U.S. Department of Transportation
Federal Highway Administration

FIRST NATIONAL

ACCESS MANAGEMENT CONFERENCE

VAIL, COLORADO 1993

Conference Proceedings

NATIONAL ACCESS MANAGEMENT CONFERENCE COMMITTEE

Under the Auspices of:

TRB Committee on Transportation Planning
GORDON SHUNK, Chair
TRB Subcommittee on Access Management
RON GIGUERE, Federal Highway Administration, Chair

Chair:

PHILIP DEMOSTHENES
Colorado Department of Transportation
Denver, Colorado

Members:

SALVATORE J. BELLOMO
Bellomo-McGee, Inc. (BMI)
Vienna, Virginia

BRIAN BOCHNER
Barton-Aschman Association

ROBERT CUELLAR
Texas Department of Transportation
Austin, Texas

ARTHUR EISDORFER
New Jersey Department of Transportation
Trenton, New Jersey

RON GIGUERE
Federal Highway Administration
Washington, D.C.

DANE ISMART
Federal Highway Administration
Washington, D.C.

MICHELE WAXMAN JOHNSON
Federal Highway Administration
Washington, D.C.

FRANK "BUD" KOEPKE
Metro Transportation Group
Bloomingdale, Illinois

GARY SOKOLOW
Florida Department of Transportation
Tallahassee, Florida

VERGIL STOVER
Texas Transportation Institute
College Station, Texas

RANDY WALTER
Indiana Department of Transportation

Advisor:

JERRY FARIS
Florida Department of Transportation

TRB Staff:

JAMES SCOTT

BMI Staff:

SALVATORE BELLOMO
ANDREW SULLIVAN
BOBBIE WALTON

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

PAGE

TABLE OF CONTENTS (Continued)

PAGE

TABLE OF CONTENTS (Continued)

PAGE

I. INTRODUCTION

ACCESS
MANAGEMENT
CONFERENCE
VAIL, COLORADO 1993

1993 Conference on Access Management
Introduction

Conference Overview

The first Access Management Conference was held in Vail, Colorado on August 1-4, 1993. The conference was sponsored by the Colorado Department of Transportation (CDOT), the Federal Highway Administration (FHWA), and the Transportation Research Board (TRB). It was attended by over 150 persons from a wide range of transportation disciplines (including engineers, planners, and legal experts) representing federal agencies, state and local departments of transportation, and private consultants.

Comprehensive access management is an effective response to the congestion, the loss of arterial capacity, and the serious access related accident experience that is plaguing our nation's roadways. Access management reduces the frequency of fatal, injury, and property damage accidents, it prolongs the functional life of existing highways, it maintains the efficiency of the transportation system, and it is an integral part of the Congestion and Safety Management Systems called for under ISTEA. While elements of it have been used for years, comprehensive access management is still relatively new in practice, and only a few states have comprehensive access management programs. This first national conference was intended to provide an overview of access management and the administrative, legal, and engineering processes necessary to put it into practice. The conference also provided a forum for state and local engineers and planners to learn about access management from those who are currently practicing it and see how other states have approached its implementation. It is hoped that this conference will encourage other states and municipalities to develop their own access management programs.

The conference featured 10 technical and administrative sessions with a total of 36 formal presentations. The presentation sessions were followed by discussion periods where audience members could ask the speakers more detailed questions. The presentation sessions were divided into two tracks: administrative and technical. The administrative sessions focused on the administrative and legal aspects of access management while the technical sessions focused on engineering, design, and case studies.

The conference was declared an overwhelming success and was hopefully just the first in a series of access management conferences. A second Access Management Conference is already being planned for 1996 in Vail, Colorado (more information is provided in Section V).

Organization of the Proceedings

These proceedings are organized in the following manner. Conference papers are presented in Section II. Papers and presentation summaries are grouped by session and are presented in the order that they were given at the conference. Each section includes a brief summary of that session. Formal papers are presented as they were written and without editing. In cases where a speaker did not write a formal paper, the editors have attempted to highlight the key points of his/her presentation in a one or two page summary.

Three discussion periods were held during the conference to allow participants to ask the speakers questions about their presentations. These discussion periods were monitored by the editorial staff and are summarized here in a Q & A format. It should be noted that each discussion period included speakers from several sessions, so the discussion topics ranged widely.

Section III presents a brief summary of remarks made at the closing session. Section IV presents a list of the conference attendees. Section V provides some preliminary information on the 2nd Access Management Conference which is scheduled to be held in 1996 in Vail, Colorado.

II. PRESENTATIONS, PAPERS, AND DISCUSSION

ACCESS
MANAGEMENT
CONFERENCE
VAIL, COLORADO 1993

Plenary Session

Moderated by Philip Demosthenes, Colorado DOT

The plenary session provided an overview of Access Management and the goals for the conference. Arthur Eisdorfer from the New Jersey DOT, Gary Sokolow from the Florida DOT, and Philip Demosthenes from the Colorado DOT highlighted some of the basic principles of access management and discussed how these principles are applied in their own access management programs. Arthur Eisdorfer presented general comments which are summarized below. Philip Demosthenes' and Gary Sokolow's papers are presented in full.

Arthur Eisdorfer, Florida DOT

Mr. Eisdorfer's presentation addressed the following four topic areas related to access management:

- Goals
- Standards
- Corridor Preservation
- Land Use Patterns

The three primary goals of access management are to: 1) limit the number of conflict points, 2) separate conflict points and 3) separate turning traffic from through traffic. He pointed out that attainment of these goals results in enhanced mobility and improved safety by limiting the number of decision points faced by roadway users.

Techniques to limit the number of conflict points include decreasing the number of left turns, using right in/right out, restricting movements at median openings and closing median openings. Separation of conflict points can be achieved through the implementation of spacing standards, corner clearance requirements, signal spacing guidelines and requirements related to the separation of access points. Turning and through traffic can be separated through the use of left and right turn lanes, two-way left-turn lanes, acceleration/deceleration lanes and shoulders.

In discussing access management standards, Mr. Eisdorfer made several points concerning their development and adoption. He recommended the recent NCHRP report on access management to activity centers and the current FHWA access management course as potential sources of up-to-date information on access management techniques. He also emphasized the importance of a public involvement program, based on his experience in New Jersey. He further noted that the ultimate standards that are adopted should be the same for highway improvement projects, private development projects and redevelopment improvements.

Mr. Eisdorfer stated that access management programs should also look to the future through corridor preservation. Examples of this could include right-of-way purchases, the preservation of access rights and land dedications from developers.

Mr. Eisdorfer concluded his presentation by discussing the effects of land use development patterns on transportation efficiency. He encouraged mixed-use developments to decrease the amount of traffic that must go in and out of the development, as well as concentrated residential, commercial or business development centers to counter sprawl. Shared access should also be encouraged, as should alternative access points to other adjacent roadways. He closed by reviewing the trade-offs between mobility and access among the various functional classes of roadways.

Gary Sokolow, Florida DOT

Mr. Sokolow reiterated the need to recruit "converts" to access management as state and local agencies move to the realm of roadway maintenance as opposed to roadway construction. He sees access management as a key component of this process as the role of at-grade arterials becomes more vital with the completion of the interstate system.

Mr. Sokolow cited experiences in Colorado and Florida that demonstrate the beneficial impacts of access management programs, including improved safety and increased capacity. Crash rate reductions of 50% have been obtained in both states through the implementation of "highly access-managed" arterials, and Florida research data has shown that an increase in access features will result in increased crashes along a corridor. Florida also conducted analyses using the 1985 Highway Capacity Manual showing that a decrease in signal density from quarter-mile spacing to half-mile spacing can allow a 4-lane road at LOS D to gain 10,000 vehicles per day. Increased capacity can also result in decreased travel time, which he points out can benefit local businesses by effectively enlarging their market area.

In describing Florida's access management program, Mr. Sokolow noted that it places a high priority on high capacity/high speed facilities. Driveway and median opening restrictions are applied to increase corridor capacity and improve safety, along with other measures such as interchange spacing guidelines.

Mr. Sokolow discussed how access management can be instituted in three environments: 1) permitting, 2) road improvements and 3) cooperation between governments. He sees cooperation between governments through site development and planning regulations as particularly important to a successful program. He went on to describe "disbenefits" of not implementing an access management program, such as adverse neighborhood impacts from one-way pairs of roadways and the proliferation of beltway-type roadways throughout the country. Mr. Sokolow closed his remarks by theorizing that access management can achieve the same level of safety benefits that have resulted from seatbelt/helmet regulations and automotive technological advances.

ACCESS MANAGEMENT
LESSONS FROM OVER TWELVE YEARS IN COLORADO

Philip B. Demosthenes

As transportation demands increase, and the ability to recapture or provide new capacity by major capital construction decreases, the preservation of the functional integrity and hierarchy of the existing highway system becomes very important. Access management is the strict control of the design and operation of all driveways and public street connections onto the highway. Good access management is an essential element and an excellent transportation system management tool. It is in fact the single most effective element in preserving safety and arterial capacity thereby reducing congestion and prolonging functional life of existing capital investments.

Such a policy is best implemented by establishing an agency program and a comprehensive set of regulatory standards that only deal with access issues. Access control regulations should address driveway spacing, intersection and signal spacing, the denial of access requests, access geometric design including turn lanes and related design warrants. These access standards should be adjusted according to the arterial hierarchy; allowing greater access and lower design on slower collectors, while being very strict and using high standards on major arterials and at higher speeds.

Failure to plan and carefully locate an access that later becomes signalized, can result in significant losses in arterial capacity. In worse cases, poor signal placement destroys arterial capacity by creating progression bottlenecks. Computerized traffic signal progression systems, no matter how fancy, cannot overcome the congestion and capacity problems caused by the physical reality of poorly located traffic signals. Significant capacity losses of twenty-five to fifty percent are not uncommon. Since actual and desire traffic volumes continue to grow, the transportation agency is faced with new capital construction costs in order to recapture the losses. Investing more tax dollars in major widening, new alignments, mass transit, and incurring all their associated social, economic and environmental costs and impacts.

The need to preserve capacity by the control of signal locations and spacing is in of itself sufficient reason to have access regulations regarding signal location and spacing standards. The federal Manual on Uniform Traffic Control Devices, does not contain such standards.

Transportation engineering and planning textbooks address the functional hierarchy of highways -- majors and minors, collectors and distributors, residential and non-residential. A good multi level hierarchy will have five to seven well defined levels -- from freeway to residential. However, if you look at our non-freeway urban principal arterials, especially many of our older U.S. routes, you most often find the principal route is working as a multi-purpose, local, collector, and commuter arterial -- and functioning poorly in its combined role. The mix of a diverse group of users, needs and interests cause significant safety conflicts, traffic delays and capacity restrictions.

The primary purpose of good access management is to maintain the arterial design and function commensurate with each level of the roadway hierarchy, thereby separating the various users and purposes and design functions. Functional maintenance of the hierarchy is the most effective way to maintain overall system capacity and safety.

