traffic Signals**—The signalized ramp intersection is treated similarly to other signalized intersections. However, queuing from the ramp onto the freeway mainline must be avoided.
- **Ramps with Free-Flow Entry or Exit**—Access separation distances to the first downstream median opening or signalized intersection should consider the various movements and operations involved. These include the merge lanes where the ramp traffic enters the arterial, the weaving movements to enter the median lanes, the transition into left-turn lanes, and the required storage length.

Table 9 presents minimum spacing for freeway interchange areas for multilane and two-lane crossroads. The

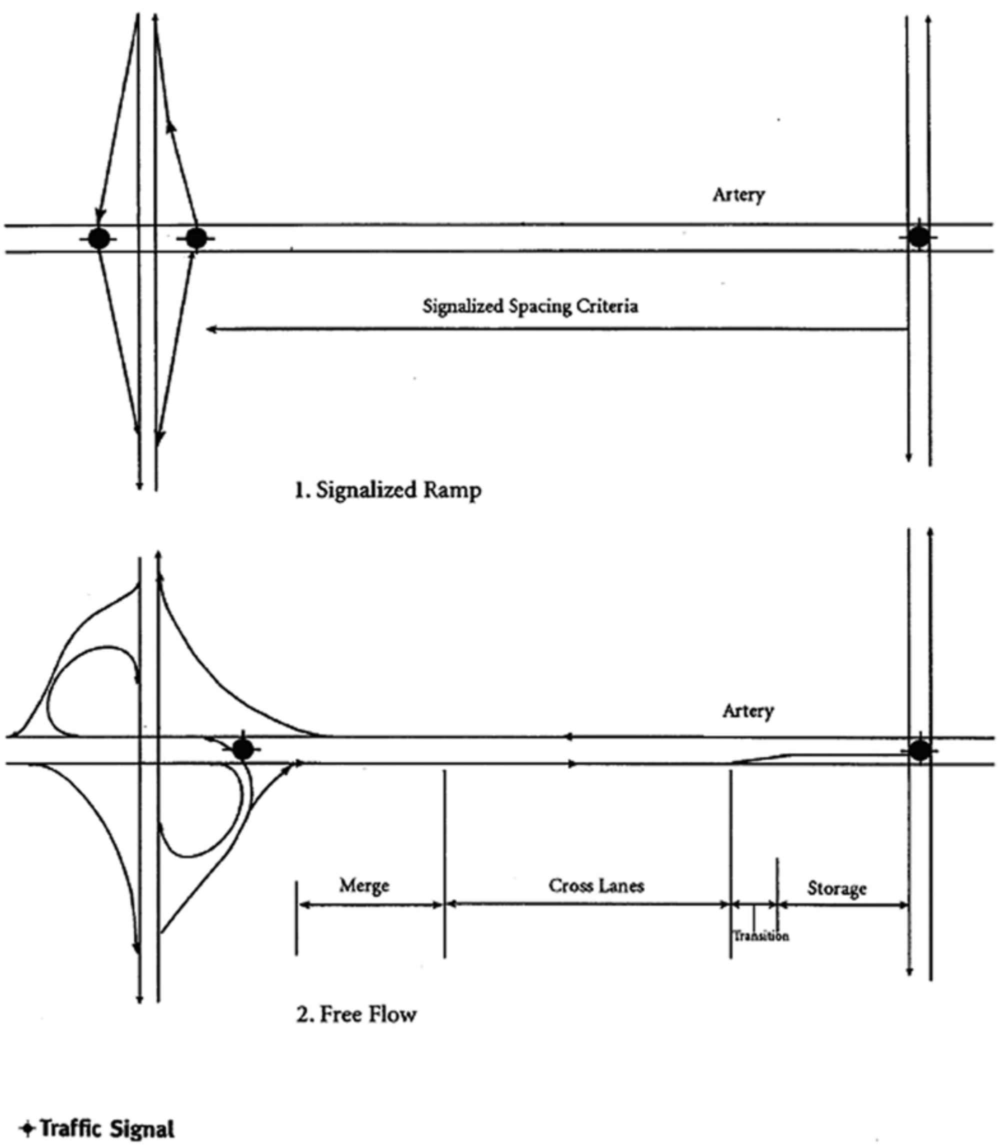


FIGURE 12 Types of ramp access to and from arterial roads. *Source*: Gluck et al. (*7*, p. 117).

table is from *Access Management Manual* (*1*, p. 160), which is based on the research performed for *NCHRP Report 420*.

Access Management Techniques

NCHRP Report 420 (*7*) identified more than 100 access management techniques that are in use or described in the literature. It stratified and organized these techniques on the basis of practicality and usefulness. These techniques then were analyzed to identify which ones were more important on the basis of potential application and effectiveness. Approximately 25 of these techniques were deemed to be more important because they were applicable to a significant portion of the roadway system and were shown to be effective in improving safety, reducing emissions, or improving traffic operations.

These techniques, shown in Table 10 from *NCHRP Report 420*, include those related to policy and those related to physical design or traffic operations. The access features noted encompass most of the nonpolicy techniques. The techniques identified in the table are frequently encountered in key access management decisions. The table provides a generalized assessment of each of the techniques shown, in terms of perceived importance to access management, the availability of related research, and the techniques' amenability to analysis.

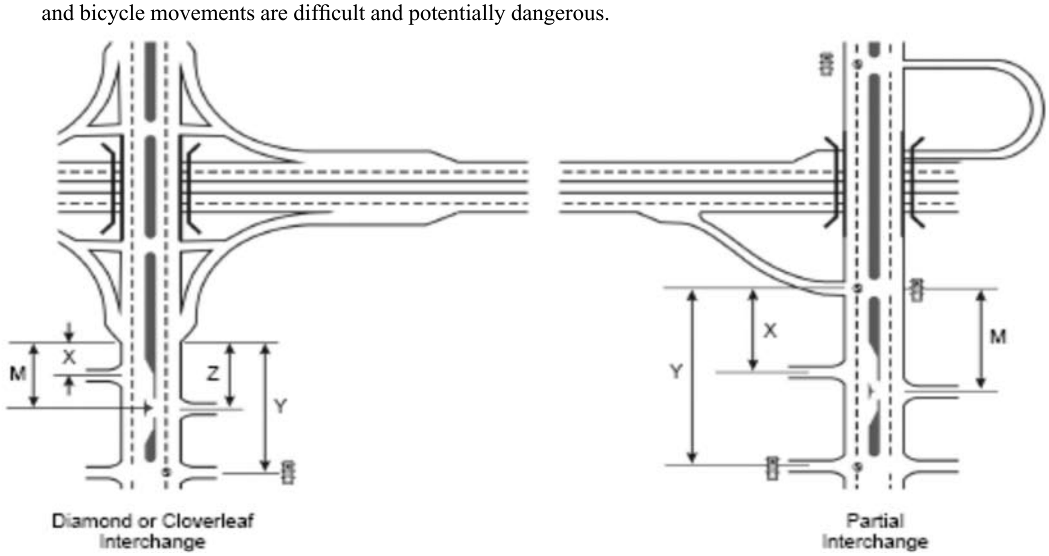
Table 11 lists selected engineering-based techniques, together with their effectiveness in achieving the six objectives shown.

Schultz et al. (*52*) developed a prioritization process for the state of Utah to determine which sections of state highways could most benefit from the implementation of access management techniques, and subsequently to recommend access management techniques and treatments for these sections. To serve as the basis for the performance index, a database was created including identifying features, characteristics, and crash history for 175 arterial road segments on Utah state routes.

TABLE 9
MINIMUM SPACING FOR FREEWAY INTERCHANGE AREAS WITH MULTILANE CROSSROADS

	Spacing Dimension			
Type of Area	*X*	*Y*	*Z*	*M*
Fully developed urban[a]	750 ft (230 m)	2640 ft (800 m)	990 ft (300 m)	990 ft (300 m)
Suburban/urban	990 ft (300 m)	2640 ft (800 m)	1320 ft (400 m)	1320 ft (400 m)
Rural	1320 ft (400 m)	2640 ft (800 m)	1320 ft (400 m)	1320 ft (400 m)

Source: Spacing dimensions from Gluck et al. (*7*).
Note:
X = distance to first approach on the right; right in/right out only.
Y = distance to first major intersection. No four-legged intersections may be placed between ramp terminals and the first major intersection.
Z = distance between the last access connection and the start of the taper for the on-ramp.
M = distance to first directional median opening. No full median openings are allowed in nontraversable medians up to the first major intersection.
[a] Free-flow ramps are generally discouraged in fully developed urban areas and are questionable in suburban/urban areas because pedestrian and bicycle movements are difficult and potentially dangerous.



A decision tree was developed to classify road segments into smaller subcategories by determining appropriate characteristics and cutoff values to categorize the data. To use the decision tree, information about annual average daily traffic (AADT), signals per mile, adjacent land use, and future growth was needed to classify arterial road segments. The goal of classifying the data was to find subcategories of road segments with similar charac-

TABLE 10
SUMMARY OF SIGNIFICANT ACCESS MANAGEMENT TECHNIQUES

Technique		Importance in Access Management	Previous Sources	Amenable to Analysis	Analysis in Phase II
A - Policy Techniques					
1	Establish Comprehensive Access Code	High	-	No	No
2	Institutionalize Advance Purchase of Right-of -Way	High	-	No	No
3	Require Internal Circulation/Site Plan Review	High	-	No	No
B - Design Techniques					
1a	Establish Traffic Signals Spacing Criteria	High	Some	Yes	Yes
1b	Establish Spacing for Unsignalized Access	High	Few	Yes	Yes
1c	Establish Corner Clearance Criteria	High	Few for Upstream	Yes	Yes
1d	Establish Access Separation Distances at Interchanges	High	-	Yes	Yes
2a	Install Nontraversable Median on Undivided Highway	High	Many	Yes	Yes
2b	Replace Two-Way Left-Turn Lane With Nontraversable Median	High	Many	Yes	Yes
2c	Close Existing Median Openings	High	Some	No	No
2d	Replace Full Median Opening With Median Designed for Left-Turns from the Major Roadway	High	Few	Yes	No
3a	Install Left-Turn Deceleration Lanes where None Exists	High	Some	Yes	Yes
3b	Install Left-Turn Acceleration Lane	Low	Few	Yes	No
3c	Install Continuous Two-Way Left-Turn Lane on Undivided Highway	Medium	Many	Yes	Yes
3d	Install U-Turns As an Alternative to Direct Left Turns	Medium-High	Few	Yes (Oper.)	Yes
3e	Install Jug Handle and Eliminate Left Turns Along Highways	Medium	Few	Yes (Oper.)	Yes
4a	Install Right-Turn Acceleration/Deceleration Lane	Medium	-	Yes (Oper.)	No
4b	Install Continuous Right-Turn Lane	Low	-	Yes	No
5a	Consolidate Driveways	Medium	-	Yes	No
5b	Channelize Driveways to Discourage or Prohibit Left Turns on Undivided Highways	High	-	Yes	No
5c	Install Barrier to Prevent Uncontrolled Access Along Property Frontage	Medium	-	Yes	No
5d	Coordinate Driveways on Opposite Sides of Street	Low-Medium	-	Site-specific	No
6a	Install Frontage Road to Provide Access to Individual Parcels	Medium	-	Yes	Yes
6b	Locate/Relocate the Intersections of a Parallel Frontage Road and a Crossroad Further From the Arterial-Crossroad Intersection	Medium	-	Yes	Yes

Source: Gluck et al. (*7*).

teristics and crash severity scores. This goal was accomplished by collecting existing characteristics and crash histories and determining the impact of access management on the safety of arterial roads. Access management techniques then were recommended for each subcategory based on correlations between access management techniques and crash severity score. Possible recommendations included limiting access points, installing raised medians, and planning for future growth by implementing standards for adequate signalized and unsignalized access spacing and obtaining sufficient right-of-way for future medians.

Access Permit Process

NCHRP Synthesis 304 (*53*, p. 46) identified that many states are finding it necessary to update and expand their driveway regulation programs in response to the expansion of metropolitan areas and related changes in the traffic environment. The increasing demands for highway access are making it increasingly clear that driveways, and the developments they serve, can have cumulative adverse impacts on the safety and efficiency of major roadways. These impacts have not been addressed adequately through traditional encroachment permitting.

Access Permit Programs

State and local agencies typically use access permitting to apply access management standards to development. A well-conceived and applied access permitting program is essential for effective access management. It is important that permitting procedures and requirements are formulated carefully and that the responsible staff members are adequately trained and informed of any changes in agency rules, standards, or policies (*1*, p. 215).

NCHRP Synthesis 304 documents the driveway regulation practices of state transportation agencies. The survey

TABLE 11

SELECTED ENGINEERING-BASED TECHNIQUES AND THEIR EFFECTIVENESS IN ACHIEVING ACCESS MANAGEMENT OBJECTIVES

	Manner in Which the Technique Contributes to Safety and Improvement of Traffic Operations					
Access Management Technique	1 Limit Conflicts	2 Separate Conflicts	3 Auxiliary Lanes	4 Conflicting Movements	5 Roadway Operations	6 Driveway Operations
Access Spacing and Design; Within the Traveled Way						
1. Traffic signal spacing		●			●	
2. Continuous two-way left-turn lane (TWLTL)			●		○	
3. Nontraversable median	●				●	
4. Replace a TWLTL with a nontraversable median	●				●	
5. Directional median opening	●	○			●	
Access Spacing and Design; At the Margin of the Traveled Way					●	
6. Unsignalized access spacing		●			●	○
7. Corner clearance		●			●	
8. Right-in/Right-out	●			○	●	
9. Consolidate driveways	●	●		○	●	
Auxiliary Lanes						
10. Left-turn deceleration lane				●	●	○
11. Isolated left-turn bay				●	●	○
12. Right-turn deceleration lane				●	●	○
13. Continuous right-turn lane				●	●	○

Source: Adapted from Stover (*51*).
Note:
● Major Effect
○ Secondary Effect

results revealed that driveway regulation practices vary widely from state to state. In addition, the scope of driveway regulation programs can vary from comprehensive access management to basic design objectives. Although the objectives of agency driveway regulation programs vary in scope, they generally are oriented toward ensuring a safe and efficient transportation system, while providing reasonable access to private property. Many agencies also seek to accomplish administrative objectives, such as uniformity of procedures and standards, consistency in decision making, efficient turnaround for issuing permits, intergovernmental coordination, and adequate training of permit staff.

At a minimum, state driveway regulation programs provide state oversight of construction within the right-of-way of a state highway and address such issues as drainage, installation of culverts, driveway location and sight distance, driveway design, and driveway construction. Applicants must obtain a permit, often called a right-of-way encroachment permit, for these activities. However, state transportation agency practices vary considerably in the extent of access control or impact mitigation activities.

An element of contemporary driveway regulation programs, identified by *NCHRP Synthesis 304*, is the establishment of an ACS that defines the planned level of access for different state highways. Access management regulations generally are designed to parallel the function of the roadway, either based on functional classification, speed, or some combination of these methods. Other components of contemporary driveway regulation programs include traffic impact assessment procedures and criteria, as well as impact mitigation requirements for large developments (*53*, p. 46).

NCHRP Synthesis 304 found that the majority of state and local agencies encourage driveway consolidation and shared access through their driveway regulation program, although most noted that it is difficult to force the issue. Several states encourage shared access through coordination with local governments, resulting from the authority of local governments related to subdivisions and site design (*53*, p. 46).

An *Access Management Toolkit* prepared for southwest Idaho (*55*, p. 41) indicates that the practice of sharing driveways and providing cross-parcel access has two benefits. The first benefit minimizes the number of driveways on the arterial road. The second benefit provides cross access between properties, broadening the access choices for the driver. If a group of smaller developments share access, the driver needing to turn left across heavy volumes usually can find an access that is signalized, allowing safer left turns. Having good cross-parcel access also maximizes the number of well-designed unsignalized driveways that have good visibility and are located to take advantage of sufficient gaps in traffic from a nearby signal. Joint driveways and cross access especially help the small corner lots and out parcels. On small corner parcels, left-turn accessibility is a problem due to the fact that the left turns conflict with the functional area of the intersection. Interconnected developments give more options for customers and deliveries, especially for safe left turns. It is easier to provide cross and joint access if it is planned at the beginning of a development process. At that time, the designer will have the ability to lay out access systems and allow good separation between these accesses.

Many communities have developed AMPs and programs aimed at reducing the number of driveways on major arterial routes. These plans often involve the provision of access roads, shared driveways, and interparcel connections that reduce the need for individual sites to have direct, driveway access to an arterial. However, accomplishing alternative access can be challenging if the local street network is sparse and the land along the major roadway already has been subdivided extensively. Alternative access is best accomplished when new lots are being created on major roads or land is being subdivided for development. Unmanaged land division and subdivision activity on major roadways is a key constraint to accomplishing street networks and alternative access. Even with effective subdivision regulations, communities can face access problems from minor land division activity that is exempt from the subdivision review process. Strengthening subdivision regulations to restrict strip lots on major roads and to preserve necessary right-of-way, as well as providing a greater variety of street types and design options for commercial and residential subdivisions, can support the use of street networks for property access, providing more opportunities for alternative access (*3*, p. 63).

NCHRP Synthesis 304 indicated that, in general, the more contemporary driveway regulation programs are oriented toward comprehensive and systemwide access management of state highways. The programs are designed to systematically regulate all highway access locations, including driveway access, as well as street connections, median openings, signals, turn lanes, and interchanges. They seek to address the more complex and comprehensive objectives of access management and mitigation of traffic impacts by developers (*53*).

Permit Application Process

Typically, any private property owner or developer intending to construct an access driveway onto the state highway right-of-way is required to apply for, and obtain, a permit from the state DOT before beginning any construction. A permit also may be required for any proposed relocation or alteration of an access driveway or median crossover, or for a significant change in the property's existing land use, and may be governed by the same regulations and standards as for a new access driveway.

Most states have an established driveway permit process that is followed by all applicants. The administrative requirements associated with driveway access permit application processes often are governed by promulgated rules of an administrative code and specified in a driveway permit manual or a similar document. The permit review process establishes when and where direct driveway access will be allowed onto the roadway network and may prohibit access at certain locations and restrict the number of driveways allowed. According to the TRB *Access Management Manual* (*1*, p. 222), the authority to deny access and criteria for denial vary according to agency policy and state law. The following are typical criteria for denial of access:

- Reasonable alternative access can be provided from roadways of a lower classification.
- The proposed access could cause safety or operational problems.

The permit application often must be accompanied by drawings, plans, and other documentation sufficient to describe in detail the specific access proposal to state review staff. Figure 13 is the cover of an informational pamphlet used by Indiana DOT to inform potential permit applicants of the department's driveway permit process.

Access permitting typically involves the following activities (*1*, pp. 215–216):

- Initial inquiry by the applicant
- Determination of application requirements
- Preparation and submittal of the complete application
- Review by the permitting agency
- Action by the agency to issue or deny

Figure 14 illustrates a general driveway permit review process that may be used by a transportation agency. The process must reflect that a permitting agency may receive access applications for a wide range of developments: from a single-family home to a large development generating thousands of trips per day. The amount of information that must be provided by an applicant and evaluated by a permitting agency depends on the size and complexity of the proposed development. For effective administration, it is helpful to keep the application requirements as simple as possible and to distinguish between the application requirements for small and large developments (*1*, p. 216).

A permit application for a small development simply may indicate the location of the property, existing zoning, and ownership, together with a site plan showing the location of existing and proposed structures, existing and proposed access drives, on-site circulation and parking, distance to adjacent access connections, and a statement of need for the proposed access connection. For a large development, an

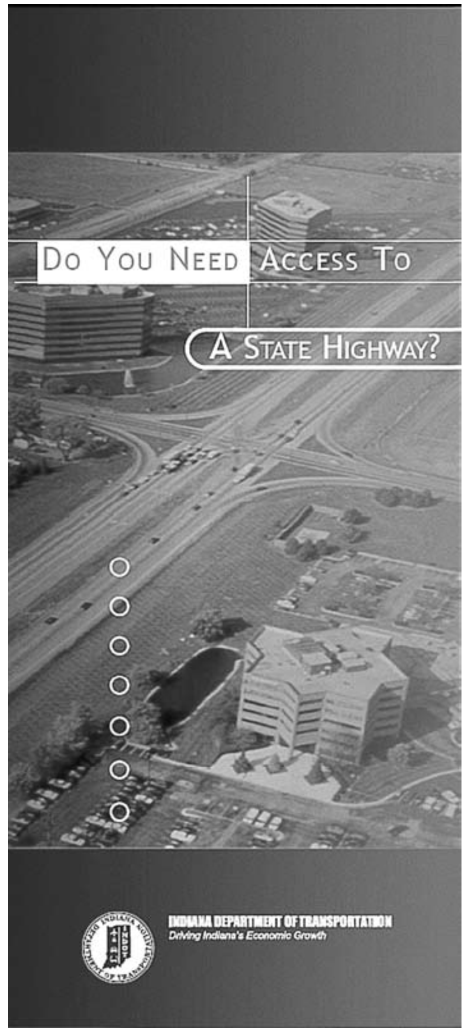


FIGURE 13 Informational pamphlet for Indiana DOT's driveway permit process. *Source: Do You Need Access to a State Highway?* (*56*).

access permit application also may require a detailed site plan and a Traffic Impact Study (TIS) as well as involve off-site mitigation (*1*, p. 216). Many transportation agencies have TIS requirements for permit applications for developments that are projected to generate a specific number of peak-hour or daily trips (*53*, p. 13).

A preapplication meeting is an effective way to establish the technical responsibilities and analyses that will be required of larger developments, particularly those that might involve a TIS, with regard to the access permit. Conducting a preapplication meeting before the applicant begins a TIS reduces conflict and helps the applicant's consultant to efficiently complete the required analysis.

Conditional Permits

NCHRP Synthesis 304 (*53*, p. 17) indicates that, in contemporary driveway regulation programs, limitations and conditions often are included in the driveway permit related to the

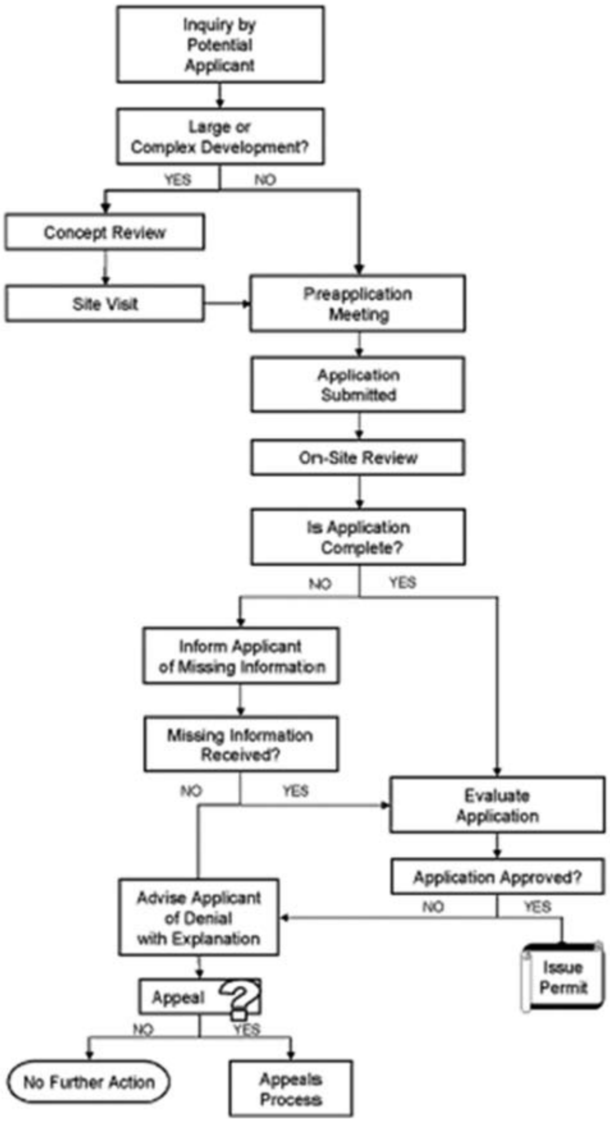


FIGURE 14 Flowchart for permitting process. *Source: Access Management Manual* (*1*, p. 218).

use of the access and other considerations. Exceeding any limit or condition could invalidate the permit and require a new permit. Such conditions may include, but are not limited to, the following:

- Maximum driveway volume
- Mix of vehicles (i.e., percentage of trucks, percentage of cars) that use the driveway
- Alternative access available (i.e., when adjacent properties develop, cross-parcel circulation and alternative access must be provided by the development)
- Traffic conditions when turn bays may need to be provided, if not part of the initial development
- Bringing a previously granted design variance up to full standards when the cause of the waiver no longer exists (i.e., the constraint is gone)

Some agencies also limit the number of driveways to that stated in the permit and specify that future subdivision of the parcel will require joint and cross access or provision of a supporting on-site roadway system (*57*).

Variances and Waivers

When administering driveway regulation programs, agencies may face a variety of site-related issues and proposed solutions that are inconsistent with adopted standards or engineering practices. In these circumstances, applicants may request variances (waivers) or exceptions to agency regulations. Therefore, procedures for considering deviations from standards, along with criteria that specify when a variance may be granted, are important aspects of an effective driveway regulation program (*53*, p. 20).

According to Eisdorfer and Siley (*58*), the ultimate goal of an effective variance process is to "reach a solution that the agency can approve for the specific location, as well as other similar locations when comparable circumstances arise in the future." A review of the literature by suggests that access variances may be appropriate under following general situations (*58*, pp. 289–297):

- **Unreasonableness of strict application**—Where strict application of access management standards will result in an outcome that both the applicant and permitting authority can agree is unreasonable.
- **Existing substandard conditions**—Where existing conditions, such as geometric deficiencies of the abutting highway, are substandard and not attributable to the applicant.
- **Existing environmental, economic, or social constraints**—Where compliance with standards is constrained due to conditions such as limited right-of-way, wetlands, waterways, historic districts, utility conflicts, topographical constraints, and environmentally sensitive areas.
- **Uniqueness of the situation**—Where a situation precludes compliance with standards that are rarely if ever encountered and, by virtue of its unique nature, would not likely set an undesirable precedent.
- **Conflicts between the requirements of agencies having jurisdiction**—Where the requirements of one or more regulatory agencies conflict, such as between transportation features and environmental policies.
- **Near the threshold**—Where a site may straddle a boundary that results in a change of standards, such as a site having frontage that is affected by two separate access categories with different driveway spacing requirements.
- **Voluntary upgrades**—Where applicants have access and could advance their project without triggering the need for a driveway permit, but would like to improve the existing condition (in such situations, lack of willingness to provide a variance may cause the applicant to leave the existing condition unimproved). Consistency in administering variances is critical

because inconsistent or infrequent application of standards makes them vulnerable to legal challenges.

In a review of variance considerations for access management, Eisdorfer and Siley (*58*) noted the following:

> An exception which is granted to a standard has the effect of lowering that standard. Because agencies are obligated to act consistently, agency staff should be wary of recommending approval of any variance that they are not prepared to grant every time a similar circumstance arises. To achieve consistency, an agency must consider future decisions based on a record established through past decisions. This requires tracking of all exceptions which have been requested and noting the disposition and reasoning behind each outcome. . . . Variances that are routinely granted should eventually be authorized as accepted practice. (pp. 289–297)

Eisdorfer and Siley (*58*, pp. 289–297) suggest the following hierarchy for variance decision making that reflects the relative importance of the access feature:

- Safety (e.g., sight distance, etc.)
- Spacing of interchanges
- Spacing of traffic signals
- Spacing of driveways
- Corner clearance
- Number of driveways on one property
- Edge clearance between the driveway and property sidelines

For example, using this concept, review staff would place somewhat less emphasis on compliance with driveway spacing in a case in which a variance is needed to maintain adequate sight distance for safe operations (*58*, pp. 289–297).

The South Carolina DOT's *2008 Access and Roadside Management Standards* included new provisions regarding access waivers (variances). The request for an access waiver should describe the undue hardship that will be placed on the applicant if a waiver is not granted. A waiver will be granted only if the following is determined:

- Denial of the waiver will result in loss of reasonable access to the site.
- The waiver is reasonably necessary for the convenience and welfare of the public.
- All reasonable alternatives that meet the access requirements have been evaluated and determined to be infeasible.
- Reasonable alternative access cannot be provided.

When a waiver is approved, the reasons for granting the waiver and any recommendations given by the South Carolina DOT need to be clearly stated and included in department files. Restrictions and conditions on the scope of the permit are imposed as required to keep potential safety hazards to a minimum. The encroachment permit may contain specific terms and conditions providing for the expiration of the waiver if, in the future, the grounds for the waiver no longer exist (*59*).

Two contemporary profiles relating to access permit processes—Minnesota DOT's Permit Process and Oregon DOT's Central Highway Approach/Maintenance Permit System (CHAMPS)—are highlighted in chapter six.

Traffic Impact Studies

As noted in the *Access Management Manual* (*1*, pp. 224–225), a site TIS assesses the effects that a proposed development will have on the surrounding transportation network, the ability to get traffic on and off the site, and the need for off-site mitigation. A TIS is an essential part of the development review process to assist developers and public agencies in making land use decisions. The studies are appropriate not only during access permitting, but also during requests for subdivision, rezoning, and other development activities when a proposal may have a substantial adverse impact on transportation operations. A well-prepared TIS helps the developer and permitting agency accomplish the following:

- Forecast the traffic impacts created by proposed development based on accepted practices, not perception
- Determine improvements needed to accommodate the proposed development
- Allocate funds more efficiently
- Relate land use decisions with traffic conditions
- Evaluate the number, location, and design of access points
- Update traffic data
- Identify needed roadway improvements
- Provide a basis for determining the developer's responsibility for specific off-site improvements

Small developments (typically fewer than 100 trips per hour) usually are exempted from preparing a TIS, because the impact of these developments generally will be limited to the vicinity of the access connection. However, a site access and circulation review can be conducted to ensure that access connections are safely located. Principal elements of this review include sight distance, driveway geometry, driveway throat length, and provisions for bicycles and pedestrians.

For all other developments (typically those that generate 100 trips or more in the peak hour), some type of TIS generally is required as part of the access permit review application (*60*). The type of analysis can depend on the size, impact, and complexity of the development. Typically, the larger the development (as measured by the number of trips generated) the larger the area that may experience a measurable traffic impact caused by the development. Table 12, from the TRB *Access Management Manual* (*1*, p. 226, Table

TABLE 12
SUGGESTED REQUIREMENTS FOR VARIOUS TYPES OF TRAFFIC IMPACT STUDIES

	Trip Generation Threshold			
	Access Location & Design Review	Small Development: Traffic Impact Assessment	Medium Development: Traffic Impact Statement	Large Development: Regional Traffic Analysis
	T<100 Peak-Hour Trips	100 ≤ T < 500 Peak-Hour Trips	500 ≤ T <1,000 Peak-Hour Trips	T ≥ 1,000 Peak-Hour Trips
Preapplication meeting or discussion	✓	✓	✓	✓
Analyses of roadway issues				
Existing condition, analysis within study area	✓	✓	✓	✓
Sight distance evaluation	✓	✓	✓	✓
Nearby driveway locations	?	✓	✓	✓
Existing traffic conditions at nearby intersections and driveways		✓	✓	✓
Future road improvements		?	✓	✓
Crash experience in proximity to site	?	✓	✓	✓
Trip generation of adjacent development		?	✓	✓
Trip distribution analysis		✓	✓	✓
Background traffic growth		?	✓	✓
Future conditions analysis at nearby intersection		?	✓	✓
Mitigation identification and evaluation		?	?	✓
Site issues				
Traffic generation	✓	✓	✓	✓
Traffic distribution	?	✓	✓	✓
Evaluation number, location, and spacing of access points	?	✓	✓	✓
Evaluate access design, queuing, etc.	✓	✓	✓	✓
Evaluate site circulation	✓	✓	✓	✓
Other analyses				
Gap analysis for unsignalized locations		?	?	✓
TSM/TDM[a] mitigation measure (car-or vanpool-ing, transit etc.) - transit agency participation			?	✓
Effect on traffic signal progression analysis of proposed signal locations	[b]	[b]	?	✓

Source: Access Management Manual (*1*, p.226, Table 12-1).
Note: ✓= required; ? = may be appropriate on a case-by-case basis.
[a] TSM/TDM = transportation system management/transportation demand management
[b] Not signalized

12-2), identifies basic analyses suggested for inclusion in the TIS. As shown in Table 12, the scope and complexity of analysis to be conducted should be determined based on the projected number of peak-hour trips.

Four profiles of contemporary TIS practices—Louisiana DOT's TIS process, Caltrans' Equitable Share Responsibility Calculations, as well as New Jersey DOT's vehicle-use limitations and transit-trip credit methodologies—are presented in chapter six.

Purchase of Access Rights

Access control by the acquisition of property rights has been used on the Interstate Highway System since it was mandated by the Federal Aid Highway Act of 1956. A growing number of agencies are recognizing the benefits of acquiring property rights to control access on other important arterial highways to preserve safety and mobility. The purchase of property rights can prevent undesirable accesses at the locations where the property rights were acquired (*61*, p. 5).

The purchase of access rights may be expensive and time-consuming compared with access regulation, but the purchase of access rights is a stronger and longer-lasting solution. Regulations can change with political administrations and attitudes (*6*, p. 10). Access rights may be purchased to achieve the following:

- Limit access to designated locations or side streets
- Control access and sight distance at intersections or interchanges
- Limit access to designated highways or new facilities and bypasses
- Introduce long-term or permanent access control
- Improve locations with high crash experience (*1*, p. 314)

Access rights may be acquired through negotiation, purchase, or the power of eminent domain, and is recorded in the county of record. The purchase of access rights offers the following advantages:

- Provides long-term assurance of access control,
- Avoids concerns over property rights and regulatory takings by compensating property owners for access rights, and
- Avoids the expense of purchase or condemnation, if it is achieved through negotiated dedication.

The purchase of access rights may have the following disadvantages:

- Cost may be prohibitive,
- It may be difficult to establish a dedicated funding source in light of other needs,
- An effective tracking mechanism is required for enforcement, and
- Condemnation is required when a negotiated purchase is unsuccessful (*1*, p. 314).

NCHRP Synthesis 351 (*61*) provides additional information regarding access rights. It was prepared for state transportation agency personnel, as well as for others who are involved in acquiring access rights along roadways other than freeways. It documents the state of the practice with the intent to limit the amount of access to the roadway to better manage highway safety and mobility. Successful practices are documented along with current policies, legal and real estate literature, and other publications that address this subject. The findings focus on the three main areas: acquisition, management, and disposal. Lessons learned and information gaps are explored.

Access Design Concepts

Access design concepts complement the access features and spacing criteria presented in this chapter. These concepts include the following:

- Alternative left-turn treatments
- Frontage roads
- Left-turn lanes
- Right-turn lanes

Appendix D contains a retrofit toolbox, adapted from South Dakota DOT (*62*), for implementing access management techniques (available on web version only).

Business Turns to Access Management Principles

One of the largest overnight package delivery companies has spent years studying and refining its vehicle routing to improve efficiency, operations, and the bottom line. The company decided to implement a routing strategy consistent with basic access management principles. By routing trucks to make right turns and minimize the number of left-turn movements, the company is saving millions of dollars on its gasoline bill. It recognized that the time the trucks spent in left-turn lanes leads to more engine idling, fuel consumption, and traffic delays. The company also recognized that left turns are not as safe as right turns. This conclusion was reached based on the extensive experience of its drivers and reconfirms the crash analysis findings in the access management research.

Source: http://compass.ups.com/features/article.aspx?id=340 and http://solveclimate.com/blog/20080422/ups-goes-left-turn-diet-slims-down-its-carbon-footprint (April 22, 2008).

Alternative Left-Turn Treatments

NCHRP Report 420 indicates that U-turns are being used increasingly as an alternative to direct left turns to reduce conflicts and to improve safety along arterial roads. U-turns make it possible to prohibit left turns from driveway connections onto multilane highways and to eliminate traffic signals that would not fit into time-space (progression) patterns along arterial roads. When incorporated into intersection designs, U-turn provisions enable direct left turns to be rerouted and signal phasing to be simplified (*7*, p. 97).

The operational and safety issues related to direct left-turn movements have been noted by an overnight delivery company.

Cities and states use various approaches for reducing the number of conflicts involving left turns along their arterials. One approach is to provide dual left turns at intersections with collector streets, with the innermost lane accommodating U-turns. Another approach is to prohibit left-turn exits onto major arterials and to provide midblock U-turn lanes to accommodate these movements. New Jersey uses jughandles along multilane divided highways. Michigan uses U-turn channels on highways with wide medians and prohibits all left turns at signalized intersections. Most states do not have standards, however, and handle U-turn provisions on a case-by-case basis (*7*, p. 97).

The prohibition of direct left turns from existing driveways may transfer the displaced left turns to the nearest traffic-signal-controlled intersection unless intermediate U-turn lanes are provided. The increased left-turn volumes at public road intersections would require longer left-turn phases, which could reduce the green time and capacity for through movements. U-turn provisions are especially important along roadways with relatively few median openings. Several approaches have evolved for accommodating the diverted left-turn volumes by providing U-turn lanes in advance of, at, or beyond intersections. The U-turns may be made from conventional left-turn lanes or via jughandles from the right (curb) lanes (*7*, p. 97). Illustrative treatments from *NCHRP Report 420* are shown in Figure 15, and are as follows:

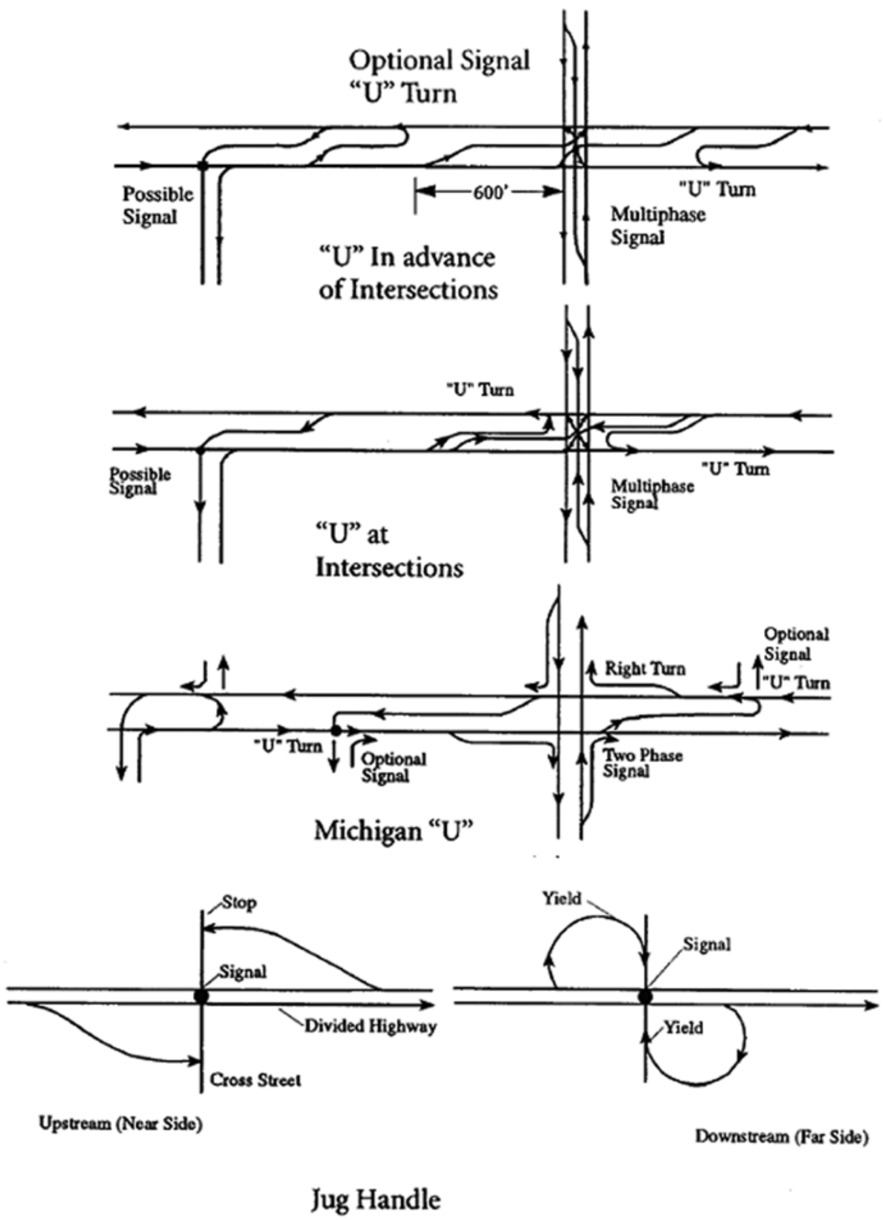


FIGURE 15 U-turns as an alternative to direct left turns. *Source*: Gluck et al. (*7*, p. 99).