In Colorado, over fifty-three percent of all accidents are access related or about 43,500 accidents out of an average of 81,200 each year. This would include about 21,500 injuries and over 125 fatalities. On the national level this has not been researched, but similar statistics would mean over 2.5 million injuries and 14,500 fatalities are access related. Fewer accesses, better spacing, better design including turn lanes, can and does reduce conflict frequency, reduces accident potential and thereby reduces accident rates. Safety research clearly shows that access managed routes experience 50 to 65 less accidents

Assuming you are convinced there is a need for improved access control. then comes the issue of how do you institute improved standards and then successfully implement the standards in an usually sensitive political and economic environment.

Colorado chose the regulatory method for access control on state highways. The regulatory method is strongly recommended. The use of guidelines, general policies, and other political and internally flexible documents is not recommended. Managing access can be very controversial and stressful and you should expect to be in court several times each year. If you are not willing to be firm, fair and consistent and go to court when necessary, then you should not regulate access in any significant manner.

Regulating access affects the planning, development and often the value of land. Business developers usually desire frequent and direct access. They do not want to hear what you cannot allow. Some will take you to the court room, or the political back room if you fail to give them what they want. Guidelines and other softer policies do not have the weight of law. They will not survive political and legal onslaughts. If you develop a good and equitable access regulation, you will win when challenged. We win over ninety percent of our legal challenges in Colorado.

This is not to say strict access management means a constant struggle with the development community. Many developers realize the importance of a well maintained arterial system. Their livelihood depends upon transportation. Unfortunately, some take a very narrow view and pressure for their perception of frequent and direct access as a necessity in the marketability of their retail operation. The cumulative impacts of such shortsightedness, frequent and multiple access for all development, is not a consideration. The concerned developer demands fairness, reasonable standards and requirements that will achieve the purpose of the regulations efficiency, not wasting his time or budget.

A good access program will still allow development reasonable access in terms of traffic operation, getting to the property safely and at a reasonable level of service. Access management is controversial only when it conflicts with the market perceptions of what is necessary to sell the property or to compete with similar businesses, and the cost of constructing access improvements.

The most difficult part of starting an access management program is developing and selecting the standards for your system. Based on experiences in Colorado, New Jersey, Florida and several other states. regulatory development takes at least two years. Costs can run from $50,000 to $500,000 depending upon the amount of original research and design development undertaken, the level of program complexity. and the amount of controversy. If new state legislation is necessary, you can add another year or more.

There are three essential design and operational considerations to address in access standards. (1) Capacity controls - primarily the spacing and location standards for traffic signals. (2) Geometric standards where direct access is allowed, standards are needed to establish appropriate spacing and geometric design including turning lane warrants and access turning restrictions. (3) Denial of direct access - define under what circumstances and conditions a request for direct access may be denied.

There are three related tasks for implementation. (1) Define an access control hierarchy, from interstate down to local residential, developing several access control levels or categories. (2) Assign signal spacing and geometric standards to each category as a function of speed, capacity and arterial purpose. Should a major arterial classification have one-half mile, one-third mile or one-fourth mile signal spacing? What should be the minimum signal progression bandwidth, thirty, forty, or fifty percent? Should driveways be denied for some categories? What should the driveway spacing be for each access control level? (3) Design a workable procedural process, usually a permit program, covering application evaluation, selection of permit terms and conditions, probable appeals, construction inspection, enforcement, and record keeping.

Colorado has established an highway hierarchy system using five levels of access control in coordination with the existing patterns of development in Colorado. It is independent from the federal aid classification system and is based upon actual roadway and land use conditions. Category One includes interstates and other freeways. Category Two includes major parkways and arterials with strong access control but allows at-grade intersections, at one or one-half mile intervals. Full access control of private property by acquiring access deeds is standard practice. Category Two is often a staged design for later upgrading to Category One.

Category Three denies private direct access under most circumstances, and restricts signals to one-half mile intervals. About 75 percent of Colorado's highways are Category Three. It is the most desirable category for major urban and most rural arterials. Deeded access rights are often acquired on primary highways. Category Four is more *urban in nature allowing more direct access than Category* Three, and is more flexible in signal spacing and progression criteria. Colorado does not consider Category Four a desirable design for major arterials. It represents about a twenty to thirty percent drop in capacity compared to Category Three. Category Five is applied only to frontage and other service roads where access service is the prime function.

Colorado's access management regulations were developed based on traffic engineering and geometric design criteria, to maximize existing arterial capacities within the context of local planning patterns and decisions. Colorado state agencies have little or no control over local land use decisions. Use of engineering standards for regulatory justification is very helpful in the legal arena.

Establishing the access hierarchy and related access standards have been very helpful to the local planners and the development sector. When developers and land use planners know up front what their options are, it is easier for them to plan and make land-use decisions. The access code established a statewide consistency. Without the cooperation of the planning agencies, and decision makers, and developers, it would almost be a fruitless struggle to maintain a good hierarchy separation.

Developers are making considerable private investments in major land development and business projects that are dependent upon good transportation service. Roadway congestion problems, loss of service and capacity, can directly impact the value of their property and retail sales.

Distribution and production efficiencies also suffer from increased travel times. Poor access management can be a losing proposition for businesses.

The issues of access management are complex at the application level. It is often difficult to balance the diverse issues of traffic operation and safety, land use patterns and circulation, developers wishes, economic development needs and politics. In working with the private sector, two of the most important items are consistency and equality. Special treatment of one property, failure to adhere to standards and procedures for whatever reason, often causes disregard for the new standards and reduces the legal strength of the agency staff to enforce good standards. Maintaining a level playing field for all developers and property owners reduces squabbles to have access as a competitive edge. It is also unfair to others who comply.

Colorado regulates highway access through a license system. About 550 access permits are issued per year over the 9200 mile state system. A permit is required for each and every access, both public streets and private driveways. When a permit is issued, access designs are required to be consistent with state regulations and the permittee is fully responsible for all construction costs. Colorado requires new access to meet desirable geometric dimensions not just minimums. Permits are issued for the intended use of the access according to volume and vehicle type. An access must be upgraded to current standards when a change in the use of the property increases access volume above twenty percent. Failure to construct, maintain or use the access consistent with the terms and conditions of the permit can lead to permit revocation. Additional regulatory controls also allow for the denial or closure of direct access when alternative access to a secondary roadway is available. The DOT, on its own initiative, can reconstruct or relocate an access when required by changes in roadway operations, design and safety. These legal techniques are derived from statutory authority including the standard powers of eminent domain and specific regulatory (police) powers regarding access. Although not without controversy, these state wide access regulations have been well received and have proven very effective in improving highway safety, maintaining capacity and providing reasonable development access.

The promulgation of supporting legislation and regulation is an early and necessary step in improved access management. The regulating highway agency needs to have clear statutory backing to enforce the standards as we]l as to ensure that the agency will carry out the mandated program. The importance of functional maintenance to achieve and maintain a cost-effective and healthy transportation system and the reduction in capital expenditures by the protection of the existing arterial system, must be sold to the law makers. The exercise of these powers also must have a basis in fact. The public agency must document the necessity for the standards set and apply the standards in a uniform and equitable manner.

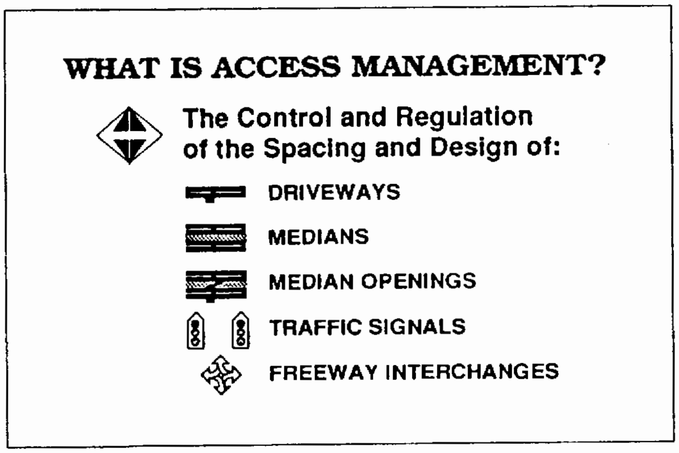
A large part of access management is also internal agency policy decisions such as providing adequate budgets and staff for an access management program. The program must have good support from upper management and be placed within the agency where it can be effective.

Access considerations also should be a standard element in the construction of any highway project. Reconstruction provides an excellent opportunity to clean up access problem areas. There should be clear federal support for access management elements in federal-aid projects.

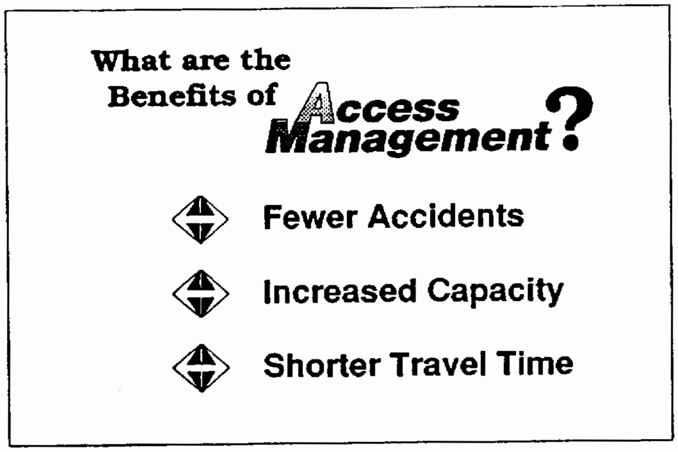
Failure to have an effective access management program means a waste of tax dollars and a waste of lives. Improved access management should not be considered an option for consideration. It needs to be considered a necessity. If you care about preserving the functional integrity of your highway system, you will develop and implement an access management program soon.

An Important Traffic Management Strategy

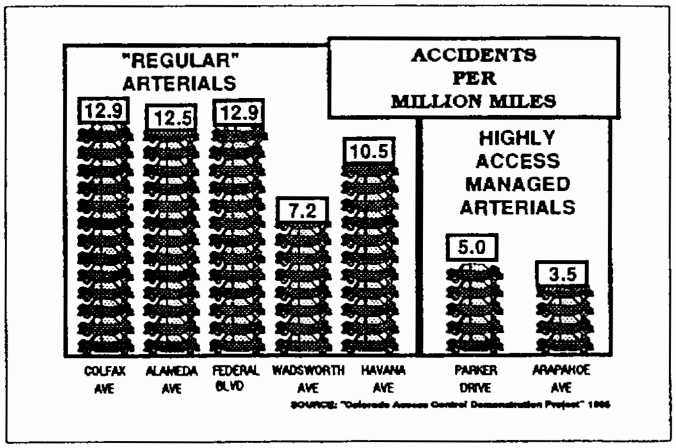
Gary Sokolow
Florida Department of Transportation



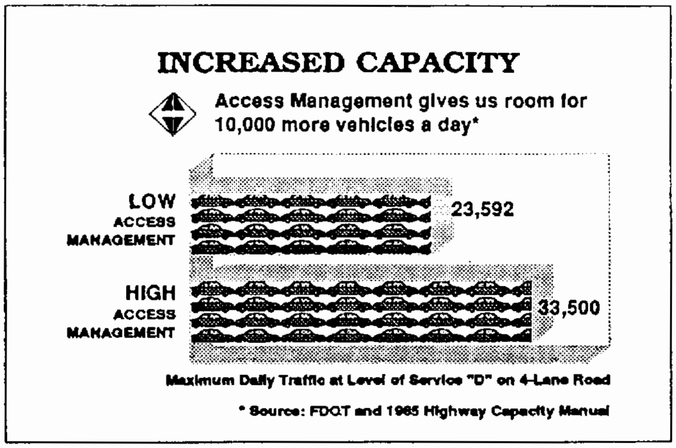
By "access management," we mean more than the control of driveways. Research over the last 20 years has shown that the management of driveways is just one aspect of access management. To support a comprehensive access management program, we must not only manage driveways but also medians, median openings, the spacing of traffic signals, and the spacing of freeway interchanges.



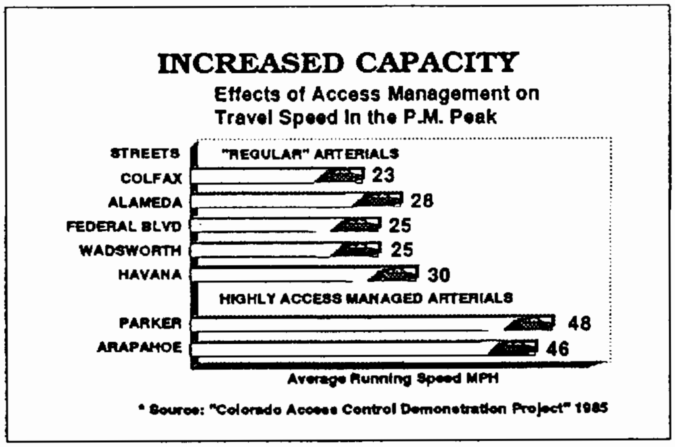
The measurable improvements to our road system which can be accomplished through a program of comprehensive access management include fewer accidents per million miles traveled, increased capacity of our highways, and shorter travel time.



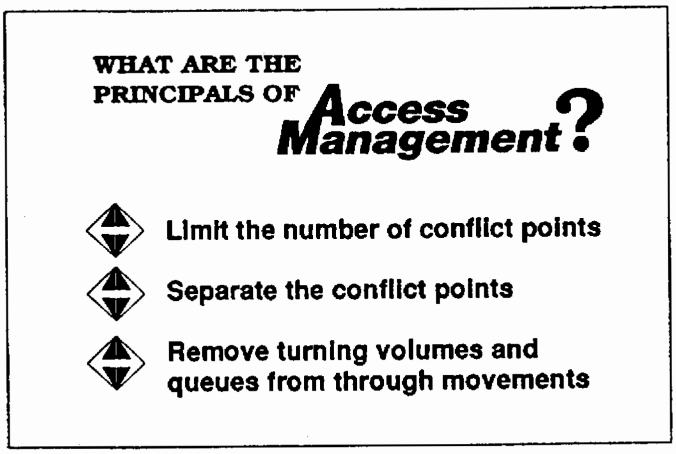
Studies in Colorado, Florida, and other parts of the nation have shown that the accident rate per million miles traveled can be 50% or less on arterials that have good access.



Hard statistical evidence shows that access management can produce an improvement in traffic safety, and the potential for improvement of capacity and level of service. In a study done for the Florida Department of Transportation, analysis showed that the typical 4-lane arterial road with a high level of access management can handle almost 10,000 more vehicles per day than the same 4-lane road without a high level of access management.

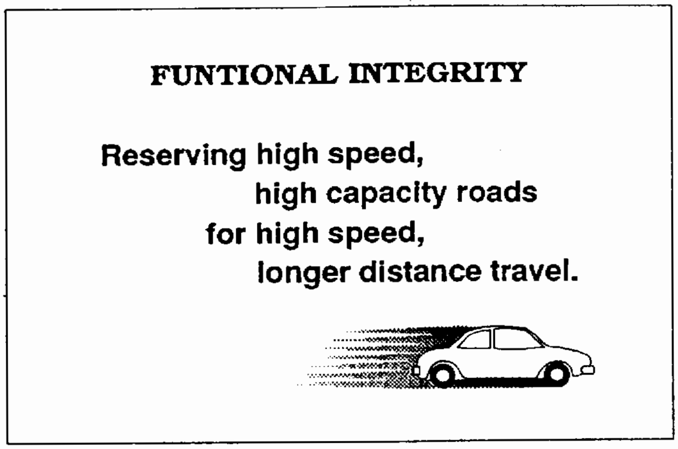


In one of the most comprehensive analysis of the effects of access management, the State of Colorado studied the travel characteristics on roads with high levels of access management as compared to those without a comparable level of access management. Their study showed conclusively that the average travel speed during the peak hours was considerably higher on well managed roads than those roads that did not have access as well managed. This analysis also took into account that the access managed roads and the "regular" arterials carried approximately the same number of vehicles per lane.

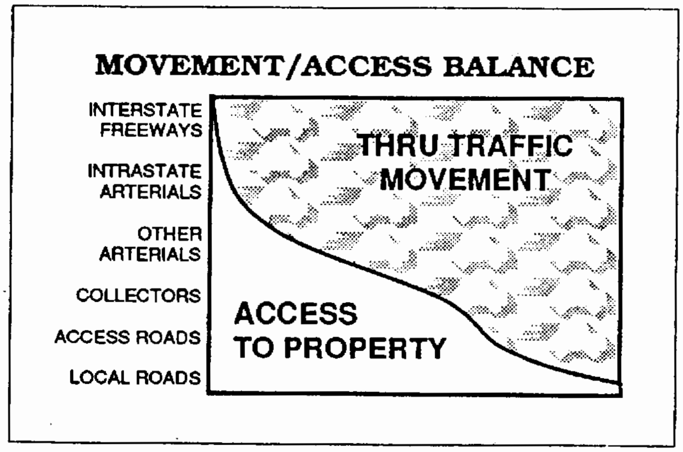


To understand how standards for access management were developed, we need to know the goals of access management, which are all based on the concept of reducing conflict. We can reduce traffic conflict by:

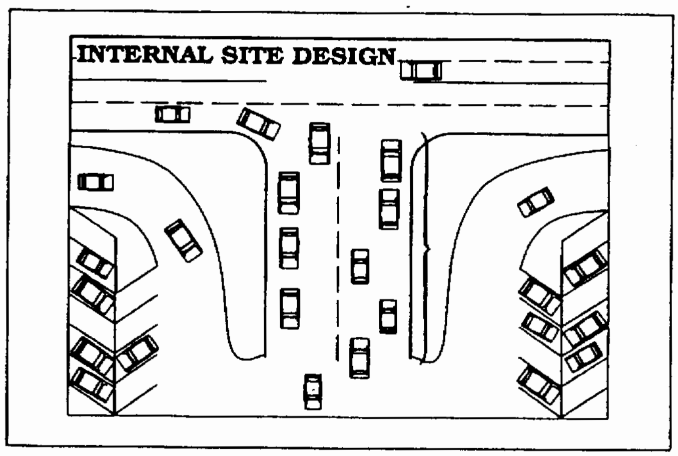
- Limiting the number of conflict points that a vehicle experiences in its travel,
- Separating conflict points as much as possible when they cannot be completely eliminated,
- Removing slower turning vehicles which require access to adjacent sites from the traffic lanes of through vehicles.



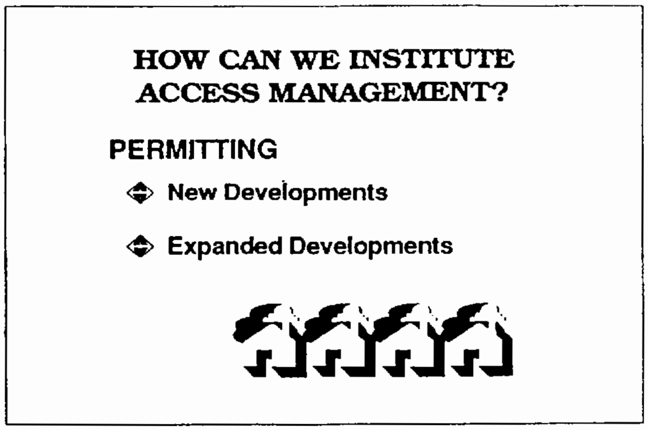
The concept of "Functional Integrity" means that we should reserve our highest speed and highest capacity roads for longer distance and higher speed travel.



Through "Road Hierarchy" we assign levels of access to each class of road, assigning the highest restriction of access to interstate freeways and the lowest restrictions to local roads. The lower the amount of access provided, the greater the potential of the road for traffic movement.

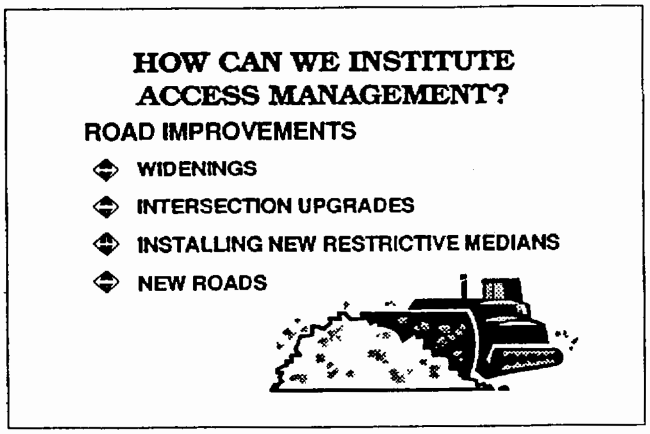


Internal Site design can greatly relieve this confusion and the traffic problems which it helps to cause.

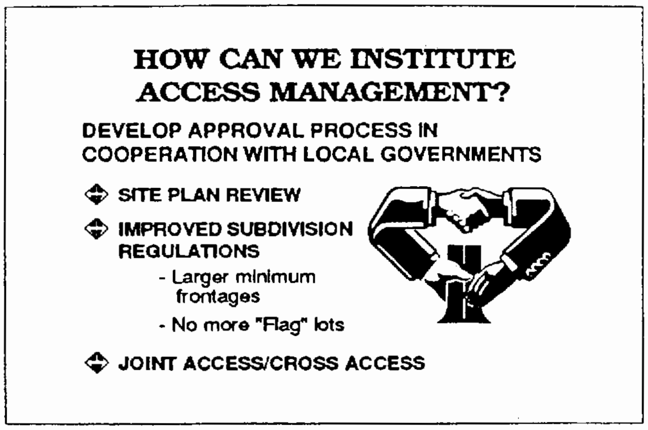


Access management can be instituted in a number of spheres in which local and state governments operate. Better access management can be instituted during permitting, road improvements, including new roads and road widenings, and through cooperation with local governments.