- Left-turn lanes can be provided for U-turning vehicles in advance (i.e., upstream) of signalized intersections. This avoids concentrating development-related turning traffic at signalized junctions of major crossroads.
- Dual left-turn lanes can be provided at signalized intersections, with the inner lane dedicated to U-turns. Many states now provide these lanes. However, they still require multiphase traffic signal controls.
- Left- and U-turn lanes can be provided downstream of signalized intersections, thereby allowing two-phase traffic signal controls.

From 2001 to 2005, a series of research projects regarding the safety and operational effects of U-turns was conducted by the University of South Florida for Florida DOT. Two basic research approaches were employed by Liu et al. (*63*, pp. 2–3) to evaluate the safety and operational effects of various driveway left-turn alternatives. The research approaches include traffic conflict technique and operational data analysis to compare the safety and operational performance of three driveway left-turn alternatives that are widely used in Florida, and nationally. These driveway left-turn alternatives include direct left turns from a driveway, right turns followed by U-turns at a median opening, and right turns followed by U-turns at a signalized intersection.

Lu and Williams (*64*, p. 61) performed a safety analysis for 258 sites in seven Florida counties to identify the safety benefit of this access control treatment. The results indicated that this treatment could lead to a statistically significant reduction of total crashes in both the crash frequency and crash rate on major arterial roadways with nontraversable medians, high traffic volumes and speeds, and moderate to high driveway and side-street volumes. Although the property-damage-only average crash numbers were similar between the direct left turns and this treatment, the injury-fatality crash rate of right turns followed by U-turns was much lower. These results indicate that the U-turn concept has a beneficial impact on safety relative to the typical full median opening design.

The conflict data analysis results from Liu et al. (*63*, pp. 13–14) show that indirect left turns generally are safer than direct left turns from driveways. Vehicles making a right turn onto the major street and a U-turn at a downstream median opening were shown to result in 47% fewer conflicts than those making direct left turns from a driveway. Vehicles making a right turn followed by a U-turn at a signalized intersection were shown to result in about 26% fewer conflicts than those making direct left turns.

The delay and travel time comparison results show that an indirect left-turn movement does not result in longer delay or travel time, if U-turns are provided at a median opening in advance of downstream signalized intersection. However, if U-turns are provided at a signalized intersection, vehicles making a right turn followed by a U-turn could encounter longer delay and travel time than those making direct left turns at a driveway. Considering the safety benefits, the longer delays related to this treatment are not considered unacceptable, when the left-turn traffic demand at a driveway is not so high. However, if the left-turn traffic demand at a driveway is relatively high—for example, greater than 150 vehicles per hour—relocating the left-turning vehicles to a downstream signalized intersection could constitute an operational concern. The increased numbers of U-turning vehicles also have some adverse impacts on the capacities of signalized intersections. Therefore, when the left-turn traffic demand at a driveway is high, consideration should be given to providing U-turn opportunities in advance of the downstream signalized intersection (*63*, pp. 13–14).

This analysis found that providing U-turn locations at a special unsignalized location before the traffic signal has many positive safety and operational impacts. Finding an appropriate location for this midblock U-turn median opening upstream of a traffic signal in built-out areas sometimes can be difficult, however, because of the tight geometric conditions. For this condition, Liu et al. (*63*, pp. 13–14) recommend the consideration of providing a median opening for U-turns after the signalized intersection.

The research performed by Zhou et al. (*65*, p. 78) developed a methodology to quantify the operational effects of U-turns as alternatives to direct left turns from driveways. The researchers noted that many concerns guide the decision about which type of median opening should be used, indicating that safety considerations are the first priority, followed by the operational efficiency of the highway, and the delay of vehicles at the driveway. Their research demonstrated that U-turns as alternatives to direct left turns provide better safety with regard to traffic conflicts and fewer effects on through-traffic operations on a major highway. *NCHRP Report 524* (*43*) provides additional research related to the safety of U-turns at unsignalized median openings.

A different potential treatment to combat congestion and safety problems at intersections is the Median U-Turn Intersection Treatment, which sometimes is referred to as the “Michigan U” or “Michigan Boulevard” treatment, because it has been used extensively in Michigan for many years. It also has been implemented successfully in Florida, Maryland, and New Jersey (*66*, p. 1). This treatment generally is applied along a corridor that involves a multilane roadway with a nontraversable median, where left turns are not allowed at or between intersections. Figure 16 illustrates how left turns are made in this treatment.

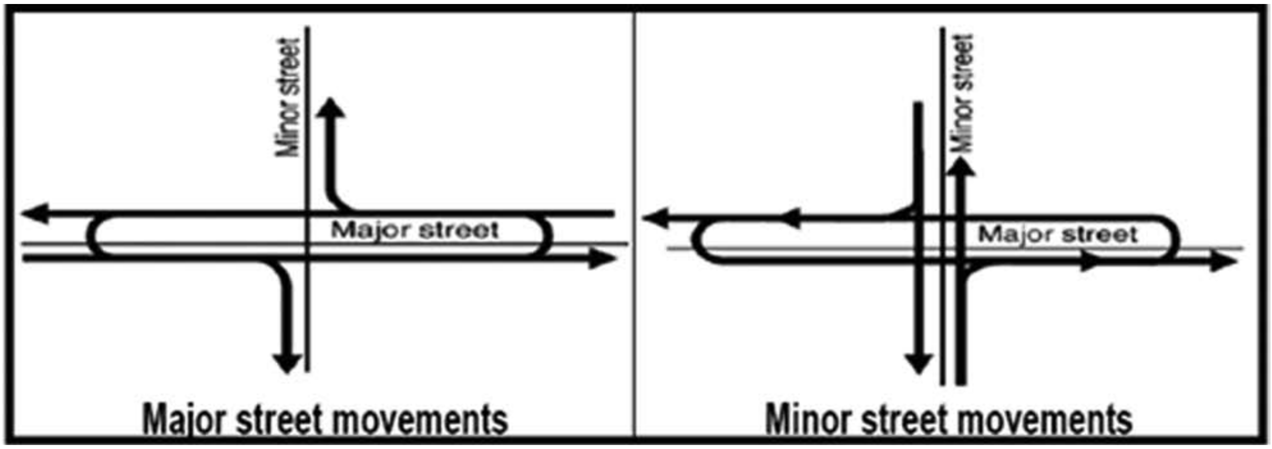


FIGURE 16 Vehicular movements at a Michigan U-turn intersection treatment. *Source*: Rodegerdts et al. (*67*, p. 243).

The treatment involves the elimination of direct left turns at signal-controlled intersections from major or minor approaches. Drivers desiring to turn left from the major road onto an intersecting cross street must first travel through the at-grade, signal-controlled intersection and then execute a U-turn at the median opening downstream of the intersection. These drivers then can turn right at the cross street. For drivers on the side street who want to turn left onto the major road, they must first turn right at the signal-controlled intersection and then execute a U-turn at the downstream median opening and proceed back through the signalized intersection. This arrangement can be implemented with and without signal control at the median openings on the major road (*66*, p. 2). Because of the additional right-turning volume, right-turn lanes may need to be added on the approaches to the intersection. Because the Michigan U-turn treatment accommodates only through and right-turning traffic at the intersection of the major and minor roads, this arrangement requires only a two-phase traffic signal, which can reduce cycle lengths and improve signal coordination.

The literature review and synthesis conducted by Jagannathan (*66*, p. 13) summarized the advantages and disadvantages of the "Michigan U" compared with conventional, at-grade signal-controlled intersections with left turns permitted from all approaches. It offered the following major conclusions:

- Michigan and other states have used this treatment successfully for more than 4 decades without major problems related to traffic operational failures or safety hazards.
- Positive guidance communicated through additional signs and pavement markings at sites with this treatment may be beneficial in reducing driver confusion and enhancing traffic safety.
- With respect to driver expectancy, this treatment should not be mixed with other indirect and direct left-turn strategies on corridor-level implementations.
- Although this is typically a corridor treatment, the concept has been used successfully for isolated intersections to improve traffic operations and safety.
- "Loons" (extra widening of the pavement beyond the normal shoulder) can be installed to accommodate larger U-turning vehicles, so this treatment can be feasible for corridors with narrow medians.

Directional median crossovers provide better operational and safety benefits compared with bidirectional median crossovers.

- The reduction in signal phases at intersections where this treatment is applied provides increased capacity in comparison to the conventional intersections. The capacity increases are typically in the range of 20% to 50%.
- The total network travel time savings can and usually do outweigh the additional travel time required for left-turning vehicles from the major road and cross street for corridors with this treatment compared with conventional intersections.
- The safety performance of this treatment is better than conventional intersections because they have fewer vehicle-vehicle conflict points. Typical total crash reductions range from 20% to 50%.
- Head-on and angle crashes that have high probabilities of injury are significantly reduced compared with conventional intersections.

In research sponsored by FHWA, Jagannathan (*66*, p. 2) applied a traffic simulation model to analyze the performance of three New Jersey Department of Transportation (NJDOT) jughandle design configurations as shown in Figures 17–19. This included a comparison with conventional intersections for a variety of traffic flows and signal settings.

The generalizations drawn from the research conclusions (*66*, p. 11) were as follows:

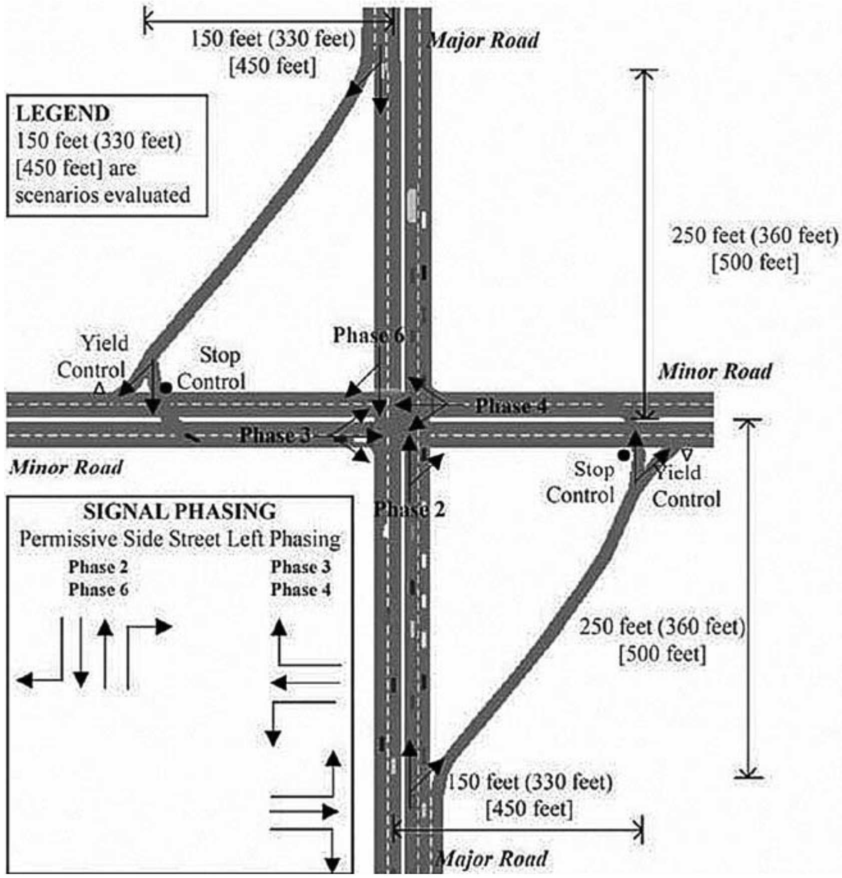


FIGURE 17 Typical geometry of the jughandle intersection—Case "A." *Source*: Jagannathan (*66*).

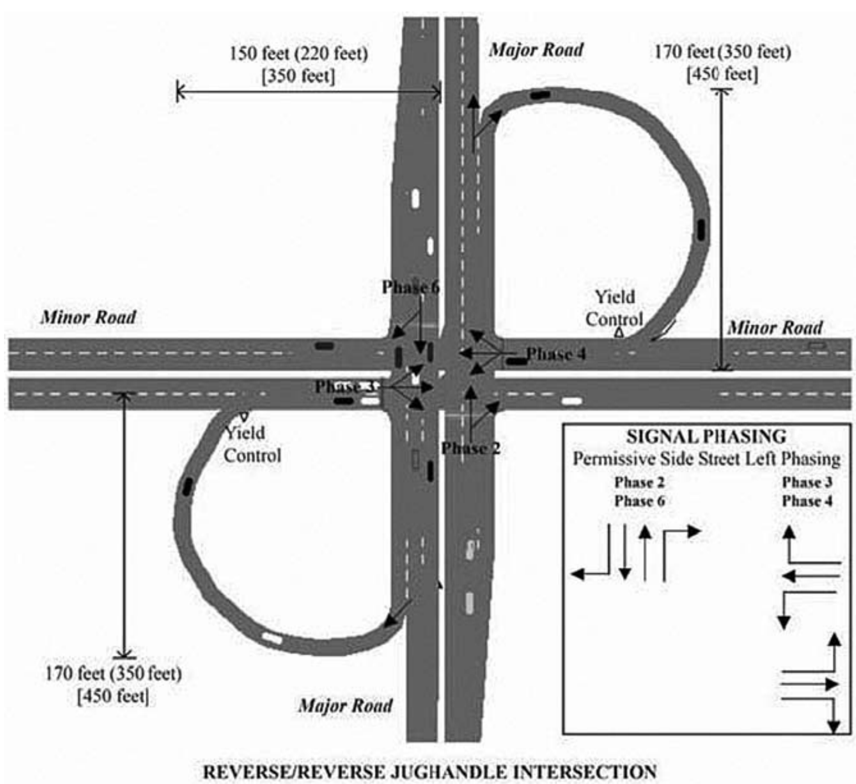


FIGURE 18 Typical geometry of the jughandle intersection—Case "B." *Source*: Jagannathan (*66*).

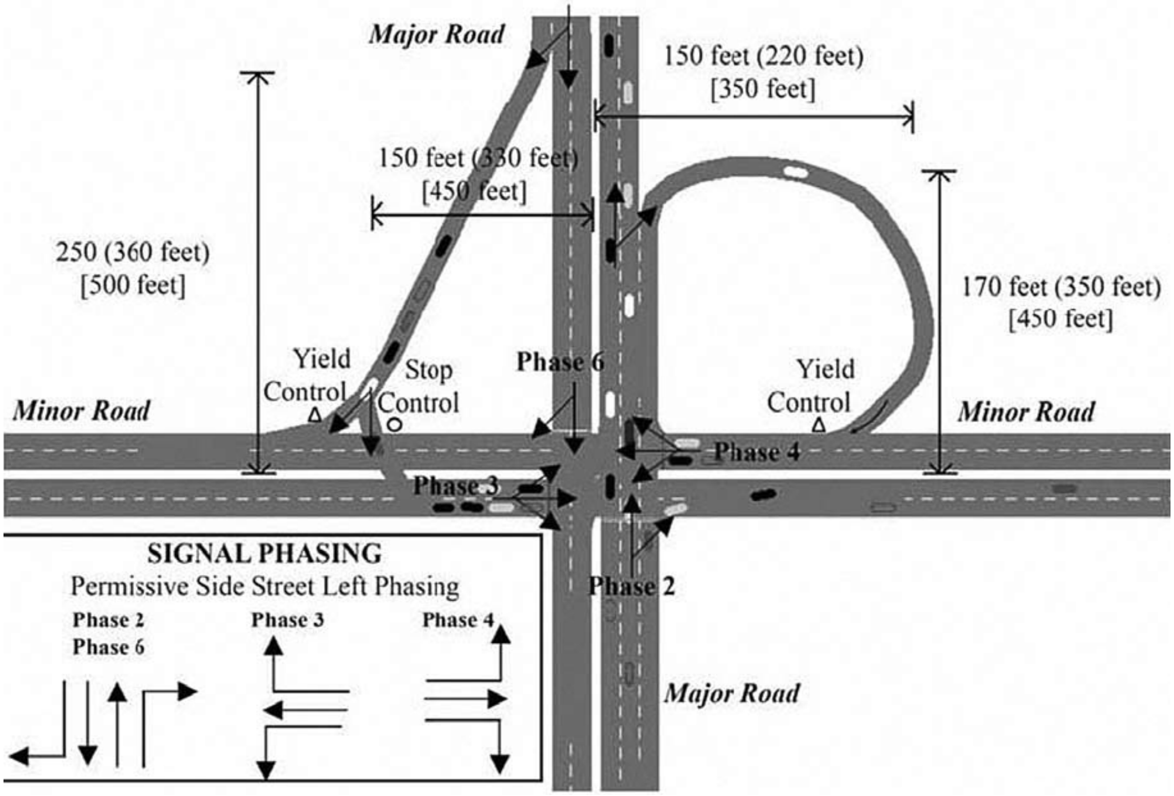


FIGURE 19 Typical geometry of the jughandle intersection—Case "C." *Source*: Jagannathan (*66*).

- Jughandles have lower average intersection delays compared with conventional intersections for near-saturated traffic conditions. The magnitude of difference ranges from 15% to 35% for forward-forward jughandles, from 20% to 40% for forward-reverse jughandles, and from 25% to 40% for reverse-reverse jughandles. The jughandles had similar traffic performance compared with conventional intersections for undersaturated traffic conditions.
- The jughandles have higher intersection capacities compared with conventional intersections for saturated traffic conditions. The magnitude of the difference ranges were 20% to 25%, 25% to 30%, and 25% to 40% for the forward-forward, forward-reverse, and reverse-reverse jughandles, respectively.
- The reverse-reverse jughandles had the highest intersection capacity, followed by the forward-reverse and the forward-forward jughandles. The changing of the left-turn gap acceptance maneuver (forward jughandle ramp) to a right-turn merge maneuver (reverse jughandle ramp) yields a 5% to 15% increase in intersection capacity based on the distribution of turning movement percentages on all approaches.
- The travel times and number of stops per vehicle for jughandles are lower compared with conventional intersections only for near-saturated traffic conditions. For other traffic scenarios, jughandles are comparable or have slightly higher travel times and stops compared with conventional intersections.
- The vehicular capacity for left turns on the major road of the jughandle decreases as the ramp offsets decrease.

NCHRP Report 348 (*6*, p. 76) illustrates a treatment at a large activity center that involves a "directional" design of access roads to separate major conflicting left-turn movements. This treatment, illustrated in Figure 20, may achieve high capacities because it permits two-phase signal operations at each intersection. It requires a divided highway and works well in cases in which dual left-turn entry lanes are provided.

"Superstreets" present another alternative left-turn treatment. Instead of allowing left-turn and through movements from side streets to be made directly through a two-way median opening, a "superstreet" redirects these movements 500 to 1,000 ft downstream on the main street to a one-way median opening. As shown in Figure 21, a left turn from a side street will be made by a right turn and then a U-turn. A through movement from a side street would be made by a right turn, a U-turn, and then another right turn.

Hummer and Jagannathan (*68*) prepared a paper on "superstreet" implementation and research, which concentrates on safety and reviews the performance of several "superstreets" in North Carolina and Maryland. In North Carolina, a rural "superstreet" application resulted in a reduction in the total crash rate of approximately 36%, and a reduction in the fatal or injury crash rate of approximately 55%. In addition, a signalized suburban

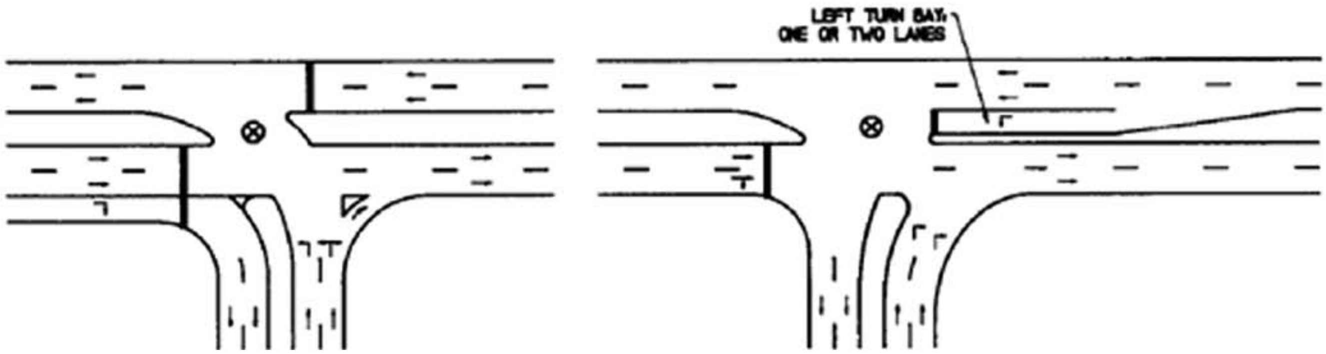


FIGURE 20 Directional access treatment. *Source*: Koepke and Levinson (*6*, p. 76).

application in North Carolina resulted in a crash rate below the statewide average for that roadway type. In Maryland, significant safety improvements were noted at the rural applications.

Advantages of a "superstreet" include a reduction in the number of conflict points, reduction in the number of traffic signal phases, improved signal progression (since the progression in one direction has little to do with the progression in the reverse direction), and potential for safer pedestrian crossings (pedestrians must cross an intersection on a diagonal as shown in Figure 21). Disadvantages and issues related to a "superstreet" include how to address high side-street volumes, the need for a wide median, potential driver confusion related to a new design, and perceived adverse impacts on roadside businesses. Hummer and Jagannathan recommend that further research be done on "superstreets" to help answer questions related to safety, efficiency, environmental benefits, design details, business impacts, and other aspects.

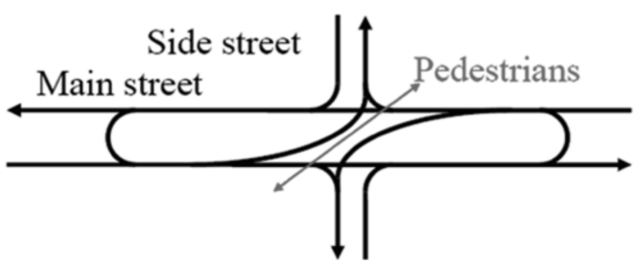


FIGURE 21 "Superstreet" schematic. *Source*: Hummer and Jagannathan (*68*).

Frontage Roads

NCHRP Report 420 identifies the frontage road as an access management technique that reduces the frequency and severity of conflicts along the main travel lanes of a highway. Direct property access is provided from the frontage roads and prohibited from the main travel lanes. The resulting spacing between the intersections along the main roadway facilitates the design of auxiliary lanes for deceleration and acceleration. Thus, frontage roads segregate through and local land-service traffic, thereby protecting the through-traffic lanes from encroachment, conflicts, and delays (*7*, p. 121).

NCHRP Report 348 indicated (as adapted for *NCHRP Report 420*) that frontage roads must be designed carefully to avoid increasing conflicts at junctions and delays on intersecting roads. The following planning and design guidelines should be considered when installing arterial frontage roads in both new developments and retrofit situations (*6*, p. 68):

- Frontage roads, especially for "retrofit" situations, should operate in one direction and should enter or leave the mainline lanes as merging or diverging movements. Preferably, these merging and diverging locations should not be signalized, as shown in Figure 22.
- The separation of frontage roads at cross streets should be maximized to ensure sufficient storage for crossroad traffic between the frontage roads and the arterial. The absolute minimum separation should be 150 ft, where two-way frontage roads are provided. This dimension is about the shortest acceptable length for placing signs and other traffic control devices. Greater distances are needed to provide adequate left-turn storage and to separate operation of the two intersections. Spacing of at least 300 ft (preferably more) enables turning movements to be made from the main lanes onto the frontage roads without seriously disrupting arterial traffic and thereby minimizes the potential of wrong-way entry onto the through lanes of the predominant highway.
- "Reverse" frontage roads, with developments along each side, are desirable in developing urban areas. A desirable separation distance is 600 ft with a minimum

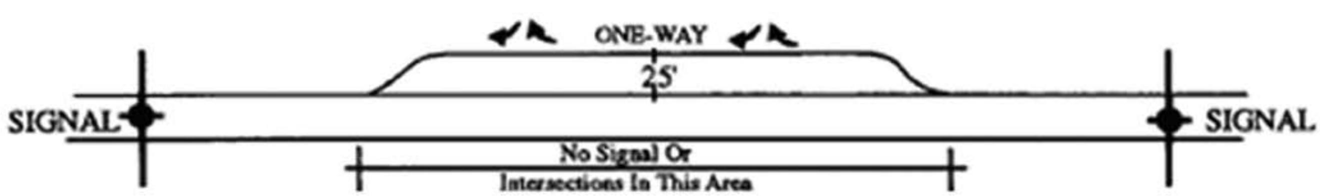


FIGURE 22 Arterial frontage road concept for retrofit conditions. *Source*: Gluck et al. (*7*, p. 125).

distance of 300 ft. The frontage road may operate in one or two directions.

- Frontage roads that can be terminated at each block operate well with respect to the arterial roadway and the cross street. This type of design should be considered in cases in which continuity of the frontage road is not needed.
- In cases in which major activity centers front an arterial roadway, frontage roads should be incorporated into the ring road or otherwise eliminated.
- A minimum outer separation of 20 ft should be used to provide space for pedestrian refuge and safe placement of traffic control devices and landscaping.
- Pedestrian and bicycle movements should use the frontage roads. Parking may be permitted where the frontage roads traverse residential areas.

The following sections discuss left-turn and right-turn lanes. *NCHRP Project 03-98* is performing research related to the development of guidelines on the use of auxiliary through lanes at signalized intersections. The research objective is to provide guidelines and procedures to analyze, justify, and design auxiliary through lanes at signalized intersections.

Left-Turn Lanes

As indicated in *NCHRP Report 420*, left turns may pose problems at driveways and street intersections. They may increase conflicts, delays, and accidents and often complicate traffic signal timing. These problems are especially acute at major suburban highway intersections where heavy left-turn movements take place, but also occur where left turns enter or leave driveways serving adjacent land development (*7*, p. 88).

The following illustrate these problems:

- More than two-thirds of all driveway-related accidents involve left-turning vehicles (*69*, pp. 37–40).
- In cases in which more than six left turns are made per traffic signal cycle, virtually all through vehicles in the shared lane may be blocked by the left-turning vehicles (*70*, pp. 45–52).
- In cases in which left-turn lanes are provided along multilane highways, each opposing left-turning vehicle reduces the through-vehicle capacity by the number of through lanes it crosses (e.g., 100 left turns/hour across three traffic lanes reduce the through vehicle capacity by about 300 vehicles) (*70*, pp. 45–52).

The treatment of left turns has an important bearing on the safety and movement along arterial roadways, and is one of the major access management concerns. Left-turn movements at driveways and street intersections may be accommodated, prohibited, diverted, or separated depending on specific circumstances (*7*, p. 88). Table 13, from *NCHRP Report 348* (*6*), provides examples of each option and shows when each should be considered.

Left-turn lanes offer important benefits by removing the turns from the through-traffic lanes. As a result, they reduce rear-end collisions and increase capacity. In addition, they improve the visibility of oncoming traffic for vehicles turning left. This helps to reduce right-angle collisions (*7*, p. 88).

Left-turn lanes normally are provided by offsetting the centerline or by recessing the physical (or painted) median. Examples of single and dual left-turn lanes are shown in Figure 23. A typical shared-lane treatment is shown for comparison purposes (*6*, p. 71).

NCHRP Project 3-91: Left-Turn Accommodations at Unsignalized Intersections is investigating what conditions warrant the installation of a left-turn lane or some other accommodation, such as provision for a left-turn bypass or indirect left turns. The objectives of the *NCHRP Project 3-91* research are as follows:

- Develop an objective and clear process for the selection of left-turn accommodations at unsignalized intersections
- Provide guidance on the design of these accommodations

Left turns should be removed from the through-traffic lanes wherever possible. Therefore, provisions for left turns (i.e., left-turn lanes) have widespread application. Ideally, left-turn lanes (or jughandles) should be provided at driveways and street intersections along major arterial and collector roads wherever the turns are permitted. This is essential to improve safety and preserve capacity (*7*, p. 95).

The design of left-turn lanes is straightforward. The lanes should be shadowed (protected) from the through-traffic lanes and transitions around the lanes for through traffic (where required) should be gradual. The storage lengths should be maximized by keeping entry tapers relatively short (*7*, p. 95). Stover and Koepke (*38*) provide extensive guidance on criteria to use in designing left-turn lanes.

The *Access Management Manual* (*1*, pp. 172–173) notes that it is important for turn lanes on roadways of a high functional classification to be of sufficient length to store all arriving vehicles most of the time. For example, at an intersection on a major arterial, it is probable that the storage length will be sufficient to store all left-turning vehicles on an acceptable percentage of the cycles at least 95% of the time. On roadways of lesser importance, a lower likelihood of storing all arriving vehicles may be acceptable.

TABLE 13
TREATMENTS OF LEFT-TURNS AT INTERSECTIONS AND DRIVEWAYS

Option	Condition	Application Considerations
Provide	Shared Lane	Limit to minor roads or places where R/W is not available for left-turn lane
	Left-Turn Lane	Protected or permissive phasing
	Dual Left-Turn Lane	Protected phasing only
Prohibit	Full Time	Requires alternate routes
	Peak Periods Only	Requires alternate routes
Divert	Jug-Handle	Divided highways at minor roads (signalized junctions only)
	Modified Jug-Handle	6-lane divided highways
	Michigan "U"	Divided highways with wide median - Allows two-phase signals
Separate	Directional Design	Very heavy turns in one direction
	Left-Turn Flyover	Very heavy turns in one direction
	Through Lane Flyover	Major congestion points

Source: Koepke and Levinson (*6*, p. 70).

Right-Turn Lanes

NCHRP Report 348 indicates that right-turn deceleration lanes remove turning vehicles from the through traffic, thereby reducing the speed differences in the main travel lanes and the frequency and severity of rear-end collisions. Right-turn lanes also increase capacity at signalized intersections and may allow refinements in phasing (*6*, p. 80).

Right-turn lanes may be provided at a single access point, or they can be extended to accommodate several nearby driveways. To operate as intended, the continuous lane should not be longer than 0.25 mi (*6*, p. 80) to avoid additional conflicts that would be introduced with both vehicular and bicycle traffic.

The objective of the *NCHRP Project 3-72* research by Potts et al. (*71*, p. 1) was to develop design guidance and criteria to address the safety and operational trade-offs for motorists, pedestrians, and bicycles to channel right turns and use right-turn deceleration lanes at driveways and unsignalized intersections. The scope of the project was limited to urban and suburban arterials with speeds of 45 mph or less (*70*, p. 2). As noted in this study, new access points, particularly busy commercial driveways, often contribute noticeably to congestion and reduced outside travel-lane capacity. Several states have established application and design criteria for right-turn deceleration lanes for driveways and intersections, but the criteria vary widely from state to state.

Following are three of the research conclusions from *NCHRP Project 3-72* (*71*, p. 116):

- Right-turn maneuvers from a two-lane arterial street at an unsignalized intersection or driveway can delay through traffic by 0 to 6 s per through vehicle, where no right-turn deceleration lane is present, depending on through volume, right-turn volume, and major-road traffic speed. Delays to through traffic due to right turns in the same situation on a four-lane arterial are substantially lower, in the range from 0 to 1 s per through vehicle, because through vehicles can change lanes to avoid delay.
- Pedestrians at unsignalized intersections or driveways can have a substantial impact on delay to through vehicles because of slowing by right-turning vehicles yielding to pedestrians. Provision of a right-turn lane can reduce delays to through traffic by 0.4 to 2.1 s per through vehicle at a pedestrian volume of 50 pedestrians per hour, by 0.6 to 3.1 s per through vehicle at a pedestrian volume of 100 pedestrians per hour, and by as much a 6 s per through vehicle at a pedestrian volume of 200 pedestrians per hour.
- An economic analysis procedure can identify areas where provision of right-turn lanes at unsignalized intersections and major driveways is cost-effective. The economic analysis procedure can be used to develop plots indicating combinations of through-traffic volumes and right-turn volumes in cases in which the provision of a right-turn lane would be warranted. Examples of such plots are presented in the *NCHRP 3-72* report.

NCHRP Project 03-89: Design Guidance for Channelized Right-Turn Lanes is developing a process to determine

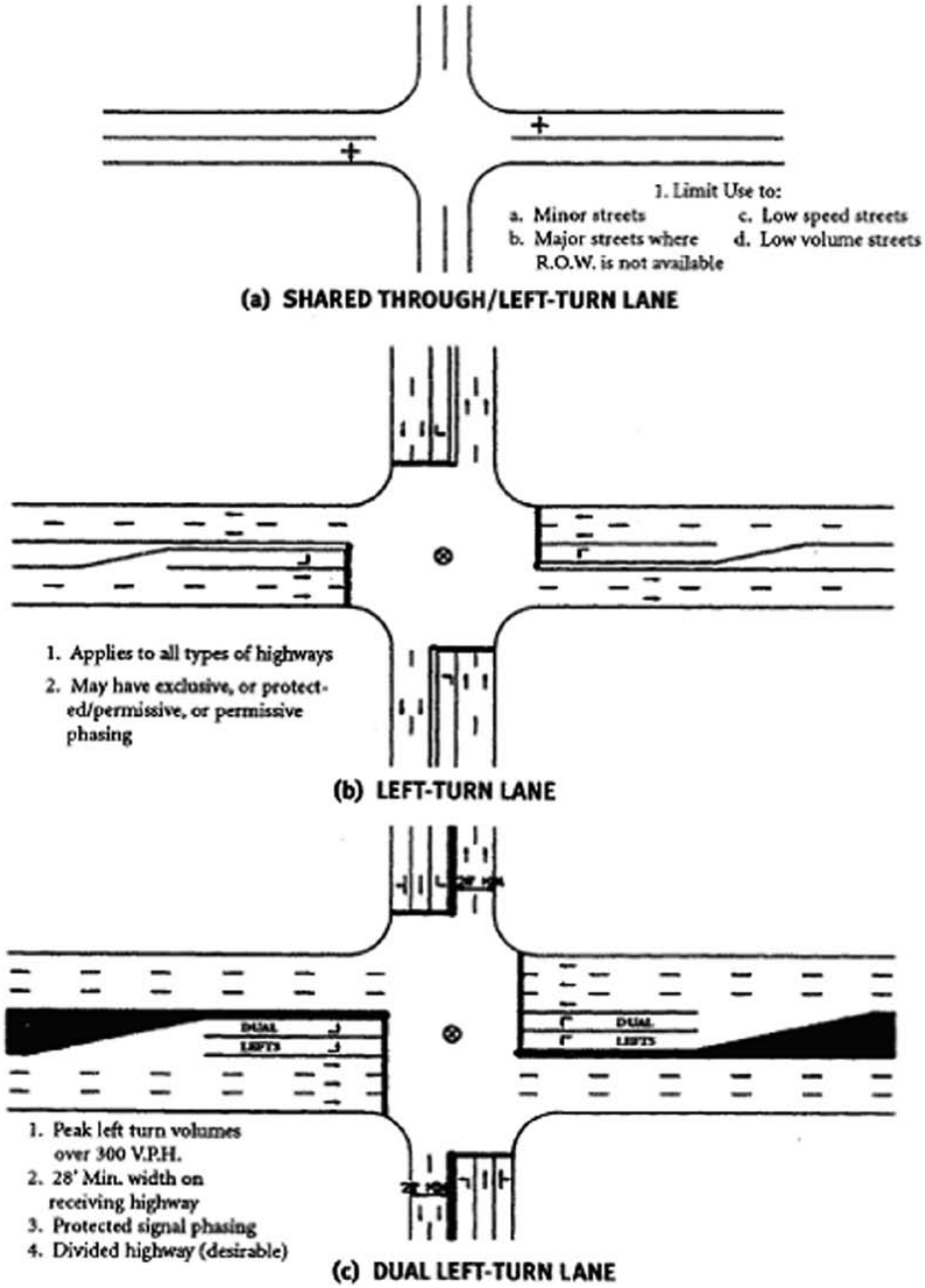


FIGURE 23 Examples of left-turn lanes. *Source*: Koepke and Levinson (*6*, p. 71).

whether a channelized right-turn lane should be installed at an intersection as well as a number of typical design diagrams for situations in which channelized right-turn lanes are desirable (*72*).

AASHTO provides guidance related to the design of each component of the right-turn auxiliary lane (*8*). The three components are the (1) taper, (2) deceleration length, and (3) storage length.

SURVEY RESULTS

This section summarizes the survey results obtained from state DOTs and local agencies regarding the structure and contents of their access management programs. The primary purpose of asking the survey questions reflected in this section was to identify *what* access management program elements are in place at transportation agencies in the United States.

Overview of Access Management Programs

The contents of access management programs vary widely by state. Table 14 illustrates a variety of general program elements—such as policies, guidelines, and standards—used by state DOTs to enhance access management implementation.

Of the 50 state DOTs, 39 (78%) indicated that they had general department policies related to their access management program. Other common program elements currently in use include guidelines (37 state DOTs, or 74%), driveway permit manuals (35 state DOTs, or 70%), roadway design manuals (33 state DOTs, or 66%), and standards (29 state DOTs, or 58%).

In general, state DOTs with access codes, and the associated statutory authority or administrative rules, are generally better suited to manage access along state highways, because the necessary legislative support exists and the regulatory documentation is in place. The police powers of the state can be used as the enabling legislation.

The Colorado DOT was the first state to develop a comprehensive access code, in 1981. Access codes were subsequently developed by other state DOTs, including New Jersey DOT, Florida DOT, and Oregon DOT. Of the 50 state DOTs, the following 19 (38%) indicated that they currently have an access code:

- Arizona DOT
- Colorado DOT
- Florida DOT
- Idaho DOT
- Illinois DOT
- Iowa DOT
- Kansas DOT
- Montana DOT
- Nebraska DOT
- New Jersey DOT
- New Mexico DOT
- Oregon DOT
- Pennsylvania DOT
- South Dakota DOT
- Utah DOT
- Virginia DOT
- Washington DOT
- Wisconsin DOT
- Wyoming DOT

Based on the results of the 45 state DOTs that completed the entire survey, Table 15 illustrates general program elements that currently are being developed or refined by state DOTs to enhance the implementation of access management.

The most common access management program elements being developed by state DOTs include guidelines (44%), general department policies (36%), driveway permit manuals (31%), and standards (31%). Ten state DOTs (22%) indicated they are developing new access codes or are enhancing their existing code.

Tables 16 and 17 show a range of specific techniques typically applied in access management and list which of the 50 state DOTs currently apply these techniques.

More than 80% of all state DOTs indicated that they apply the following access management techniques:

- Installation of medians
- Spacing for median openings
- Unsignalized access and intersection spacing
- Traffic signal spacing
- Turn prohibitions
- Corner clearance
- Spacing on crossroads in interchange areas
- Intersection sight distance and setbacks
- Driveway geometric design standards
- Right-turn and left-turn lane provisions
- Requirements for traffic impact studies

Access rights are purchased by 66% of all state DOTs. Internal connections of parking lots between adjacent parcels and subdivision restrictions for large parcels are applied, respectively, by 48% and 30% of all state DOTs. Some 16% of all state DOTs have requirements for traffic impact fees.

Among the 43 respondents for local agencies, the most common access management techniques cited included general departmental policies (56%), guidelines (49%), use of a driveway permit manual (44%), and standards (37%). The following 10 local agencies indicated that they currently have access codes:

- Forsyth County (Georgia)
- McHenry County (Illinois)
- Hancock County (Indiana)
- Harford County (Maryland)
- Licking County (Ohio)
- Washington County (Oregon)
- City of Durham (North Carolina)
- City of Tigard (Oregon)
- City of Federal Way (Washington)
- Rochester–Olmstead Council of Governments (Minnesota)

Access Classification Systems

An ACS is a fundamental element of any access management program. The synthesis survey revealed that 27 of the 50 state DOTs (54%) have a formal ACS, and 14 others (28%) indicated

TABLE 14
ACCESS MANAGEMENT PROGRAM ELEMENTS CURRENTLY IN USE BY STATE DOTS (50 RESPONSES)

State	Statutory Authority or Administrative Rules	General Departmental Policies	Access Code	Standards	Guidelines	Driveway Permit Manual	Roadway Design Manual
AL		X			X	X	
AK		X		X		X	X
AR		X		X	X	X	X
AZ			X			X	X
CA	X	X			X	X	X
CO	X		X	X			X
CT						X	X
DE		X		X		X	X
FL	X	X	X	X	X	X	X
GA	X	X		X	X	X	X
HI					X		X
IA	X	X	X	X	X		
ID	X	X	X		X		
IL	X		X				
IN	X					X	X
KS	X	X	X	X	X	X	X
KY		X			X	X	X
LA		X		X	X		
MA	X	X			X		X
MD	X	X		X	X	X	
ME	X			X		X	
MI		X		X	X	X	
MN		X			X		X
MO		X		X	X	X	X
MS	X	X		X	X		X
MT	X	X	X	X	X	X	X
NC		X			X	X	X
ND		X		X	X	X	X
NE	X	X	X	X	X	X	X
NH		X				X	X
NJ	X	X	X	X	X		X
NM	X	X	X				
NV		X		X	X		
NY						X	
OH	X	X		X		X	
OK		X		X	X	X	X
OR	X	X	X	X	X	X	X
PA	X		X		X	X	X
RI		X		X	X	X	X
SC	X	X			X	X	
SD	X	X	X				X
TN		X		X	X	X	X
TX	X				X	X	
UT	X	X	X	X	X	X	X
VA	X		X	X	X	X	X
VT	X	X		X	X		
WA	X	X	X	X	X		X
WI	X	X	X	X	X	X	
WV	X	X			X	X	X
WY		X	X		X	X	

TABLE 15
ACCESS MANAGEMENT PROGRAM ELEMENTS BEING DEVELOPED OR REFINED BY STATE DOTS (45 RESPONSES)

State	General Departmental Policies	Access Code	Standards	Guidelines	Driveway Permit Manual	Roadway Design Manual	No Changes
AK	X		X				
AR	X				X		
AZ	X		X	X	X	X	
CA				X	X	X	
CO							
CT							X
DE							X
FL							
GA			X	X	X		
HI	X		X	X			
IA	X	X	X	X			
ID		X		X			
IN	X	X		X			
KS	X	X	X	X	X	X	
KY				X	X		
LA	X	X	X	X			
MD							
ME							X
MN				X			
MO							X
MS	X	X	X	X	X		
MT	X		X	X	X	X	
NC	X	X	X		X		
ND	X		X				
NE							X
NH							
NJ		X		X			
NM							X
NV							
NY		X		X			
OH					X	X	
OK					X	X	
OR							
RI							X
SC	X			X	X		
SD							
TN							
TX							X
UT	X			X			
VA			X		X	X	
VT							X
WA	X		X	X			
WI	X	X	X	X	X		
WV				X			
WY							

TABLE 16
TYPICAL ACCESS MANAGEMENT TECHNIQUES APPLIED BY STATE DOTS (50 RESPONSES)

State	Installation of medians	Spacing for median openings/breaks	Spacing for unsignalized public street intersections	Spacing for unsignalized private driveways	Spacing for traffic signals	Prohibition of certain turning movements	Corner clearance (distance from a public street intersection to the first driveway)	Spacing for cross-streets in the vicinity of interchanges
AL	X	X		X	X	X	X	X
AK	X	X	X	X	X	X	X	X
AR	X	X	X	X	X	X	X	X
AZ	X	X	X	X	X	X	X	X
CA	X	X	X	X	X	X	X	X
CO	X	X	X	X	X	X	X	X
CT	X	X	X	X	X	X	X	X
DE	X	X	X	X	X	X	X	
FL	X	X	X	X	X	X	X	X
GA	X	X	X	X	X	X	X	X
HI	X	X	X	X	X	X	X	X
IA	X	X	X	X	X	X	X	X
ID	X	X	X	X	X		X	X
IL						X		
IN	X	X		X		X	X	X
KS	X	X	X	X	X	X	X	X
KY	X	X	X	X	X	X	X	X
LA	X	X			X			X
MA	X	X	X	X	X	X	X	X
MD	X	X	X	X	X	X	X	X
ME		X			X	X	X	X
MI		X		X			X	
MN	X	X	X	X	X	X	X	
MO	X	X	X	X	X	X	X	X
MS	X	X	X	X	X	X	X	X
MT	X	X	X	X	X	X	X	X
NC	X	X				X		X
ND								
NE	X	X	X	X	X	X	X	X
NH	X	X	X	X		X	X	X
NJ		X	X	X	X	X	X	X
NM	X	X	X	X	X	X	X	X
NV	X	X	X	X	X	X	X	X
NY	X	X			X	X		
OH	X	X	X	X	X	X		X
OK	X	X	X	X	X	X	X	X
OR	X		X	X	X	X	X	X
PA	X	X	X	X	X	X	X	X
RI	X	X		X	X		X	X
SC	X	X	X	X	X		X	X
SD	X	X	X	X	X	X	X	
TN	X	X	X	X			X	X
TX	X	X		X		X	X	X
UT	X	X	X	X	X	X	X	X
VA	X	X	X	X	X	X	X	X
VT	X		X	X	X	X	X	X
WA	X	X	X	X	X	X	X	X
WI	X	X	X	X	X	X	X	X
WV	X	X	X	X	X	X	X	X
WY			X	X	X		X	X

TABLE 17
TYPICAL ACCESS MANAGEMENT TECHNIQUES APPLIED BY STATE DOTS (50 RESPONSES)

State	Intersection sight distance and setbacks	Geometric design standards for driveways	Provisions for right-turn and left-turn lanes	Purchase of access rights	Internal connection of parking lots between adjacent parcels	Subdivision restrictions for large parcels	Requirements for Traffic Impact Studies	Requirements for Traffic Impact Fees
AL	X	X	X	X			X	
AK	X	X	X	X	X	X	X	X
AR	X	X	X	X			X	
AZ	X	X	X	X		X	X	
CA	X	X	X	X	X	X	X	X
CO	X	X	X	X	X	X	X	
CT	X	X	X	X	X	X	X	
DE	X	X	X	X	X		X	
FL	X	X	X	X	X		X	
GA	X	X	X	X	X	X	X	X
HI	X	X	X		X		X	
IA	X	X	X	X			X	
ID	X	X	X	X			X	
IL	X	X	X	X			X	
IN	X	X	X	X			X	
KS	X	X	X	X	X		X	
KY	X	X	X	X			X	
LA					X		X	
MA	X	X	X		X		X	
MD	X	X	X	X	X	X	X	
ME	X	X	X					
MI	X	X	X		X			
MN	X	X	X				X	
MO	X	X	X	X	X		X	
MS			X				X	
MT	X	X	X	X	X	X	X	
NC	X	X	X				X	
ND								
NE	X	X	X	X		X	X	
NH	X	X	X				X	X
NJ	X	X	X	X		X	X	
NM	X	X	X	X			X	
NV	X	X	X	X	X		X	X
NY	X	X	X	X			X	
OH		X	X	X	X		X	
OK	X	X	X	X	X	X	X	
OR	X	X	X	X		X	X	
PA	X	X	X	X	X		X	
RI	X	X	X	X	X		X	
SC	X	X	X				X	
SD	X		X	X			X	
TN	X	X	X					
TX				X			X	
UT	X	X	X	X	X		X	X
VA	X	X	X	X	X		X	
VT	X	X	X		X	X		
WA	X	X	X	X			X	X
WI	X	X	X	X	X	X	X	X
WV	X	X	X	X		X	X	
WY	X	X	X				X	

that they rely on the functional classification system for access management purposes. The remaining nine states indicated that they did not have an ACS. Figure 24 illustrates the most commonly cited elements considered among the state DOT ACSs.

The more common considerations cited by the state DOTs in their ACS are functional classification (58%), urban–rural environment (56%), and posted speed (42%). Other considerations include traffic volume (38%), number of travel lanes (31%), and type of median cross-section (31%).

Of the 43 local agencies that responded to the survey, only 8 (19%) indicated that they had an ACS, and 16 (37%) indicated that they rely on the functional classification for access management purposes. The remaining 15 local agencies (35%) indicated that they do not have an ACS, and 4 agencies (9%) did not respond. The most commonly cited ACS elements cited by the local agency respondents were traffic volume, functional classification, urban-rural distinction, and number of lanes.

Access Features

Signal Spacing

Establishing criteria for traffic signal spacing—in terms of frequency and uniformity—is one of the most important and basic highway access management techniques, because traffic signals govern the performance of urban and suburban highways and account for most of the delay that motorists experience. Closely or irregularly spaced signals can reduce arterial travel speeds and result in an excessive number of stops, even under moderate traffic volume conditions. Figure 25 illustrates the most commonly cited variables used by state DOTs for establishing traffic signal spacing criteria.

The primary variables used by state DOTs to establish traffic signal spacing criteria are speed (56%), cycle length (49%), allowable movements (38%), and bandwidth (27%). "Other variables" for traffic signal spacing noted by responding state DOTs included the following:

- Roadway classification
- Roadway access category
- Safety considerations leading to alternative solutions (other than a traffic signal)
- Urban versus rural distinctions
- Traffic volumes
- Accident rates
- Adequate stacking distance
- Adjacent land use
- Sight distance
- Fixed spacing distances are applied (ranging from 0.25 mi to 1 mi)

The most commonly cited variables used by the responding local agencies included allowable movements (33%), speed (21%), cycle length (19%), and bandwidth (19%).

As traffic volumes increase over time, longer cycle lengths may be introduced to accommodate additional signal phases, improve intersection capacity, and reduce

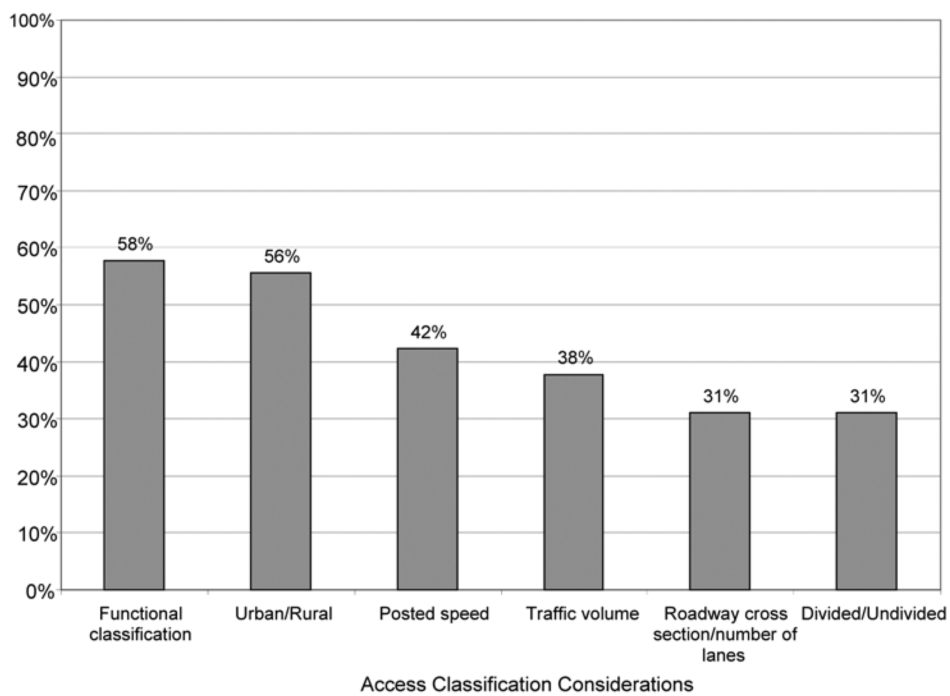


FIGURE 24 Most commonly cited elements considered in state DOT access classification systems (45 responses).

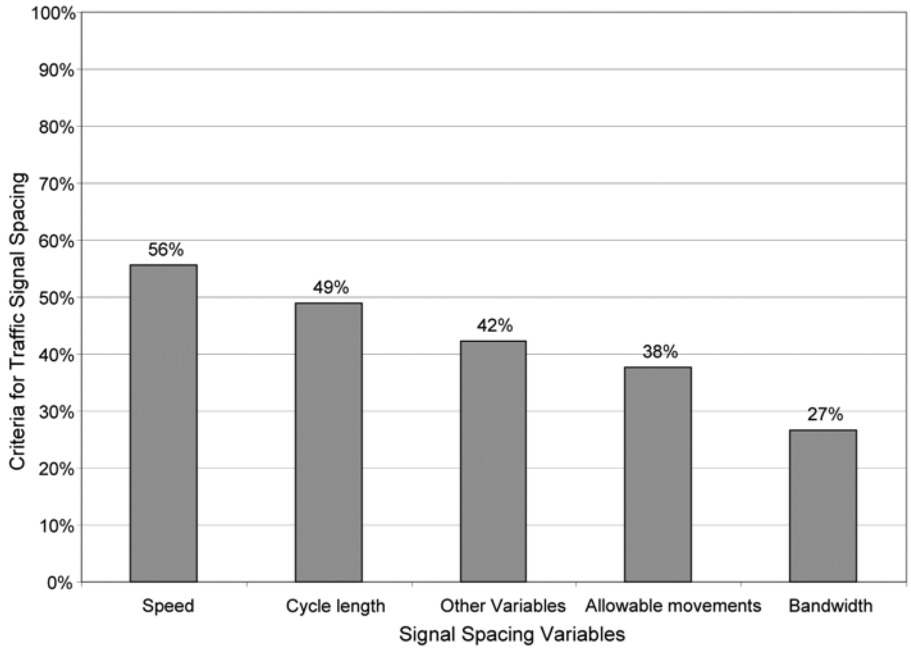


FIGURE 25 Most commonly cited variables for traffic signal spacing (45 responses).

overall delays. Longer cycle lengths, however, also can result in longer delays and longer queues, and make effective signal coordination more difficult. In practice, cycle lengths of 120 s (2 min) or more are generally considered to be long, with 180 s (3 min) a practical maximum for acceptance by motorists. Minimum cycle lengths generally range between approximately 45 s and 60 s. Figures 26 and 27 illustrate the ranges of maximum and minimum cycle lengths, respectively, typically implemented by state DOTs.

The maximum cycle lengths typically implemented by state DOTs are 120 s or less (36%), 130 to 170 s (30%), and 180 s or more (34%). Of the 17 local agencies that responded to this question in the survey, 6 (35%) indicated maximum cycle lengths of 90 to 120 s, and 8 (47%) indicated maximum cycle lengths exceeding 120 s.

The minimum cycle lengths typically implemented are 60 s or less (80%), 70 to 80 s (7%), and 90 s (13%). Of the 17 local agencies that responded to this question in the survey, 12 (71%) indicated minimum cycle lengths of 30 to 60 s, and 2 (12%) indicated minimum cycle lengths of 90 s or more.

Unsignalized Spacing

Unsignalized driveways and street intersections introduce conflicts and friction into the flow of traffic along a highway. Vehicles entering and leaving the highway at these locations often slow the movement of through traffic, and the difference in speeds between through traffic and turning traffic increases the potential for crashes. Increasing the spacing between the access points improves traffic flow and safety along the highway by reducing the number of conflicts per mile, providing a greater distance for motorists to anticipate and recover from turning maneuvers, and providing opportunities for the construction of turn lanes. Figure 28 indicates the most commonly cited criteria by state DOTs for driveway location and design.

The most common driveway location and design criteria cited by the state DOTs are related to development type (93%), development size or intensity of use (91%), location (84%), functional classification (80%), and posted speed (80%). “Other criteria” cited included the following:

- The location of adjacent driveways and intersections
- Corner clearance
- Opportunities for alternative access (i.e., from side streets)
- Opportunities for shared access with adjacent properties
- Accident experience
- Intersection level of service
- Sight distance
- Precedence set by previously allowed driveway locations along the same (or a similar) corridor

For local agencies, the most common driveway location and design criteria cited are related to roadway classification (65%), development size or intensity of use (63%), development type (60%), posted speed along the roadway (60%), and development location (47%).

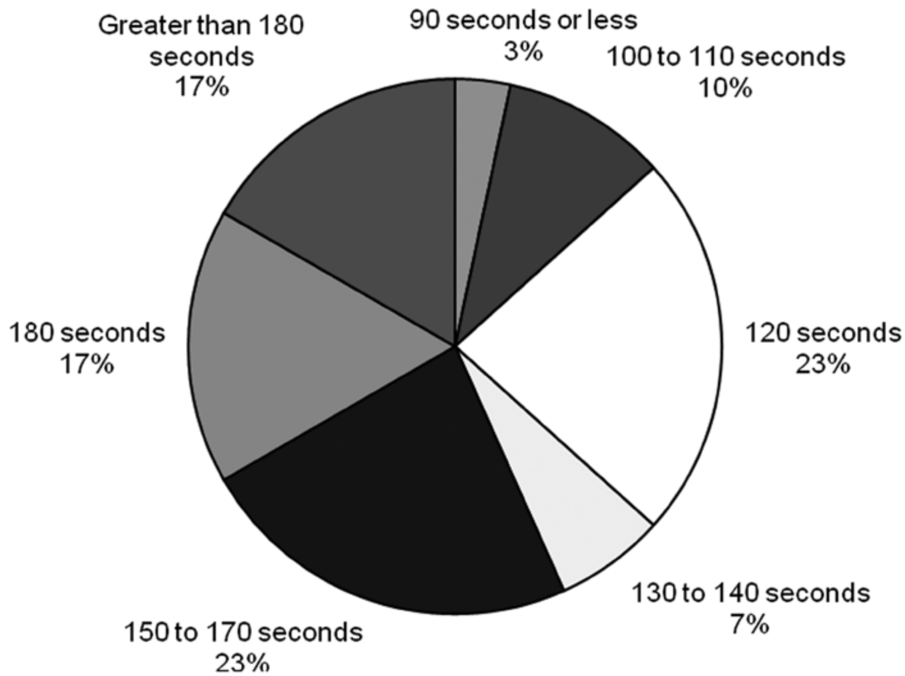


FIGURE 26 Maximum cycle lengths typically implemented by state DOTs (30 responses).

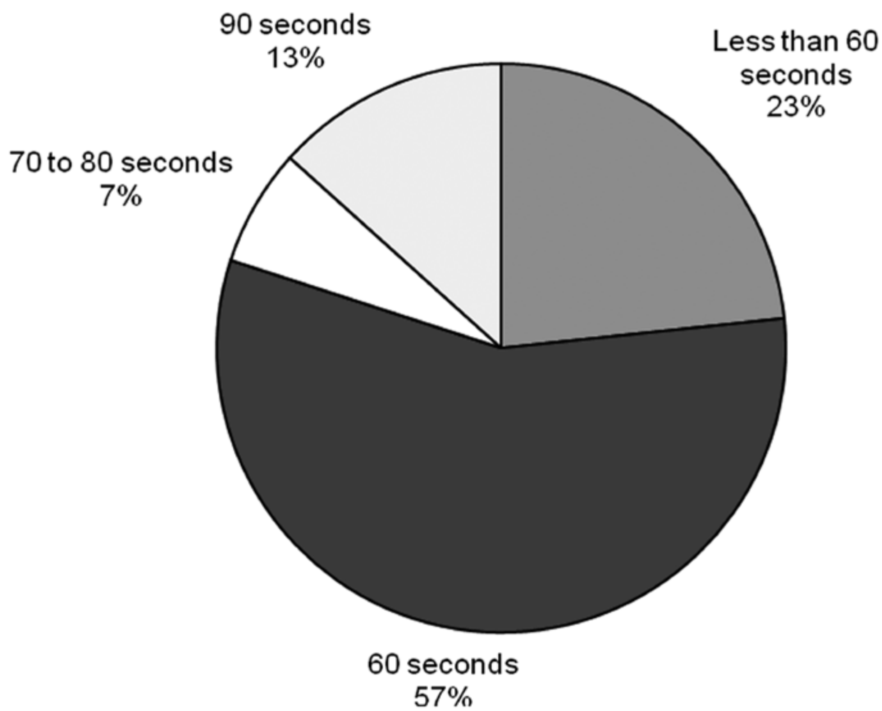


FIGURE 27 Minimum cycle lengths typically implemented by state DOTs (30 responses).

The synthesis survey revealed that 31 of the 50 state DOTs (62%), and 21 of the 43 local agencies (49%), stated that they have provisions for instances in which the spacing criteria and geometric design standards cannot be met. These provisions usually involve a variance, waiver, or design exception process, and are considered on a case-by-case basis. At DOTs, the final decision may be elevated to a higher authority within the agency, such as a statewide access engineer or an access review committee. Of the remaining agencies, 16 state DOTs (32%) and 13 local agencies (30%) indicated that their agency did not have any such provisions. Three state DOTs (6%) and nine local agencies (21%) did not respond to this question.

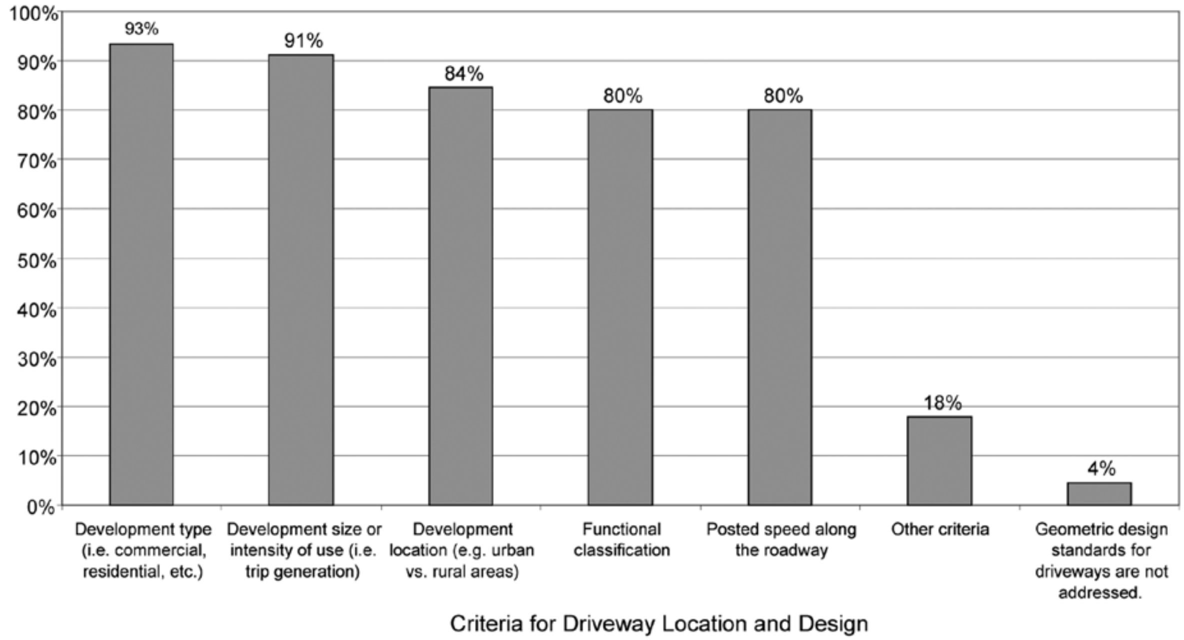


FIGURE 28 Most commonly cited state DOT criteria for driveway location and design (45 responses).

Access Permit Process

State and local agencies typically use access permitting to apply access management standards to development. A well-conceived and applied access permitting program is essential for effective access management. All of the state DOTs surveyed have a driveway permit process. The majority of states (37 of the 45 state DOTs responding to the entire survey, or 82%) stated that the permit process also applies to changes in existing land uses, as well as to new developments. Of the 43 local agencies responding to the survey, 32 (74%) indicated that they had a driveway permit process, and 17 of those 32 (53%) indicated that the permit process also applies to changes in existing land uses.

Figure 29 illustrates percentages of responding DOTs that utilize each of several common access enforcement actions.

Of the 45 state DOTs responding to the entire survey, 31 (69%) indicated that their agency had a process for an appeal by the permit applicant. Similarly, 23 of the 43 responding local agencies (53%) indicated that their agency had an appeals process. Most of the state DOTs and local agencies indicated that any access-related decision could be appealed (in writing) by the applicant, including access denials and decisions related to the terms and conditions of the access permit (e.g., driveway location, turning movement restrictions, and requirements for auxiliary lanes). Applicants often appeal access decisions on the basis of the following:

- Disagreement over the interpretation of engineering criteria, particularly in unique, site-specific circumstances
- Staff decisions that are not supported by administrative rules
- Lack of “reasonable access”
- Undue financial hardship would be imposed on the property owner
- Unreasonable or costly roadway improvements are required
- Inconsistencies in the application of access criteria across districts or regions within the same state

Within state DOTs, appeals of access-related decisions typically are made to successively higher levels of management, from the subdistrict or district level, to the central office or headquarters office level, and to a chief engineer, director, or commissioner level. Many state DOTs use a committee to render access decisions in an appeal situation, for example:

- Appeals Committee (Ohio DOT)
- Appeals Board (New Hampshire DOT)
- Access Management Review Committee (Maine DOT)
- Access Control Committee (New Mexico DOT)
- Driveway Permit Appeals Committee (North Carolina DOT)
- State Transportation Board (Vermont DOT)
- Transportation Commission (Colorado DOT)

Among local agencies, access-related decisions typically can be appealed to the local planning board or commission, county board of supervisors or commissioners, city council, or another similar governing body. Ultimately, access-related decisions can be challenged in the applicable state or local court system.

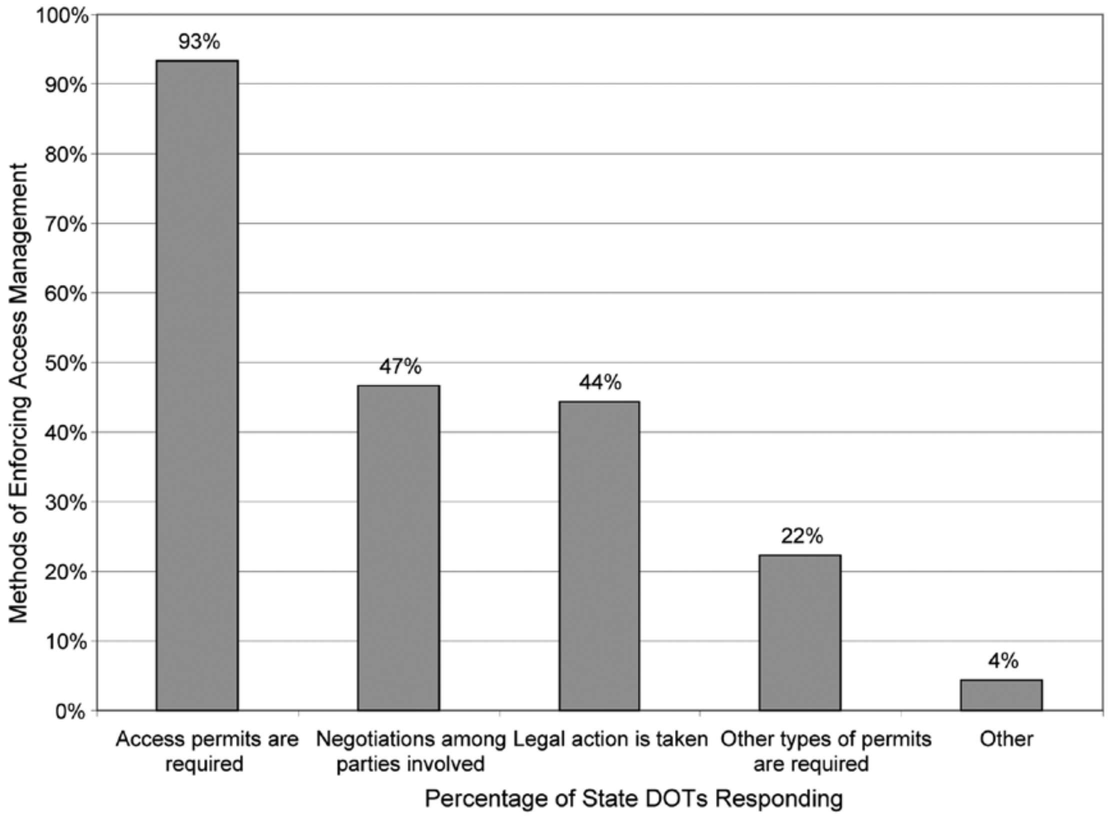


FIGURE 29 Common access enforcement actions undertaken by state DOTs (45 responses).

Traffic Impact Studies

Survey participants were asked to identify the circumstances under which a TIS would be prepared as part of the access permit application process. The responses varied widely. Of the 45 state DOTs that responded to the entire survey, 37 (84%) indicated that traffic volume was a key determining factor regarding whether or not a TIS was required and 14 (31%) indicated that their agency applies a threshold of 100 peak-hour trips in some manner in the determination of whether or not to conduct a TIS. Other circumstances cited by the responding state DOTs as reasons for conducting a TIS included the following:

- Safety concerns exist or are anticipated
- Development is proximate to a highly congested area
- Request for a new traffic signal, or where signal warrants will be met
- Proposed changes to a median or median opening
- Need for a turn lane
- Proposal for certain types of land uses, particularly high-volume uses, or those with sharp peaking characteristics
- Unusual geometric conditions
- Unique site considerations
- A variation from the access standard is expected
- Local agency has requirements for a TIS
- At the district or state traffic engineer's discretion

Of the 45 state DOTs responding to the entire survey, 43 (96%) indicated that the TIS is used to identify transportation system improvements to mitigate traffic impacts. Only five state DOTs—Alaska, California, Maine, New Hampshire, and Washington—indicated that a Traffic Impact Fee (TIF) can be collected by the state. Respondents from Alaska, California, and New Hampshire indicated that the TIF is assessed based on projected traffic impacts, whereas Washington DOT also uses land use type and size to determine the TIF. Maine DOT assesses a TIF in lieu of improvements in areas in which the department may have an ongoing highway improvement project. It was noted by several states that TIFs are often assessed by MPOs, counties, or other local agencies, rather than the state DOT.

Based on the survey responses, 40 of the 45 state DOTs responding to the entire survey (89%) indicated that the property owner, permit applicant, or developer was responsible for paying for any necessary on-site improvements, whereas 3 (7%) responding state DOTs indicated that the *on-site* costs were negotiated or shared among the state, local government, and the property owner, permit applicant, or developer. Of the 31 local agencies responding to this question, 30 (97%) indicated that the property owner, permit applicant, or developer was responsible for paying for any necessary on-site improvements, whereas 1 (3%) indicated that the on-site costs were negotiated or shared between the county and the property owner, permit applicant, or developer.

For *off-site* improvements, 34 of the 45 state DOTs responding to the entire survey (76%) indicated that the property owner, permit applicant, or developer was responsible for paying, whereas 8 (18%) indicated that the off-site costs were negotiated or shared among the state, local government, and the property owner, permit applicant, or developer. Of the 31 local agencies responding to this question, 24 (77%) indicated that the property owner, permit applicant, or developer was responsible for paying for any necessary on-site improvements, whereas 5 (16%) indicated that the on-site costs were negotiated or shared between the local agencies and the property owner, permit applicant, or developer.

CHAPTER FOUR

PROGRAM IMPLEMENTATION

This chapter provides an overview of the implementation aspects of the various states' access management programs, including the organizational "location" of access management activities within each DOT, the number of staff members dedicated to access management, and access management-related resources typically consulted. It includes a literature search regarding key aspects of program implementation, such as transportation and land use coordination, AMPs, education and training activities, and community outreach. The chapter concludes with state-of-the-practice information from the survey of state DOTs regarding program implementation.

Although strong program implementation is one of the keys to the success of any access management program, there is comparatively little background literature available in comparison to other elements of access management. However, the feedback from survey participants presented at the end of this chapter is useful in gaining an understanding of the current state of the practice in this area. A profile of the Louisiana Department of Transportation and Development's (DOTD) approach to implementing access management is highlighted in chapter six as a recent example of how access management may be implemented strategically.

LITERATURE SEARCH

Organization and Staffing

Transportation agencies apply access management in a variety of ways, including at the statewide, corridor, project, or permit levels. Statewide applications may include policies that apply broadly to the entire state highway system, the development of an overall ACS and associated design standards for all state highways, or legislative actions that establish a legal basis for access management throughout the state. Access management can be applied by states at the corridor level, through efforts focused on managing property access along specific, high-priority state highways or segments of highways. Access management may be implemented at the project level, with state DOT taking actions to incorporate access management treatments in conjunction with highway improvement projects. Finally, access management may be applied at the permit level, with state DOT making decisions in response to specific requests for access made by property owners abutting the state highway system.

NCHRP Report 548 (*3*, p. 75) provides guidance for establishing a policy and planning basis for access management so that decisions are not made on a project-by-project or permit-by-permit basis. It can be used to address access management at the policy, system, and corridor planning levels. The guidance also identifies how the land use planning and development review processes may address access management. Figure 30 lists the individual guidance areas included in *NCHRP Report 548* and specifies the jurisdiction levels to which they are applicable. The report provides further guidance on the implementation steps and issues that need to be addressed as well as information on cases in which the planning process has incorporated access management and resources for additional information.

Land Use and Transportation Coordination

A critical element of access management is the land use authority held by local units of government. While state DOTs are responsible for state highways, land use decisions for adjacent and nearby properties most often are made by local governments. Local planning, zoning, and elected officials are the community land use decision makers, and they ensure that new development is consistent with local land use (or master) plans, compatible with other land uses in the community, and in compliance with local regulations. These local officials are responsible for assessing the affects of land use decisions within their community's borders, but not beyond. The local development review process often is segregated. In other words, local officials often review development plans without consulting the appropriate road agency (city, county, or state) responsible for managing access in their area. Through zoning, subdivision regulations, condominium regulations, private road regulations, and building codes, local governments can approve new developments with or without considering the impact on access (*73*, p. 9).

A large body of literature discusses the actions that local agencies may take to foster access management. The www.accessmanagement.info website contains materials from various sources with information on different strategies that local agencies could use not only to enhance their own programs, but also to better coordinate transportation and land use planning and decision making.

Guidance Area	Jurisdiction
Overall Planning Process	
1. Establish an owner for access management within the organization.	State, MPO, and local.
2. Integrate access management principles, benefits, and techniques into the public and stakeholder involvement processes.	State, MPO, or local (dependent on action presented to the public).
3. Establish a process to coordinate access management provisions developed at the system and corridor levels with operational activities.	State would generally take the lead, working with local jurisdictions to implement appropriate procedures.
4. Establish and resource a staffing, training, and technical assistance plan for access management support.	State, MPO, and local.
5. Monitor performance in implementing access management.	State, although partnerships can be formed with MPOs and local jurisdictions.
Policy and System Planning—Long-Range Plans	
1. Consider access management strategies as a mechanism for achieving broader policy goals.	State, MPO, and local.
2. Include specific policy statements related to access management in the long-range plan.	State, MPO, and local.
3. Consider and/or promote access management strategies as a complement to traditional approaches for increasing transportation capacity.	State, MPO, and local.
4. Establish and maintain an access classification system with access standards or guidelines.	State or local.
5. Evaluate the impact on roadway system performance of applying an access classification system and implementing associated access standards/guidelines.	State and MPO.
Programming	
1. Develop mechanisms to support the selection of projects that incorporate access management strategies and principles.	State for the Statewide Transportation Improvement Program, MPO for the Transportation Improvement Program, and local for Capital Improvement Plans.
2. Program stand-alone access management projects, such as for the acquisition of access rights in high-priority locations or for incorporating medians on multilane arterials.	State, MPO, and local transportation agencies.

(figure continues on next page.)

Guidance Area		Jurisdiction
Corridor and Subarea Planning		
1.	Prepare an access management plan as a component of an area-wide or corridor plan.	State, MPO, or local.
2.	Address access management in corridor plans.	State and MPO.
3.	Ensure that geometric design standards incorporate best practices for access management.	State, MPO, and local.
4.	Ensure that traffic impact analysis procedures address access management.	State and local planning authorities, MPOs.
5.	Ensure that traffic signal warrant criteria are consistent with the access classification system.	State and local.
Establishing MPOs as Advocates for Access Management		
1.	Coordinate with agency decisionmakers to facilitate the integration of access management principles.	MPO.
2.	Maintain the consistency of access management efforts in the MPO area.	MPO.
3.	Support access management activities through the Unified Planning Work Program.	MPO.
Implementing through Local Governments		
1.	Address access management in community planning as a means of accomplishing a broad range of transportation and land use goals.	Local planning department.
2.	Establish a master street plan or thoroughfare plan that incorporates access management principles.	Local transportation planning or public works departments.
3.	Support access management through land use planning; organize land uses into activity centers to support local street network development and alternative access.	Local planning department.
4.	Strengthen local subdivision regulations and expand street design types to promote alternative access to major roadways.	Local planning department, public works, and development services/administration.
5.	Use subarea and sketch planning techniques to facilitate the development of service roads and internal street networks for properties under multiple ownership.	Local planning department and development services/administration.
6.	Integrate transportation safety and operations considerations into land use decision making.	Local planning or public works department.
7.	Establish and apply a traffic impact analysis process to help ensure access management principles are applied in the planning of new developments.	Local transportation planning/public works.
8.	Ensure coordination and consistency across local planning and development functions and among jurisdictions with regard to access management.	Local planning department.