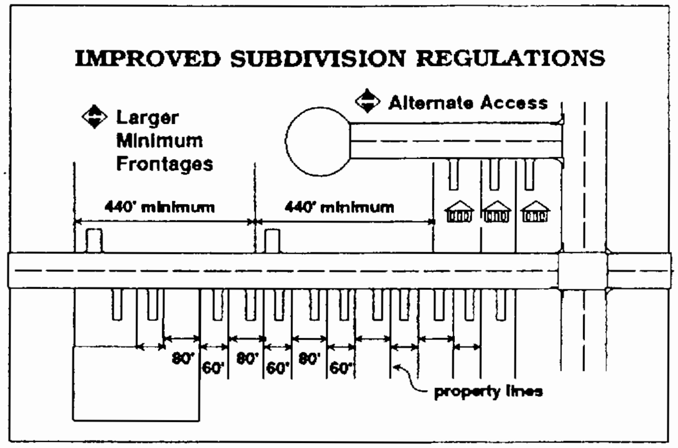
In the permitting process, an applicant requests a driveway onto the road system and this request is analyzed by transportation professionals for its impacts and a final design is approved before actual construction. These permits are handled not only during the approval for new developments, but also when a land use undergoes a significant change.



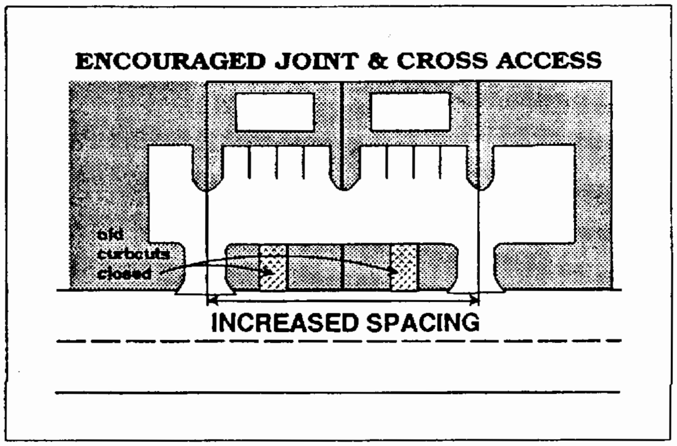
One of the most effective times to institute a high quality of access management is when we make road improvements. Each year, thousands of driveways and median openings are altered during road improvement projects. At that time, we can attempt to retrofit the existing access features, as much as possible, to the standards. This may also be done during widening projects, intersection upgrades, and installing more restrictive medians and median openings. The provision of new restrictive medians is one of the most effective ways to improve access management in cases where the corridor is already developed. Ideally, we gain the best opportunity to institute the highest level of access management when new roads are constructed.



Working with local governments, we can make great strides in instituting access management. Local governments regularly review site plans and approve the subdivision of land. To prevent numerous small lots, each with its driveway, it will be desirable for local governments to coordinate with the Florida Department of Transportation on subdivision site plans that satisfy the access management standards.



By requiring minimum frontages for property lines along our major arterials, we can assure the greatest separation between driveways. Subdivision regulations that require alternative access to smaller properties is also an effective strategy for access management.



Even in areas where building has been completed, there are methods for working with local governments to encourage better access management. One way is to encourage joint and cross access. To institute this technique, we can assure the highest quality access management along arterial roads.

What are the effects of

NOT managing access?

- **Damage to homes and businesses to widen roads**
- **Damage to established nieghborhoods providing "1-Way Pairs" parallel to overburdened arterials**
- **Build "Bypass" routes which usually become as congested as the roads they were built to relieve**

Idea from: Philip Demosthenes Colorado D.O.T.

What are the effects of not managing access? We don't have to look far to see the cost we will pay if we do not manage access today.

One means chosen in the past has been to widen existing roads. When we widen any existing road, it is usually done at a great cost in both money and damage to the neighboring properties.

Session 1

Federal Perspectives on Access Management

Moderated by Philip Demosthenes, Colorado DOT

The first session focused on how access management relates to federal programs and policies, and in particular, how it fits into ISTEA. Three speakers from the Federal Highway Administration (FHWA) presented federal perspectives on access management.

The first speaker was Dane Ismart from the Intermodal Division of the Office of Environment and Planning at FHWA. His paper, entitled "Access Managements Role in ISTEA," discusses some of the ways that access management can be a useful tool in meeting the congestion management requirements of ISTEA and the air quality requirements of the Clean Air Act Amendments.

The second speaker was Bob Gorman, who works in the Planning Programs Branch in the Office of Environment and Planning at FHWA. His paper "The National Highway System - Preserving Mobility for Tomorrow" discusses the proposed National Highway System (NHS) and its future role in maintaining national mobility. Gorman stresses the importance of preserving mobility on designated NHS routes and argues that without comprehensive access management programs these routes probably will not be able to fulfill their intended function.

The final speaker was by Bob Johnson from the Policy Development Branch of the Office of Right-of-Way at FHWA. His paper, "Access Management and Corridor Preservation," discusses the importance that corridor preservation will play in the coming years as travel patterns change and VMT increases. Access management will be an integral part of corridor preservation programs, which will attempt to protect right-of-way for existing or planned facilities through the coordination of planning and development along highways.

This session was attended by approximately 150 people. Questions and answers for the speakers are summarized in the Discussion section for Sessions 1 and 2.

Access Management's Role in ISTEA

Dane Ismart
Federal Highway Administration

Access management provides two major benefits to transportation systems: (1) preservation of capacity and (2) improved safety. These benefits are also important parts of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA).

A closer examination of ISTEA will show that because of the benefits it can provide, access management can play an important role in fulfilling ISTEA requirements on management systems, environmental impacts, and statewide and metropolitan planning.

The first area of ISTEA in which access management will play a significant role is in congestion management. As part of ISTEA, the States and MPO's with a population of over 200,000 must develop and implement a congestion management system (CMS). The purpose of the CMS is to identify areas of congestion and develop a program of strategies and actions to address these traffic problems. For non-attainment air quality areas, projects that significantly increase single occupant vehicle (SOV) capacity must come from the CMS to be eligible for federal funding.

The proposed CMS regulation identifies a series of transportation actions that should be considered as part of the congestion management program. Access management is specifically listed in the proposed regulations as one of the transportation actions that should be considered for implementation. With access management's capability of preserving capacity for a relatively low capital cost, many States and metropolitan areas will be including an access management program as part of their CMS.

For non-attainment areas, the proposed CMS regulations state that all reasonable and appropriate transportation demand management (TDM) and transportation system management (TSM) strategies and actions must be implemented as part of any project that significantly increases the single occupant vehicle (SOV) capacity. The TDM and TSM strategies and actions must be considered for implementation not only as part of the project but also as part of the project's transportation corridor. Even if the TDM and TSM strategies and actions do not eliminate congestion, they must be implemented as part of any project that increases the SOV capacity in a non-attainment area. Access management with its capability of preserving capacity could be an important consideration for any proposed project which will construct new capacity in a non-attainment area. Based on the proposed CMS regulations, if access management is reasonable and appropriate it should be considered for implementation as part of the project or corridor plan.

ISTEA and the Clean Air Amendments Act (CAAA) require the Federal Highway Administration to determine if the State and metropolitan area transportation plans conform with the air quality requirements. The resultant conformity analysis demonstrates the impact that transportation projects will have on emissions for the non-attainment pollutant.

Generally, air pollutant emissions are reduced when congestion is reduced and higher arterial speeds are maintained. Estimates of air pollutant emissions from EPA's Mobile 5.0 model are reduced when low speeds on arterials are raised. Access management programs can increase the operating speed and reduce the frequency of speed changes for through traffic. With improved speeds and fewer speed changes, the air quality models will indicate a reduction in the air pollutant emissions. Increases of 3 or 4 miles per hour in the average speed of major segments of the transportation system could play a significant role in reducing emissions and assisting States and metropolitan areas in meeting mandated air quality standards.

Statewide and metropolitan planning is another area in ISTEA where access management can play a significant role. As part of ISTEA, planning requirements include the development of a transportation plan that is consistent with the metropolitan area's land use plan.

An effective access management program provide consistency between transportation plans, projects, and land use plans. For example, a program with well defined design standards for driveway spacing and median treatment can serve as an effective tool in managing land use so that it is consistent with State's and metropolitan areas plans. The transportation planning process must coordinate its efforts with the access management program to maintain a consistency between planning, access management, and land use development. Without an access management program, a highway project may have unforeseen impacts on land use that are not consistent with the land use plans for the area.

Safety is another area in ISTEA where access management can play an important role. In ISTEA, there are numerous programs to improve the safety of our transportation system. One very prominent program is the requirement for each State to develop a safety management system

(SMS). The SMS will identify safety problem areas and develop a program to improve the safety of the transportation system.

An access management program improves safety by reducing conflicts and traffic speed differentials. Studies consistently show access management strategies effectively improve safety. As part of the SMS identification of strategies and projects to improve safety, access management program can provide important contributions.

This paper described just a few examples of how an access management program can have an impact on ISTEA programs in the areas of the environment, planning, management systems, and safety. There are other examples of how an access management program can support the programs in ISTEA. The important point to remember is that the objective of ISTEA is to improve the safety and efficiency of the transportation system. An access management program has the same objectives.

THE NATIONAL HIGHWAY SYSTEM - PRESERVING MOBILITY FOR TOMORROW

Robert A. Gorman
Federal Highway Administration

Abstract
This paper discusses the concepts of functionally classifying highways, the uses of functional classification and how it became the basis for the development of Federal-aid highway systems. It further discusses the update or functional reclassification of highways required by the ISTEA and how that then becomes the basis for the development of the National Highway System. Once the National Highway System is designated steps should be taken to preserve that system's function of providing a high degree of regional and inter-regional mobility. The author then summarizes the policies and procedures of selected states and localities to manage access and why others should also consider adopting some of these methods for routes on the National Highway System.

The single largest public works project that this nation ever embarked upon was building the Interstate highway system. For 35 years, this monumental task was the cornerstone for the Federal-aid highway program. As time passed, more and more miles of the system were completed, it became possible to drive from coast to coast on a continuous system of high speed freeways. Soon only small isolated gaps remained to be built. With the realization that the entire system was nearing completion, transportation planners began to direct their attention to the future. Several new ideas began to emerge. However, the one that captured most peoples' imagination was a national highway system (NHS).

Objectives Of The National Highway System (NHS)
Although the Interstate highway system was the dominant Federal-aid highway system, it was not the only one. There were three other Federal-aid systems: the Primary (FAP), the Secondary (FAS) and the Urban (FAU) systems.

The Federal-aid program began in earnest after World War I with the passage of the Federal-aid Highway Act of 1921. That Act created the Primary system, a national system of interconnected roads that were important to interstate, statewide, and regional travel.

This system consisted of rural arterials and their extensions into or through urban areas.

The next system was the Secondary system, which was established in 1944 and consisted of rural major collector routes. The Federal government began providing aid for this class of roads during the depression when County governments could no longer maintain their roads without Federal assistance. After the depression ended, the Federal government recognized that it should have a continuing role in providing assistance for these roads. As a result, these roads were included in a Federal-aid Secondary system.

The last system designated was the Urban system, which was established in 1970 and consisted of arterial and collector routes in urban areas. Although the Federal-aid systems generally consisted of roads with the same highway functional classification, there were numerous exceptions. The 1973 Federal-aid Highway Act addressed this problem by realigning the Federal-aid systems to make them compatible with the road's functional classification.

This practice of classifying roads based on their function actually predates the Federal-aid period. The central idea is that roads provide two distinct functions: moving traffic (mobility) and providing access to adjacent land development. Although most roads provide both functions, they are classified on the basis of which function predominates. Roads whose primary function is moving traffic are classified as arterials. Roads that mainly serve as access for land development are classified as locals. Collectors channel traffic from local roads to arterials and maintain a relative balance between providing mobility and access (see Figure 1) (1).

There are a number of practical uses of classifying highways by their function. Two of the more important ones include the concept that higher functional systems should be the responsibility of the Federal and State governments and the other one is that if a road is to maintain its function over time

appropriate design standards should be associated with that road's function. (2) As these concepts became widely accepted, they were used to rationalize the Federal-aid highway systems along functional lines.

In recent years, the Federal Highway Administration had begun to redefine its role and become less involved in the detailed administration of the Federal-aid Secondary and Urban systems. Proposals for terminating these programs and providing the Federal funds as a block grant to the States were seriously considered. The 1987 Surface Transportation Assistance Act provided for a Combined Road Plan (CRP) demonstration program which was implemented in five states. The CRP allowed the states to administer the FAS, FAU and bridges off the FAP system as a single category of funds. This served as a forerunner to the ISTEA Surface Transportation Program.

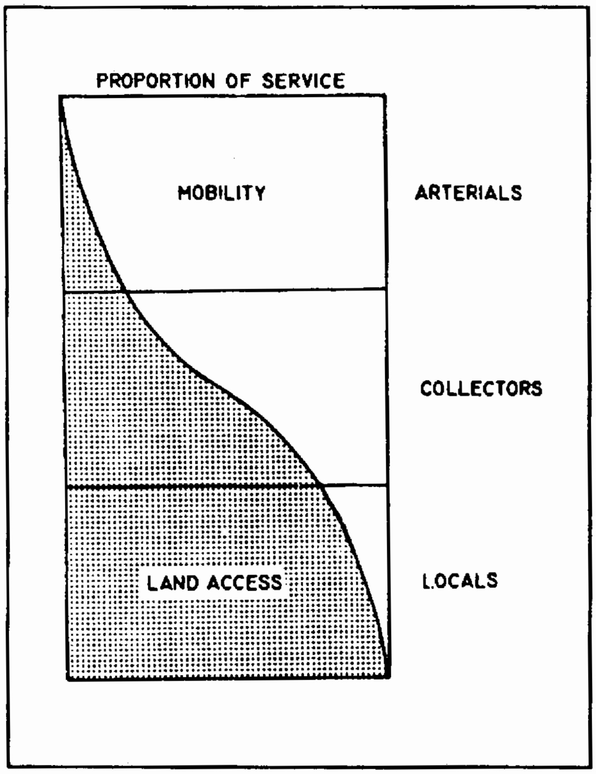


Figure 1: Relationship of Functionally Classified Systems in Serving Traffic Mobility and Land Access

Another feature of this redefinition of roles in a post Interstate highway era was to distinguish between roads that are of national importance and those that are of local importance. It seems logical for the Federal government to continue to play an active role in building and maintaining roads of national significance. Obviously the Interstates would continue to be the backbone for moving much of our traffic and just maintaining that system would be expensive. However, the Interstate system was actually developed during the forties even though it was not implemented by legislation until 1956. Since that time significant shifts in population and economic activity occurred.

The next most important system from a national perspective is the Primary system. Originally established more than 70 years ago, it also provides for interstate and inter regional travel. Together with the Interstate it includes about 7% of total road mileage. However, concentrating Federal aid on a system of this size would have spread Federal funds pretty thin as many States found when they decided to develop priority systemwide plans.

In recent years, several States that had developed systemwide plans for highway development focused their efforts on upgrading a system of roads that were considerably smaller than their entire Primary system. Since the Primary system includes both principal and minor arterials in rural areas, many states decided to place a higher priority on their principal arterial portion of the system.

Proceeding in a similar vein, the American Association of State Highway and Transportation (AASHTO) Officials endorsed the concept and advocated a system of roads of national significance that served the following national objectives:

* serve interstate and international commerce and travel,
* provide for the national defense,
* enhance economic vitality and international competitiveness,
* provide service to all portions of the nation and,
* respond to changing population and travel patterns.

At the same time, the US DOT also adopted a similar proposal and incorporated it into its national transportation policy.

Development Of The "Illustrative" NHS

After adopting the idea of a highway system of national significance, AASHTO convened a committee to determine its size. Although this committee recognized that their focus should be on a system of principal arterials, they also recognized that there should be more uniformity among the states in applying that criteria to designate principal arterial routes. At this point AASHTO decided to adopt a policy supporting the national highway system in upcoming legislation instead of trying to develop the system. They decided to defer the actual task of developing the system until after legislation passed.

During Congressional hearings on a new transportation bill, AASHTO testified before the House Public Works sub-Committee on Transportation supporting the development of a national highway system. Members of that sub-Committee were receptive to the concept but wanted a clearer idea of what types of routes would be included. They therefore directed FHWA to work with AASHTO to develop a system for illustrative purposes only and submit it to the sub-Committee.

An "Illustrative" system of 150,000 miles was developed after evaluating a variety of proposed routes using the following criteria:

* the ability to accommodate the Strategic Highway Network (STRAHNET) which is a system of routes identified by the Department of Defense as critical for military purposes,

* the ability to provide access to major ports, terminals and international border crossings,

* the ability to serve most urban areas over 10,000 population,

* the ability to provide a continuous system across state boundaries,

* the ability to provide an interconnected system between rural and urban areas, and

* the ability to provide multi state routes that served important interregional travel patterns.

It is estimated that such a system would probably carry over 40% of total traffic and more than 75% of heavy truck traffic. A map depicting this "Illustrative" national highway system was submitted to Congress in February 1991. (Although the map only displayed the rural portion of the system and their connecting links through urban areas, the recommendation for 150,000 mile system provided enough mileage for additional urban routes).

Developing The Proposed NHS As Required By ISTEA

In December 1991, Congress passed and the President signed into law the Intermodal Surface Transportation Efficiency Act (ISTEA). This act established a national highway system and directed the Secretary of DOT to submit a proposed national highway system to Congress for approval by December 1993. Congress must approve the final system before September 30, 1995.

This system is being developed in consultation with local and state officials. It must include the Interstate highway system, the Strategic Highway Network (STRAHNET), STRAHNET connectors to major military bases, and access links to major ports, airports and intermodal terminals. In addition, it must include 21 specific high priority corridors that are listed in the legislation. After the required routes are included, States and locals may select candidate regional routes provided they are classified as principal arterials. In developing the proposed system, DOT was directed to start with the "Illustrative" NHS previously submitted to Congress. Each State was allocated a mileage target based on the "Illustrative" NHS. Although most of the routes included in the "Illustrative" NHS are expected to be included on the proposed NHS, there could be some changes.

Because of the major realignment of the Federal-aid highway systems, ISTEA requires the states and locals to functionally reclassify their highway systems prior to the designation of the NHS. After each State has reclassified their highway system, roads classified as principal arterials may be selected for the proposed NHS. Any principal arterial not selected will become part of the Surface Transportation Program which will also include the minor arterials, urban collectors and the rural major collectors.

Characteristics Of The NHS

Although the proposed NHS will not be finalized until December 1993, we can get an idea of what the system might look like by analyzing the route data submitted during the development of the "Illustrative" NHS. The system is likely to have full access control on about 14% of its non-Interstate route mileage, and partial access control on 16% of the mileage. The remaining 70% of the non-Interstate mileage would have no access control.

About 4% of the non-Interstate routes will have five or more lanes, 40% will have four lanes and the remaining 56% will have only two lanes of traffic. It's expected that the system will carry somewhere between 40% to 45% of total traffic.

Should We Try To Manage Access On The System?

Before answering this question, let's not forget that the two main reasons for classifying highways are: (1) basing jurisdictional responsibility on a road's functional classification, and (2) establishing design standards so that a road can continue to fulfill its primary function. The NHS will be the primary responsibility of the Federal and State governments. But will it be able to continue to fulfill its primary responsibility of moving traffic safely, efficiently and at reasonable travel speeds if future land use development occurs unimpeded along its right of way?

Probably not, unless steps are taken to restrict access to the system. If 70% of the non-Interstate mileage has relatively little access control at the present time, eventually these roads will lose their ability to carry medium and long distance traffic safely and efficiently.

Much of these non-Interstate routes with no access control are in sparsely developed areas. However, now is the time to develop access management policies that will guide future development along these corridors.

State Access Management Policies

Once it is recognized that the predominant function of certain classes of roads is moving traffic, a number of steps can be taken to ensure that these roads will continue to be able to perform that function in the future. Several states have developed access management policies as a remedy for some of the problems of congestion, capacity loss and accidents that result from uncontrolled development along major highways. Often these policies relate the degree of access restriction to a road's functional classification, the degree of adjacent land development, and the amount of traffic carried.

Colorado places particular importance upon preserving access control on its arterial facilities. A central theme of their Highway Access Code is "... the proliferation of driveways and other access approaches is a major contributor to highway accidents and the greatest single factor behind the functional deterioration of highways." (3) Colorado has developed different levels of access for five classes of roads. The three highest levels are for arterial facilities. At the highest level are freeways which have full access control. Next, are arterial highways that are in a stage design for upgrade to freeways. Colorado acquires the access rights from property owners, but allows at-grade intersections at one mile intervals in rural areas and at one-half mile intervals in urban areas. For other urban and most rural arterials, deeded access rights may be acquired and traffic signals are located at one-half mile intervals. Access to the entire 9,200 mile state system is regulated through a license system.

Florida has assigned an access classification and a design standard to all segments of their state highway system. The entire state system has seven levels of access, based on the degree of development along the right of way and posted speed limits. The standards affect minimum spacing between connections, minimum spacing between openings in the medians and minimum spacing between traffic signals.

New Jersey also adopted an access management policy that considers seven levels of access (LOS). Although their seven LOS are currently related to the existing roadway's geometrics, N.J. proposes to apply these standards based on a road's functional classification, its geometrics, and its posted speed limit. Separate criteria are applied in urban and rural areas.

Wisconsin has had an access management policy since 1949 when their legislature gave the Highway Commission the authority to regulate access on all state trunk highways that had traffic exceeding 2,000 AADT (average annual daily traffic). Their policies are based on a road's functional classification, its design year AADT and the nature of adjacent land development. No private driveway or public road intersection may be opened without DOT approval. Wisconsin DOT also has the authority to acquire and, thus, control individual access rights.

Oregon classifies its highway system by four levels of service: Interstate, Statewide, Regional and District. Statewide highways function to provide high speed continuous flow operation in rural areas and moderate to high speed operation with limited interruptions of flow in urban areas.