FIGURE 30 Guidance areas from *NCHRP Report 548*. *Source*: Rose et al. (*3*).

The importance of coordinating permit and access management decisions between state, county, and local agencies cannot be understated. Michigan's *Access Management Guidebook* (*74*) notes that:

> To optimize the benefits of access management, multi-jurisdictional coordination with all appropriate transportation agencies is essential when applying access management standards on driveway permit, lot split, subdivision, site plan and other local zoning reviews. This is best accomplished through coordinated permit review and approval procedures involving local governments and road authorities. (pp. 4–16)

When local governments approve development or redevelopment on a site without considering access issues typically addressed by road authorities during the driveway permit process, unnecessary conflict and project delays can occur. The same problem can arise if a road authority issues a driveway permit without local input. Access management is best achieved when state, regional, county, and local units of government cooperate in land use and transportation management decisions.

The Michigan *Access Management Guidebook* identifies local regulatory techniques to help solve common traffic problems (*74*, pp. 4-1–4-9). Many access management techniques are best implemented through local zoning regulations and others through local lot split, subdivision, condominium, and private road regulations. Lot split, subdivision and condominium regulations are frontline ordinances that come into play when lots are first being designed. This is the best time to prevent common access problems. The guidebook provides guidance concerning narrow lots, flag lots, corner lots, double frontage lots (frontage on a local road and an arterial), and width-to-depth requirements. It identifies how subdivision regulations and zoning ordinances can be coordinated with access management and how overlay zones may be used to manage access.

Guidance from the Community Planning Association of Southwest Idaho indicates that one of the most effective tools in applying corridor standards is a corridor overlay district. Similar standards can be adopted with a corridor plan or map, but the overlay district can be more effective because it stays in the forefront during planning decisions and zoning actions. An overlay district, or corridor plan, applies to parcels that are adjoining or within a certain distance from a roadway, usually an arterial or state highway. A corridor ordinance contains additional regulations that are overriding, and in some cases, additive to existing zoning regulations. It should involve standards governing access, visibility, and corridor aesthetics and provide standards for the number and location of access points, interparcel connections, size and location of signs, and landscaping and buffer requirements (*55*, p. 7).

Many local governments may not be well informed of state driveway permitting requirements. They may know little about how development decisions affect the safety and function of state highways and other roads. Moreover, the process of access permitting often does not occur until after land use decisions are made. As a result, state DOTs and other road agencies often have little, if any, input regarding land use decisions. This can result in frustration among all participants if project design changes are needed to obtain a driveway permit. If access problems are identified too late in the decision process, some solutions that may have worked earlier in the design stage may no longer be options. Simply involving the state DOT or local road agency early in the process of planning and reviewing a development can produce many benefits. Access-related issues can be raised earlier and solutions more easily identified. Although no laws or regulations may require local planning, zoning, and building permitting agencies to coordinate their efforts with state DOTs (or local road agencies), some local governments have worked out procedures, some informal, with their state's local district or subdistrict offices (*73*, p. 10).

Figure 31 from Michigan's *Access Management Guidebook* (*74*) shows the typical separate project review procedures most often used by local governments and road agencies, as well as an alternative procedure used in some communities that coordinate development reviews with road authorities. Coordinated reviews help achieve the objectives of all parties involved. The coordination works best when everyone understands that both site plans and driveway permit approvals are required before a developer can begin development or redevelopment activity (*74*, p. 5-5).

Better project review coordination between state and local governments leads to better access management. Better access management allows motorists to conveniently and safely access their homes and local businesses with fewer delays. If local permit procedures are coordinated with driveway permit procedures, many access-related conflicts and issues can be avoided. Coordinated land use and access management decision making can achieve the following:

- Prevent conflicts involving the community, developer, and road authority created because—
  - A driveway permit was issued by the state DOT before local site plan review has been completed; and
  - The community approved a site plan or building permit before determining whether a driveway permit has been issued by the state DOT.
- Build a professional relationship based on a common understanding of local road issues, which in turn can improve cooperation and mutual support on future maintenance or improvement projects.
- Prevent unnecessary redesign, which typically results in higher development costs.

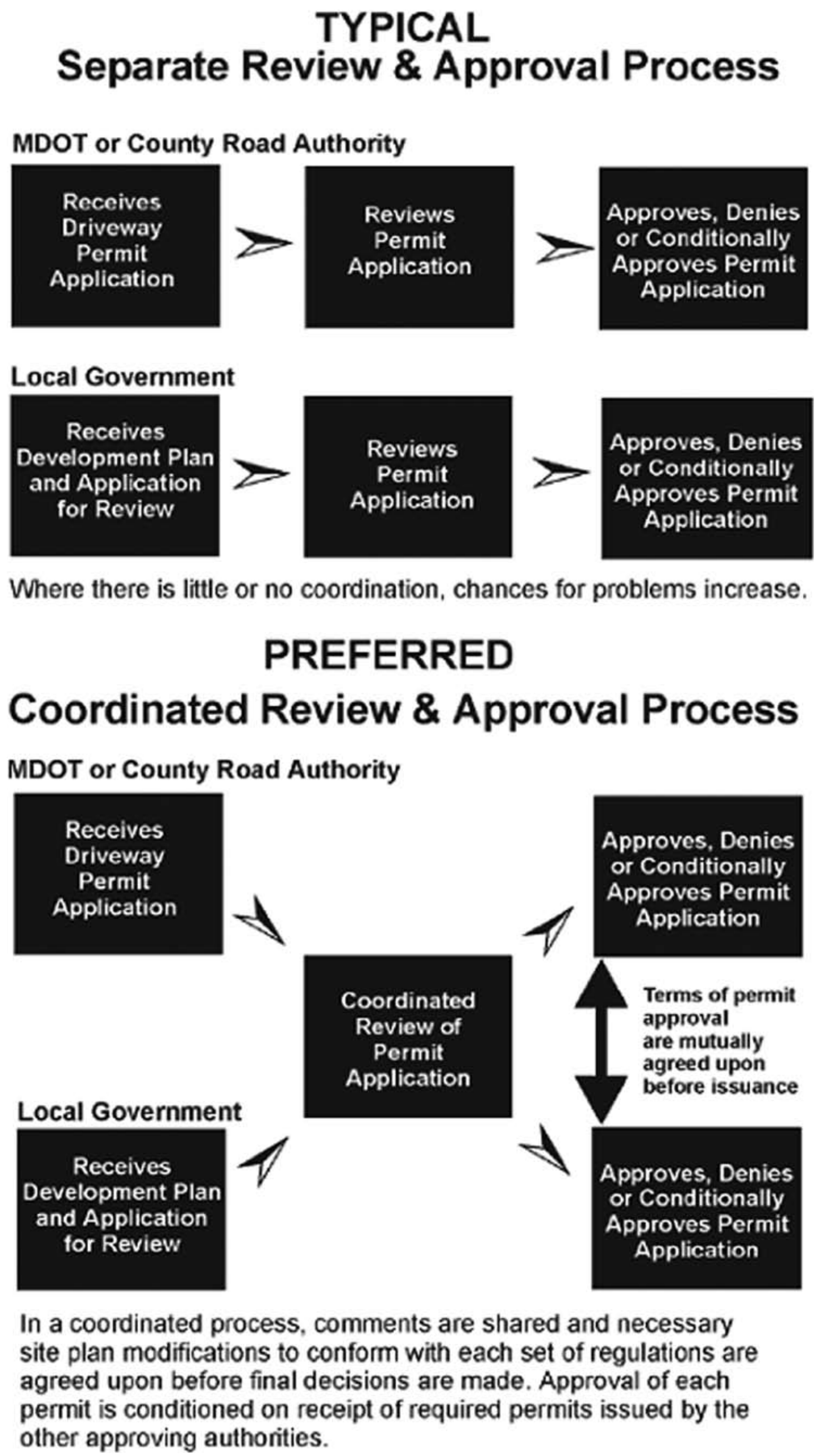


FIGURE 31 Typical and preferred permit review processes. *Source: Reducing Traffic Congestion and Improving Traffic Safety in Michigan Communities: The Access Management Guidebook* (*74*, p. 5-5).

The key elements of coordinated decision making are as follows:

- Simultaneous review—all relevant government agencies review proposed projects at the same time
- Compatible standards
- Conditional approval—each permit is approved on receipt of required permits issued by other approving authorities

Coordinated decision making requires the state DOT or other road agency to review proposed site plans for most projects at the same time they are being reviewed by local zoning authorities. Very large projects should go through a two-step review process, in which the developer meets with the road authorities and local government officials early in the project design process. At the discretion of local officials, these preliminary site plan review meetings should be conducted together with the appropriate road authorities. If local zoning authorities have no access management standards, compatibility of standards is not an issue. But if local access management regulations do exist, and they conflict with the road agency's standards, then in most cases, the developer must comply with the more stringent regulations. If the responsible road authority is not aware of local standards, it could issue a driveway permit that is inconsistent with local requirements.

By conditioning local site plan approval on receipt of required permits from the responsible road authority, the local government will ensure compliance of the project with the standards of the state or other road agencies. Similarly, state DOT and county road agencies that condition approval of their permits with local land use standards will help ensure that new development does not violate local zoning and related requirements. Coordination between road authorities and local land use authorities is the best way to ensure that future land use decisions protect motorists and the public's investment in the highway system.

The FHWA Domestic Access Management Scan provides an example involving the Gateway 1 Corridor in mid-coast Maine. This initiative has shown success in gaining support and cooperation from all 21 existing towns along the corridor. Access management practices and strategies have been progressed along the corridor, while carefully preserving the local culture of each town (*75*).

The Gateway 1 Corridor initiative is consistent with the Maine access management program, which includes access management rules, corridor planning, and preservation initiatives. The program focus is on prioritized planning and the preservation of mobility arterial corridors that are most at risk of losing capacity, reducing safety, and decreasing posted speeds, as a result of increasing development and commuter or visitor pressures. The corridor planning and preservation program includes corridors where Maine DOT joins forces with adjoining municipalities, property owners, corridor committees, scenic byway corridor committees, and other stakeholders along a mobility arterial to develop strategies that ensure that the stated purposes of the Access Management Law are met and maintained. The initiative is intended to address many dimensions, including access management. Route 1 serves multiple purposes because there is no parallel interstate highway route. As a result, Maine DOT needs to balance the needs of local traffic and through traffic.

Planning for and implementing access management practices along the Gateway 1 Corridor has successfully aided in moving traffic and maintaining a level of aesthetics acceptable to the affected town. Towns that controlled access by buying access rights along that corridor have achieved different outcomes. The program has successfully improved and maintained relationships between multiple jurisdictions along the corridor (*75*).

The Michigan *Access Management Guidebook* contains sample access management model ordinances for three common local situations (*74*, pp. 8-1–8-40):

- Option 1: for a slowly growing rural community with one or two state highways or major county roads
- Option 2: for a rural community in the path of growth or a growing suburb with significant undeveloped land along major arterials
- Option 3: for an urban community with little undeveloped land and many retrofit or redevelopment opportunities

Williams and Sokolow (*47*) provide model ordinance language for Florida cities or counties wishing to incorporate access management and other regulatory techniques into their local land development codes. Commentary is provided for guidance in interpreting the model language and identifying issues associated with some of the regulatory standards. Local governments are encouraged to modify the standards to fit local conditions and administrative practices.

The *Kentucky Model Access Management Ordinance* (*76*) was adapted from the Florida Model Land Development and Subdivision Regulations That Support Access Management. The Kentucky Transportation Cabinet prepared this model ordinance to assist Kentucky cities and counties in developing access management ordinances to further improve safety and traffic flow efficiency of Kentucky's roadways. The introduction to the document notes that, although the ordinance does not cover all access treatments, it does cover the most-used treatments. It urges municipalities to tailor the ordinance to meet local needs and develop additional language as necessary.

Access Management Plans

As defined in the *Access Management Manual* (*1*), an AMP is a planning tool that addresses land development and access management considerations along a roadway corridor, or series of corridors, within the study area. A typical AMP shows the location—and in some cases the design—of access for every parcel on the roadway segment(s) within the study area. The plan is often jointly developed and adopted by the state (if the road is a state highway) and local agencies that have jurisdiction over land development in the affected area.

An AMP is useful for dealing with areas that are undeveloped, or areas where redevelopment is possible. An AMP may be a stand-alone document, or prepared as part of subarea or corridor plan. The agency lead in preparing an AMP may be a state department of transportation, an MPO, or a local government. The plan essentially focuses on a specific area, of smaller geographic scale than a statewide or MPO plan. It may address, for example, several communities or areas with roadways that are projected to be or are in need of improvement. An AMP may be prepared as an integral component of areawide plans or as an independent effort, and should incorporate provisions for coordination of area growth with development of the roadway network and any required traffic mitigation. An AMP relates to both comprehensive (that is, areawide) transportation planning and to detailed construction plans.

An AMP has several important features as identified in *NCHRP Report 548: A Guidebook for Including Access Management in Transportation Planning* (*3*, p. 45):

- It is designed to achieve better long-range planning for highway access. It enables the state, MPO, county, or local jurisdictions to specify, in advance, where access in a given area or along a given stretch of highway can be provided. It also enables these agencies to identify current access problems and to work toward their alleviation.
- It provides a coherent frame of reference for developers and local governments. It provides a predictable and consistent basis by which to plan and locate access points, thereby introducing access considerations into the local planning process.
- It gives property owners guidance for sharing access between two adjacent lots, consolidating access for contiguous lots, and obtaining alternative access via collector streets, local streets, or frontage roads.
- It can lead to a higher density of development from the improved road capacity resulting from better traffic management. This translates into higher land values.
- It can facilitate the administration of access regulations and the issuance of driveway permits. It assists municipalities and developers by defining the conditions under which driveway permits will be issued. A developer can use the plan to establish permissible access points and can be assured that access permits will be forthcoming where access conforms to the plan.

An AMP should be a clear and concise document. It should include a map and an accompanying report showing where and how access can be provided, specifying how development and associated roadway network changes should be implemented, and indicating who is responsible for each element.

The major steps involved in preparing an AMP are as follows (*3*, pp. 45–46):

- Identify the study area and participating agencies/stakeholders.
- Develop a public involvement plan that will engage interested parties and consider different opinions for the future of the corridor to shape a realistic plan.
- Establish a vision and supporting goals and objectives to provide a basis for weighing various options.
- Perform policy, land use, and traffic analyses to provide a basis for the development of alternative options and the selection of the components to include in the AMP.
- Evaluate options based on potential social, economic, and environmental impacts, as well as specific impacts on (1) roadway safety, (2) roadway efficiency and operation, (3) the supporting road network, (4) accessibility of neighborhoods and commercial areas, and (5) diversion of nonlocal trips through an existing residential area.
- Establish the responsibilities of each of the participants for the improvements contemplated by the plan.
- Identify the manner in which the timing and sequence of construction of the improvements are to be implemented.
- Provide, if necessary, for temporary access pending completion of the improvements.
- Identify expected future mitigation measures, including traffic limitations and lots with "nonconforming" access (as in Florida and New Jersey).

As identified in *NCHRP 548*, the following issues should be addressed in an AMP (*3*, p. 46):

- Intergovernmental collaboration—The defining characteristic of a successful AMP is the level of cooperation achieved among affected property owners and agencies involved in carrying out the plan.
- Access plans—These plans can be incorporated into the project through the National Environmental Protection Act, road design, and public involvement processes and documents.
- Incentives—Provide incentives to encourage local governments to initiate and develop plans. Incentives could include state and local sharing of costs and facilitation of the permit review process.

- Support—Successful plans require supporting land use actions by local jurisdictions.
- New access approaches—The issuance of temporary access permits is one strategy for phasing and adjusting access as an area develops or is redeveloped. A temporary permit can specify when a temporary driveway is to be removed and a permanent driveway installed. This requires careful planning and coordination and a clear understanding of who pays for what.

As indicated in the *Access Management Manual*, the defining characteristic of a successful AMP is the level of cooperation achieved among affected property owners and agencies involved in carrying out the plan. If a state highway is involved, such cooperation is even more critical. This cooperation is critical because state agencies have little or no jurisdiction over land development issues that must be addressed to carry out the plan. Such authority rests with local planning and development agencies and is exercised through the political process—a process heavily influenced by affected property owners and the general public (*1*, pp. 83–84).

Education, Training, and Community Outreach

As indicated in the *Access Management Manual* (*1*, pp. 10–11), access management has many dimensions. It crosses jurisdictions, organizational lines, and professions. The primary professions that guide development—planners, engineers, and architects—have important roles in determining access outcomes (summarized in Table 18). Other key players include developers, elected officials, citizens, and attorneys who interact with each other and agency staff to shape land use and transportation policies and make access decisions. A variety of jurisdictions may be involved, including local governments that share a transportation corridor, state transportation agencies, and environmental agencies that address land use and development issues. Because access management is multidisciplinary, it requires partnerships within organizations and greater awareness of how decisions of one division affect the next. Government agencies must collaborate—both internally and with other agencies—if they are to manage access effectively.

Implementation of an access management program often requires new staff skills and involves new agency procedures. It is advisable, therefore, to provide early and ongoing training for agency staff. Training provides a variety of benefits, including the following (*1*, p. 47):

- Preparing staff and consultants to address various challenges in planning, design, and permitting, including methods of working with applicants and the public
- Keeping staff and consultants up to date on technical advances in the field
- Identifying implementation problems
- Promoting good communication and dialogue within and across agencies involved in access issues
- Building interest in and support for access management
- Improving consistency in decision making

Workshops provide an opportunity for closer interaction between agency personnel and those with expertise in access management or related issues. This interaction can be beneficial for addressing specific program objectives, such as median

TABLE 18
TYPICAL PROFESSIONAL ROLES AND RESPONSIBILITIES IN ACCESS MANAGEMENT

Transportation/Urban Planners	Transportation Engineers [a]	Civil/Design Engineers [a]	Architects/Site Designers [a]
Classify roadway by function and desired level of access control	Establish right-of-way widths and roadway cross sections	Develop construction specifications and standards	Influence roadway design and cross-section criteria
Produce plans, studies and policies that relate to access	Develop standards and guidelines for access design, location and spacing	Prepare roadway construction plans and specifications	Establish design and layout of development sites
Develop regulatory programs for land development and access management	Review access and signal requests, prepare traffic impact analyses	Prepare construction plans and specifications for site improvements	Determine relationship of buildings to internal and external circulation
Address access issues in subdivision and site plan review	Review traffic impact analyses and approve site access and circulation plans; issues access permits	Review and approve construction plans and design variances	Prepare site access and circulation plans

Source: Access Management Manual (*1*, Chapter 1, p.11, Table 1-1).
Note: These roles and responsibilities are not necessarily discrete, given the overlap across the planning, engineering, and architectural professions.
[a] Have liability for access design decisions under tort claims.

design or coordinating with local governments. Outreach to those affected by the program also will clarify agency objectives and reduce misunderstandings. Brochures, websites, and videos describing the program can be helpful for informing the public and policy makers about the purpose of access management and any agency changes in policies or procedures.

Any access management program will benefit greatly from continuous monitoring to identify and resolve administrative problems. This can be accomplished through quality assurance programs, as well as through periodic task team meetings or facilitated discussions during training. Finally, all agencies involved in access management would benefit from an established process for monitoring actual impacts of access management actions and documenting this information for future use. Before-and-after studies of similar projects are valuable in achieving future support—especially when the study is within the agency's service area. Monitoring activities may include opinion surveys; systematic tracking of operational, economic, and safety data; stakeholder interviews; and so on. Monitoring actual impacts will provide essential information that could assist in allaying public concerns in future access management efforts. Such monitoring also identifies unanticipated impacts that could be avoided in future projects and policies.

Ongoing training and education efforts are critical in developing and enhancing the understanding of access management among all parties, particularly among state DOT staff, municipal transportation and land use planning staff, and the engineering, architectural, and planning consultant community, as well as business owners and the general motoring public. Recognizing the importance of education and training, a number of agencies have prepared materials for use by access management practitioners.

FHWA has prepared a primer, and related video, titled *Safe Access Is Good for Business* (*77*) to provide stakeholders with a better understanding of the basis for access management changes and how they may affect area businesses. The primer focuses on economic concerns that may arise in response to proposed access changes or policies, such as installing a raised median, closing a median opening, or reconfiguring a driveway.

Michigan DOT's *Access Management Guidebook* (*74*) is targeted for use by elected and appointed local government officials, planners, and road authority personnel. It is written for both technical and nontechnical audiences and contains extensive graphics to help the reader understand the principles presented. Figure 32 is one example of the graphics used in the guidebook. The *Access Management Guidebook* (*74*) states that the preparation of the document:

> [I]s based on the growing recognition that many benefits are achieved through local, county, regional and state cooperation in solving existing and preventing future transportation problems. It is believed that by raising awareness of planning, design and regulatory techniques on effective access management among local, county, regional and state officials, that better communication and success in the pursuit of common transportation and land use objectives will result. Chief among these common objectives is the prevention of needless deaths and injury caused by poor access design. Good access design also prevents traffic crashes, improves roadway performance, and preserves the investment in our roadways. (Preface)

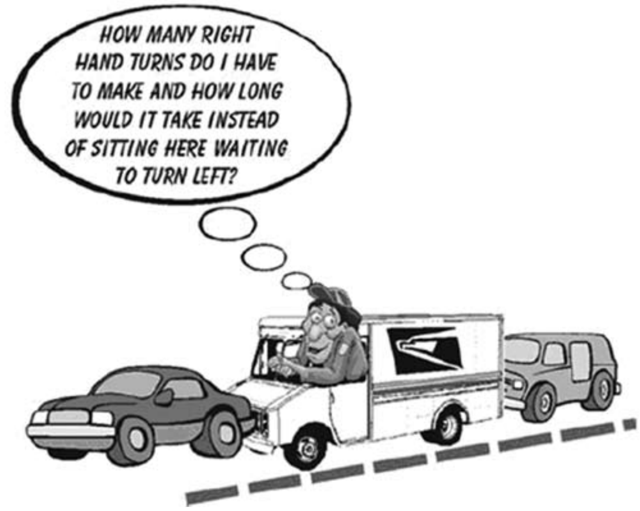


FIGURE 32 Illustration from Michigan's *Access Management Guidebook. Source: Reducing Traffic Congestion and Improving Traffic Safety in Michigan Communities: The Access Management Guidebook (74).*

The guidebook includes three parts:

- Part I—Common Problems and Solutions
- Part II—Model Plans and Ordinances
- Part III—Bibliography and Appendixes

SURVEY RESULTS

This section describes state-of-the-practice information from the survey of state DOTs regarding program implementation. The primary purpose of asking the survey questions reflected in this section was to identify *how* access management is implemented in practice by transportation agencies in the United States.

Organization and Staffing

Figure 33 shows the four general areas where access management typically is applied at the state DOT level, and the percentage of all 50 state DOTs applying access management in each of these areas.

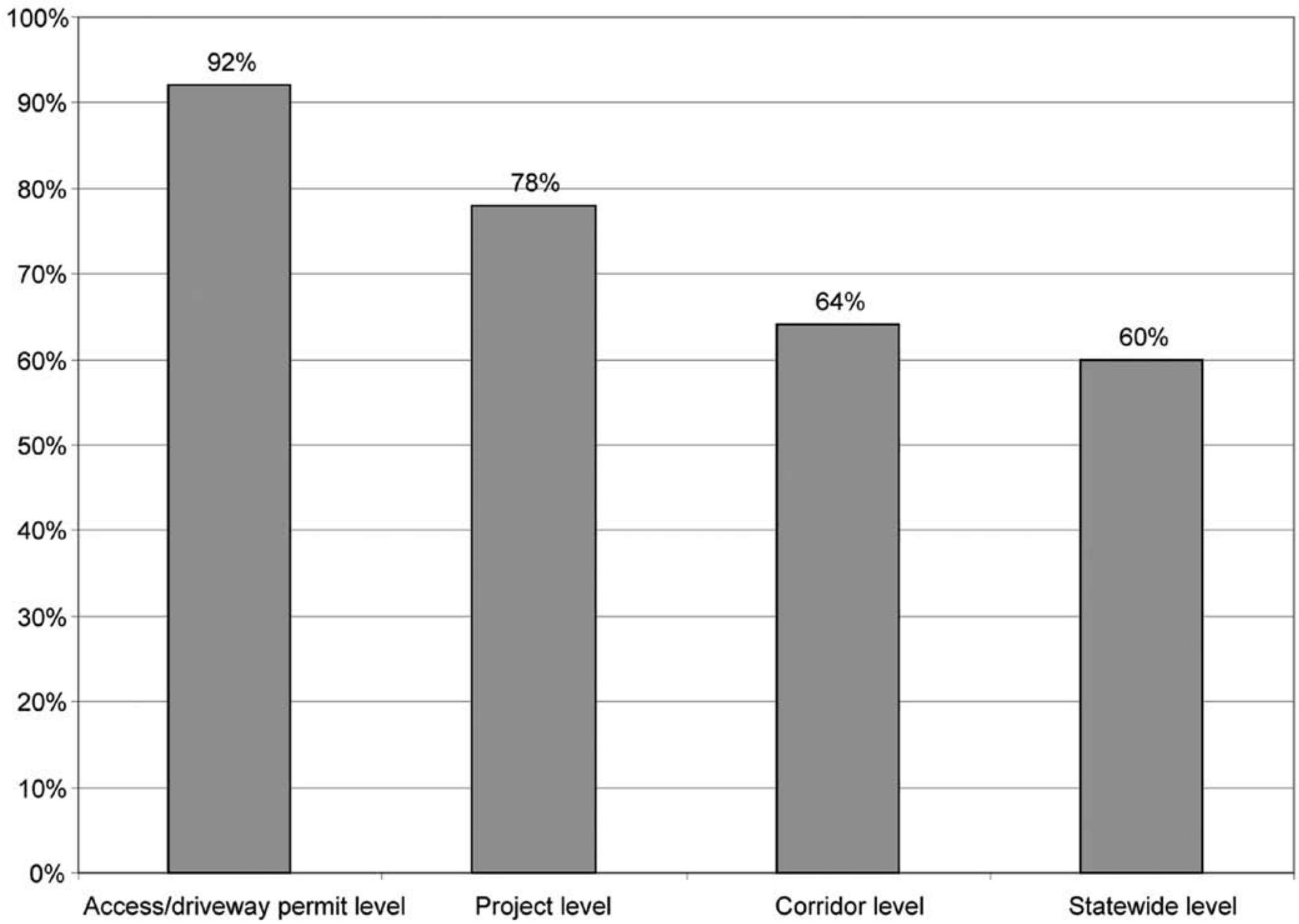


FIGURE 33 Where is access management applied at state DOTs? (50 responses).

As shown in Figure 33, among the 50 state DOTs, access management is most commonly applied at the driveway permit level (46 state DOTs, or 92%), although it is also applied at the project level by 39 state DOTs (78%), at the corridor level by 32 state DOTs (64%), and at the statewide level by 30 state DOTs (60%).

Access management responsibilities within a particular state DOT vary widely. They may be limited to only one division or group (e.g., planning, design, and permitting), or they may be distributed among a variety of divisions or groups, with each having specific access management-related responsibilities. Survey participants were asked which divisions or groups within their agency are involved in access management. Figure 34 illustrates the frequency of responses from among the 45 state DOTs responding to the entire survey.

As shown in Figure 34, traffic engineering (89%) and permitting or development review (87%) are the most commonly involved groups, based on responses from the 45 state DOTs responding to the entire survey. Design and operations and maintenance are also involved in a majority (78%) of the state DOTs, as well as planning (71%), and right-of-way (67%).

Among the 43 responding local agencies, permitting and development review staff (70%) and traffic engineering staff (53%) are the most commonly involved groups. Planning (47%), operations and maintenance (37%), and design (28%) staff are the next most involved groups at the local level.

Often, one division or group with a state DOT is recognized as leading access management efforts within the agency. Based on the survey results, Figure 35 illustrates the divisions or groups that were indicated as being responsible for leading the access management efforts within the state DOTs responding to the entire survey.

As Figure 35 shows, access management–related leadership responsibilities vary widely by division or group among the 45 state DOTs responding to the entire survey. Traffic engineering (20%), permitting and development review (18%), and planning (18%) typically have the lead. Approximately 11% of the responding state DOTs indicated that no single division or group leads access management efforts within their agency.

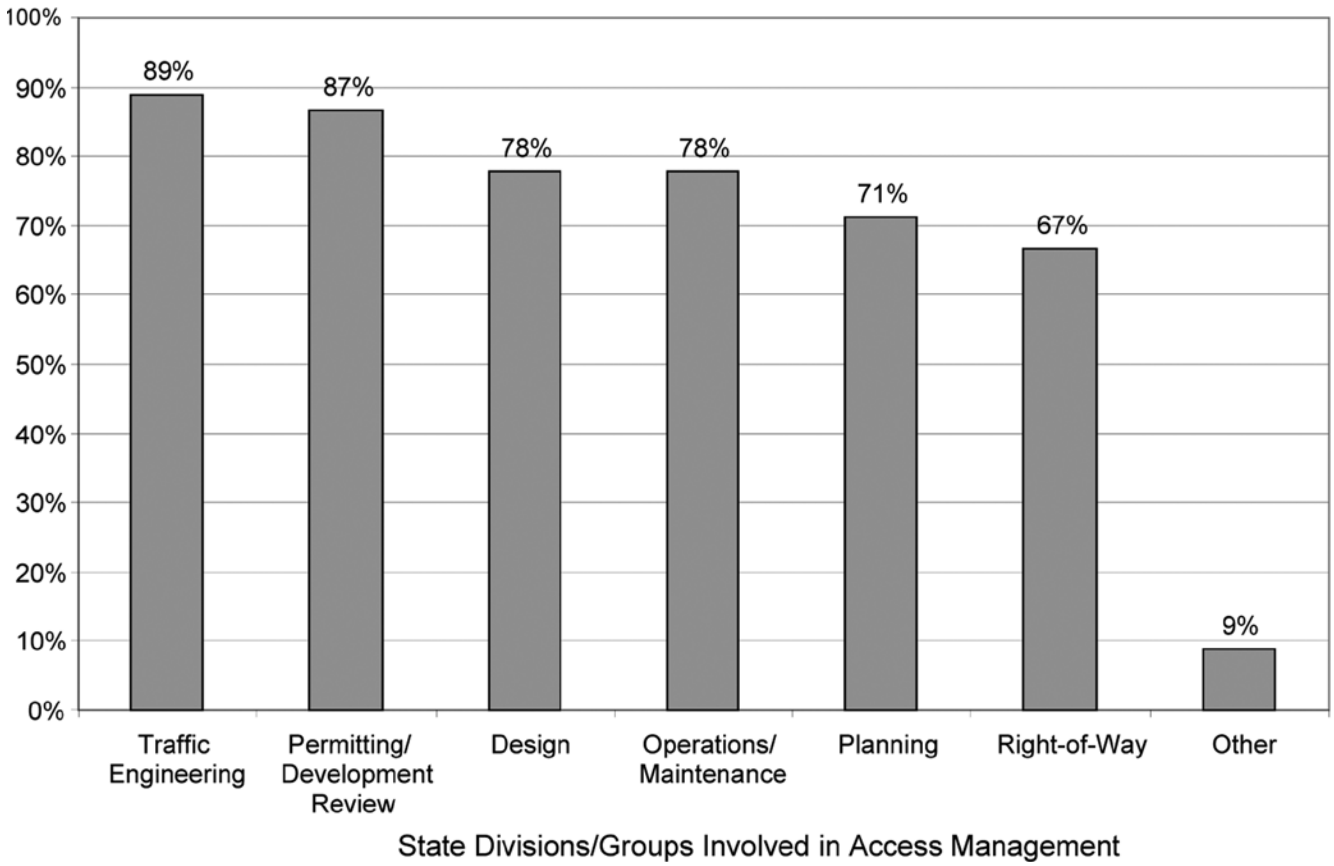


FIGURE 34 State DOT divisions and groups involved in access management activities (45 responses)

Similarly, Figure 36 illustrates the divisions or groups within local agencies that were indicated as being responsible for leading the access management efforts.

As Figure 36 shows, access management-related leadership responsibilities also vary widely by division or group among the responding local agencies. Planning (26%), permitting and development review (24%), and traffic engineering (18%) most commonly have the lead. Approximately 16% of the responding local agencies indicated that no single division or group leads access management efforts within their agency.

Only 16 of the 45 responding state DOTs (36%), and only 4 of the responding local agencies (9%), indicated that they had staff exclusively devoted to access management. In practice, access management responsibilities often are shared among various groups and staff members within a particular agency. The number of staff members devoted to access management—as well as their roles, staff levels, and location (i.e., central versus district office)—vary widely among the responding agencies. Staff titles may include the following:

- Planners
- Traffic engineers
- Access management engineers
- Engineering technicians
- Permit engineers or permit specialists
- Right-of-way specialists
- Permit inspectors
- Statewide, regional, or district managers and supervisors (or access management managers)

References Consulted

The TRB *Access Management Manual* is the most comprehensive resource on the topic of access management. It draws on decades of research, including many NCHRP research projects, to address a wide range of access-related issues, ranging from the benefits of access management treatments, to specific spacing and design criteria, to land use and legal considerations. Because access management responsibilities often fall under the domain of traffic operations, planning, and design, the TRB *Highway Capacity Manual* and AASHTO's "Green Book" (*A Policy on Geometric Design of Highways and Streets*) are common reference documents. In addition, many states have developed access management-related resource documents, including policies, permit manuals, and design guides. Based on the results of the survey, Figure 37 indicates the percentage of responding state DOTs that consult various reference documents during their daily work on access-related issues.

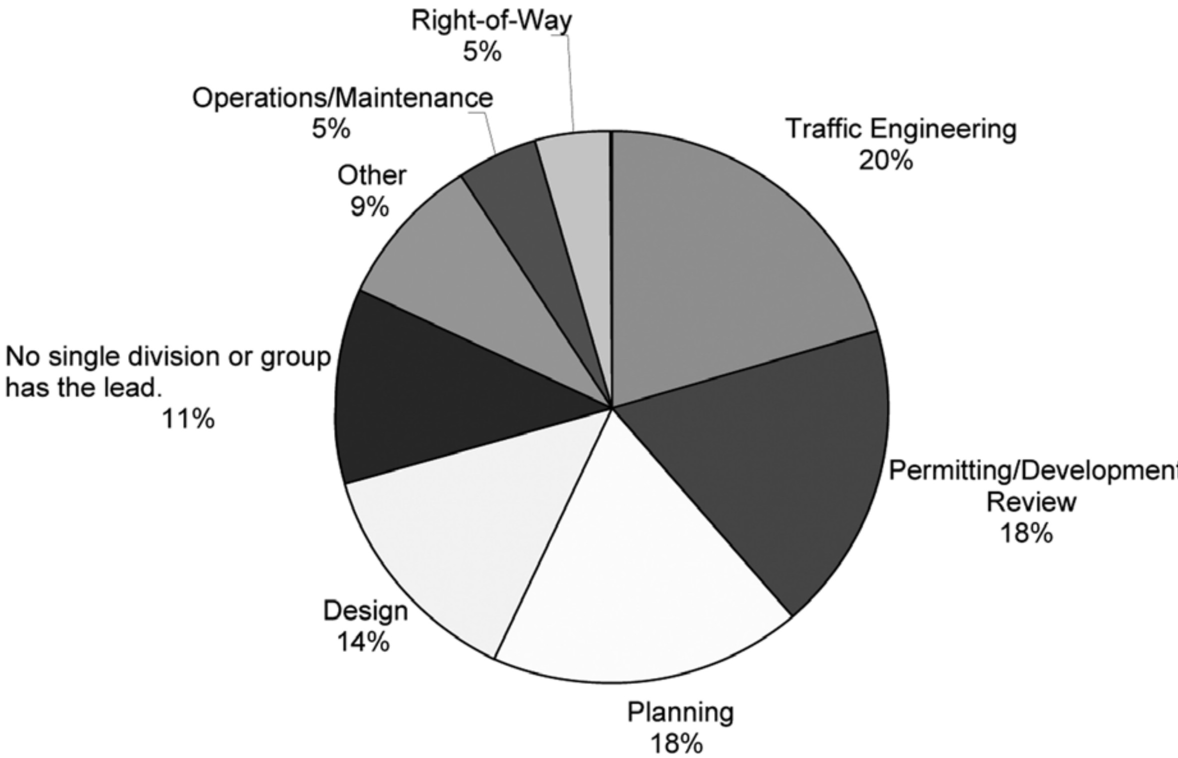


FIGURE 35 State DOT divisions and groups responsible for leading access management activities (45 responses).

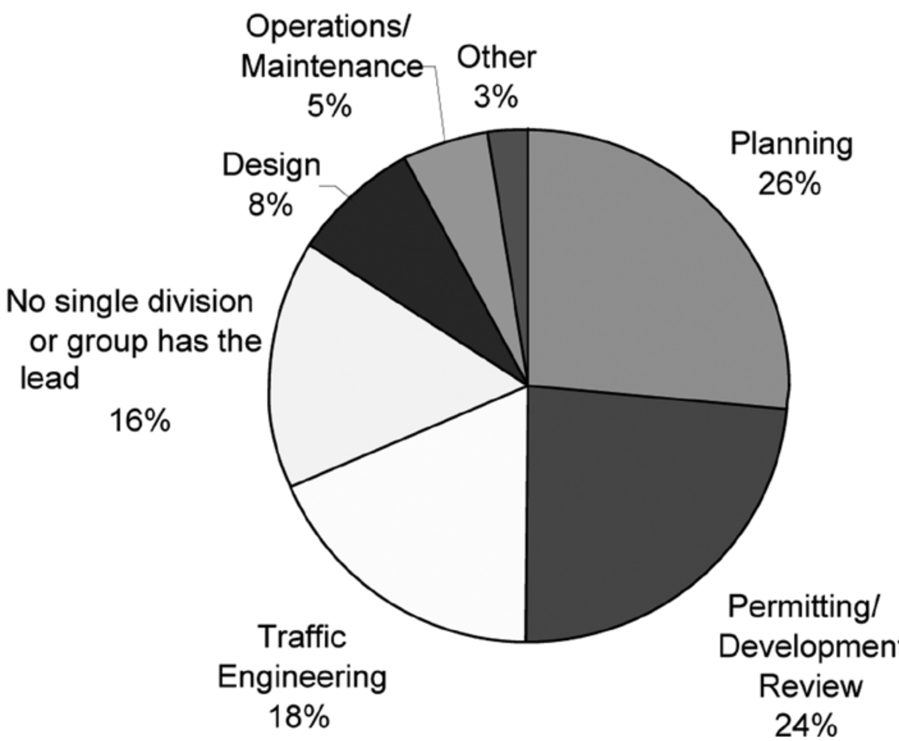


FIGURE 36 Local agency divisions and groups responsible for leading access management (38 responses).

As shown in Figure 37, the most common publications referenced by state DOTs are AASHTO's "Green Book" (87%), the *Highway Capacity Manual* (67%), and the *Access Management Manual* (60%). In addition, most respondents (84%) cited the use of independent reference documents developed by their agency to address access management issues.

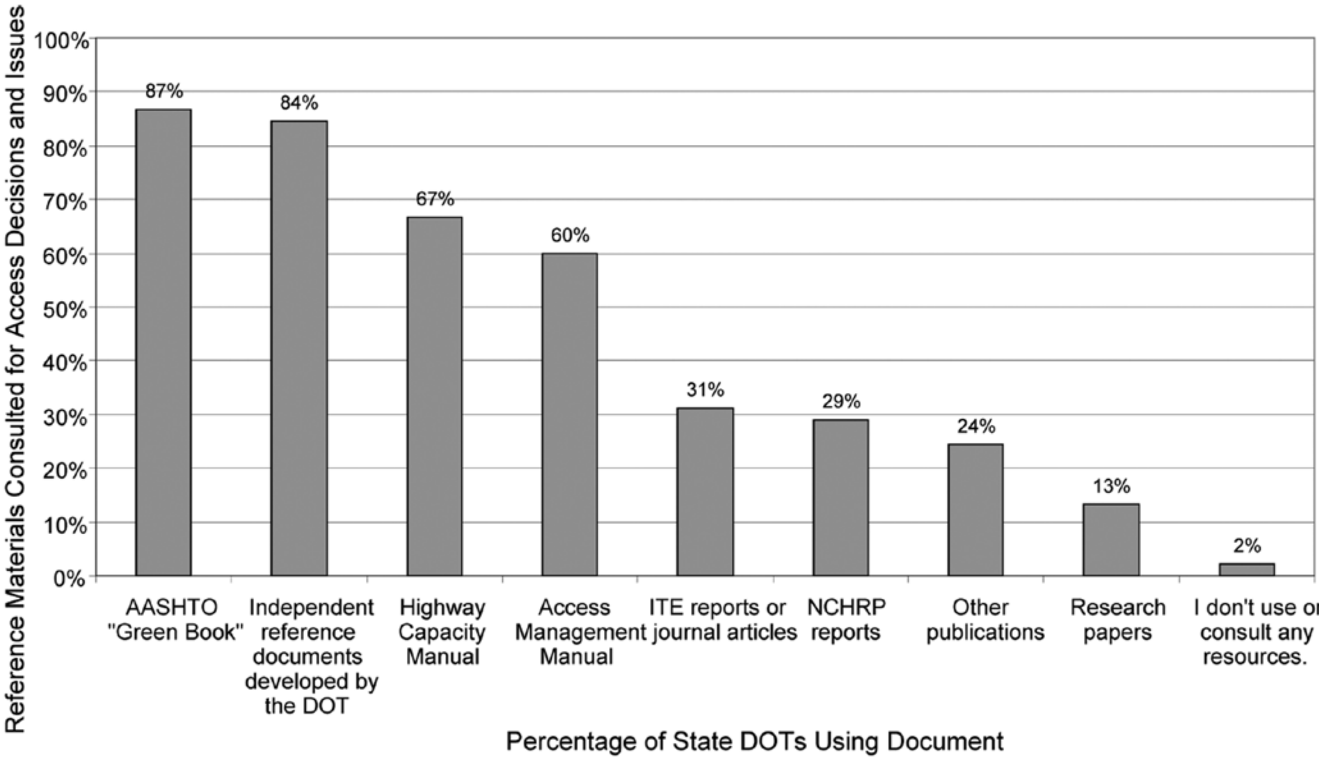


FIGURE 37 Resource documents consulted for access-related issues (45 responses).

Similarly, among the responding local agencies, the most commonly referenced publications are AASHTO's "Green Book" (63%), followed by the *Highway Capacity Manual* (42%), and the *Access Management Manual* (42%). Approximately 37% of the local agencies also cited using independent reference documents developed by their agency.

The following agency-specific documents were cited by state DOT respondents for consultation on access-related issues. Web-links are provided where available.

- Arizona
  - *Access Management Manual:* http://www.azaccessmanagement.com/Access_Management_Manual.asp
- Arkansas
  - *Access Control and Median Opening Criteria*
- California
  - *Highway Design Manual:* http://www.dot.ca.gov/hq/oppd/hdm/hdmtoc.htm
  - *Permit Manual*
- Colorado
  - *State Highway Access Code, March 2002:* http://www.dot.state.co.us/AccessPermits/PDF/601_1_AccessCode_March2002_.pdf
- Florida
  - *Median Handbook:* http://www.dot.state.fl.us/planning/systems/sm/accman/pdfs/mhb06b.pdf
  - *Driveway Information Guide:* http://teachamerica.com/FDOT/Driveway08.pdf
  - *Plans Preparation Manual:* http://www.dot.state.fl.us/rddesign/PPMManual/2009/PPM2009.shtm
  - *Access Management Standards—Rule 14-97:* http://www.dot.state.fl.us/planning/systems/sm/accman/pdfs/1497.pdf
  - *Florida Design Standards:* http://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtm
- Kansas
  - *Corridor Management Policy:* http://www.ksdot.org/burTrafficEng/CMPWorking/Index.asp
- Kentucky
  - *Highway Design Manual:* http://transportation.ky.gov/design/designmanual/
  - *Permits Guidance Manual:* http://transportation.ky.gov/maintenance/PermitsManual.html
- Maine
  - *Access Management Rules:* http://www.maine.gov/mdot/planning-process-programs/access-mngmnt.php
- Maryland
  - *State Highway Access Manual:* http://www.sha.maryland.gov/businesswithsha/permits/ohd/proced.asp
- Minnesota
  - *Access Management Manual:*

http://www.oim.dot.state.mn.us/access/
  - *Road Design Manual:* http://www.dot.state.mn.us/design/rdm/index.html
- Missouri
  - *Engineering Policy Guide:* http://epg.modot.org/index.php?title=Main_Page
- Nevada
  - *Access Management System and Standards:* http://www.nevadadot.com/business/forms/pdfs/TrafEng_AccesMgtSysStandards.pdf
- New Hampshire
  - *Driveway Access Policy:* http://www.nh.gov/dot/org/operations/highway-maintenance/documents/DrivewayPolicy.pdf
- New Jersey
  - *State Highway Access Management Code:* http://www.nj.gov/transportation/business/accessmgt/NJHAMC/
  - *Roadway Design Manual:* http://www.state.nj.us/transportation/eng/documents/RDM/sec1.shtm
- North Carolina
  - *Policy on Street and Driveway Access to North Carolina Highways:* http://www.ncdot.org/doh/preconstruct/altern/value/manuals/pos.pdf
  - *North Carolina Median Crossover Guidelines:* http://www.ncdot.org/doh/preconstruct/traffic/congestion/CM/docs/MCGuidelines.pdf
- Ohio
  - *State Highway Access Management Manual:* http://www.dot.state.oh.us/divisions/prod-mgt/roadway/accessmanagement/documents/state%20highway%20access%20management%20manual%20march%202008.pdf
- Oklahoma
  - *Roadside Design Manual*
  - *Policy on Driveway Regulations for Oklahoma Highways*
- Oregon
  - *Access Management Administrative Rules—Division 51:* http://www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/DIVISION_51.pdf
  - *Access Management Manual:* http://www.oregon.gov/ODOT/HWY/ACCESSMGT/accessmanagementmanual.shtml
  - *Highway Design Manual:* http://www.oregon.gov/ODOT/HWY/ENGSERVICES/hwy_manuals.shtml
  - *Development Review Guidelines:* http://www.oregon.gov/ODOT/TD/TP/docs/publications/DRG/toc.pdf
- Texas
  - *Access Management Manual:* http://onlinemanuals.txdot.gov/txdotmanuals/acm/acm.pdf
- Utah
  - *Utah DOT Administrative Rule R930-6:* http://udot.utah.gov/main/f?p=100:pg:0:::1:T,V:675
- Virginia
  - *Access Management Regulations and Standards:* http://virginiadot.org/projects/accessmgt/default.asp
  - *Traffic Impact Analysis Regulations:* http://virginiadot.org/projects/chapter527/default.asp
- Vermont
  - *Access Management Program Guidelines:* http://www.aot.state.vt.us/vam/Documents/AccManProgGuidelinesRev072205.pdf
- Washington
  - *Design Manual:* http://www.wsdot.wa.gov/Publications/Manuals/M22-01.htm
- West Virginia
  - *Department of Highways Design Manual*
- Wyoming
  - *Access Manual:* http://www.dot.state.wy.us/webdav/site/wydot/shared/Traffic/WYDOT%20Access%20Manual.pdf

Land Use and Transportation Coordination

The survey responses from state DOTs indicated that, although the advantages of early coordination with local agencies generally are recognized, the extent of coordination between state DOTs and local land use agencies still can vary considerably. Many survey respondents from state DOTs indicated that limited or inconsistent coordination with local land use agencies continues to exist and often depends on the specific district or location within the state, the particular ordinances and regulations of the individual local governments, and the working relationships among professional staff at the state and local levels. Staff turnover and changes in elected officials also have significant affects on the success of coordination efforts.

Some local agencies solicit (or are required by law to obtain) comments from state DOTs on site plan reviews for properties abutting the state highway, but may not act (or be required to act) on these comments. Other local agencies require the property owner or developer to acquire an access permit from the state DOT before approving a site for occupancy. Others adopt access management standards that are consistent with, or at least as restrictive as, state DOT standards. In some urban areas, local governments are entirely responsible for access management.

New York State DOT (NYSDOT) staff noted that they typically support up to 15 local planning and zoning projects each year, working directly with local communities to develop plans and zoning that are sensitive to the needs of the state highway system. Most successes have been achieved when NYSDOT has persuaded local communities to adopt sound access management practices as part of active participation in local planning and zoning efforts, rather than trying to integrate local governments into collaborative planning efforts that are undertaken independent of their own planning and zoning activities.

Figure 38 shows several typical local land use actions and the percentage of all 50 state DOTs citing coordination with local land use agencies on such actions.

As shown in Figure 38, most of the responding state DOTs were found to coordinate with local agencies on site plan reviews (78%), subdivision reviews (64%), and zoning or rezoning actions (54%). Similarly, among the 43 local respondents, approximately two-thirds indicated that they coordinated with the state DOT (or other transportation agency) on subdivision reviews (67%) and zoning or rezoning actions (65%). Approximately 60% of the local agencies indicated that they coordinated with state DOT on the site plan reviews.

Figure 39 summarizes responses from state DOTs regarding how transportation and land use decisions related to access management typically are coordinated among two or more agencies.

As shown in Figure 39, approximately 38% of the 45 state DOTs responding to the entire survey indicated that the access management-related decisions are governed solely by the DOT (or the agency with jurisdiction over the subject roadway), while 7% indicated that these decisions are governed by the land use agency. Results were similar among the 43 responding local agencies: approximately 49% indicated that access management-related decisions are governed by the DOT or applicable transportation agency, and 9% indicated that these decisions are governed by the land use agency.

Approximately 18% of the 45 responding state DOTs indicated that transportation and land use decisions are made separately by each agency and not coordinated, whereas only 5% of the local agencies responded as such.

Approximately 22% of the 45 state DOTs responding to the entire survey, and 21% of the responding local agencies, indicated that coordination meetings occur among the involved agencies regarding access management. Survey respondents noted that such collaborations were effective. Although the local land use agency ultimately may make final decisions regarding land use, in cases in which a state highway access permit is required, the local staff may solicit the opinion of state DOT staff and defer to DOT's expertise in this area. Discussions and negotiations between state DOTs and local land use agencies were cited as leading to requirements for crossover access between adjacent properties and the preparation of AMPs.

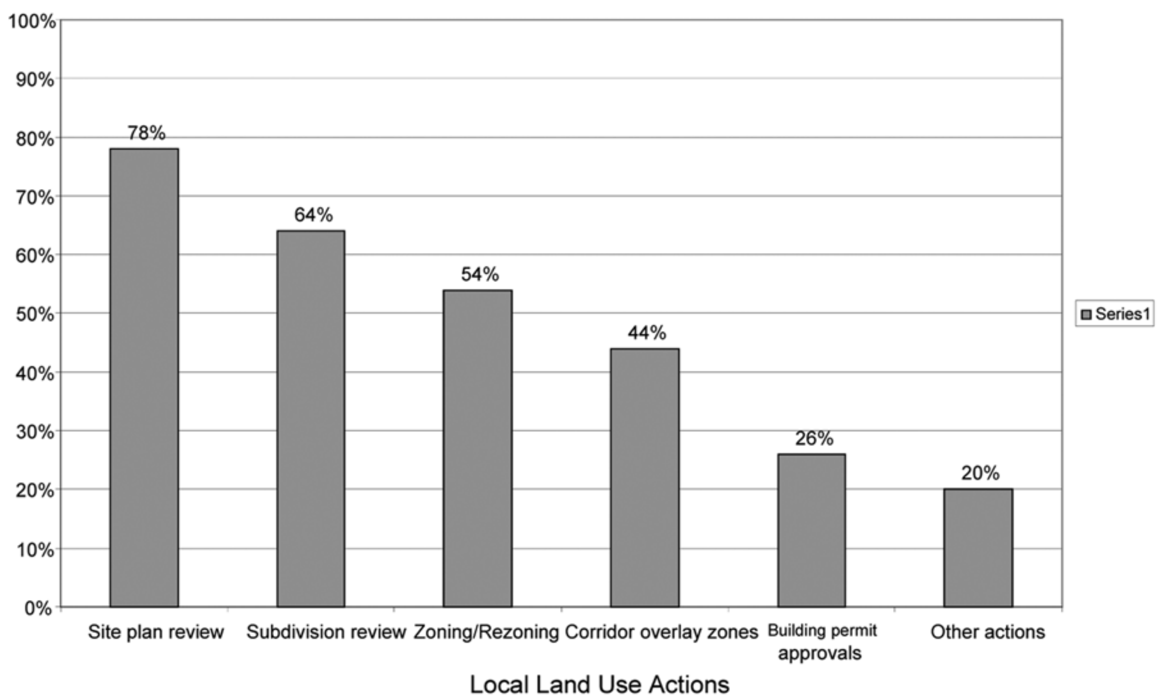


FIGURE 38 Frequency of coordination between state DOTs and local agencies on typical local land use actions (50 responses).

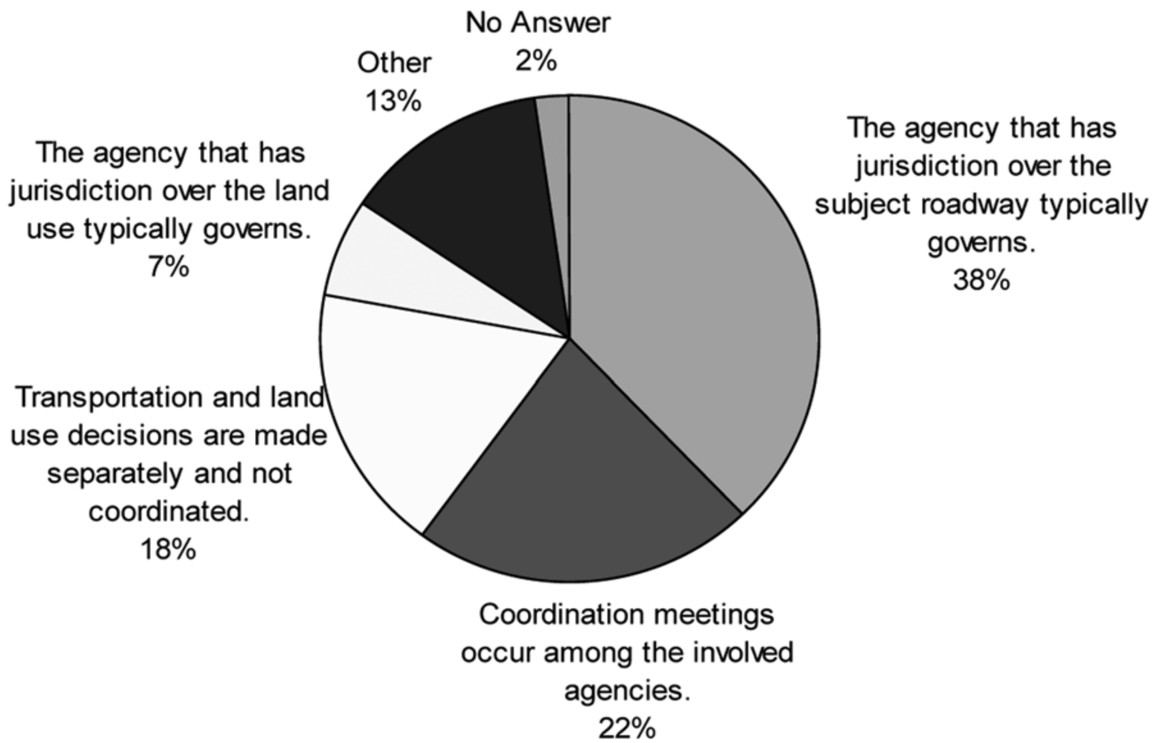


FIGURE 39 How are access management-related transportation and land use decisions typically coordinated? (45 responses).

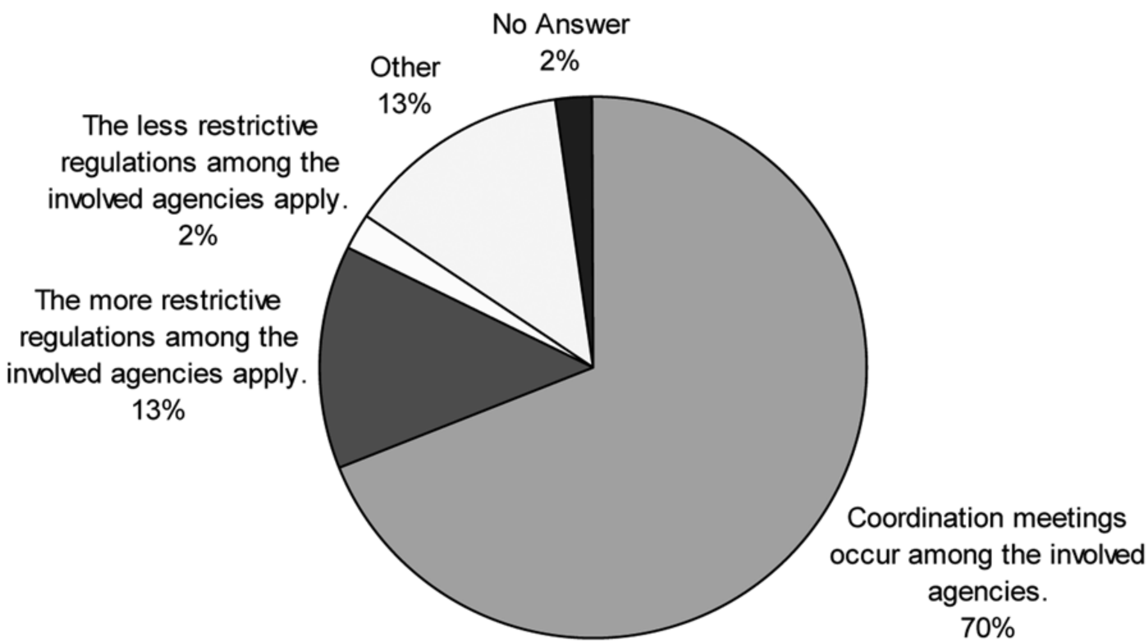


FIGURE 40 How are access-related conflicts with other agencies resolved? (45 responses).

Figure 40 summarizes responses from state DOTs regarding how access-related conflicts are resolved with other agencies.

As shown in Figure 40, when access-related conflicts occur, the majority (70%) of the responding state DOTs indicated that they become involved in coordination meetings with the other involved agencies. Approximately 58% of the responding local agencies also indicated that coordination meetings occurred to resolve access-related conflicts. Approximately 13% of the state DOT respondents and 16% of the local respondents indicated that the more restrictive regulations among the involved agencies would apply. Some respondents from state DOTs noted that although the more restrictive regulations of one agency technically may apply, or the agency with approval authority may have the power to make the final decisions, coordination meetings still do occur in the event of conflicts in an effort to negotiate the best overall transportation solution. Other state DOTs define strict minimum access standards or mitigation requirements, but also may suggest improvement alternatives and support the local agency in implementing them.

Access Management Plans

Of all 50 state DOTs, 26 (52%) indicated that their agency has provisions for the preparation of AMPs or corridor management plans. Only 9 of the 43 responding local agencies (21%) indicated that they had AMP provisions. Preparation of an AMP may be led (and funded) by either the state DOT or the local government(s) (including cities, towns, counties, and MPOs), but considerable involvement and input by both state and local officials usually is part of a cooperative effort. AMP participants at the state and local levels may include staff from planning, traffic engineering, design, access permits, right-of-way, and local public works. Consultants may be hired to provide technical assistance and outside expertise, and may facilitate the development of the plan. Other stakeholders—such as residents and business or property owners—also may be included in the development of the plan. AMPs were cited by state DOTs and local agencies as being prepared for a variety of reasons, including the following:

- **Improving traffic operations and safety**—An AMP may be prepared to address existing access-related operational or safety deficiencies along a highway or segment of highway.
- **Preserving the highway system**—An AMP may be prepared to preserve the operational integrity and functional life of a highway, especially on strategic corridors where existing access standards otherwise may not provide adequate protection. Over time, mobility along the corridor is maintained (rather than eroded), making the corridor more attractive for motorists and businesses.
- **Guiding future transportation improvements with development activity**—An AMP provides planners and engineers with guidance for the implementation of highway improvements in conjunction with future development activity. AMPs are especially useful in areas where significant development is anticipated.
- **Establishing specific design criteria for a highway**—An AMP may be prepared as a formal mechanism to proactively establish desired design features (e.g., a raised median) and withstand future pressures for access-related exemptions (e.g., for a median break) associated with development actions.
- **Addressing access needs where standards cannot be met**—An AMP may be prepared to address property access areas where the prevailing access standards otherwise cannot be met.
- **Taking advantage of road reconstruction opportunities**—An AMP may be prepared in conjunction with a road reconstruction project to take advantage of the opportunity to make access-related changes as part of the reconstruction project.
- **Upgrading the highway to its access classification**—An AMP may be used to bring a portion of a state highway into conformance with its designated access classification.
- **Achieving a consensus among state and local agencies regarding future access locations**—When an AMP is prepared with the involvement and approval of both state and local officials, it helps both agencies come to an agreement on access locations and address future access requests by property owners and developers in a consistent manner.
- **Meeting requirements to obtain funding**—Preparation of an AMP may be a requirement to obtain federal or state funding for construction or reconstruction projects.

AMPs may contain a range of specific elements, generally including all or most of the following items:

- Identification of the participating agencies
- Description and boundaries of the subject corridor
- Goals and objectives of the AMP
- Description of stakeholder input or public involvement process
- Existing land use and zoning analysis for abutting properties, and identification of anticipated future land use and zoning changes
- Locations of existing street intersections, traffic signals, access driveways, and median breaks
- Existing traffic volumes, future traffic projections, and traffic analysis
- Summary of existing operational and safety deficiencies, and environmental constraints
- Recommended land use and zoning changes and overall access management strategies
- Recommended transportation improvements for the corridor and the supporting street network, including planned future locations of street intersections, traffic signals, access driveways, median breaks, auxiliary lanes, and interparcel connections (cross-access easements)
- Recommended geometric driveway design characteristics
- Implementation phasing plan (e.g., short-term versus long-term improvements)
- Narrative text and associated maps illustrating the bulleted items

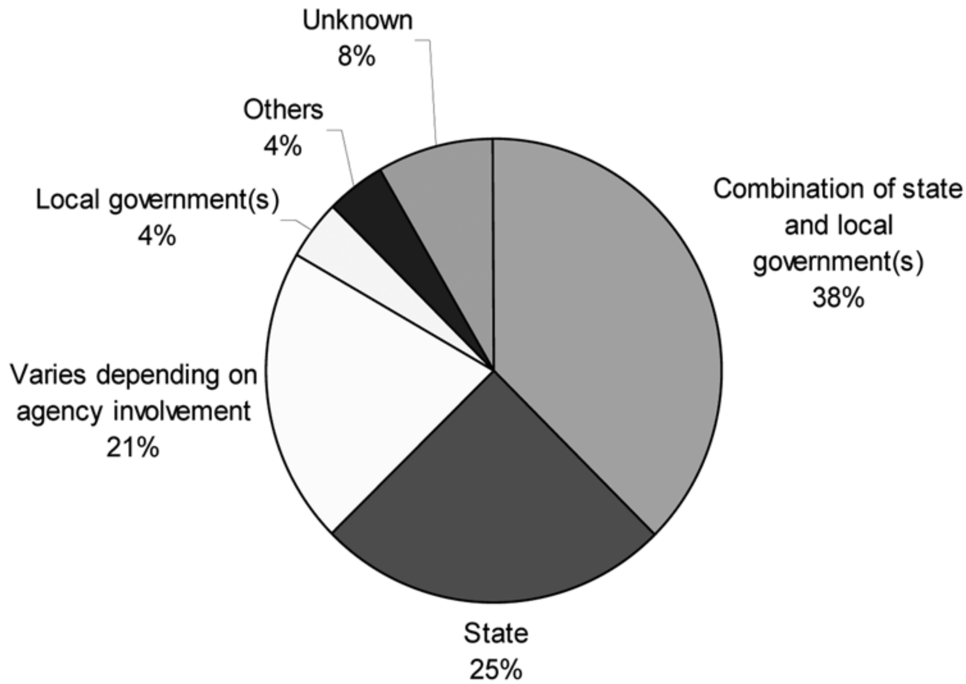


FIGURE 41 Funding sources for access management plans (24 responses).

Figure 41 identifies how AMPs typically are funded, based on the state DOTs responding to this question in the survey.

As shown in Figure 41, 38% of the state DOTs with AMP provisions indicated that AMPs were funded by a combination of state and local government contributions, and 25% were funded exclusively by the state DOT. Only 4% of state DOTs indicated that AMPs were funded exclusively by local governments.

Following adoption of the AMP, the transportation improvements identified in AMPs were most commonly cited as being implemented in cases in which opportunities for transportation or land use changes arise. Such opportunities generally include development activity, as well as the availability of funding for highway widening or safety improvements. Some states use separate funding sources to purchase access rights or properties from willing property owners.

Most of the responding state DOTs indicated that their agency prepared AMPs relatively infrequently (less than one AMP per year). Exceptions included the following:

- Colorado (approximately two to three per year since 2006)
- Kansas (approximately two per year for the past 3 to 4 years)
- Montana (approximately two to three per year)
- New York (approximately two to four per year)
- Oregon (approximately 13 in 9 years)

Figure 42 shows how the responding state DOTs rated the success of their AMPs.

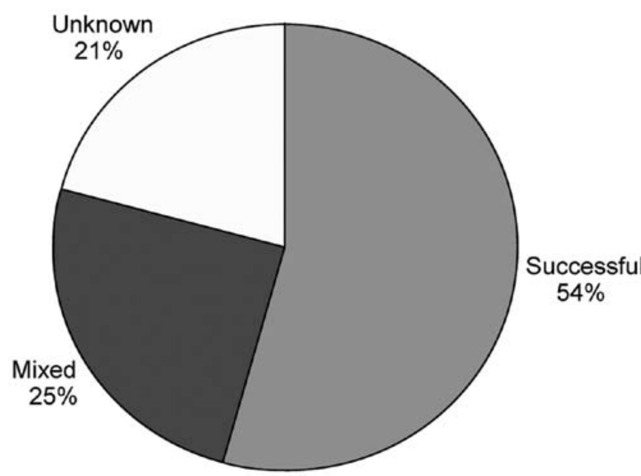


FIGURE 42 Success of access management plans (as indicated by state DOTs) (24 responses).

In general, state DOTs and local agencies noted that AMPs were successful and effective tools to manage access along specific corridors, provided that cooperation continued between state and local governments and that funding was available. The state DOTs and local agencies with AMP experience noted the following benefits:

- "[P]lans have been successful in that they were done with local support, there have been few contests or exceptions, and have been received in a generally positive light by the media and locals."
- "[A]re rarely litigated."
- "[V]ery helpful procedurally."
- "Some have been very successful, usually if incorporated early enough."

- "We have been very successful in our coordination with local jurisdictions and our access permitting staff in coordinating elements of the respective plans via the developer review and mitigation process. We have also been successful in coordinating plan concepts into local master plan updates."
- "By community measures, moderately to very successful if evaluated on their follow-through and local gains."
- "The plan is valuable so that developers can see what's expected before they lay out a lot of time and money with an unacceptable plan."
- "Plans have been successful where local entities and state work together going forward."
- "[R]easonably successful due to buy-in from local governments."
- "The vast majority are approved and not appealed."

The state DOTs and local agencies noted the following challenges with AMPs:

- "[A]nytime there are conflicts of interest among agencies with regard to land use decisions and development objectives, the plan becomes disputable among the involved agencies."
- "Mixed results depending on the cooperation of the local partners."
- "[F]unding has been reduced considerably in recent years."
- "The plans with a short-term component have seen more success than those with just long-term plans."
- "Limited success because of the process to modify them after approval. They appear to be more trouble than the value they provide."
- "[T]oo infrequent."
- "[T]oo early to judge the long term effectiveness of most plans."
- "[T]hey often rely on re-development, which tends to take place one parcel at a time, and the whole vision needs multiple parcels to work."

Forty-two of the 45 state DOTs responding to the entire survey (93%) and 30 of the 43 responding local agencies (70%) indicated that driveway reduction or consolidation is considered as part of highway reconstruction projects. Some 20 of these state DOTs (44%) and 10 of the local agencies (23%) indicated that their agency has attempted to target exclusive access management projects toward the reduction or consolidation of driveways and median openings.

Education, Training, and Community Outreach

Of the 45 state DOTs responding to the entire synthesis survey, 38 (88%) indicated that education or training opportunities related to access management had been provided within their agency. These opportunities included in-house training sessions concerning the content and application of agency-specific documents related to access management, as well as general access management training sessions offered by the National Highway Institute (NHI), ITE, various local technical assistance programs, universities, and others. In some cases, the training opportunities have been extended beyond the state DOT staff, to include municipal staff and members of the consulting community as well. Among the 43 responding local agencies, in-house training and education opportunities were considerably less frequent, with only nine agencies (21%) indicating that these had occurred.

Training efforts appear to have been largely well-attended and well-received by state DOT staff and other participants and have raised awareness of the importance of access management, as well as leading to more consistent and knowledgeable application of access management principles in practice. In some cases, repeat training sessions have been requested. However, a few state DOTs did indicate encountering mixed responses or skepticism with respect to access management.

Of the 45 state DOTs responding to the entire synthesis survey, 26 (58%) indicated that their agency has undertaken access management–related outreach activities, compared with only 11 of the 43 responding local agencies (26%). Groups targeted as part of state DOT outreach activities have included the following:

- Elected officials
- Municipal land use and transportation agencies
- MPOs
- Regional planning commissions
- State land departments
- Bureau of Land Management
- Building industry associations
- Retail associations
- Local property owners
- Development community
- Indian tribes (Arizona)
- General public, especially including residents of areas affected by access management proposals

Responses from these groups ranged from "well-received" to "mixed." Survey respondents acknowledged that the outreach activities were helpful in educating participants about the rationale behind access management–related actions that otherwise may be perceived negatively (e.g., installation of a median that prohibits left-turn access), and fostering more agreeable attitudes about such actions. Outcomes of these community outreach efforts have, in some cases, been quite positive and action oriented. Outcomes also have included a significantly greater level of collaboration with local agencies in developing access management–related projects, as well as local agencies taking substantial and independent initiatives to revise their comprehensive plans and zoning regulations in cooperation with the state DOT.

Independent Studies and Research

Nineteen of the 45 state DOTs responding to the synthesis survey and 1 of the 43 responding local agencies indicated that their agency had undertaken access management-related studies or research. The following is a list of the studies and research as noted by the survey respondents. Web-links are provided where available.

- Alaska
  - Alaska Department of Transportation, *Parks Highway Corridor Planning Study.* http://www.parkshighway44-52.info/
- Arkansas
  - Gattis, J.L., *Assess the Need for Implementing an Access Management Program,* TRC 04-04, Arkansas State Highway and Transportation Department, Sep. 2005.
  - Gattis, J.L., et al., *NCHRP Project 15-35: Geometric Design of Driveways,* Transportation Research Board, National Research Council, Washington, D.C.
- Colorado
  - *Final Report of the Colorado Access Control Demonstration Project,* Colorado Department of Highways, 1985.
- Florida
  - *Median Handbook,* Florida Department of Transportation, Jan. 1997. http://www.accessmanagement.info/pdf/FL_Median_Handbook.pdf
  - *Driveway Information Guide,* Florida Department of Transportation, 2008. http://www.accessmanagement.info/pdf/FL_Driveway_Handbook.pdf
  - *Florida Highway Landscape Guide,* Florida Department of Transportation, April 14, 1995. http://www.accessmanagement.info/pdf/landscap.pdf
- Georgia (Metropolitan Atlanta)
  - *Gwinnett County Access Management Case Study,* Parsons Brinckerhoff for the Atlanta Regional Commission, Atlanta, Georgia, May 2, 2008. http://www.atlantaregional.com/documents/gwinnett_access_mgmt.pdf
- Iowa
  - Abstracts and links for the following reports, prepared by Iowa State University's Center for Transportation Research and Education, are available at http://www.intrans.iastate.edu/research.htm
  - Garms, A., J. Rees, and G. Karssen, *Access Management Plan for Des Moines MPO,* Iowa State University Center for Transportation Research and Education for the Iowa Department of Transportation and the Des Moines Area Metropolitan Planning Organization, Sep. 2004. http://www.intrans.iastate.edu/reports/desmoines_access.pdf
  - Loehr, E. and K.S. Bernhardt, *Decision-Support System for Management of Slope Construction and Repair Activities: An Asset Management Building Block,* Iowa State University Center for Transportation Research and Education for the U.S. Department of Transportation, 2002.
  - Maze, T., Plazak, D., P. Chao, J.K. Evans, E. Padgett, and J. Witmer, *Access Management Research and Awareness Program (Phases I, II, III, and IV),* Iowa State University Center for Transportation Research and Education for the Iowa Department of Transportation. Reports. http://www.ctre.iastate.edu/research/access/index.htm
  - Plazak, D., *Access Management and Corridor Management Training,* Iowa State University Center for Transportation Research and Education for the Iowa Department of Transportation, 2005.
  - Plazak, D., *Economic Impacts—Real or Perceived?* Iowa State University Center for Transportation Research and Education for SAIC, 2006.
  - Plazak, D. and C. Albrecht, *Access and Corridor Management Support Program for Iowa—Phase I,* Iowa State University Center for Transportation Research and Education for the Iowa Department of Transportation, 2008.
  - Plazak, D., and C. Albrecht, *Access Management at Major Intersections,* Iowa State University Center for Transportation Research and Education for the Iowa Department of Transportation, 2005.
  - Plazak, D., J. Rees, J. Luedtke, and C. Kukla, *Corridor Management Pilot Project—Phase I,* Iowa State University Center for Transportation Research and Education for the Iowa Department of Transportation, 2003.
  - Plazak, D., R. Souleyrette, R. Boeckenstedt, L. Edgar, K. Kosman, and J. Luedtke, *Process to Identify High-Priority Corridors for Access Management Near Large Urban Areas in Iowa,* Iowa State University Center for Transportation Research and Education for the Iowa Department of Transportation, Dec. 2002. http://www.intrans.iastate.edu/reports/HPCaccess.pdf
  - Roohanirad, A.M., *Guidelines for a Roadway Management System (RMS) for Local Governments,* Iowa State University Center for Transportation Research and Education for the U.S. Department of Transportation, 2002.
- Indiana
  - Indiana Department of Transportation, *Indiana Access Management Study,* http://www.in.gov/indot/3273.htm
- Kentucky
  - House, B., *Access Management Implementation in Kentucky: Technical Support Document and*

Status Report, Kentucky Transportation Center at the University of Kentucky for the Kentucky Transportation Cabinet, May 2008.
http://www.ktc.uky.edu/Reports/KTC_08_05_SPR_290_05_2F.pdf
- Kirk, A., J. Pigman, and B. House, *Quantification of the Benefits of Access Management for Kentucky,* Kentucky Transportation Center at the University of Kentucky for the Kentucky Transportation Cabinet, July 2006.
http://www.ktc.uky.edu/Reports/KTC_06_16_SPR_290_05_1F.pdf
- Stamatiadis, K., et al., *Access Management for Kentucky,* Kentucky Transportation Center at the University of Kentucky for the Kentucky Transportation Cabinet and Federal Highway Administration, Feb. 2004.
http://www.ktc.uky.edu/Reports/KTC_04_05_SPR_251_01_1F.pdf

- Louisiana
  - *Louisiana Land Use Toolkit,* Louisiana Center for Planning Excellence, Apr. 13, 2009.
http://landusetoolkit.com/pdf/LUToolkit-V1.1.pdf
- Minnesota

  Abstracts and links for the following reports are available on the Minnesota DOT website at http://www.oim.dot.state.mn.us/access/research.html#other
  - *Access Operations Study: Analysis of Traffic Signal Spacing on Four-Lane Arterials,* prepared by the Minnesota Department of Transportation, Office of Investment Management, Access Management Unit, Nov. 2002.
http://www.oim.dot.state.mn.us/access/pdfs/AnalysisofTrafficSignalSpacingonFourLane.pdf
  - *Access Operations Study: Intervening Access Analysis—Gaps,* prepared by the Minnesota Department of Transportation, Office of Investment Management, Access Management Unit, Dec. 2002.
http://www.oim.dot.state.mn.us/access/pdfs/InterveningAccessAnalysis-Gaps.pdf
  - *Greater Minnesota Access Study,* prepared by the Minnesota Department of Transportation, June 2004.
http://www.oim.dot.state.mn.us/access/pdfs/GreaterMinnesotaAccessStudy.pdf
  - *Highway Access Management Policy Study: Minnesota Department of Transportation Report to the 1999 Minnesota Legislature,* prepared by the Minnesota Department of Transportation, Jan. 15, 1999.
http://www.oim.dot.state.mn.us/access/pdfs/legis.pdf
  - Plazak, D., *I-394 Business Impacts Case Study,* Iowa State University Center for Transportation Research and Education and Howard R. Green for the Minnesota Department of Transportation, 2003.
  - Preston, H., D. Keltner, R. Newton, and C. Albrecht, *Statistical Relationship between Vehicular Crashes and Highway Access,* prepared for the Minnesota Department of Transportation, Aug. 1998.
http://www.oim.dot.state.mn.us/access/pdfs/mg1144a.pdf
  - *Public Understanding of State Highway Access Management Issues,* prepared by Market Research Unit for the Minnesota Department of Transportation, June 1998.
http://www.oim.dot.state.mn.us/access/pdfs/issues.pdf
  - *Systems Thinking Process Analysis: Access Management Initiative, Technical Study #1,* prepared by Access Management Initiative for the Minnesota Department of Transportation, Sep. 1999.
http://www.oim.dot.state.mn.us/access/pdfs/systemsthinking.pdf
- Missouri
  - Plazak, D., T. Maz, K. Knapp, *Development of a Comprehensive Access Management Plan and Training Program for Missouri,* Iowa State University Center for Transportation Research and Education for the Missouri Department of Transportation, Sep. 2003.
http://www.intrans.iastate.edu/research/detail.cfm?projectID=200
- Montana
  - *Access Management and Land Use Planning | Policy Paper,* Montana Department of Transportation, 2007.
http://www.mdt.mt.gov/publications/docs/brochures/tranplan21/accessmgmt.pdf
  - *Huffine Lane Access Management Plan,* Montana Department of Transportation, Aug. 2007.
  - *Montana Access Management Project Report,* Dye Management Group and Urbitran Associates, 1999.
- Nevada
  - *US 50 East Corridor Study,* Nevada Department of Transportation, Nov. 2007.
http://www.nevadadot.com/projects/reports/pdfs/US_50_2007.pdf
- New Jersey
  - Ewing, R. and M. King, *Flexible Design of New Jersey's Main Streets,* Alan M. Voorhees Transportation Center, Edward J. Bloustein School of Planning and Public Policy, Rutgers University.
  - Ewing, R., M. King, and S. Hartshorn, *Scoring Formula for New Jersey's Main Streets,* Alan M. Voorhees Transportation Center, Edward J. Bloustein School of Planning and Public Policy, Rutgers University, Mar. 2003.