Oregon uses a variety of methods to manage access on their main arteries. In particular, the State integrates transportation planning and land use planning. Oregon works closely with local government to ensure that land redevelopment is coordinated with the transportation system. The State is notified by the locals of land use changes. Where access control is desired mutual support by State and local agencies will help ensure that it occurs.

Once a State recognizes the importance of restricting access on major arterials, it should adopt a policy to preserve the roads' ability to move traffic safely and efficiently. After adopting such policies there are a variety of mechanism to use in implementing them.

Steps That Could Be Taken To Preserve Access On The NHS

Effective access management policies should address a number of issues. A recent NCHRP report (4) *recommended that the following elements should be* considered: "(1) the classification of the road to which access is requested, (2) the type of access requested relative to the allowable access, (3) relevant spacing standards, (4) highway and intersection capacity, (5) geometric design considerations, (6) the type of proposed traffic control, (7) guidelines for access denial where reasonable alternative access exists, and (8) the need, if required, for any variance to access permit criteria." It should also address the conditions when abutting property owners are entitled to compensation, the legislation needed to implement these policies, and how these policies will be implemented and coordination between State and local government agencies.

Oregon works closely with local government in the land development process. All request for road approach permits to the state highway system are submitted to the State. This alerts the State whenever any land use changes are being pursued. Oregon has found that by getting involved early in the process they can influence property owner's plans before any significant cost and effort have occurred.
Their first step after receiving a request is to perform a conceptual review, so that changes can be made before significant effort and cost have occurred.

Oregon's legislation addresses several policy issues (5). Their policy prescribes significant spacing between (or no) private access points for much of the state highway system. Properties with alternative access should not be given direct access. Properties without alternatives are given a single point of access unless frontage exceeds prescribed spacing. In some cases, the State has acquired access control rights.

The legislation also addresses the process of writing and issuing road approach permits. Construction or alteration of approach roads require a permit from state. And it requires local agency review as well. It should also address the conditions when abutting property owners are entitled to compensation, the necessary legislation that should exist, how these policies will be implemented and coordination between State and local government agencies.

Several states have considered the concept of a strategic arterial system to complement their expressways. These strategic arterials are considered the most important principal arterial routes and would be designed to emphasize the movement of regional traffic. (4) Illinois DOT has designed a 1,340 mile network in Northeastern Illinois. Among the steps that they'll take to manage access on this system include providing raised medium whenever possible, consolidating access on suburban routes into access spacings of 500 foot apart, and providing frontage roads on rural highways as well as providing for future grade separation at interchanges.

A proposed strategic arterial system for Harris County Texas would include the following design features: median barriers, prohibition of left turns, auxiliary right-hand lanes for emergency parking, provision for U-turns, and signalized intersection spacing of 1-2 miles with preferential green time of 70%.

Summary

In the next few years we will have a unique opportunity to ensure that America's mobility needs for the 21st century can be satisfied. The Interstate Highway System has served as the backbone of our transportation system for the latter part of the 20th century and it will continue that role. However, Interstate highways alone will not be able to provide for all our mobility needs. Now that system will be reinforced by over 100,000 miles of additional routes on the National Highway System.

While the Interstates were constructed on new location and designed to have full access control, most of the additional NHS routes already exist and most of these routes have no existing access control features. Will these routes be able to handle tomorrow's traffic? Probably not, unless steps are taken to manage access to the system and preserve new corridors wherever possible.

References

1. Highway Functional Classification: Concepts, Criteria and Procedures. FHWA, U.S. Department of Transportation, 1974.

2. Highway Functional Classification: A Management Tool, FHWA, U.S. Department of Transportation, 1982.

3. "The State Highway Access Code", State of Colorado Department of Highways, August 15, 1985.

4. F. J. Koepke and H.S. Levinson, "Access Management Guidelines for Activity Centers". NCHRP Report 348, TRB, National Research Council, Washington, D.C., 1992.

5. X.R. Falconi, "Access Management: Relationship Between Developers, Local Government and State Government", Institute of Transportation Engineers, Compendium of Technical Papers, 61 st Annual Meeting, Milwaukee, 1991.

ACCESS MANAGEMENT AND CORRIDOR PRESERVATION

Robert A. Johnson
Federal Highway Administration

Over the past four decades, federal, state and local governments have created a magnificent highway transportation network. The backbone of this network is the Interstate System. That system, and the road design concepts used in creating it, impacted the development of our cities and accelerated growth in rural areas like no other public works project in history. Interstate mobility has been vastly improved. Urban mobility has also been improved, at least in providing access to central cities. Those of you that live in major metropolitan areas and commute by car during rush hour(s) may question that statement.

Our commitment to transportation in and around our cities was based on perceived needs to serve the economy of 20 plus years ago. The job center was downtown. People lived in the 'burbs'. We built the roads to meet those needs. We provided mass transit, HOV lanes, reversible lanes, and other innovative methods to move people to and from the centralized work place. In many cases the solutions didn't work and somewhere along the line our economy changed. We ceased being a manufacturing nation, and saw a rapid growth in our service economy.

Our road network, replete with fashionable cloverleaf interchanges provided many new locations around the central city to create suburban work places. These suburban office and commercial sites now rival the Central Business District as job centers. Also, the suburban retail developments, the malls, in all shapes and sizes, have changed where and how we shop. These changes created new travel demands on our developed road network. Suburb to suburb, central city to suburb, and cross city commutes were required to connect housing with jobs and retail centers. The network was not designed for these diverse travel patterns.

It certainly wasn't designed to accommodate the other major change that occurred during this period. That change was the increased number, in metropolitan areas especially, of two or three income households. The additional job holders only compounded road network deficiencies. From a highway perspective the past two decades have seen a major increase in the number of vehicle-miles driven, the number of car registrations, and the number of licensed drivers. The increased road mileage (+4.5 %) during that same period has been nominal while the capital outlay for road improvements (-10 %) was actually less when computed based on 1968 dollars.

What does all this have to do with access management? Well for one thing, the additional travel demands made by our dispersed population, requires our arterial roads handle successfully an increasing volume of traffic, and that they do it for as long a period as possible, in as safe a manner as possible. The alternative may require more capital investment in new facilities, whether for highway or transit. Providing new facilities involves an extensive commitment of governmental (Public) resources in both personnel and funding, over increasingly long implementation periods. Serving immediate needs can be better accomplished by sound management of existing facilities and taking active, prudent steps to preserve and enhance their operational characteristics. Access management is a way to achieve these ends within existing transportation corridors and preserve our investment in our existing system.

A major part of access management deals with intersection design, spacing of access points, and application of signalization technology. A critical factor to the success of preserving capacity along existing highways is the coordination of development along the roadway. How landowners adjoining our facility use or develop their property and gain access to the highway system has a direct impact on how well we can serve the highway user. Land use and access considerations are critical to a successful capacity preservation program.

Preservation considerations have been a part of the highway development process for some time. As project development cycles lengthened and budgetary considerations delayed highway agencies capability to begin right-of-way acquisition along new alignments, several highway agencies used advance acquisition or protective purchase programs to forestall imminent development. Such action protected the alignment, and assured that future construction would not be delayed because of accelerating private development in the area and the added cost in time and money that would be required to acquire and provide relocation services for fully developed properties.

Preservation as a concept for use during the early development of highway facilities was first discussed during the mid to late 80's. The concept originated when new facility alignments were lost during the extended development process because land use changes and related environmental impacts made the potential development too costly. Even where new facilities were built, they often were delayed for years and required extensive mitigation efforts to comply with environmental concerns. Although various jurisdictions had attempted forms of corridor preservation, there has been few processes institutionalized to date. The concept is still evolving. A brief history of what has occurred in recent years and what is currently underway is in order.

The first major study on the subject was initiated by AASHTO in 1988. Based on a survey of all states they published a report in July, 1990 that pointed out substantial benefits to use preservation initiatives to protect corridors early in the project development process. With systems planning as a foundation, Corridor Preservation was a way to compete for a valuable resource, land. If used during the normal project development process there could be more assurance that a needed, and vital transportation facility could be constructed in a timely manner. The report made fourteen (14) major recommendations. It drew on the experience of numerous state and local agencies that had expanded on the use of alignment protection and used various corridor preservation strategies. Some of the key recommendations were...

A. Accentuate environmental considerations in early planning

B. Prioritize corridors

   1. Ability to avoid sensitive areas.
   2. Significant development in immediate area
   3. Necessity of Project
   4. Rapidly increasing values
   5. Improvement will be priority in 10-15 years
   6. Relocations can be kept to a minimum
   7. Cooperation is attainable.

C. Improve coordination and cooperation between levels of government, and with the private sector.

D. Be creative in implementing corridor preservation

In addition to the above, the report recommended further study be done to seek good models for implementing preservation strategies. It recommended that a course be developed to promote the concept and it provided some interim recommendations on how to make the concept work within existing NEPA, and project development regulations.

Based on the AASHTO report, the FHWA initiated three research contracts within the past three years. The first contract titled "Corridor Preservation: Case Studies and Analysis of Factors in Decisionmaking" has produced a draft report to be used by transportation program administrators in evaluating projects as candidates for corridor preservation. A number of case studies were used to identify the range of techniques available to protect transportation corridors. The study pinpoints the critical factors to consider prior to using preservation measures. The draft report is now in final review.

The findings and case studies from the initial research were the foundation for a second research effort. This second contract titled "Corridor Preservation: Techniques and Applications" involved development of a training course to provide technical staff with the tools necessary to apply corridor preservation techniques to specific projects. Three pilot courses were presented during 1992 and the course was finalized by mid-1993. It has been presented twice this year with four or five other presentations planned. The course is available for presentation through the NHI and is listed as Course Number 15130. It is a two day course designed for presentation to a mix of disciplines including planners, environmental specialists, and right-of-way personnel from local, state and federal agencies involved in transportation programs. The course stresses inter-disciplinary and inter-agency coordination, and promotes the use of a variety of regulatory, negotiated agreements, and acquisition techniques to maintain options within planned transportation corridors.

The third research effort is titled "Corridor Preservation: Legal and Institutional Barriers". This study is designed to produce a guidebook for use by State and local government officials to identify ways to overcome barriers that exist for successfully implementing corridor preservation strategies. A draft task report has been prepared which identifies critical institutional and legal barriers. The remainder of the research project will develop best case solutions to eliminate or lessen the impact of each identified barrier. Preservation options covered by the study include official mapping laws, land use planning and development controls, land acquisition, and access management.

Recent legislation has also addressed corridor preservation. The ISTEA contains several specific provisions relating to Corridor Preservation. In both new sections relating to the development of a revised metropolitan planning process and the totally new statewide planning process, several factors listed for consideration are directly tied to finding ways to preserve both existing and future transportation corridors. A key element is the consideration of policy decisions on land use and development. The linkage of transportation development with land use is a fundamental concept necessary to implement successful preservation strategies.

The ISTEA contains several other references to preservation of corridors, or rights-of-way. In Section 1017(c) Congress requested a report, listing rights-of-way identified by MPOs and States where preservation would be necessary to prevent further loss. The coordination process to gather information began in December of last year. Through our Division Offices we sought identification of three basic types of corridors where preservation actions might be appropriate. The first, came from a literal reading of the Congressional request. We asked for identification of abandoned rail or other transportation facilities where assembled rights-of-way would be lost if action were not taken to preserve the already acquired alignment. This area has been a concern of special interest groups and throughout the ISTEA one can find indications that conversion of rail lines to alternative transportation uses is a desirable objective.

The preservation of future corridors was a second form of corridor we requested be identified. These corridors more closely conform to the type of preservation program addressed by the AASHTO study. While regulatory measures using official maps are the predominant way to preserve planned corridors, there can be costs associated with programs that use key parcel acquisition. Such a program seeks to preserve alignment options within a planned transportation corridor by selectively buying keystone parcels of land. Use of this type of buying program for many states is limited, at least with the use of eminent domain, because specific project need will in most cases not be clearly defined during the early stages of project planning.

Finally we asked for identification of existing facilities where action was required in order to preserve or enhance capacity. These projects directly relate to access management concerns. Based on a preliminary review of submissions received from all 50 states, this also is the area where most preservation activity can be expected to take place. In fact, several of the States that have pilot corridor preservation projects in place are involved with work along existing facilities.

What then is corridor preservation? One definition taken from the current training course is that ...

> "Corridor Preservation is the **coordinated application** of **various measures** to **obtain control** of or otherwise **protect** the right-of-way needed for an **existing** or **planned** transportation facility..."

The key elements in the definition provide that preservation requires a coordinated process. All parties must be aware of what is being planned and how plans are to be implemented. Secondly, the process is applied, which means action must be taken. Preservation action involves the use of various measures in order to be effective. From the research case studies it was obvious that the most successful programs use combinations of tools or strategies to preserve corridors. Regulatory controls predominate, but amicable negotiations with private owners and developers to acquire land interests were also used.

What are the basic tools available for preservation programs? As indicated the primary tools use available regulatory action by state or local governments under their police powers. These tools include:

* Entrance permit regulations
* Setback ordinances
* Exactions in connection with zoning or development approvals

Negotiated agreements are also available to protect corridors. Some of these include...

* Inducements
* Transferable development rights
* Land Swaps
* Provisions for alternate access
* Purchase Options

When all else fails there is available in some jurisdictions the purchase option. Either full fee acquisition or the purchase of a lesser land interest such as development easement could be used to keep development out of corridors under study or planned for development.

While most jurisdictions have available some or all of the above tools, there has been reluctance to use them to place restrictions on land development. The main factor that impedes the use of land use controls is the "taking" issue. Just when the use of police powers will create a "taking" has been a moving and evolving issues. The bottom line however is that when created, the finding requires payment of "just compensation" as a remedy. Such findings when not in the normal budget cause consternation of officials and create the atmosphere that leads to the reluctance to actively use land use controls that may be available.

The concepts and controls for preserving corridors when coordinated with an active access management program can preserve or enhance roadway capacity, promote safety, and assist in the orderly growth of surrounding communities.

To be effective the controls to be imposed must be coordinated with the community through an active public involvement program. Private citizens must know what is being planned. Consequences for inaction must be clearly defined. Internal cooperation within local governments must also be improved. Land use and building permit sections must be aware of transportation needs and concerns. Personnel needs to get out of their organizational box and expand their view of how their actions affect others.

The application of corridor preservation concepts blend quite well with the goals sought by access management. All of the engineering expertise available to maintain a safe flow of traffic along a non-access controlled facility will be wasted if land development issues have not been appropriately addressed. Since both the access rights and development rights of property owners are a part of the police powers of government, it is appropriate to assure that they be properly coordinated to enhance the public safety, and to reduce the cost related with providing new capacity.

The application of controls must of course comply with constraints to regulate imposed by the U.S. Constitution. To build a preservation program will require that we find a way to meet, and sell, the concept that what we are about is serving the general public interest. Therefore as we develop our long range planning objectives for providing transportation improvements we will need to 'consider' the advisability of preserving our existing facilities, and protecting our options along planned corridors using corridor preservation tools and strategies. By considering the use of preservation during development of annual improvement programs, including public involvement in developing appropriate policies the appropriate coordination and buy-in may be achieved. As programs are developed we must take care that standards adopted are reasonable and are not applied capriciously or they will fail. Further, they must not be unduly oppressive, or they will fail. In order to meet the diverse needs within an area they will have to have built in flexibility if they are to succeed.

Session 2

Legal Aspects of Access Management

Moderated by Randall Sampson, Colorado Department of Law

The second technical session focused on legal aspects of access management. While the planning and engineering aspects of access management often receive the bulk of the attention, the importance of legal concerns must not be overlooked. This session examined state access control statutes, constitutional and case laws, property rights, police power, denials of access, the use of guidelines vs. regulations, and access modifications in project related eminent domain proceedings. The session featured three speakers from New Jersey and Colorado, two states that have active access management programs and extensive experience dealing with access related legal issues.

The first speaker was Charles Guenzel of New Jersey DOT, who presented a paper for Mark Stout also of New Jersey DOT. The paper, entitled "New Jersey's State Highway Access Management Act," presents an overview of the State Highway Access Act. The act, which was passed in 1989, authorized the state department of transportation to adopt an access code. The author describes the process by which the New Jersey act was reviewed and adopted and makes recommendations for other states that may be considering similar programs.

The next speaker was Harry Morrow, Assistant Attorney General for the Colorado Department of Law, who presented a paper entitled, "Constitutional and Case Law Principles Guiding Access Control." In it he presents the primary methods for controlling access to highways, general concepts of eminent domain and the government's police power, and the nature of the property right of access. He concludes with examples of access management projects and project related litigation.

The final paper was presented by Randall Sampson, also Assistant Attorney General for the State of Colorado. Entitled "A Legal Perspective on Colorado's Experience with Regulatory Control of Highway Access," the paper describes certain legal factors, such as the standard of review and placement of the burden of proof, which have contributed to Colorado's success in sustaining its access determinations when challenged on appeal. It then provides several case examples of access appeal rulings in the State of Colorado.

The session was attended by approximately 150 people. Questions and answers for the speakers are summarized in the discussion section for Sessions 1 and 2.

NEW JERSEY'S STATE HIGHWAY ACCESS MANAGEMENT ACT

Mark L. Stout
New Jersey Department of Transportation

Abstract
In 1989, the New Jersey legislature enacted a State Highway Access Management Act authorizing the state department of transportation to adopt an access code. The bill grew out of a study of the "Route 1 Corridor" which determined that the state had inadequate powers to manage access on land service highways in growth corridors.
The seven main provisions of the bill, as enacted, are: (1) a statement of purpose which clearly articulates the reasoning behind the bill, (2) authority to adopt an access code, (3) a description of the required elements of the code, (4) a provision requiring a new access permit application where certain "change in use" conditions have been met, (5) a provision authorizing revocation of permits in specified cases where an "alternative access" procedure has been followed, (6) a provision authorizing detailed, site-specific "access management plans" to be jointly adopted by the state and a municipality, and (7) a requirement that municipalities incorporate the access code into local land use ordinances.

The bill underwent two years of legislative scrutiny and amendment before enactment. The main opposition to the bill came from a group of large-scale developers. The most controversial issue in the legislation was the revocation and alternative access provision.

The author recommends that anyone considering access legislation (1) review current law to see if a new law is needed, (2) get a thorough grounding in the legal issues, (3) clearly articulate the purpose of the legislation, and (4) be prepared to participate in a long and complicated legislative process.

In the 1980s New Jersey, despite its "rust belt" image, was experiencing an economic boom. Attracted by its Northeast Corridor location between New York and Philadelphia and its large tracts of undeveloped suburban land, developers and corporations were strewing the landscape with office parks, corporate headquarters, "back office" operations of New York--based firms, "high tech" research facilities and other white collar employment centers. The predominant form of development was freestanding office buildings on large, landscaped tracts fronting on state highways and remote from urban centers.

These developments were often highly prized by local officials eager for "clean," low-service property tax generators. Unfortunately, the resulting traffic problems and other infrastructure burdens only became widely apparent in an area after the development process was well underway. In particular, state and local officials were left with inadequate resources to expand congested state and local roads.

For most New Jerseyites, the archetype of the new development pattern, with all its cost and benefits, was what became known as the "Route 1 Corridor," a 19-mile long strip along U. S. Route 1 between Trenton and New Brunswick. Princeton University, a major land owner in the corridor, spearheaded the changes, developing large parcels near the highway into office buildings and research facilities. Other developers and major corporations followed. Within a few years, sod farms connected by 2-lane county roads were replaced with large employment centers. Unfortunately the same 2-lane county roads were still supplying much of the road network.

Route 1 itself, the spine of the corridor, was a 4-lane, divided, signalized, land service highway. With no freeway providing direct service to the area, Route 1 had to serve a wide variety of highway uses--regional traffic, journey-to-work traffic for the new employment centers, and shopping trips.

The New Jersey Department of Transportation, painfully aware of its inability to meet the demand for new transportation infrastructure stemming from the boom on Route 1 and other growth corridors, began a major Route 1 corridor planning study in 1983. The study was a pilot for other corridor studies in the state and incorporated land use, demographic, and economic work as well as traffic and infrastructure analysis. A major effort was made to involve local officials, developers, and citizens groups in the study effort.

The initial findings of the study effort confirmed the Department's view that it would be impossible--as well as destructive--to meet the needs of unmanaged growth through building new highways and expanding the capacity of existing ones. The Department began to pursue a new policy, which it has continued to pursue through changing administrations, of emphasizing the need to coordinate land use planning and infrastructure planning.

In particular, the study identified three deficiencies in New Jersey state law which needed to be addressed to provide state and local officials with the tools to connect land use and transportation. First, the Department of Transportation needed statutory authority to adopt an access management code on state highways to cope with the debilitating effects of proliferating access points on land service highways, such as Route 1. Second, a transportation development district mechanism was called for to enable state and local officials to pool "off-site" developer contributions to finance key transportation improvements on a joint planning basis. Third, a complete overhaul of the inadequate county planning statutes was recommended as a way of institutionalizing regional land use planning.

Three bills were drafted and discussed with legislative leaders. The need for solutions to the problem of unmanaged growth was so widely felt that all three bills were formally introduced in the Legislature in the fall of 1986 with the bipartisan sponsorship of all members of the Senate and Assembly transportation committees. "Transplan" was the popular name given to the whole package.

The State Highway Access Management Act, the subject of this paper, was enacted in February, 1989 (P. L. 1989, c. 32). The New Jersey Transportation Development District Act, which established a new, county-based, public-private planning and financing mechanism, was enacted in June of that year (P.L. 1989, c. 100). The third Transplan bill, the County-Municipal Planning Partnership Amendments bill, ran afoul of traditional jealousies between county and municipal governments and was not passed. The need for improved regional land use planning has been met, in part, by new mechanisms being developed under New Jersey's State Planning Act, but the county planning statutes are still archaic and inadequate.