- *New Jersey Highway Access Code Reevaluation Study,* New Jersey Department of Transportation, Mar. 2009.
- North Carolina
  - *Benefits and Capacity of Super-Streets,* North Carolina Department of Transportation (ongoing).
  - *Economic Impacts of Access Management in North Carolina,* North Carolina Department of Transportation (ongoing).
  - *Operational and Safety Impacts of Access Management,* North Carolina Department of Transportation (ongoing).
- Oregon
  - Aksan, A., and R.D. Layton, *Right-in Right-Out Channelization,* prepared by the Transportation Research Institute of Oregon State University for the Oregon Department of Transportation, Oct. 1998. http://www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/RtInRtOut.pdf
  - *Functional Intersection Area,* prepared by the Transportation Research Institute of Oregon State University for the Oregon Department of Transportation, Jan. 1996. http://www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/FnctlIntArea.pdf
  - *Intersection Sight Distance,* prepared by the Transportation Research Institute of Oregon State University for the Oregon Department of Transportation, Feb. 1997. http://www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/IntSgtDist.pdf
  - Lall, B.K., A. Eghtedari, T. Simons, P. Taylor, and T. Reynolds, *Analysis of Traffic Accidents Within the Functional Area of Intersections and Driveways,* Portland State University, Department of Civil Engineering, 1995.
  - Lall, B.K., A. Eghtedari, T. Simons, P. Taylor, and T. Reynolds, *Traffic Safety and Parkway Development—Assessment & Evaluation,* Portland State University, Department of Civil Engineering, 1995.
  - Layton, R.D., *Use of Volume/Capacity Ratio Versus Delay for Planning and Design Decisions for Signalized Intersections,* prepared for the Oregon Department of Transportation, Apr. 1996. http://www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/VolCapSigInt.pdf
  - Layton, R.D., *Interchange Access Management,* prepared for the Oregon Department of Transportation, Aug. 1996. http://www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/IntAccMgmt.pdf
  - Layton, R.D. and V. Stover, *Access Management Classification and Spacing Standards,* prepared for the Oregon Department of Transportation, Aug. 23, 1996. http://www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/ClassSpacStds.pdf
  - Layton, R.D., *Functional Integrity of the Highway System,* prepared for the Oregon Department of Transportation, Aug. 8, 1996. http://www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/FnctlIntgHwySys.pdf
  - *Left-Turn Bays,* prepared by the Transportation Research Institute of Oregon State University for the Oregon Department of Transportation, May 1996. http://www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/LeftTurnBays.pdf
  - *Medians,* prepared by the Transportation Research Institute of Oregon State University for the Oregon Department of Transportation, Feb. 1996. http://www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/Medians.pdf
  - *Right-Turn Lanes*, prepared by the Transportation Research Institute of Oregon State University for the Oregon Department of Transportation, May 1996. http://www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/RightTurnLanes.pdf
  - *Signalized Intersection Spacing*, prepared by the Transportation Research Institute of Oregon State University for the Oregon Department of Transportation, Oct. 1996. http://www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/SigIntSpac.pdf
  - *Stopping Sight Distance and Decision Sight Distance*, prepared by the Transportation Research Institute of Oregon State University for the Oregon Department of Transportation, Feb. 1997. http://www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/StopDist.pdf
- Utah
  - Schultz, G.G., K.T. Braley, and T. Boschert, *The Relationship between Access Management and Other Physical Roadway Characteristics and Safety*, accepted for publication in *Journal of Transportation Engineering*, Vol. 136, No. 2, 2010, pp. 141–148.
  - Schultz, G.G., K.T. Braley, and T. Boschert, "Prioritizing Access Management Implementation," *Transportation Research Record: Journal of the Transportation Research Board, No, 2092*, Transportation Research Board of the National Academies, Washington D.C., 2009, pp. 57–65.
  - Schultz, G.G., J.S. Lewis, and T. Boschert, "Safety Impacts of Access Management Techniques in Utah," *Transportation Research Record: Journal of the Transportation Research Board, No. 1994*, Washington D.C., 2007, pp. 35–42.
  - Schultz, G.G., C.G. Allen, and D. L. Eggett, *Crashes in the Vicinity of Major Crossroads*, UDOT Report No. UT-08.25, Utah Department of Transportation Research Division, Salt Lake City, 2008.

– Schultz, G.G. and K.T. Braley, *A Prioritization Process for Access Management Implementation in Utah*, UDOT Report No. UT-07.05, Utah Department of Transportation Research Division, Salt Lake City, 2007.
– Schultz, G.G. and J.S. Lewis, *Assessing the Safety Benefits of Access Management Techniques*, UDOT Report No. UT-06.08, Utah Department of Transportation Research Division, Salt Lake City, 2006.

- Virginia
  – Rakha, H., A.M. Flintsch, M. Arafeh, A.G. Abdel-Salam, D. Dua, and M. Abbas, *Access Control Design on Highway Interchanges*, prepared by the Virginia Tech Transportation Institute for the Virginia Department of Transportation, Jan. 2008. http://vtrc.virginiadot.org/PubDetails.aspx?PubNo=08-CR7
  – Miller, J., L. Hoel, S. Kim, and K.P. Drummond, *The Transferability of Safety-Driven Access Management Models for Application to Other Sites*, prepared for the Virginia Transportation Research Council and the Federal Highway Administration, June 2001. http://vtrc.virginiadot.org/PubDetails.aspx?PubNo=01-R12
- West Virginia
  – *Corridor "L" in Fayette County.*

CHAPTER FIVE

REPORTED EFFECTIVENESS OF PROGRAM IMPLEMENTATION

This chapter presents findings related to the implementation of access management, including the results of a literature search and a summary of results and lessons learned from the survey questionnaire. It includes survey findings relative to access management-related court decisions, areas where additional information or resources are needed, and information concerning states' evaluations of their access management programs, including the successes and strengths of these programs, barriers and difficulties encountered, and areas for improvement.

LITERATURE SEARCH

As indicated in *NCHRP Report 548* (*3*, p. 34), performance monitoring and evaluation are integral parts of most government programs. Most policies need monitoring and evaluation to assess their value in terms of benefits versus costs.

The TRB *Access Management Manual* (*1*, p. 37) identifies the following sample questions that may provide useful information in the evaluation of access-related practices. Useful information includes current practices that relate to access management, problems to be resolved, roles and responsibilities, and better coordination of access-related activities. Sample questions for this effort are as follows:

- How would you define "access management"?
- What state statutes, agency policies, procedures, rules, standards, or guidelines are you aware of related to the location, design, or management of access to state highways?
- What practices or work tasks of your division directly or indirectly affect access to state highways?
- What challenges have you faced in your practice as it relates to managing roadway access?
- Do you have any suggestions for addressing any of these challenges?
- How could a state access management program help you accomplish your division's objectives?

NCHRP Report 548 (*3*, pp. 34–35) identifies the following potential measures as examples that may be used to identify performance related to access management:

- Determining the rate at which access management is implemented when opportunities emerge.
- Measuring impacts on speeds and accident rates where access management has been implemented.
- Tracking the number of variances granted.
- Tracking the number of driveways consolidated.
- Tracking the number of miles of access rights acquired or controlled.
- Learning the reasons access management could not be implemented in cases in which an apparent opportunity existed.

SURVEY RESULTS

Survey participants were asked a variety questions relating to the effectiveness of access management programs in their state. The following sections includes survey findings relative to access management–related court decisions, areas for which additional information or resources are needed, and information concerning states' evaluations of their access management programs, including the successes and strengths of these programs, barriers and difficulties encountered, and areas for improvement.

Court Decisions

Of the 45 DOTs responding to the entire synthesis survey, some 25 (56%) indicated that their access decisions had been challenged in the courts at some time, compared with only 4 of the 43 responding local agencies (9%). Figure 43 illustrates the basis for these challenges from responding state DOTs that had access-related cases brought before the courts.

"Reasonable access" (43%) was the most-commonly noted basis for court challenges among responding state DOTs, followed by "lack of direct access" (41%), and "reduction in property value" (32%). Some 30% of the responding state DOTs indicated that they had been challenged on the basis of perceived inequalities relative to other accesses being granted in the area. This finding underscores the need to deal with any unusual access-related circumstances through a waiver or variance process. Doing so avoids establishing a precedent that other potential challengers can point to in the future, but a waiver or variance process does not eliminate the potential for legal challenges.

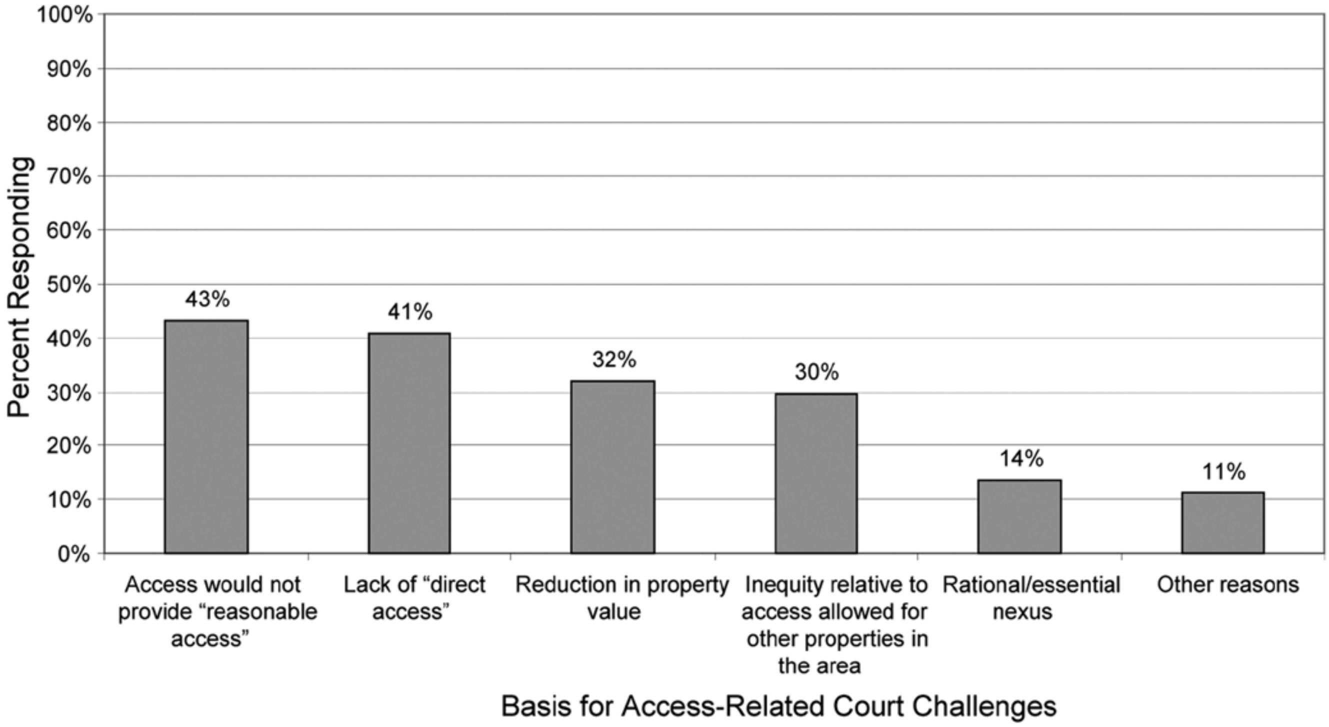


FIGURE 43 Most commonly cited reasons for access-related court challenges (45 responses).

Additional Resources and Research Needed

Survey participants were asked what additional resources and research they would like to see developed to improve the implementation of access management. Resource suggestions from the respondents included the following:

- **Enhanced online resource center for general public and legislators**—This online resource would be geared toward a nontechnical audience and include presentation materials on the benefits of various access management techniques—such as construction of raised medians and the consolidation of access points—as well as case studies of success stories. The purpose of such a tool would be to educate local officials, business owners, and other affected stakeholders regarding the benefits of various access management techniques. (Idaho DOT noted that FHWA's *Safe Access is Good for Business* publication was widely distributed throughout the state and has been an effective publication for communicating the importance and economic benefits of access management to business owners and elected officials.)
- **Additional case studies of success stories**—Well-documented case studies of access management successes are helpful in convincing others of the need for access management and the real-world benefits that can be realized. In particular, case studies concerning methods of overcoming legal challenges on retrofit projects would be helpful.
- **Additional cost factors**—Additional quantifiable cost-savings factors associated with the benefits of access management techniques would be desirable.
- **Relationships to other areas of current interest in transportation**—It would be useful to have a greater understanding of the relationships between access management and other key policy objectives, such as the following:
  - Smart growth and sustainability
  - Transit-Oriented Development (TOD)
  - Context-Sensitive Solutions (CSS)
  - Transit provisions
  - Pedestrian provisions
- **Applications of the "Michigan U-turn" concept in retrofit circumstances.**
- **Statistics indicating the improved safety and increased capacity associated with the application of access management.**

Research suggestions from the respondents included the following:

- **Access management guidance for "fringe" areas**—Fringe areas are typically suburban or actively developing areas located between developed urban areas and undeveloped rural areas. Because of the focus on imminent land development and the associated need for transportation improvements, fringe areas present excellent opportunities to implement access management proactively or to incorporate retrofit highway improvements. Access management guidance usually is limited to either “urban” or “rural” areas.

- **Acceleration lanes for at-grade intersections**—More research and guidance is needed regarding the use and length of acceleration lanes at at-grade intersection. Respondents noted that current guidance in the AASHTO “Green Book” and the TRB *Access Management Manual* were limited.
- **Additional nationwide research on the economic benefits of access management.**
- **“Profiles” spotlighting bad examples of failed corridors**—Examples would be helpful to demonstrate the associated capacity and speed reductions of poor access management decisions or lack of access management planning.
- **Cost-benefit analysis of a roundabout versus a signalized intersection, including a quick test to determine which intersection control type is more appropriate.**
- **Accident and crash statistics relative to roadway classification, traffic volume, number of accesses, and spacing of accesses may be useful.**
- **Impact of median openings on rural expressways (especially with ADT volumes less than 12,000).**
- **Guidance for Interchange AMPs incorporating both transportation and land use elements.**
- **Before-and-after studies.**

TRB’s Access Management website (www.accessmanagement.info), in particular the “Resources” link, contains a wealth of information that addresses many of the noted topics. Among other items, the website includes links to the following:

- Access Management Conference proceedings
- NCHRP research reports
- Key access management–related papers and research reports
- Guides and handbooks
- State access codes and related state program information
- Model access management ordinances and local regulations
- Link to state’s access management websites
- Digital video library and other media
- Outreach materials

What is clear from the survey findings of this synthesis is that greater awareness is needed with respect to the existing access management resources that are available.

Program Successes and Strengths

Periodic “self-evaluations”—and associated follow-up program adjustments—are key aspects of any successful access management program. As part of the synthesis survey, all 50 state DOTs were asked to rate the success of their access management program. Figure 44 summarizes the results.

As shown in Figure 44, 40% of the responding state DOTs rated their access management program as successful or very successful, and 46% indicated mixed success. A total of 12% of the responding state DOTs indicated that their programs were unsuccessful (8%) or very unsuccessful (4%). Among the 43 local respondents, a total of 53% rated their access management program as successful or very successful, with

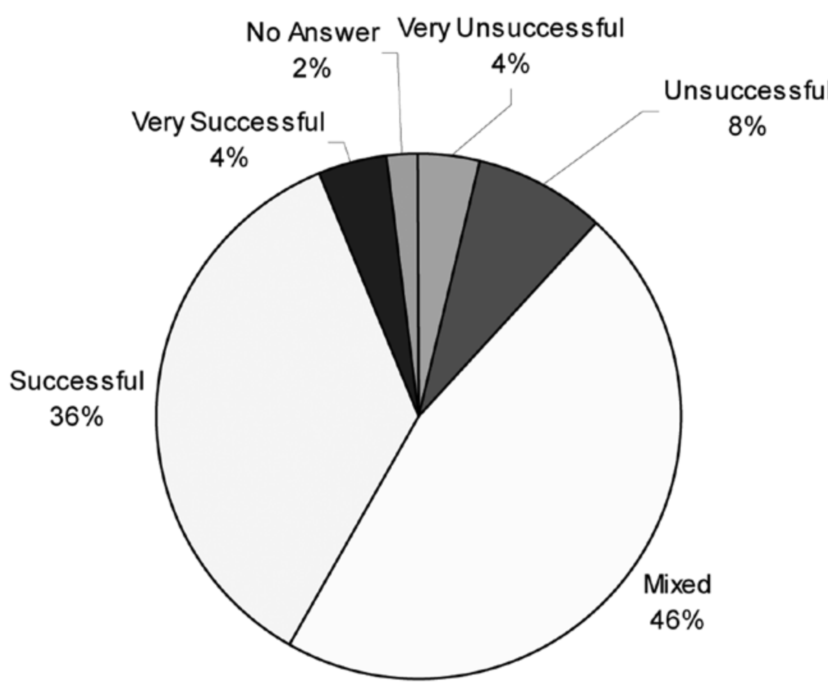


FIGURE 44 Rating of access management program success among state DOTs (50 responses).

19% indicating mixed success. Approximately 11% of the local agencies responded that their programs were unsuccessful (9%) or very unsuccessful (3%).

Survey respondents cited the following particularly successful aspects of state access management programs:

- **Possessing statutory authority**—Access management laws or codes give state DOTs the ability to establish standards and enforce them uniformly statewide.
- **Integration into business functions and operations**—Efforts to broadly integrate access management standards and procedures across the daily business functions of an agency's planning, permitting, project delivery, and operations and maintenance activities form a strong foundation for access management within a state DOT or transportation agency.
- **Commitment to staffing**—Implementation efforts have added effect when state DOTs and transportation agencies can dedicate staff to access management.
- **Pursuing AMPs**—These plans enable access management to be implemented on a case-by-case basis along key corridors, particularly where there is local support. AMPs can become an important implementation tool, especially if the state DOT or transportation agency does not have a formal statewide program.
- **Training and education**—Education outreach efforts to local communities, business groups, and the public were cited as achieving successes in helping to inform stakeholders of the potential safety and operational benefits of access management.

Figure 45 indicates the most commonly cited strengths of access management programs among state DOTs.

Among state DOTs and local agencies, the most commonly cited strengths related to the program having some inherent flexibility for making judgment decisions (76% of state DOTs and 53% of local agencies), representing a defensible administrative rule (60% of state DOTs and 23% of local agencies), and providing uniformity when controlling access (52% of state DOTs and 51% of local agencies). Strong organizational commitment was cited as a strength by 40% of the responding state DOTs, and 26% of the local agencies. Some specific program strengths cited by state DOT respondents underscored the need for flexibility, including the following:

- **Allowances for design waivers**—To permit flexibility under circumstances in which a particular design cannot fully adhere to the desired design standard.
- **Flexibility in design guidelines**—Flexible guidelines enable agency staff to address a range of potential

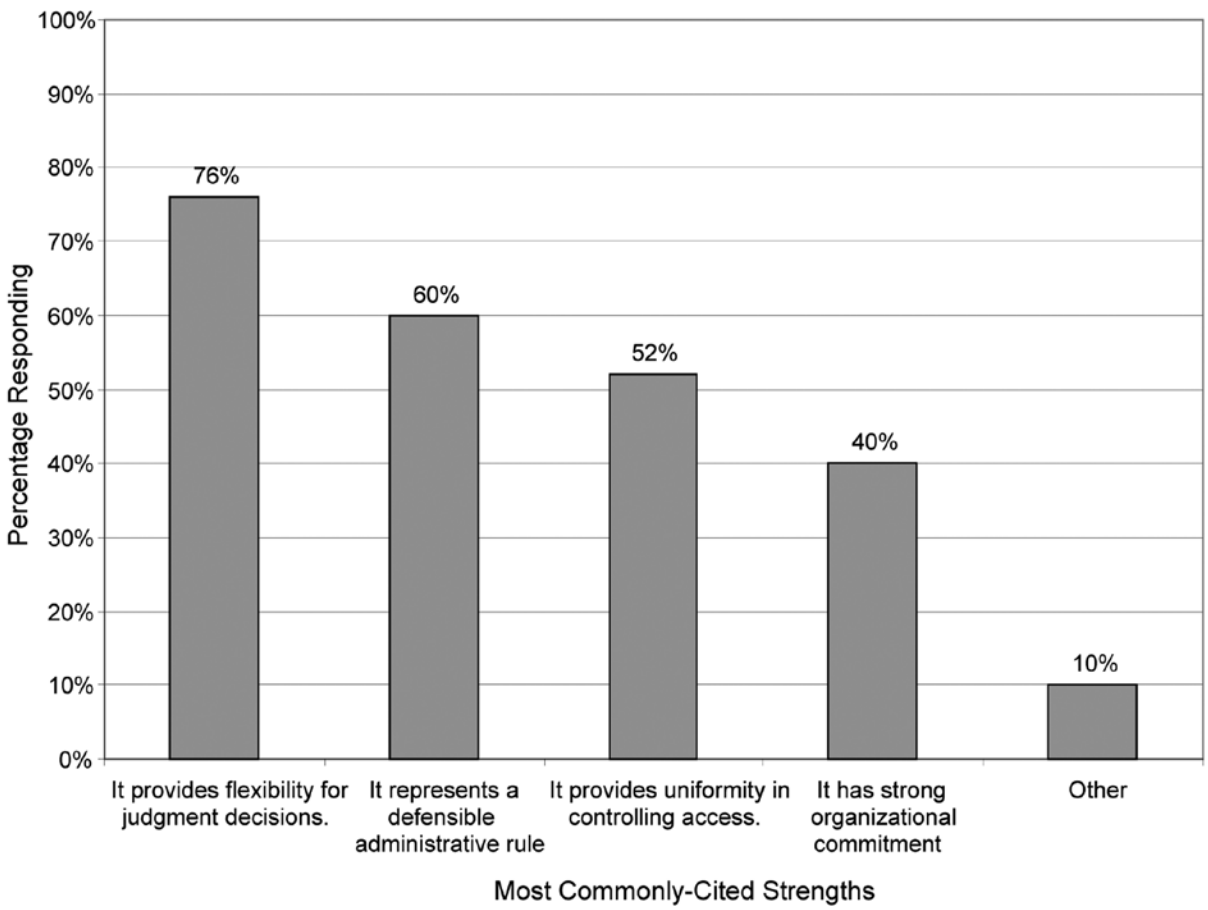


FIGURE 45 Most commonly cited program strengths among state DOTs (50 responses).

design conditions. This is particularly important when access management treatments must be implemented broadly under widely varying design circumstances (e.g., a densely developed urban environment versus an undeveloped rural area).

Only six state DOTs—Colorado, Florida, Georgia, New Hampshire, Utah, and Washington—indicated that their agency used performance measures to identify progress made in access management. Of these six DOTs, the performance measures included the following:

- Before-and-after studies to compare safety performance
- Comprehensive safety goals, relative to number of accidents per mile of travel
- A quality assurance program with regular meetings
- A permit database to document and track the speed at which access permits are processed (however, the focus was related to "permit processing speed" and "agency responsiveness" rather than product quality)

Respondents were asked how relevant their agency's programs are with respect to the following areas of emerging interest within access management:

- Sustainability
- TOD
- CSS
- Transit provisions
- Pedestrian provisions

Figures 46 through 50 summarize the state DOT responses relative to the extent to which access management relates to these five items.

As shown in Figure 46, "sustainability" was noted as being relevant to the access management programs of 7% of the responding state DOTs, and moderately or somewhat relevant to a total of 62%. Only 18% of the responding state DOTs indicated that sustainability was not considered.

Of the local agencies surveyed, 46% indicated that sustainability was somewhat (23%), moderately (14%), or very relevant (9%) to their access management programs, and 9% indicated that it was minimally relevant. Nineteen percent of the local agencies indicated that sustainability was not considered.

As shown in Figure 47, 49% of the access management programs from the responding state DOTs do not consider TOD, and an additional 22% consider it minimally relevant. However, 27% of the state DOTs consider it to be very, moderately, or somewhat relevant.

Similar results were found among the local agencies. Approximately 16% consider TOD to be minimally relevant to their access management programs, and 37% do not consider it. Approximately 16% consider it to be somewhat relevant, and 9% consider it to be moderately relevant. None of the responding local agencies consider TOD to be very relevant to their access management programs.

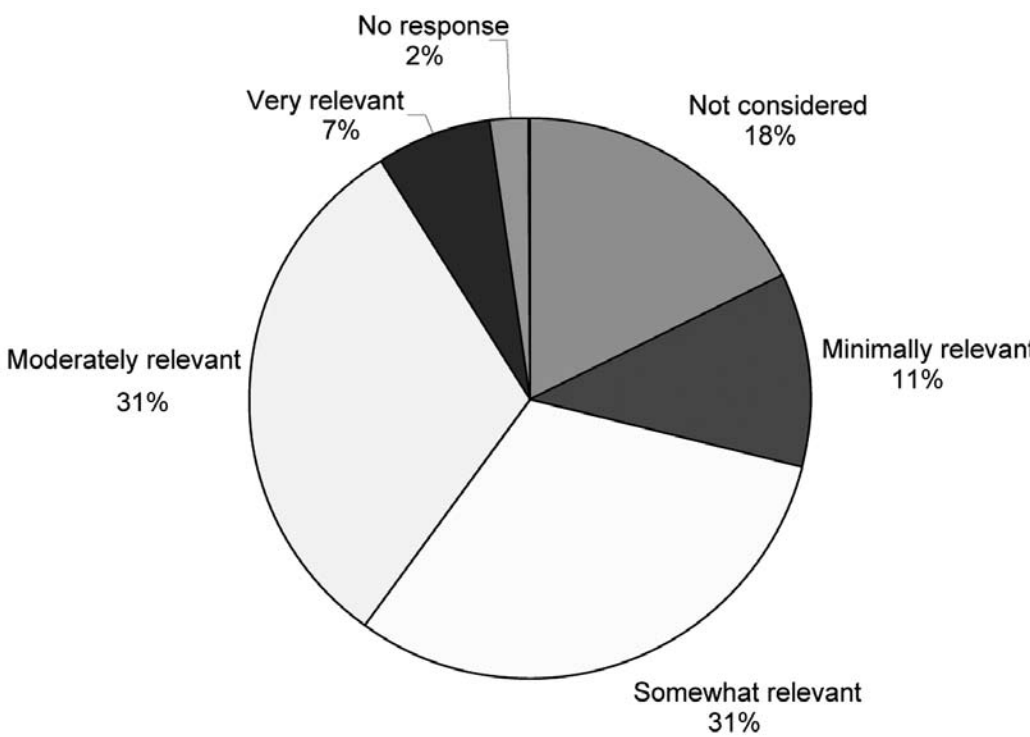


FIGURE 46 Relationship between access management and sustainability (45 responses).

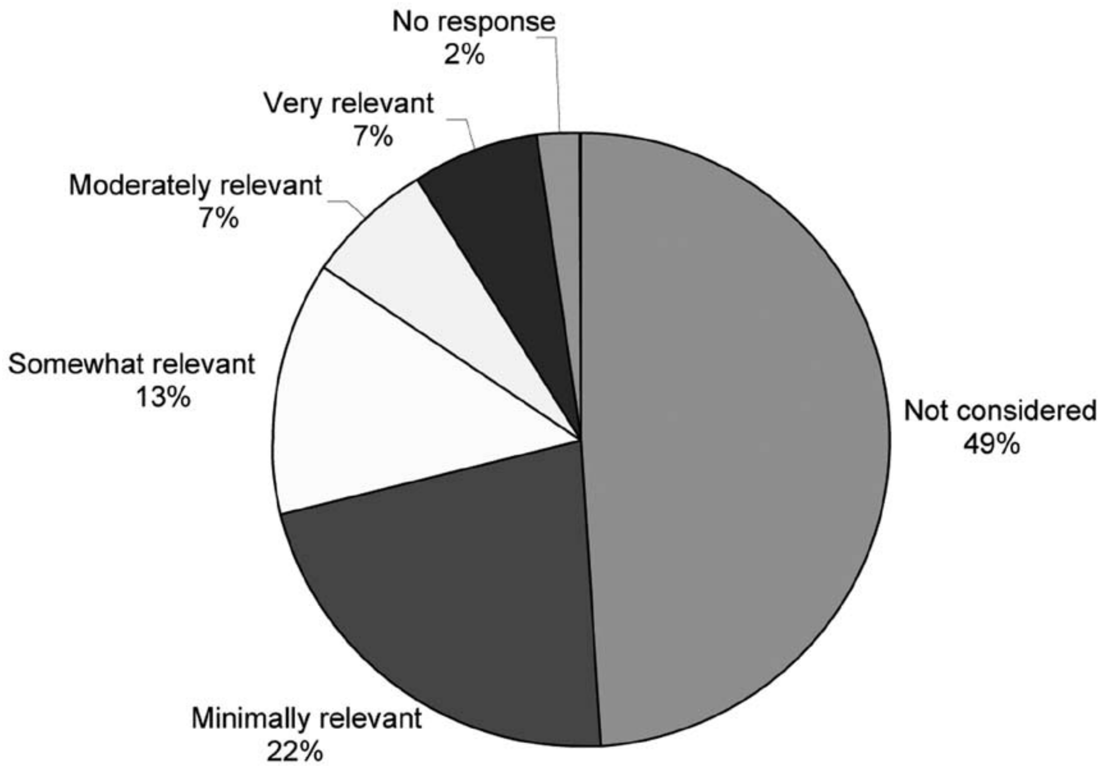


FIGURE 47 Relationship between access management and transit-oriented development (45 responses).

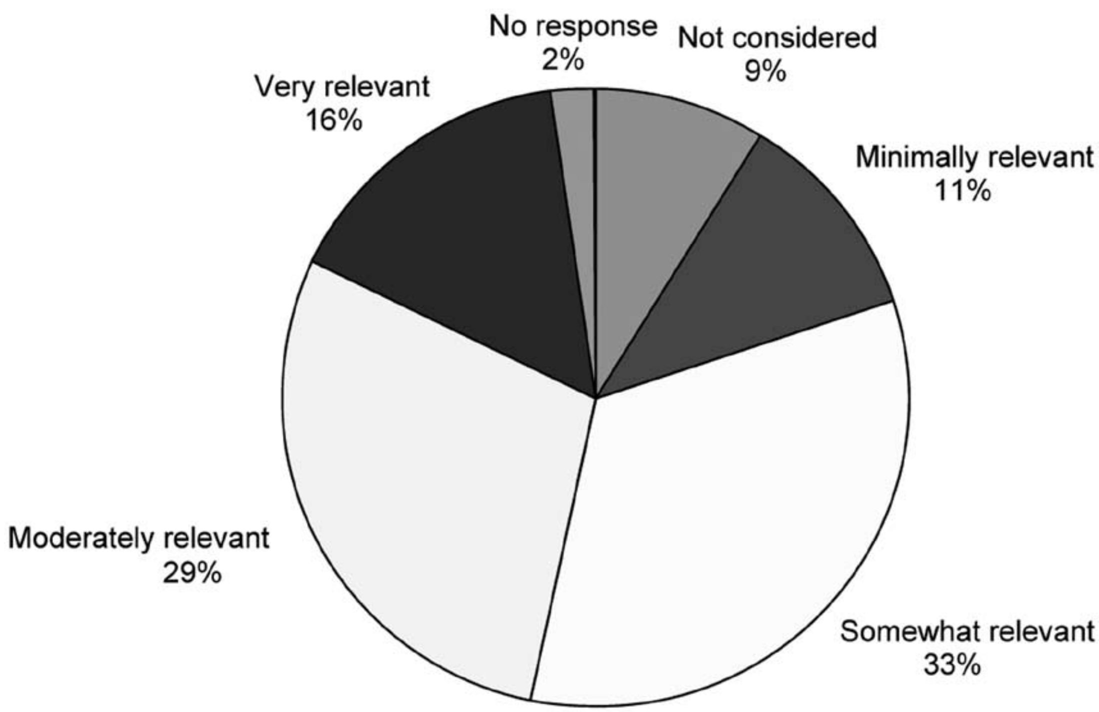


FIGURE 48 Relationship between access management and context-sensitive solutions (45 responses).

As shown in Figure 48, CSS was noted as being very relevant to the access management programs of 16% of the responding state DOTs, and moderately or somewhat relevant to a total of 62%. Only 9% of the responding state DOTs indicated that CSS was not considered and 11% that it was minimally relevant.

Among the local agencies surveyed, a total of 49% indicated that CSS was somewhat (21%), moderately (21%), or very relevant (7%) to their access management programs, and 16% indicated that it was minimally relevant. Twelve percent of the local agencies indicated that CSS was not considered.

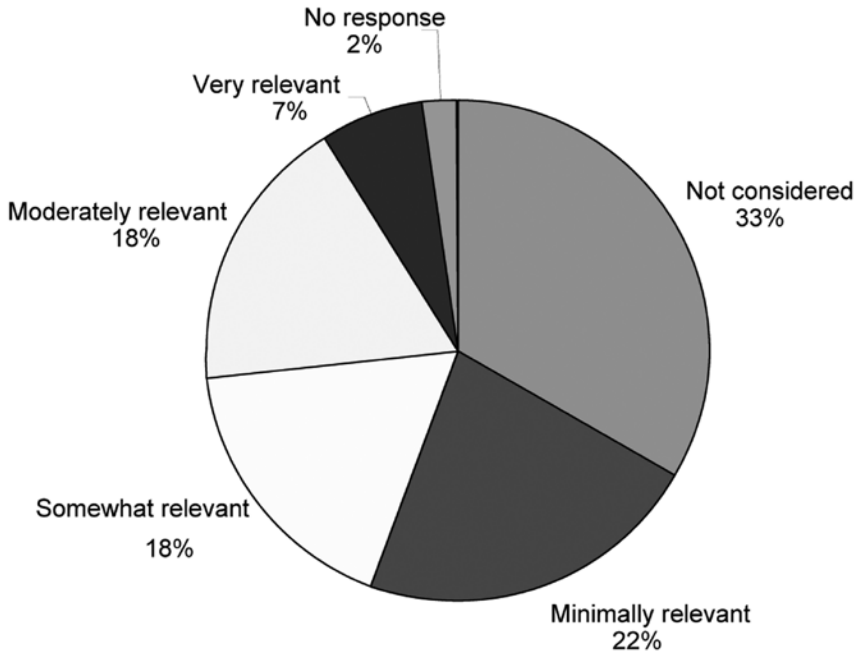


FIGURE 49 Relationship between access management and transit provisions (45 responses).

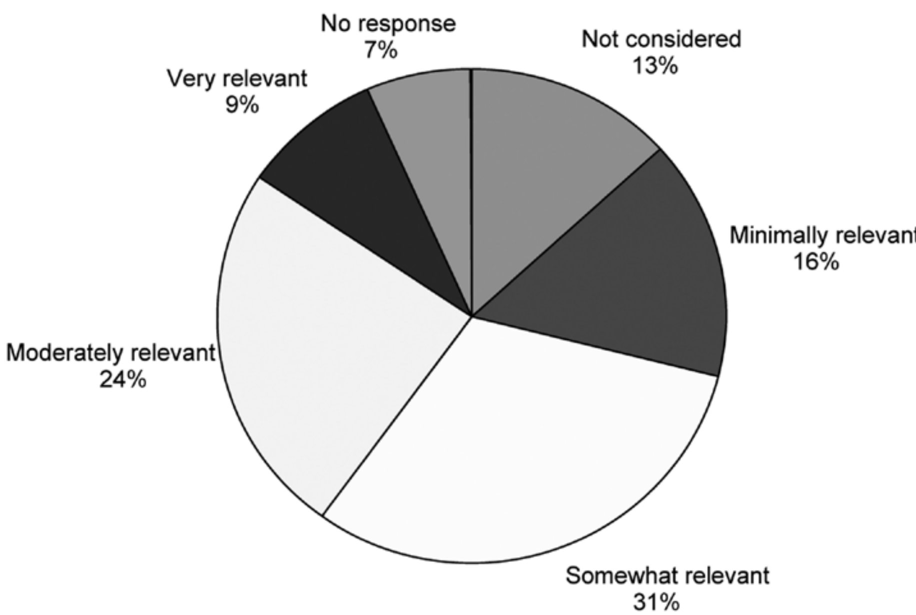


FIGURE 50 Relationship between access management and pedestrian provisions (45 responses).

As shown in Figure 49, one-third of the access management programs from the responding state DOTs do not consider transit provisions, and an additional 22% consider them to be minimally relevant. However, 25% consider them to be very or moderately relevant.

Among the local agencies surveyed, a total of only 27% indicated that transit provisions were somewhat (16%), moderately (9%), or very relevant (2%) to their access management programs. Approximately 23% indicated that transit provisions were minimally relevant, and 28% of the local agencies indicated that transit provisions were not considered.

As shown in Figure 50, pedestrian provisions were noted as being very relevant or moderately relevant to the access management programs of one-third of the responding state DOTs and somewhat relevant to a total of 31%. Only 13% of the responding state DOTs indicated that pedestrian provisions were not considered.

Among the local agencies surveyed, a total of 52% indicated that pedestrian provisions were somewhat (21%), moderately (19%), or very relevant (12%) to their access management programs. Approximately 9% indicated that pedestrian provisions were minimally relevant, and 16% of the local agencies indicated that pedestrian provisions were not considered.

Program Barriers and Difficulties

State DOTs and local agencies were asked to indicate what barriers have been encountered in implementing access management within their agency. Figure 51 summarizes the results from the 45 state DOTs that responded to the entire survey.

As shown in Figure 51, political resistance is the most commonly encountered barrier to implementing access management among responding state DOTs (80%), followed by a lack of staff and resources (60%), and organization and institutional limitations (52%).

Similarly, among local agencies, the most commonly encountered barrier is political resistance (49%), followed by a lack of staff and resources (21%), technical aspects (16%), and organizational and institutional limitations (14%).

Many survey respondents elaborated on specific problems areas shown in Figure 51. The following is a summary of the responses.

- **Political barriers**—State DOTs are tasked with protecting the safety and operational integrity of the state highway system, while trying to achieve a balance with the land use and growth plans of local governments. Final access-related decisions often are influenced by political pressures that arise on behalf of the local governments and property owners. Political commitments and influences were noted as contributing to the "watering down" of access standards to their minimum (rather than desirable) values, which then become the "rule" for the development community. Elected officials were cited as often making decisions based on economic priorities that come before access management concerns, and their perceptions of potential negative economic impacts associated with access management. Some concerns were noted with respect to access management reflecting an antidevelopment posture of "heavy-handed government regulation." In addition, elected officials often are supported by well-organized and well-funded lobbyists for special interest groups who may perceive that their agendas may not

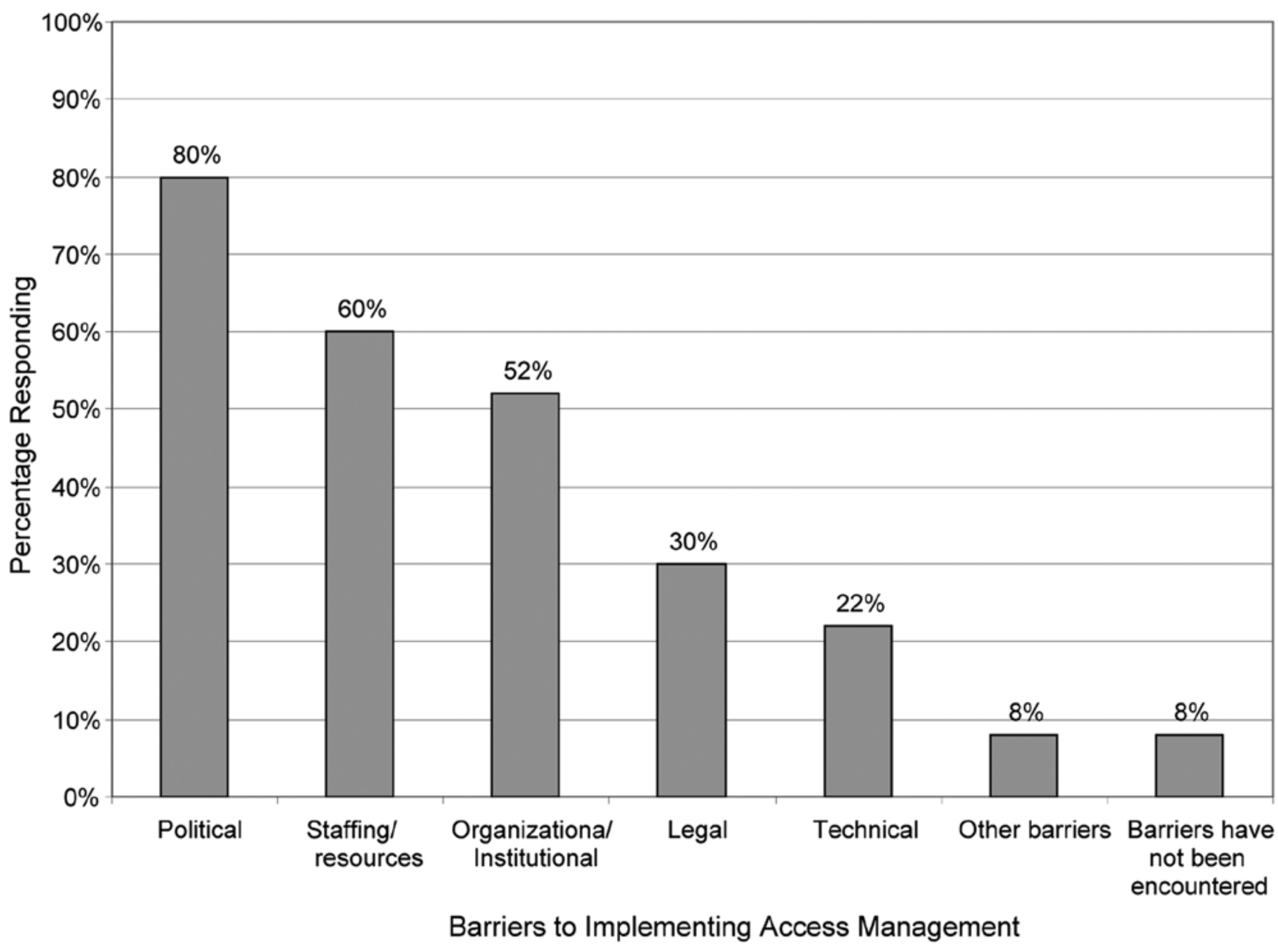


FIGURE 51 Most commonly cited barriers to implementing access management at state DOTs (45 responses).

align with access management. For these reasons, the education of elected officials is a key element of implementing a successful access management program.

- **Staffing and funding limitations**—Many state DOTs indicated that their access management programs currently are limited in some manner by staffing and hiring "freezes" (and even staffing reductions), as well as funding constraints. These situations leave relatively few staff members to review access permit applications, coordinate with local governments, and develop and implement corridor plans. Local agencies, particularly small cities and towns, often suffer from a lack of qualified staff. The lack of staff often results in a reactive, rather than proactive, approach to access management.
- **No "home" for access management**—Good access management practices sometimes are undermined organizationally, because no single unit or group within the agency is responsible for, or deliberately committed to, leading the effort. A lack of centralized staff devoted to access management weakens the overall program.
- **Lack of education and training**—Education and training efforts are needed at various levels. Additional technical training is needed to help state DOT staff with the review of traffic impact studies, the processing of access permits, and inspection-related matters, particularly on projects with complex access issues. Uninformed staff are more likely to make concessions that undermine program strength. Conversely, they are more likely to be less flexible in the application of access standards in situations in which some creativity and flexibility—and an understanding of broader policy goals and objectives—is warranted. When experienced staff members leave, their replacements experience a learning curve until they are fully trained. Additionally, the education of elected officials is critical in gaining program support.
- **Resistance by the development community**—The development community is often not in favor of access management unless they can directly influence program development. Also, when concessions are made to a particular developer, a precedent is set such that the developer (and sometimes other developers) tends to expect the same at other locations, despite the fact that different conditions exist.
- **Lack of coordination with local governments**—A lack of coordination with local governments can lead to a critical disconnect between land use planning and transportation system planning. The ability to manage access and mitigate development impacts is complicated by inadequate local street systems.
- **Legal issues**—Several state DOTs cited difficulties over home-rule attitudes and actions that tend to favor property owners. A lack of statewide legal authority leaves the concept of "reasonable access" a matter of debate that is left to the courts to decide and also limits what transportation improvements the state DOT can condition on an access permit. Legal issues sometimes arise when state DOT-funded improvement projects restrict or limit access to previously developed properties, or when roadway improvements make greater access more desirable, but less available. Costly legal actions sometimes result in less than desirable conditions.
- **Lack of vision**—The lack of a clear vision for what the state transportation system should look like contributes to internal conflicts and inconsistencies in the application of access management at state DOTs.

Areas for Improvement

Approximately 71% of the 45 state DOTs responding to the entire survey indicated that changes were needed to make their program more effective, compared with only 40% of the 43 local agencies surveyed. Approximately 62% of state DOTs—compared with only 19% of local agencies—stated that changes were being planned or currently being implemented. These findings suggest that, in general, state DOTs are perhaps more active (or more equipped to act) than local agencies in identifying and making changes to their access management programs. Figure 52 illustrates commonly cited areas for which programmatic improvements are needed, based on responses from the 45 state DOTs responding to the entire survey.

In addition, survey participants were asked what improvements could be made to overcome the barriers noted previously. Funding, additional staff, and training and education were commonly cited as areas for improvement. Respondents identified various points of consideration to improve the implementation and enhancement of access management programs, including the following:

- **Legislation**—Strong access management legislation provides the foundation for a successful access management program. This legislation can take the form of laws or amendments to the state administrative code that recognize the need for access management, identify the program goals and objectives, and summarize its benefits.
- **Institutional commitment**—Access management programs are most successful in cases in which the agency has institutional commitment to implement the program. Ideally, this would involve support from the very highest levels within the organization (e.g., director, commissioner, and so on), down to the permit specialists and technicians who address access issues in their daily work. The commitment of the entire organization to access management ensures consistency in program implementation and presents a united front to resist external challenges.

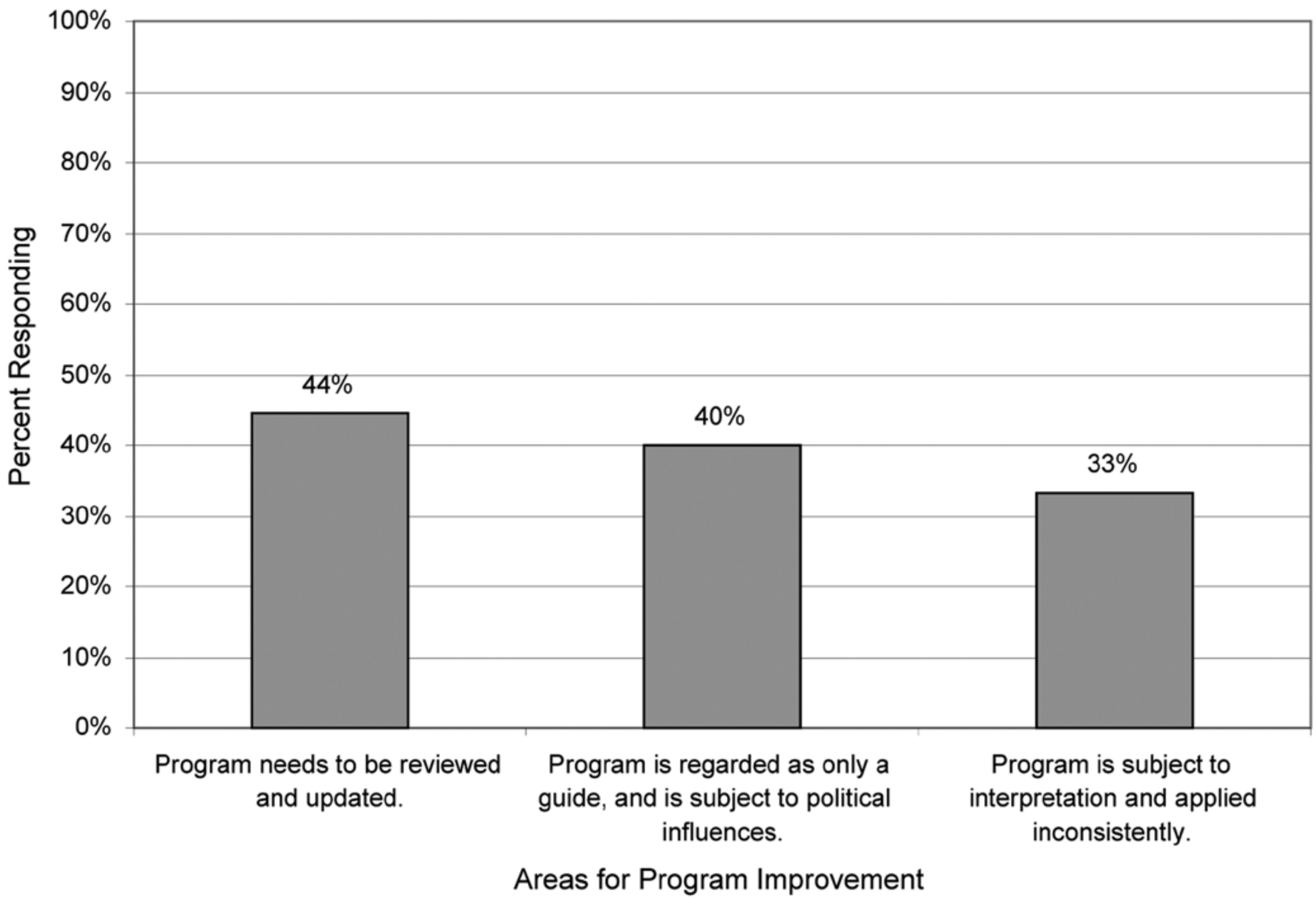


FIGURE 52 Commonly cited areas for needed program improvements (45 responses).

- **Access champion**—A person (or persons) can push the access management agenda within an agency. Ideally, these "champions" are people who are high-profile, energized, and empowered to make changes and withstand challenges faced by the political pressures.
- **Legal case history**—Court cases set the legal precedent for access management decisions in each state. State DOTs with a strong case history of winning court cases are more empowered in making future access-related decisions than those with a history of losing cases, which can undermine the authority of the state DOT.
- **Case studies**—Real-world case studies that clearly illustrate the benefits of access management are instrumental in convincing elected officials, state and local government officials, the development community, and other decision makers of its merits. Ideally, the case studies would highlight local access management projects with which the intended audience has some familiarity to reinforce the notion that access management principles apply to all roadways. Case studies could involve before-and-after studies of access management retrofit projects or safety and operational performance comparisons of corridors experiencing good access management planning relative to poorly managed corridors.
- **Education and training**—Access management training efforts can be initiated and maintained to educate new staff members and reach existing staff throughout an agency. In addition, elected officials and the development community need to be educated about the rationale and benefits behind access management.
- **Access committee**—One strategy that state DOTs can use to address access-related conflicts, and to lessen the effects of external political pressure, is to establish an internal committee or review panel that is charged with reviewing and ruling on difficult or controversial access-related issues that otherwise cannot be resolved. This committee could include an independent body of knowledgeable professionals (including representatives from state DOTs, local agencies, and private entities) that falls outside the organizational framework of normal access permitting operations. Strong assistance from state officials and DOT upper management can support the committee's decisions and resist external political pressures.
- **Statewide master plan**—A statewide plan that provides some land use controls at the state level may guide local land use and discourage land use actions that are contrary to the state's access management program.

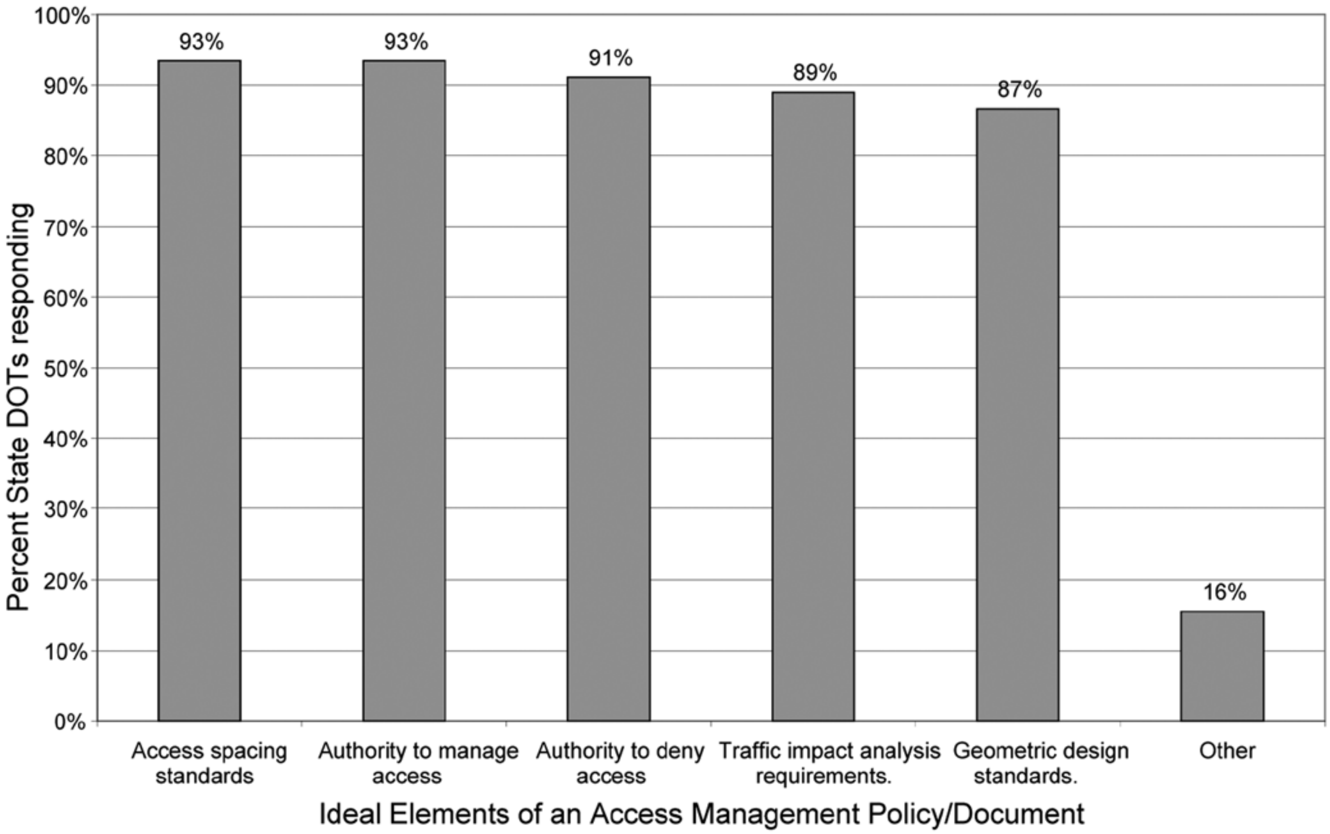


FIGURE 53 Ideal elements of an access management policy or document (45 responses).

In addition, survey respondents were asked to identify the elements of an ideal access management policy or document. Figure 53 summarizes the results of the responses to this question from among the 45 state DOTs responding to the entire survey.

Nearly all of the responding state DOTs identified the following as ideal elements of an access management policy or document: (1) access spacing standards, (2) authority to manage or deny access, (3) traffic impact analysis requirements, and (4) geometric design standards.

CHAPTER SIX

PROFILES OF CONTEMPORARY PRACTICES

This chapter presents profiles of contemporary access management practices and highlights key aspects of how transportation agencies develop and administer their access management programs. These profiles are noteworthy because they may be considered as state of the practice and have potential applicability elsewhere. They include specific examples of unique or innovative practices related to access management. The chapter reflects a range of dimensions involved with access management, including the legal basis, policy and program elements, implementation tools, and key technical areas.

The profiles include the following:

- Implementation of a Statewide Access Management Program in Virginia
- North Carolina DOT Strategic Corridors Initiative
- ACS Development for Indiana DOT
- Minnesota DOT's Development and Access Permitting Review Process
- Oregon DOT's Automated Permit Database (CHAMPS)
- Louisiana DOTD's TIS Policy and Process
- Louisiana DOTD's Approach to Implementing Access Management
- Caltrans' Equitable Share Responsibility Calculations
- New Jersey DOT's Vehicle-Use Limitations for Nonconforming Lots
- Transit-Related Trip-Generation Credits in the New Jersey Access Code

IMPLEMENTATION OF A STATEWIDE ACCESS MANAGEMENT PROGRAM IN VIRGINIA

The access management program for the Virginia Department of Transportation (VDOT) began in the mid-1990s with efforts to develop a program within the department and to promote it externally (*78*). In 1995, the Traffic Engineering Division established an Access Management Committee, followed by an Education Awareness Program in 1997 that involved outreach presentations to public and private sector organizations across Virginia. The feedback obtained through surveys of participants at these presentations indicated strong support for access management. In addition, in 1998 the Virginia Transportation Research Council prepared a document entitled *Access Management: Transportation Policy Considerations for a Growing Virginia* (*92*) that examined access management implications in Virginia from the legal, planning, and engineering perspectives. Despite the noteworthy progress, Virginia lacked a political "champion" to advance and promote the program and to establish associated legislative authority.

Conditions changed by 2006, when the state highway system in Virginia faced a fiscal crisis. The gas tax had not been raised since 1986, and revenue was insufficient to meet the needs for roadway construction. In addition, because Virginia law mandates using highway funds for maintenance first, construction funds were being diverted to address maintenance needs. These constraints were compounded by the fact that VDOT is responsible for maintaining nearly every roadway in the state (from freeways to local subdivision streets). Therefore, the state faced a critical challenge of how to fund increasing roadway construction and maintenance projects without raising taxes.

In response to this challenge, VDOT reached out to the Senate Finance and Transportation Subcommittees of the General Assembly in 2006, and made presentations to educate their members on the benefits of access management. These presentations focused on using access management as a tool to improve the vehicle-carrying capacity of the state highway system and to reduce the state's capital costs for new roads and road widening projects by maximizing the use of the state's existing highway infrastructure. Recognizing the cost-savings benefits of access management, the General Assembly directed VDOT to develop a legislative proposal for a comprehensive access management program for consideration by the 2007 General Assembly. This proposal authorized VDOT to create and implement statewide access management standards and regulations, with the recognition and support of the state legislature. The goals of the VDOT access management program were to achieve the following:

- Reduce traffic congestion
- Reduce fuel consumption and air pollution
- Enhance public safety by reducing crash rates
- Reduce the need for new highways and road widening by maximizing the performance of existing highways
- Preserve the public investment in new highways
- Support economic development, while respecting property owners' rights to reasonable access

In 2007, an access management bill was submitted by Governor Timothy M. Kaine and approved unanimously by the Virginia House and Senate. This bill added statutory language to the Code of Virginia expanding the powers of VDOT with respect to their authority to manage access. These changes included the following:

- Giving VDOT the ability to not only construct, improve, and maintain the state highway system, but also to "preserve the efficient operation" of the system.
- Allowing access driveways affected by state highway construction or repair projects to be reviewed by VDOT and replaced in a manner that would ensure safe and efficient highway operations.
- Developing and implementing design and spacing standards for driveways, median openings, street intersections, traffic signals, and turn lanes based on the federal functional classification.

To begin drafting statewide access management standards, VDOT formed an internal Technical Committee consisting of staff representing a broad range of disciplines throughout the department, including the Central Office divisions, regions, districts, residencies, as well as the Virginia Transportation Research Council. A detailed literature review was conducted of other states' access management standards to inform the development of the Technical Committee's first draft of access management regulations and standards. In addition, VDOT formed a Policy Advisory Committee—consisting of representatives from local government, development, environmental, and transportation engineering organizations, as well as VDOT management and the Office of the Secretary of Transportation—to obtain feedback and guide the development of the standards and regulations.

Furthermore, to ensure a broad outreach for public input, VDOT encouraged the public to provide comments on the proposed regulations and standards via an e-mail form on the agency website, through the mail, and in person at public hearings. News releases on the public input opportunities were prepared for wide distribution to various media sources throughout the state, including 13 newspapers and 50 media outlets. The draft standards and regulations developed by the VDOT Technical Committee and the Policy Advisory Committee were refined based on more than 250 public comments. At least for proposed statewide regulations and standards, e-mail was the most popular and productive means for gaining public involvement.

In late 2007, the Policy Advisory Committee revised the access management standards and regulations, and submitted their recommendations to the commissioner. The standards and regulations were approved and published in December 2007 and took effect in July 2008. They included the following key elements:

- Establishing spacing standards for intersections, median openings, and driveways
- Encouraging shared driveways
- Providing vehicle and pedestrian connections to adjacent properties
- Locating driveways a safe distance from the functional area of intersections and interchange ramps
- Achieving efficient progression through proper traffic signal spacing
- Expanding the use of right-in/right-out driveways
- Establishing corner clearance and driveway throat depths
- Providing a process for exceptions to the regulations and spacing standards
- Encouraging the development of highway corridor AMPs

In 2008, the General Assembly adopted legislation to require the access management standards and regulations to be implemented in phases, starting with the state's principal arterial network—including interstates, expressways, and other principal arterials, comprising 4,161 miles (6%) of all state roadways—beginning in July 2008. The second phase, in October 2009, extended the access management standards and regulations to the state's 65,000 miles of minor arterials, collectors, and local streets.

Against the backdrop of the state's fiscal crisis for highway funding, VDOT clearly benefited from implementing access management "at the right place at the right time." The lessons learned in Virginia underscore the effectiveness of broad outreach and consensus-building among various public and private stakeholders, as well as the importance of educating elected officials and decision makers on how access management can make more efficient use of state highway expenditures. VDOT is optimistic that with continued legislative support, and the associated statutory authority now in place, Virginia's access management program is well-positioned to resist potential conflicts and external challenges in the future.

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION STRATEGIC CORRIDORS INITIATIVE

The North Carolina Strategic Highway Corridors (SHC) initiative (*79*) is a collaborative effort among the North Carolina Department of Transportation (NCDOT), Department of Commerce, and Department of Environment and Natural Resources to preserve and maximize mobility and connectivity on a core set of highway corridors throughout the state, by developing a long-range, consensus-based vision for each corridor to guide decisions related to funding, project planning, design, driveway permit approvals, and local land use decisions. Adopted in September 2004, the primary purpose of the SHC initiative is to provide a network of high-speed, safe, and reliable roadways throughout the state. The initiative promotes environmental stewardship by maximizing the use of existing facilities to the extent possible, and fosters economic prosperity through the quick and efficient movement of people and goods. The initiative offers NCDOT, partnering agencies, and other stakeholders an opportunity to consider a long-term vision when making land use decisions, as well as design and operational decisions on the highway system.

Implementation of the SHC initiative focuses on six areas: (1) Education, (2) Long-Range Planning, (3) Project Planning and Design, (4) Land Use, (5) Corridor Protection, and (6) Driveway Permits and Traffic Signals. Access management and the purchase of access rights are identified as key strategies under Corridor Protection. In addition, under Driveway Permits and Traffic Signals, alternative solutions to traffic signals and driveway consolidation and sharing are highly encouraged.

As part of the SHC initiative, four Facility Types—Freeways, Expressways, Boulevards, and Thoroughfares—and associated Control of Access Definitions were developed to create a set of understandable and consistent definitions for all roadways for NCDOT and its partners to use in the planning, design, and operations processes. The definitions are based primarily on the function of the roadway, level of mobility and access, and whether the facility has traffic signals, driveways, or medians. These definitions were developed from a committee composed of members from FHWA and NCDOT's Traffic Engineering, Highway Design, Project Development, and Transportation Planning branches. Table 19 shows a comparison of NCDOT facility types.

DEVELOPMENT OF ACCESS CLASSIFICATION SYSTEM FOR INDIANA DEPARTMENT OF TRANSPORTATION

In 2004, the Indiana Department of Transportation (INDOT) initiated the Indiana Statewide Access Management Program (*81*) to develop and begin implementing an access management strategy to support INDOT's Long-Range Transportation Plan and implementation of its Statewide Mobility Corridor Concept. The study involved a review of INDOT's existing access management process to identify its limitations, as well as opportunities for its refinement. The following key project issues were addressed in the study:

- Crafting a pragmatic approach to access management that fit Indiana's conditions
- Reflecting the diversity of transportation conditions in Indiana
- Addressing Indiana's institutional and policy environment
- Explaining the benefits of access management enhancements
- Drawing creatively from lessons learned in other states
- Assessing what can be accomplished within the existing framework
- Establishing agreement on recommendations and implementation approach
- Improving stakeholder understanding about access management

As part of the study, INDOT's Statewide Mobility Corridor hierarchy, shown in Figure 54, was used to develop an ACS for all state highways in Indiana.

As part of this effort, ACS from numerous state DOTs were examined within the context of the INDOT Statewide Mobility Corridor hierarchy. An initial ACS was drafted and subsequently refined through several reviews by a Study Advisory Committee composed of key staff from INDOT's central and district offices, as well as representatives from FHWA and various Indiana MPOs and counties.

Table 20 provides an overview of INDOT's ACS. The ACS uses INDOT's Statewide Mobility Corridor hierarchy as the primary basis for a tiered system of access categories. (Because interstate highways and freeways are of the highest level of importance and are fully access controlled, they represent the highest category within the ACS. Spacing criteria for these roadways are established in other sources such as the INDOT Roadway Design Manual and AASHTO's "Green Book.")

Tiers 1 and 2 of the ACS include all "Statewide Mobility Corridors" and "Regional Corridors," respectively, on the INDOT highway system. Tier 3 of the ACS includes all "Local Access Corridors" on the INDOT highway system. Because these "Local Access Corridors" serve a mobility function and accommodate some through-traffic volume, the term "Sub-Regional Corridors" has been used for Tier 3 roadways in the INDOT ACS.

In the classification system, Statewide Mobility Corridors (Tier 1), Regional Corridors (Tier 2), and Sub-Regional Corridors (Tier 3) are each subdivided into two subcategories (Type A and Type B) that reflect distinct variations within each of these Tiers. For all three tiers, the Type A distinction applies exclusively to multilane roadways, and the Type B distinction applies exclusively to two-lane roadways. The purpose for this distinction was to reflect the unique characteristics associated with two-lane roadways, which constitute approximately 76% of Indiana's state highway network.

A summary of the key differences in the signalized intersection spacing guidelines for the three tiers is shown in Table 21.

As shown in Table 21, the ideal spacing guideline for signalized intersections on all tiers of the state highway system is 0.5 mi in most cases. The 0.5 mi spacing typically accommodates progression speeds ranging between 30 mph and 60 mph, depending on the length of the signal cycle that is selected. For

TABLE 19
NORTH CAROLINA DOT FACILITY TYPES COMPARISON CHART

	Freeways	Expressways	Boulevards	Thoroughfares
Functional Purpose	High Mobility, Low Access	High Mobility, Low to Moderate Access	Moderate Mobility, Low to Moderate Access	Moderate to Low Mobility, High Access
AASHTO Design Classification	Interstate or Freeway	Arterial	Arterial or Collector	Collector or local
Posted Speed Limit	55 mph or greater	45 mph to 60 mph	30 mph to 55 mph	25 mph to 55 mph
Control of Access	Full	Limited or Partial	Limited or Partial	None
Traffic Signals	Not Allowed	Not Allowed	Allowed	Allowed
Driveways	Not Allowed	Limited Control of Access - Not Allowed Partial Control of Access - One Driveway Connection per Parcel; Consolidate and/or Share Driveways and Limit Access to Connecting Streets or Service Roads, Restrict to Right-in/Right-out	Limited Control of Access - Not Allowed Partial Control of Access-one Driveway Connection per Parcels Consolidate and/or Share Driveways and Limit Access to Connecting Streets or Service Roads; Restrict to Right-in/Right-out	Allowed with Full Movements; Consolidate or Share Connections, if possible
Cross-Section	Minimum 4 Lanes with Median	Minimum 4 Lanes with Median	Minimum 2 Lanes with Median	Minimum 2 Lanes; No Median; Includes Facilities with Two Way Left Turn Lane
Connections	Provided only at interchanges; All Cross Streets are Grade-Separated	Provided only at interchanges for Major Cross Streets and At-Grade Intersections for Minor Cross Streets; Use of Acceleration and Deceleration Lanes for At-Grade	At-Grade Intersections for most Major and Minor Cross Streets (Occasional Interchange at Major Crossing); Use of Acceleration and Decelerations Lanes	Primarily At-Grade Intersections
Median Crossovers	Public-use Crossovers Not Allowed; U-turn Median Openings for Use by Authorized Vehicles only when Need is Justified	Allowed; Alternatives to All-Movement Crossovers Encouraged; Minimum Spacing between All Movement Crossovers is 2000 feet (posted speed limit of greater than 45 mph) or 1200 feet (posted speed limit of 45 mph or less)	Allowed; Minimum Spacing between All-Movement Crossovers is 2000 feet (posted speed limit of greater than 45 mph) or 1200 feet (posted speed limit of 45 mph or less)	Not Applicable

Source: Facility Type & Control of Access Definitions (*80*, p. 8).

state highways with posted speeds of 40 mph or less that are located in built-up urban areas, a 0.25 mi spacing guideline applies. The 0.25 mi spacing typically accommodates progression speeds ranging between 15 mph and 30 mph, depending on the length of the signal cycle that is selected.

In cases in which the signal spacing guidelines cannot be met, a deviation may be allowed, provided a minimum acceptable bandwidth criterion can be met. This minimum acceptable bandwidth criterion varies depending on the tier of the state highway system and the location of the highway in either an urban or rural area.

The spacing guidelines for unsignalized intersections and driveways are based on AASHTO stopping sight distances, and are a function of speed, irrespective of tier. The decision-making process with respect to the application of the access spacing guidelines may consider existing and projected future traffic volumes and the type of environment (built-up, intermediate, suburban, and rural areas). In general, greater flexibility is needed for lower speed roadways in built-up areas.

TABLE 20
OVERVIEW OF INDOT ACCESS CLASSIFICATION SYSTEM

Level of Importance/ Access Category	Type	Traffic Function	Design Standards
Interstate Highways and Freeways		Accommodates high-speed, high-volume, and long-distance through traffic for interstate, intrastate, or intercity travel. Also can provide a major connection between suburban areas and metropolitan centers.	Multi-lane roadways with full access-control. Access via interchanges only (no direct private access to abutting properties allowed). All roadways are multi-lane and median-controlled/divided. At-grade intersections and access driveways not permitted under any circumstances. Interchange spacing is in accordance with the INDOT *Roadway Design Manual.*
Tier 1: Statewide Mobility Corridor	A	Provides connections to major metropolitan areas within the State and to neighboring states. Provides accessibility to cities and regions around the state. Accommodates high-speed and long-distance trips. Can accommodate heavy commercial vehicle traffic. Includes most rural non-Interstate routes on the Principal Arterial System.	Includes all multi-lane roadways. Access generally occurs only at interchanges or at-grade public street intersections. Some movements at public street intersections may need to be restricted based on existing and projected operating conditions and intersection spacing. Private access to abutting properties is not allowed, unless property has no reasonable alternative access (via joint-use driveways or frontage roads) or opportunity to obtain such access.
	B	Same traffic function as Tier 1, Type A. Generally provides key rural connections between metropolitan areas.	Includes only 2-lane roadways. Access generally only occurs via at-grade public street intersections. Some movements at public street intersections may need to be restricted based on existing and projected operating conditions and intersection spacing. Private access to abutting properties is not allowed, unless property has no reasonable alternative access (via joint-use driveways or frontage roads) or opportunity to obtain such access.
Tier 2: Regional Corridors	A	Provides connections to smaller cities and regions, feeds traffic to the Statewide Mobility Corridors, and provides for regional accessibility. Accommodates moderate to high-speed traffic, medium distance trips, and moderate volumes of through traffic and commercial vehicle traffic. Can accommodate local heavy traffic volumes.	Includes all multi-lane roadways. Generally median-controlled/divided. Public street connections occur at-grade. Private access to abutting properties is allowed. Full movements and signalization are allowed for public street connections and "commercial major" driveways only. All other private driveways are limited to unsignalized, right-in/right-out (median-controlled) access, with left-turns allowed conditionally subject to INDOT review and approval.
	B	Same traffic function as Tier 2, Type A.	Includes only 2-lane roadways. Public street connections occur at-grade. Private access to abutting properties is allowed. Full movements are allowed at all private driveways, with the exception of access driveways located within 300 feet of an existing (or potential future) signalized intersection which must be right-in/right-out (with left-turn access allowed conditionally subject to INDOT review and approval). Signalization is allowed for public street intersections and "commercial major" driveways only.
Tier 3: Subregional Corridors	A	Typically provides access to local residences and businesses in rural areas and small towns. Accommodates moderate to low speed traffic, short distance trips, and moderate local traffic volumes.	Includes all multi-lane roadways. Public street connections occur at-grade and may be signalized. "Commercial major" driveways may also be signalized. Full movements are allowed at public street intersections and all private access driveways.
	B	Same traffic function as Tier 3, Type A.	Includes only 2-lane roadways. Public street connections occur at-grade and may be signalized. "Commercial major" driveways may also be signalized. Full movements are allowed at public street intersections and all private access driveways.

Source: Access Management Guide (*83*, Table 3-1, p. 29).

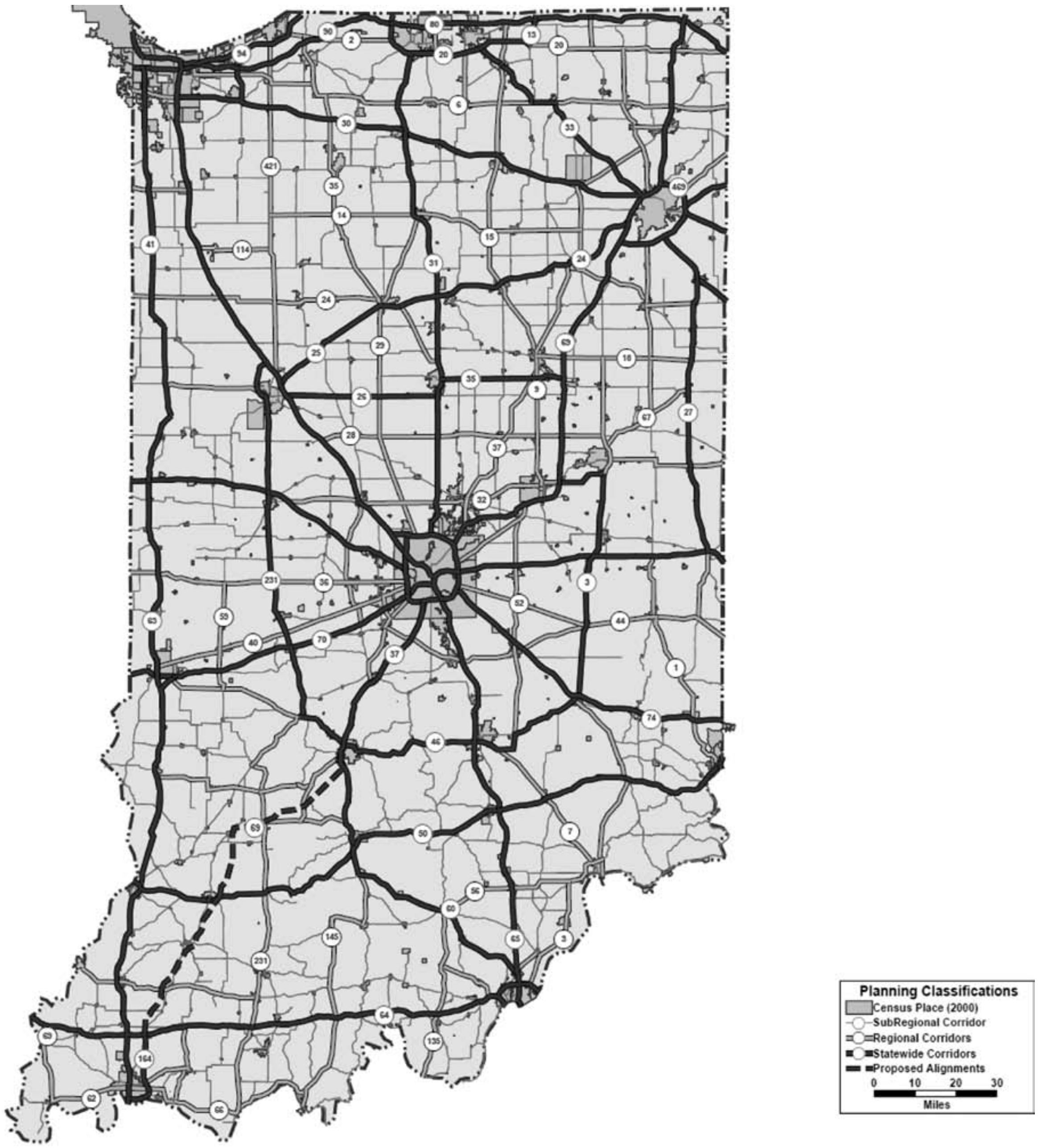


FIGURE 54 INDOT statewide mobility corridor hierarchy. *Source: INDOT 2030 Long Range Transportation Plan* (*82*, Chapter 6, Figure 6-2, p. 78).

The INDOT ACS provides the following access spacing and design details for all three tiers:

- Type of access permitted (at-grade intersection, private driveway)
- Traffic movements allowed (full movements, right-in/right-out only)
- Traffic control devices permitted (traffic signal, stop sign)
- Spacing criteria for public intersections and driveways

MINNESOTA DEPARTMENT OF TRANSPORTATION'S DEVELOPMENT AND ACCESS PERMITTING REVIEW PROCESS

Figure 55 identifies the development and access permitting process used by the Minnesota Department of Transportation (MnDOT) (*84*, pp. 2–3). The access review process begins the same way, whether reviewing a development plan or a permit application for a public street connection or private driveway. For development plans, the process ends with comments to the local government unit (LGU). For permit applications, the process continues through the completion of the access connection. As shown in Figure 55, three major phases each involve several steps:

TABLE 21

SUMMARY OF KEY DIFFERENCES IN SIGNALIZED INTERSECTION SPACING GUIDELINES BY TIER OF INDIANA ACCESS CLASSIFICATION SYSTEM

Tier	Ideal Signalized Intersection Spacing Guideline[a]	Minimum Acceptable Bandwidth for Deviation from Ideal Signalized Intersection Spacing	
		Urban	Rural
1A and 1B	0.5 mi	45%	50%
2A and 2B	0.5 mi	40%	45%
3A and 3B	0.5 mi	35%	40%

Source: Access Management Guide (*83*, Table 3-2, p. 30).
Note: A 0.25 mi spacing guideline applies to all state highways with speeds ≤ 40 mph located within a built-up urban area, regardless of tier.

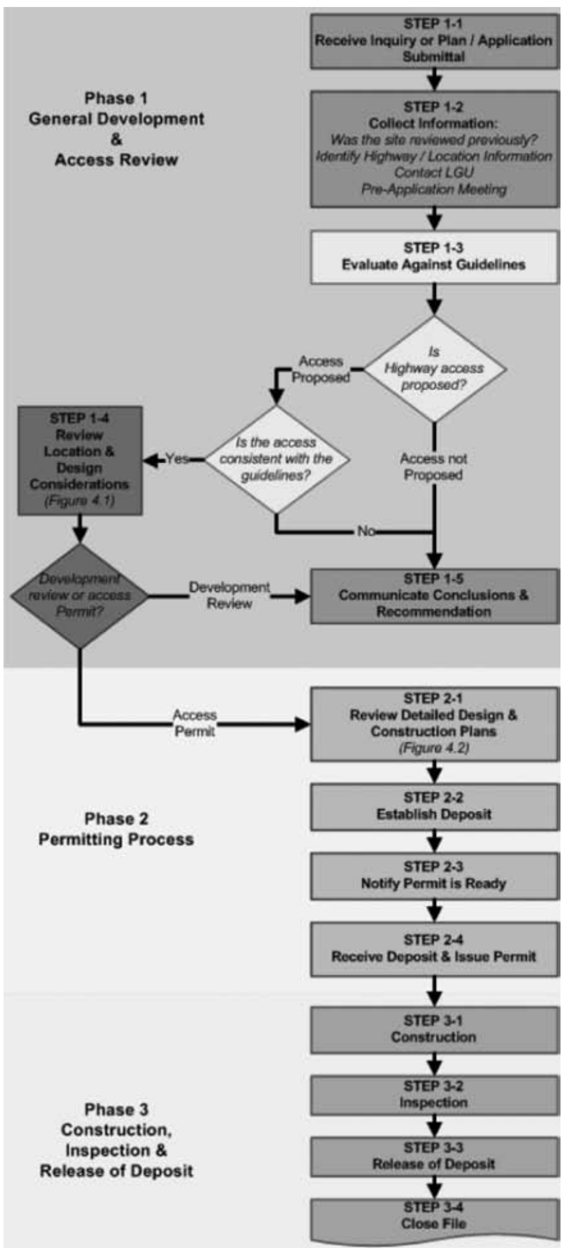


FIGURE 55 Minnesota DOT development and access permit review process. *Source: Access Management Manual* (*84*, Chapter 4, p. 4).

- **Phase 1—General Development and Access Review:** During the first phase of the review, MnDOT staff is initially contacted and gathers information related to the proposed development or access request. The development plan or access request is evaluated against the guidelines and considerations in Chapter 3 of MnDOT's *Access Management Manual* (i.e., "Guidelines for Public Street and Driveway Connections") and MnDOT prepares recommendations. When reviewing development plans, the review process ends when the official comments are submitted to the LGU.
- **Phase 2—Permitting Process:** During the second phase, MnDOT determines the conditions specific to an access permit, establishes the amount for the deposit, and issues the permit.
- **Phase 3—Construction, Inspection, and Release of Deposit:** During the last phase, the applicant constructs the access, MnDOT inspects it, and when it is constructed in accordance to the conditions of the access permit, MnDOT returns the deposit and closes the file.

MnDOT's *Access Management Manual* highlights the importance of the following key principles in the development review and permitting process:

- **Address Access Early**—Every effort should be made to address access as early as possible, while the greatest number of options remains available. As development decisions are made, they may preclude the LGU or developer from later implementing the best access option for the site.
- **LGUs Are Partners in Access Management**—Because they have the authority to develop the local street network, approve development plans, and require access-related improvements, the LGU plays a key role in determining where development occurs, how access is provided, and what highway improvements will be made.
- **Access Review Is an Iterative Process**—MnDOT guidance is written as though the review process was linear, but access reviews are an iterative process. It will often be necessary to contact the LGU or property owner more than once and to consider more than one option for providing access to a particular property.

- **Prioritize Efforts**—The level of effort given to a particular review should be commensurate with the safety and mobility impacts of the access. Access related to higher-volume development, and access to high-volume arterials and interregional corridors, should be given the greatest degree of analysis in search of the best alternative. The greatest scrutiny should be given to access that has the greatest potential to affect highway safety and mobility. For this reason, low-volume access and access to lower-order roads generally receives a more routine evaluation.
- **Permit Conditions Must Be Legally Defensible and Enforceable**—While the best access option will vary with each specific situation, all decisions must be based in MnDOT's legal authority to regulate access, constitutional protections of property rights, and the consistent application of guidelines. All conditions imposed by regulatory permit must be enforceable. The LGU or applicant must have the reasonable ability to comply with all conditions of a permit.

OREGON DEPARTMENT OF TRANSPORTATION'S AUTOMATED PERMIT DATABASE (CHAMPS)

The Oregon Department of Transportation (ODOT) has developed and implemented a statewide online access permit database called CHAMPS (Central Highway Approach/Maintenance Permit System) for use by ODOT permit specialists (*85*). The purpose of CHAMPS is to consistently manage the application and permit records and processes used by ODOT permit specialists located across the state. Through ongoing inventory and permitting activity, each approach road and driveway connecting to the state highway system—including those that existed before the permitting process was implemented, and those constructed as part of a private development or an ODOT construction project—are recorded and tracked in CHAMPS. Through an extensive array of capabilities and features, the CHAMPS system enhances uniformity in the permit application, review, and approval process. Figure 56 shows one of the main CHAMPS windows.

Individuals or entities desiring access to a state highway must submit an "Application for State Highway Approach" to an ODOT District Office. The District Office reviews the application and notifies the applicant of any additional documents required to continue the application process. Once ODOT approves a completed application, including construction drawings and plans, it issues a "Preliminary Construction Specification," if construction is required. The applicant reviews the specifications document, signs the document, and returns it to the District Office with proof of liability insurance and bond or cash deposit. Once ODOT receives these documents, it issues the "Permit to Construct a State Highway Approach." After construction of the approach, ODOT inspects it and, if approved, issues a "Permit to Maintain, Operate and Use a State Highway Approach." The CHAMPS database is used by ODOT permit specialists to assist in the daily organization and management of these activities.

The master CHAMPS database resides on ODOT's central application server, and can be accessed locally by ODOT permit specialists (and other authorized ODOT staff) from their desktop workstations through the agency's intranet. The CHAMPS system allows permit specialists to complete the following:

- Initiate, deny, or void new access permit applications
- Open, view, update, and save existing "in-process" permit applications
- Identify and update permit review and approval status
- Record the results of field inspections
- Amend or cancel existing permits
- Generate formal letters for typical access-related actions using standardized templates
- Issue new permits to applicants

Figure 57 shows the Application/Permit Window from the CHAMPS database.

CHAMPS allows users to search the database for individual access permits, or groups of permits, using specific screening criteria such as highway number, applicant name, or permit specialist name. Summary reports can be prepared and printed.

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT'S TRAFFIC IMPACT STUDY POLICY AND PROCESS

The TIS policy (see Figure 58) developed by the Louisiana Department of Transportation and Land Development (LADOTD) was developed to ensure that requests for new access are evaluated in a consistent manner by using objective data to facilitate decision making (*87*).

The policy applies to requests for access associated with new businesses and subdivisions (and incremental additions, if the addition was not part of the full build-out) or any development that will generate more than 100 additional peak hour–peak direction trips. The policy does not apply to requests for access to interstates, freeways, expressways or any other controlled access facilities, or to individuals requesting single-family residential access. The TIS is intended to provide developers and the department with the information needed to make sound traffic management decisions regarding operations and safety. The TIS process is as follows:

FIGURE 56 Example of main CHAMPS window. *Source: CHAMPS User Guide, Version 2.11* (*86*, p. 9).

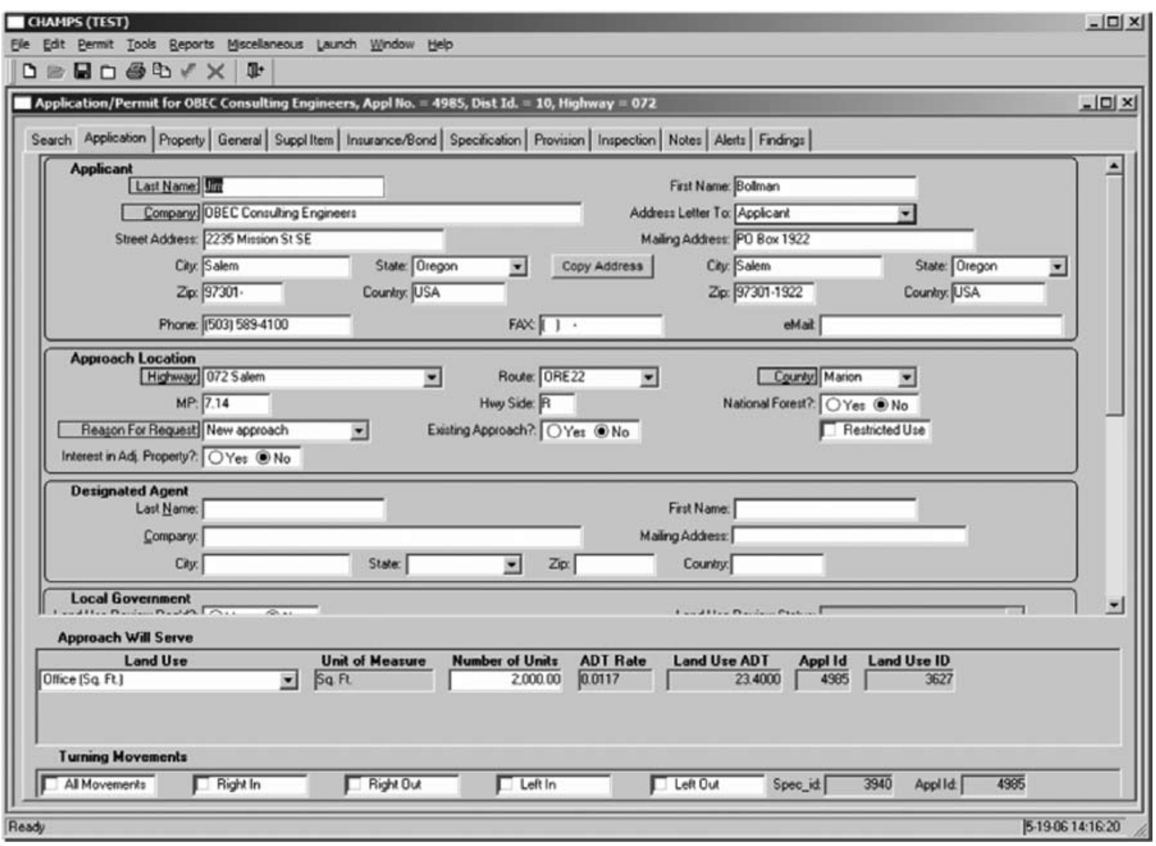
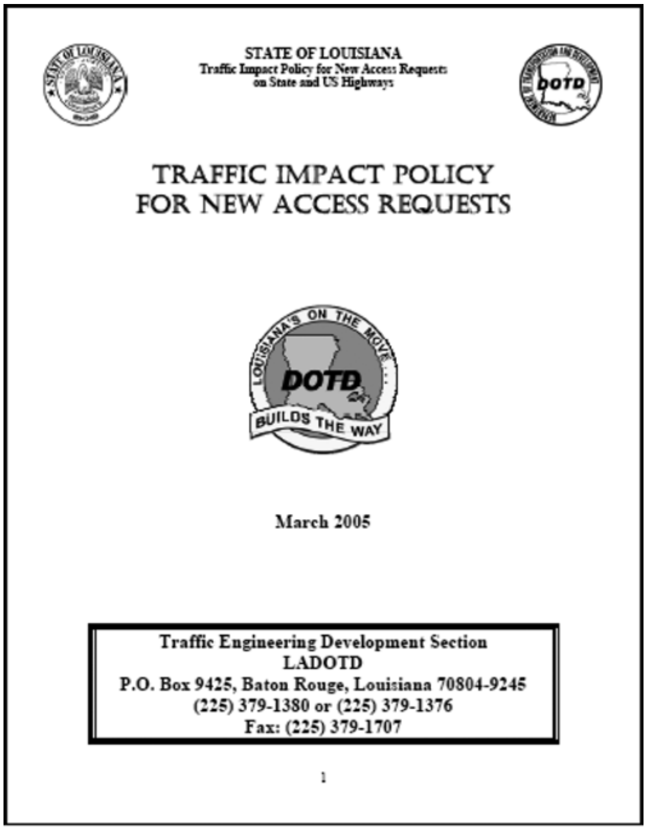


FIGURE 57 CHAMPS application/permit window. *Source: CHAMPS User Guide, Version 2.11* (*86*, p. 58).


STATE OF LOUISIANA
Traffic Impact Policy for New Access Requests
on State and US Highways

TRAFFIC IMPACT POLICY
FOR NEW ACCESS REQUESTS

March 2005

Traffic Engineering Development Section
LADOTD
P.O. Box 9425, Baton Rouge, Louisiana 70804-9245
(225) 379-1380 or (225) 379-1376
Fax: (225) 379-1707

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FIGURE 58 Cover of Louisiana DOTD traffic impact study policy. *Source:* Louisiana Department of Transportation and Development.

- **Preapplication meeting**—During the preliminary site layout stage (before the developer's request for an access permit), the applicant meets with the District Office (district traffic operations engineer and district permit specialist) to discuss whether a TIS is needed, and if so, what are the department's expectations and standards. The applicant is requested to provide a projection of the site's trip generation. A preapplication meeting is required for any proposed development that may require access onto a state highway, or is located within 0.25 mi of a state highway and may generate traffic on the state highway. If a TIS is determined to be needed, the district traffic operations engineer will inform the headquarters traffic impact engineer of the requirement, and District Office staff will provide the applicant with the roadway classification and access classification. The applicant may be required to conduct traffic counts or use traffic counts provided by the department.
- **Preparation of a TIS**—According to the policy, the TIS must be prepared by a currently licensed engineer (or qualified person under the supervision of a licensed engineer) and must be sealed by the engineer. The TIS should include the following items, at a minimum:

1. *Executive Summary*

2. *Table of Contents* (including List of Figures and List of Tables)

3. *Introduction,* including the following:
   - Description of the proposed development
   - Location of the project
   - Site plan, including all direct or indirect access to state highways
   - Circulation network, including all direct or indirect access to state highways
   - Land use and zoning
   - Sequence of construction including proposed dates of project (phase) completion
   - Project sponsor and contact person
   - References to other traffic impact studies
   - Summaries of alternative site configurations that were evaluated

4. *Traffic Information*, including the following:
   - Clearly stated assumptions.
   - Existing morning and afternoon peak-period traffic volumes of the adjacent street. Some developments have peak traffic time periods that differ from the peak period of the adjacent street. In this case, in addition to the morning and afternoon peak periods of the adjacent street, existing traffic counts taken during the peak traffic time periods of the proposed development must also be taken. All traffic counts will include turning movements, existing roadway geometry, including storage lengths, and traffic controls.
   - Existing plus generated morning and afternoon peak-period traffic volumes of the adjacent street and—if the development has a peak time period different than the adjacent street—the peak period of the traffic generator (including turning movements) *without* roadway improvements. Existing roadway geometry, including storage lengths and traffic controls are used.
   - Existing plus generated morning and afternoon peak-period traffic volumes of the adjacent street and the peak period of the generator (including turning movements) *with* proposed roadway improvements, and proposed roadway geometry, including storage lengths, and traffic controls.
   - Project trip generation, including references.
   - Project-generated trip distribution and assignment.
   - Level-of-service (LOS) and warrant analyses—existing conditions, cumulative conditions, and full build of general plan conditions (for all peak periods).

5. *Conclusions and recommendations*, including the following:
   - LOS and appropriate Measure of Effectiveness (MOE) data, such as delay time, in accordance with the latest version of the *Highway Capacity Manual*,

of affected facilities with and without mitigation measures.
- Mitigation phasing plan, including dates of proposed mitigation measures.
- Responsibilities for implementing mitigation measures.
- Cost estimates for mitigation measures and financing plan.

6. *Appendixes*
   - Description of traffic data and how data were collected.
   - Description of methodologies and assumptions used in analyses.
   - Worksheets used in analyses (i.e., signal warrant, LOS, traffic count information, etc.).

- **Review process**—Either an independent review of the TIS by the district traffic operations engineer or a joint review, also involving the headquarters traffic impact engineer, is conducted. This may be an iterative process with the applicant, and may require multiple submittals until the applicant proposes mitigation measures acceptable to the department. The department may take one of the following actions:
  - Indicate that additional improvements—such as turn lanes, intersections, a frontage road, shoulder(s), signal(s), and channelization islands—will be required. The applicant is required to incorporate these improvements into the plans and resubmit them for review.
  - Approve the TIS and issue a letter of compliance to the applicant.
  - Deny the TIS. If denied, no further reviews are made. The applicant may file an appeal or resubmit a request for a new review based on a different proposal.
- **Appeal process**—When the applicant and the district traffic operations engineer or headquarters traffic impact engineer disagree regarding the decision reached during the review process, the developer may appeal to the Administrative Review Committee. The committee shall be composed of representatives of the following divisions within the LADOTD:
  - Maintenance Division
  - Legal Division
  - Office of the District Traffic Operation Engineer (office of particular district in which the development is located, nonvoting)
  - Traffic Engineering Division (the headquarters traffic impact engineer shall not be a voting member if the TIS was reviewed jointly with the district traffic operations engineer (in this case, another employee of the Traffic Engineering Division will become a voting member of the Administrative Review Committee)

The committee, pursuant to a majority vote, may arbitrate and resolve disputes that arise during the review process and grant or deny relief to appealing parties. The appealing party must bring his or her complaint before the Administrative Review Committee no later than 30 days after notification of decision by the department. The Administrative Review Committee will convene in a timely fashion to review all appeals that are filed. The Administrative Review Committee will give due notice of the meeting time and place to those filing the appeal and will render a decision of its action within 14 days of its meeting. The party appealing the decision shall submit the written reason for the appeal along with the appropriate exhibits to the LADOTD, Traffic Engineering Development Section. Such submittal must be received at least 14 days before the Administrative Review Committee meeting. Failure to submit an appeal in a timely manner shall constitute a denial of the administrative appeal.

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT'S APPROACH TO IMPLEMENTING ACCESS MANAGEMENT

The state of Louisiana has taken a unique approach to implementing access management. The political climate in Louisiana is difficult for passing new legislation. Because new policies proposed by LADOTD are frequently met with political opposition, the LADOTD has chosen to pursue access management by introducing several components individually over time.

For nearly 2 years, individual policy memoranda that provide provisions for various restrictions—including median opening spacing, signal spacing, signal timing, and roundabouts—have been written and approved. These memoranda are the first components of a greater access management implementation strategy being undertaken by the LADOTD. As part of the development of each memorandum, LADOTD traffic staff from throughout the state were asked to review and comment on the drafts, to solicit input, and to proactively address any potential issues identified by staff. In addition, an administrative rule was passed that requires the submittal of a TIS in certain situations.

Louisiana's "Driveway Rule"—a law that specifies the processes for gaining access to state roadways, and defines the constraints of that access—currently is in draft form and still under development. This has been the most controversial of all policies in the access management realm, but also is the most needed. The LADOTD current policy regarding driveway connections makes corridor preservation and access management difficult. The new rule now refers to "access connections," rather than driveways, to fully encompass all new connections, including residential subdivision roads. In writing the rule, references were made to other access management–related policies and memoranda. Once enacted, this rule will form the core of the LADOTD AMP.

The LADOTD contracted with the University of South Florida's Center for Urban Transportation Research to conduct a thorough study of the state of the practice of access management in Louisiana. The study was recently completed and has helped LADOTD formulate a plan of action for moving forward with the development of additional access management policies.

The most important element of developing a plan in this way has been consistency. It is important that terminology, as well as related policy, remain consistent across all documents, memoranda, and rules. These individual parts soon will be combined into a single document—the LADOTD AMP—and it is imperative that these components fit well together.

These individual undertakings are tools being developed for a comprehensive access management toolbox. The order in which they have been developed largely has been based on the specific needs by the LADOTD staff to address predominant issues currently being faced by the department. The approach is intended to be largely proactive. Although it generally is more difficult and costly to ameliorate existing problem areas (i.e., poor driveway locations and median openings, and so on), it is considerably easier to prevent future occurrences of the same.

With each of the elements in place, the LADOTD anticipates a comprehensive AMP that will aid in the preservation of the investments made in the state's roadway system, increase highway capacity, and reduce the risk of crashes, thus providing for a state highway system that affords motorists a faster, safer, and more pleasant traveling experience.

CALIFORNIA DEPARTMENT OF TRANSPORTATION'S EQUITABLE SHARE RESPONSIBILITY CALCULATIONS

Appendix B of the *Guide for the Preparation of Traffic Impact Studies* (*88*), published by the California Department of Transportation (Caltrans) in December 2002, includes a methodology for calculating the equitable share of mitigation costs for proposed developments. As stated in the guide, the methodology is neither intended as, nor does it establish, a legal standard for determining equitable responsibility and cost of a project's traffic impact. Rather, the intent is to provide the following:

- A starting point for early discussions to address traffic mitigation equitably (Equation 1).
- A means for calculating the equitable share for mitigating traffic impacts (Equation 2).
- A means for establishing rough proportionality (Equation 3).

Equations 1, 2, and 3 are used in the following situations:

- A project has impacts that do not warrant mitigation immediately, but their cumulative effects are significant and will require mitigating in the future.
- A project has an immediate impact and the lead agency has assumed responsibility for addressing operational improvements.

The equations are not intended for circumstances in which a project proponent will be receiving a substantial benefit from the identified mitigation measures. In these cases (e.g., midblock access and signalization to a shopping center), the development project should take full responsibility for providing the necessary infrastructure.

<u>Equation 1: Equitable Share Responsibility</u>

$$P = \frac{T}{T_B - T_E} \qquad (1)$$

Where:

P = The equitable share for the proposed project's traffic impact.

T = The vehicle trips generated by the project during the peak hour of adjacent state highway facility in vehicles per hour (vph).

T_B = The forecasted traffic volume on an impacted state highway facility at the time of general plan build-out (e.g., 20-year model or the furthest future model date feasible), vph.

T_E = The traffic volume existing on the impacted state highway facility plus other approved projects that will generate traffic that has yet to be constructed or opened, vph. (Note: $T_E < T_B$).

<u>Equation 2: Equitable Cost</u>

$$C = P(Cr) \qquad (2)$$

Where:

C = The equitable cost of traffic mitigation for the proposed project ($, rounded to nearest 1,000 dollars).

P = The equitable share for the project being considered (from Equation 1).

C_T = The total cost estimate for improvements necessary to mitigate the forecasted traffic demand on the affected state highway facility in question at general plan build-out ($).

Once the equitable share responsibility and equitable cost has been established on a per trip basis, these values can be utilized for all projects on that state highway facility until the forecasted general plan build-out model is revised. If the per trip cost is not used for all subsequent projects, then Equation 3 is used to determine the costs for individual project impact and will require some additional accounting.

Equation 3: Proportionality

$$C = P(CT - Cc) \quad (3)$$

Where:

C = Same as Equation 2.

P = Same as Equation 2.

C_T = Same as Equation 2.

C_C = The combined dollar contributions paid and committed before the current project's contribution. This is necessary to provide the appropriate cost proportionality.

Example: For the first project to affect the state highway facility in question, C_C would be equal to zero. For the second project, however, C would equal $P_2(C_T - C_1)$, and for the third project, C would equal $P_3[C_T - (C_1 + C_2)]$, and so on until build-out or the general plan build-out was recalculated.

NEW JERSEY DEPARTMENT OF TRANSPORTATION'S VEHICLE-USE LIMITATIONS FOR NONCONFORMING LOTS

In New Jersey, permit applicants seeking access to a state highway are subject to the driveway spacing requirements set forth the *State Highway Access Management Code* (*89*). A property that does not conform to the required access spacing as defined in the code is referred to as a "nonconforming lot" and is subject to vehicle-use limitations (i.e., a maximum allowable trip-generation limit). The formulas to calculate the vehicle-use limits for lots in urban and rural areas are as follows:

For urban areas:

$$V = 50 + \frac{(L+R)^2}{(2 \times S)^2} \times A \times 100 \quad (4)$$

For rural areas:

$$V = 50 + \frac{(L+R)^2}{(2 \times S)^2} \times A \times 70 \quad (5)$$

Where:

V = Permissible peak-hour vehicular trips (total to and from lot).

L = Left distance between the lot centerline and the centerline of the next adjacent non single-family residential lot (L_{max} = S).

R = Right distance measured similar to "L" above (R_{max} = S).

S = Spacing distance, based on posted speed.

A = Area of the lot expressed in acres (for urban areas: $Amax$ = 3.0 acres, and for rural areas: A_{max} = 2.0 acres).

Based on Equations 4 and 5, the number of permissible peak-hour vehicular trips for lots in urban areas ranges from a minimum of 50 trips to a maximum of 350 trips. For rural areas, the number of permissible trips ranges from a minimum of 50 trips to a maximum of 190 trips. These peak-hour trip limits apply only to properties seeking access to the New Jersey state highway system that cannot meet the required spacing identified in the *Highway Access Management Code*.

TRANSIT-RELATED TRIP-GENERATION CREDITS IN THE NEW JERSEY ACCESS CODE

In 2004, the New Jersey Department of Transportation (NJDOT) initiated the New Jersey Access Code Reevaluation Study (ACRS) to assess the relationship between the New Jersey State Development and Redevelopment Plan (SDRP) and the State Highway Access Management Code to recommend modifications to the code that would strengthen implementation of SDRP policies and the governor's executive orders on smart growth (*90*). The ACRS examined a wide range of issues arising from the state's second SDRP adoption in March 2001, and recommended a variety of modifications to the code to facilitate implementation of smart growth principles and the SDRP. Outcomes of the study included the enhancement of existing intradepartmental procedures and programs designed to ensure that the code and its outcomes are consistent with the principles of smart growth, and improvement of code provisions to better assist counties, municipalities, and private developers with achieving smart growth objectives.

As part of the ACRS, a methodology was developed by the project team to estimate appropriate transit-related trip-generation credits for use in traffic impact studies for medium- to large-size residential, office, and industrial developments that are expected to benefit from a proximity to bus and rail transportation. This action is envisioned to promote development in and around rail stations and major bus stops, and is consistent with the New Jersey State Long-Range Transportation Plan (SLRTP), which calls for the following:

> Promoting transit-oriented development and redevelopment at rail stations and bus stops with significant levels of transit service. Advancing the Transit Village Initiative and Transit Friendly Land Use Initiative; stressing the need for affordable housing and job opportunities in these locations.

In New Jersey, a TIS is required for all "Major with Planning" access permit applications (i.e., applications for a development action projected to generate 500 or more vehicle trips per day, and 200 or more peak-hour vehicle trips). As part of the TIS, the number of vehicle trips expected to be generated by the proposed development is estimated by the applicant's traffic engineer, often using data from the ITE standard reference manual, *Trip Generation* (*91*). In highly developed areas of New Jersey, where frequent transit service is accessible, a significant number of trips to and from a particular site could occur via transit. The study sites reflected in the ITE data, however, typically consist of suburban, auto-oriented land uses where a negligible portion of the vehicle trips occur via transit.

Although the New Jersey Access Code allows applicants to estimate trip-generation credits for trips made via transit, data to support such credits are limited and no formal calculation methodology is available to determine the magnitude of the credit. NJDOT recognized the need for a more reliable estimate of transit usage in the TIS process. Therefore, in conjunction with New Jersey TRANSIT, a methodology was developed to identify whether or not a transit-trip credit could be taken in the TIS for a "Major with Planning" application, as well as the magnitude of any such credit.

The methodology utilizes a numerical demographic index developed by New Jersey TRANSIT called the "Transit Score," which reflects a given area's propensity for transit usage. The Transit Score is based on the composite average of four factors that influence the potential for transit ridership and is estimated for each of the 1,950 census tracts in New Jersey. The four factors that are included in the Transit Score are as follows:

- Household Density
- Population Density
- Employment Density
- Zero and One-Car Household Density

An increase in any of these four factors results in an increase in the numerical value of the Transit Score.

All Transit Scores are classified into one of five categories. These five categories represent ranges based on observed land use characteristics and actual transit service patterns. Following are the five Transit Score categories and the corresponding range of numerical values for each:

- LOW—0 to 0.5 Transit Score
- MARGINAL—0.5 to 1.0 Transit Score
- MEDIUM—1.0 to 3.0 Transit Score
- MEDIUM-HIGH—3.0 to 9.0 Transit Score
- HIGH—>9.0 Transit Score

NJDOT has indicated that a transit trip credit could be taken provided that the following four transit service criteria are met:

1. The proposed land use is residential, office, or industrial (no credit is allowed for retail developments under this methodology).

2. The site is located in an area with a numerical Transit Score corresponding to the following ranges:
   – MEDIUM-HIGH or HIGH (≥3.0) for residential developments, or
   – HIGH (≥9.0) for office and industrial developments.

3. Transit service is frequent (headways ≤ 30 min) during the weekday morning and afternoon peak hours.

4. The occupied area of the site is *pedestrian accessible* within a *reasonable walking distance* from transit service that operates during the weekday morning and afternoon peak periods, where:
   a. Pedestrian-accessible: on-site and off-site sidewalk and crosswalk connections to transit exist or are proposed by the developer in conjunction with the proposed development.
   b. Reasonable walking distance: 0.25 mi for bus and 0.5 mi for rail.

Provided that the proposed development meets the four factors, a transit-trip credit can be taken. New Jersey TRANSIT developed transit-trip reduction factors at the census tract level and summarized them in reference tables that identify the magnitude of the credits for qualifying census tracts.

As a hypothetical example, the weekday afternoon peak-hour trip-generation credit for a proposed 200-unit apartment development located on a site in census tract 000100 in Atlantic City that meets the four transit service criteria (i.e., the site is pedestrian-accessible and located within a reasonable walking distance of frequent transit service) would be computed as follows:

Weekday afternoon peak-hour trip-generation rate (as per ITE) =	0.62 trips/unit
Number of apartments =	200 units
Weekday afternoon peak-hour trips (*before* transit adjustment) =	124 trips

Allowable transit-trip reduction credit (from reference table) =	0.14 (14%)
Reduction in afternoon vehicle trips associated with transit credit =	−17 trips
Weekday afternoon peak-hour trips (*after* transit adjustment) =	**107 trips**

This process is based on existing transit service being available. For locations for which future transit service is proposed, the determination about whether or not a transit-trip credit is applicable, and the magnitude of that credit, is determined in cooperation with NJDOT and New Jersey TRANSIT. NJDOT is considering the proposed methodology for inclusion in its Access Code.

CHAPTER SEVEN

CONCLUSIONS AND IMPLICATIONS

This chapter presents conclusions associated with this synthesis project. It is organized as follows:

- Overview of current programs and experiences of transportation agencies in the administration of access management
- Best practices for access management program implementation
- Suggestions for future research and for development of additional resources to support access management implementation

OVERVIEW OF CURRENT PROGRAMS

Access management practices—whether part of a formal access management program, or conducted informally as part of normal business operations—currently are used at all state departments of transportation (DOTs) in the United States. Approximately two-thirds of the 50 state DOTs indicated that they have a formal access management program and, although the remaining one-third do not have a formal program, they manage access as part of an informal part of their normal operations. Among all state DOTs, access management is most commonly applied at the driveway permit level (92%), although it is also applied at the project level (78%), at the corridor level (64%), and at the statewide level (60%).

The most commonly cited strengths related to the implementation of access management are as follows:

- Having some inherent flexibility for making judgment decisions (76% of state DOTs and 53% of locals)
- Representing a defensible administrative rule (60% of state DOTs and 23% of locals)
- Providing uniformity when controlling access (52% of state DOTs and 51% of locals)

Strong organizational commitment was cited as a strength by 40% of the responding state DOTs, and 26% of the local agencies. Some specific program strengths cited by state DOT respondents—including allowances for design waivers and flexible guidelines—underscored the need for flexibility.

The most commonly cited barriers related to the implementation of access management among responding state DOTs are as follows:

- Political resistance (80%)
- A lack of staff and funding resources (60%)
- Organization and institutional limitations (52%)

Other common barriers cited included a lack of education and training opportunities, resistance by the development community, limited coordination with local governments, legal issues, and a lack of vision.

PRACTICES FOR PROGRAM IMPLEMENTATION

The successful *implementation* of access management is the objective of any program. Based on the survey findings presented in this synthesis, the following items were identified by survey respondents as helping to improve the implementation and enhancement of access management programs:

- **Legal basis/legislation**—*Strong access management authority provides the foundation for a successful access management program.* States with access management-related statutory authority or administrative rules have stronger legal backing for their access management programs and policies. State DOTs with access codes (based on the enabling statutory authority or administrative rules) are generally better suited to manage access along state highways. An access code enables state DOTs to establish standards and enforce them uniformly.
- **Access Classification System (ACS)**—*An ACS provides a framework for the comprehensive implementation of access management on a systemwide basis.*
- **Access committee**—*Access management is most successful in cases in which the agency has the institutional commitment to implement the program and integrate it into the daily business functions.* This could involve planning, permitting, traffic engineering, project delivery, and operations and maintenance activities to form a strong foundation for access management within a state DOT or transportation agency. An internal committee can be formed to review and provide feedback on difficult or controversial access-related issues.

- **Staffing**—*Implementation efforts have the greatest effect when state DOTs and transportation agencies can dedicate staff to access management*. The number of staff members devoted to access management—as well as their roles, staff levels, and location (i.e., central versus district office)—vary widely among the responding agencies. In most states, the staff devoted to access management also has responsibilities in other areas.
- **Access champion**—*What is often needed is a person (or persons) to emphasize and support the access management agenda within an agency*. Ideally, these "champions" are people who are empowered to make changes and withstand challenges resulting from political pressure.
- **Legal case history**—Court cases set the legal precedent for access management decisions in each state. *State DOTs with a strong case history of winning court cases are more empowered in making future access-related decisions* than those with a history of losing cases, which can undermine the authority of the state DOT.
- **Case studies**—*Real-world case studies that clearly illustrate the benefits of access management are instrumental in convincing elected officials, state and local government officials, the development community, and other decision makers of its merits*. Ideally, the case studies would highlight local access management projects with which the intended audience has some familiarity to reinforce the benefits that were achieved by implementing access management.
- **Education and training**—*Access management training for agency staff is crucial*. Training efforts need to be initiated and maintained to educate new staff members and reach existing staff throughout an agency. It is advisable to provide early and ongoing training for agency staff dealing with, or expected to deal with, access management–related issues. Implementation of an access management program often requires new staff skills and involves new agency procedures.
- **Outreach activities**—Outreach to parties affected by the implementation of an access management program can clarify agency objectives and reduce misunderstandings. *Elected officials, the development community, and the general public need to be educated about the rationale and benefits behind access management*. The education of elected officials, in particular, is a key element of implementing a successful access management program. Education outreach efforts to local communities, business groups, and the public were cited as successes in informing stakeholders of the potential safety and operational benefits of access management. Brochures, websites, and videos describing the program can be helpful for informing the public, policy makers, and staff about the purpose of access management and any agency changes in policies or procedures. A variety of outreach materials can be found at http://www.accessmanagement.info/resources.html.
- **Stakeholder cooperation**—*Access management is best achieved when state, regional, county, and local units of government cooperate in land use and transportation management decisions*. A critical element of access management is the land use authority held by local units of government. Although state DOTs are responsible for traffic on the state highway, land use decisions for adjacent and nearby properties most often are made by local governments. Therefore, it is crucial that local governments be aware of the traffic- and access-related ramifications of their local land use decisions. The importance of coordinating permit and access management decisions between state, county, and local agencies cannot be understated. Simply involving the state DOT or local road agency early in the process of planning and reviewing a development can produce many benefits.
- **Statewide master plan**—An Access Management Plan (AMP) is a planning tool that addresses land development and access management considerations along a roadway corridor, or series of corridors. These plans enable access management to be implemented on a case-by-case basis along key corridors, particularly where there is local support. The plan is often jointly developed and adopted by the state (if the road is a state highway) and local agencies that have jurisdiction over land development in the affected area, and is useful for dealing with areas that are undeveloped or areas where redevelopment is possible. *The defining characteristic of a successful AMP is the level of cooperation achieved among affected property owners and agencies involved in developing and carrying out the plan.*
- **Monitoring and evaluation**—*Any access management program will greatly benefit from continuous monitoring and self-evaluation to identify issues and resolve problems*. What was clear from this synthesis is that greater awareness is generally needed with respect to the existing access management resources that are available. It is important to note that TRB's Access Management website (www.accessmanagement.info) contains a wealth of information.

FUTURE RESEARCH AND NEEDED RESOURCES

Based on the survey responses, the following topics are suggestions for future research and needed resources:

- Access management successes for use in educating and convincing stakeholders of the need for access management and the real-world benefits that can be realized. In particular, case studies concerning retrofit projects and methods of overcoming potential legal challenges would be helpful.
- Profiles spotlighting examples of poor practice in "failed corridors" where inadequate capacity and speed reductions were related to poor access management decisions or lack of access management planning.

- Economic benefits of access management, including quantifiable cost-saving factors associated with the benefits of implementing access management techniques.
- Relationships between access management and other key policy objectives, such as smart growth and sustainability, transit-oriented development, and context-sensitive solutions.
- Guidance for "fringe" areas. These typically suburban or actively developing areas are located between developed urban areas and undeveloped rural areas. Fringe areas present excellent opportunities to either implement access management proactively or incorporate retrofit highway improvements. (Access management guidance usually is limited to either "urban" or "rural" areas.)
- Guidance for interchange area management plans, incorporating both transportation and land use elements.
- Relationship between eminent domain law and access management implementation.
- Safety and operational studies, under a range of traffic volumes and other considerations, to identify the situations in which road diets would be appropriate. This would help agencies evaluate traffic operations and capacity at a given site before implementing a road diet or other lane reduction measures.

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Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation

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