In 1986, when the State Highway Access Management Act was first introduced, access to state highways was governed by an old provision of law that required any person encroaching on a state highway to obtain a permit. After decades of court decisions, attorney generals' rulings, and Department of Transportation practice, the actual state of affairs was that the Department granted a permit to virtually any abutting landowner who applied for one and virtually never revoked or amended one due to changed circumstances. The Department's ability even to use eminent domain powers to remove an access point with compensation was severely restricted. In practice, good access planning, in terms of location, spacing, and geometric design, was the result, where it happened at all, of a landowner's own initiative or of Department "jawboning."

The Route 1 corridor study had led planners to believe that access management could be a low-cost, effective way to preserve arterial flow on land-service highways. This solution was felt to be particularly valuable along the state's growth corridors, where feasible and affordable physical improvements were bound to be too little and too late to prevent worsening congestion. Colorado's access management code had been studied by Department staff and was used as a benchmark for New Jersey efforts.

New Jersey's encroachment statute was obviously much too weak a foundation upon which to build a regulatory structure. The main goal of the proposed State Highway Access Management Act was, therefore, to give the Department clear statutory authority to adopt regulations implementing an access code. At the same time, the bill was used as a vehicle to correct deficiencies in the statute governing full access control highways, the freeways and parkways act of 1945.

When the three-bill Transplan package was introduced, proponents anticipated that the access bill would be the least controversial and the first to be enacted. They also anticipated that the main opposition would come from small retailers and gas station owners, whose businesses were very sensitive to highway access, and not from large developers, who were normally induced to provide high quality access as a result of negotiations.

In the event, opposition to the bill was led by a loose coalition of large Route 1 corridor developers, the "Princeton Area Developers," who engaged an influential former commissioner of transportation to represent them. Fortunately for proponents of the legislation, the Princeton Area Developers from the beginning said that they would not oppose enactment of a bill altogether, provided it was amended ~o address their concerns. Much of the 28 months between initial introduction and final enactment was consumed with negotiations between Department of Transportation staff and the Princeton Area Developers group, mediated by staff from the Senate and Assembly transportation committees. Key to this process was Senator Walter Rand, chairman of the Senate transportation committee, who used his prestige to insist that all parties interested in the legislation negotiate to resolve their differences and agree to support the resulting compromise provisions.

As we shall see below, the main interest of the Princeton Area Developers group was to incorporate into the bill additional procedural safeguards for adoption of the access management code and, more importantly, additional safeguards and standards for implementation of certain key features of the code.

The bill, as enacted, has seven main provisions dealing with adoption of an access management code.

1. Statement of purpose

The drafters felt it to be essential that the bill incorporate a clear statement of the purposes and reasoning behind the bill. In New Jersey law, the legislative "findings and declarations" contained in the body of a statute often constitute the only basis on which legislative intent can be construed. Since future litigation could be anticipated and since a series of U.S. Supreme Court and other court decisions had recently focussed new attention on the legal boundary between what constituted legitimate regulation and what constituted a compensable taking, the drafters consulted leading land use attorneys and attempted to set out a clear statement of state interest in access management.

The main "findings" in the bill are that:

- "The purpose of the State highway system is to serve as a network of principal arterial routes for the safe and efficient movement of people and goods in the major travel corridors of the State."

- These highways "were constructed at great public expense and constitute irreplaceable public assets."

- The state has a "public trust responsibility to manage and maintain effectively each highway within the State highway system to preserve its functional integrity and public purpose for the present and future generations."

- "Land development activities [the word "inappropriate" was stricken by amendment] and unrestricted access to State highways can impair the purpose of the State highway system and damage the public investment in that system."

- Property owners have a "right of reasonable access to the general system of streets and highways in the State, but not to a particular means of access."

- The right of access is subject to regulation for "public health, safety and welfare."

- Elimination of all access requires compensation.

- Access rights of individuals must be "subordinate to the public's right and interest in a safe and efficient highway."

- It is desirable for the Department of Transportation to adopt access management regulations to protect the "functional integrity" of the state highway system.

With the exception of the deletion of the word "inappropriate," as noted above, these provisions remained intact throughout the legislative process.

Two other findings were added by amendment:

- Areas of strip commercial development should not by reason of those characteristics alone be classified as "urban," and in these areas the Department should seek to mitigate nuisances of congestion, high accident rates, and low speeds.

- The Department **should "avoid undue burdens on property owners and should,** where feasible, incorporate mitigation measures into comprehensive highway improvement programs."

2. Adoption of the code

The Commissioner of Transportation was charged, within one year of enactment, with adopting an access management code by regulation. Amendments were added during the course of the legislative process which required holding a number of public hearings on the draft code and setting up an advisory committee representing interests affected by the code to provide comments and recommendations. Perhaps not surprisingly, the detailed provisions of the code attracted as much controversy as the legislation, and a full three years was required for development and adoption of the code.

3. Elements of the code

The bill outlined a number of elements which were to be included in the code:

- A classification of state highways.

- A set of access standards appropriate to each designated classification, including standards for geometric design and spacing.

- A procedure for issuing, amending, and revoking access permits.

4. Change in use

One of the problems encountered under the old access permit system was that a permit, once issued, was virtually permanent regardless of changes in the land use it supported. The bill therefore included a provision that a permit would be considered to have expired when "the use of the property served by the access permit changes or is expanded."

The development community was dissatisfied with this broad language and argued for the incorporation of a specific standard. In the end, the phrase quoted above was amended to read: **"the use of the property served by the access permit changes <u>resulting</u> <u>in a significant increase in traffic</u> [emphasis added] or is expanded." "Significant increase" was defined as an increase "that adds the greater**

of 100 movements during the peak hour, **or 10 percent of the previously anticipated daily movements."**

5. Revocation where alternative access exists
As introduced, the bill contained a simple provision empowering the Commissioner of Transportation, to "upon written notice and hearing, revoke an access permit after determining that reasonable alternative access is available." The object of the provision was to give the Department a tool to shut down direct access to a state highway when the property could be better served, from a highway planning point of view, from access points on local roads connected to the state highway. The broad standard of "reasonable alternative access" was intended to allow specific revocation decisions to be made on a case-by-case basis. It was assumed that the property owner's rights would be ensured through more detailed standards in the regulations themselves, through the administrative hearing process required in the provision, and ultimately by the courts, which had shown themselves to be jealous of any perceived state evasion of compensation through regulatory overreaching.

In the event, this provision was the subject of more controversy than any other in the bill. As with the "change of use" provision discussed above, the developers, and especially the Princeton Area Developers group, argued forcefully that specific standards and protections should be written into the bill Although the amendments ultimately adopted were formally agreed to by all parties to the negotiations, they are characterized better as major concessions by the Department than as a compromise.

As enacted, the bill requires the Department to meet a number of rigorous requirements before a permit can be revoked under this provision:

- "Alternative access" must **be found to exist according to specified standards.** For instance, for commercial property, alternative access must provide a roadway which can "support commercial traffic" and which is "so situated that motorists will have a convenient, direct, and well-marked means of both reaching the business or use and returning to the highway."

- The property owner must be provided with a plan showing how alternative access is to be obtained.

- The Department is responsible for funding whatever improvements may be needed to establish alternative access. These could include driveway construction, on-site circulation improvements, signing on state highways, and relocation or removal costs.

6. Access management plans
In addition to the general standards governing access under the access management code, the Department of Transportation is authorized to adopt site-specific access plans as supplements to the code. These "access management plans" are detailed schemes designating existing and planned access points for a segment of state highway. They are intended to be adopted jointly by the Department, as part of the access management code, and by the municipality, as part of its planning and zoning documents. This provision offers municipalities the option of pursuing joint planning with the state and therefore developing land use plans with real teeth.

7. Incorporation into local land use codes
Under New Jersey law, municipalities have constitutionally protected powers over land use and zoning matters. State law can, however, set standards for master plans and zoning~ ordinances. The access management act requires all local site plan approval, subdivision approval, zoning, **and master planning ordinances** to conform to the provisions of the access management code.

The provisions summarized above authorized the New Jersey Department of Transportation to adopt an access management code. However, the statute also included other provisions relating to access issues, some of which will be noted here briefly.

First, the act authorized counties and municipalities to adopt access codes of their own. Although none has yet come forward, some local governments should find that this provision gives them an additional planning tool of some strength.

Second, the act empowered the Department to acquire access rights by purchase or condemnation on a finding of public health, safety, and welfare. This elementary power was previously clouded at best under state law.

Third, the act completely revised the old "freeways and parkways" statute and replaced it with modern provisions. Among many other changes, these new sections eliminated the need for a separate law each time a highway is to be built with limited access. Under the new law, all new state highways are to be built as access controlled facilities unless a finding is made justifying an exception.

Fourth, the act authorized the Department of Transportation to incorporate a "fair share" contribution provision into the access code. Under the original Transplan package, developer contribution issues were to be dealt with in general cases under the county-municipal planning bill. The Transportation Development District bill was to deal with developer contributions in designated districts. As the access bill began to move through the

Legislature (and the county-municipal planning bill languished) members of the development community put forward the idea that a "fair share" provision governing developer contributions for off-site improvements should be included in the access bill.

Their stated purpose was to provide a "fair share" rule which would safeguard against excessive **demands from the Department of Transportation.**

The enacted language said that no permit applicant could be "required to contribute an amount that exceeds his fair share of the costs of off-site improvements that have a rational nexus with **the proposed development on the property** for which the permit is requested." "Fair share" must be "based upon the added traffic growth attributable to the development."

In conclusion, the New Jersey State Highway Access Management Act was the product of more than a year of study and drafting and more than two years of legislative deliberation. The process demonstrated the importance and complexity of land use issues in a densely populated state like New Jersey. The product will, the author hopes, provide a durable and effective mechanism for better highway and land use planning for the public good.

Transportation statutes and legislative practice vary widely from state to state, and New Jersey's experience may not be directly applicable everywhere. However, anyone thinking about proposing access management legislation may want to consider these recommendations:

1. Review current state law, with the assistance of the attorney general's office, to see if a new statute is really needed. In New Jersey, the laws governing access were so deficient that a broad new legislative mandate was needed. This may not be the case everywhere .

2. Get a thorough grounding in the law governing eminent domain, compensable taking, and police power regulation. Consultation with the attorney general's office and land use attorneys in private practice and careful review of state and federal court decisions are important. Any new law in this sensitive area must be ready to meet tough judicial scrutiny.

3. Clearly articulate, in legislative language, legislative testimony, and public statements, the public purpose and benefits behind the legislation. Clear statements of purpose will help to focus legislative discussion as well as to prepare for future litigation.

4. Be prepared to participate in a long and complicated legislative process with unexpected twists. Many interests are affected by access management legislation and each of these must be addressed and, where possible, accommodated in the legislative process.

Constitutional and Case Law Principles Guiding Access Control; Access Modifications in Projects and Project Related Eminent Domain Proceedings

Harry Morrow
Assistant Attorney General
State of Colorado

I. Primary methods for controlling access to highways

A. Eminent domain (condemnation) proceedings for highway projects in which there is a concurrent exercise of the state's police power to control or limit access

B. Modifications which limit or control access made within the existing right of way

C. A regulatory program in which written regulations, such as Colorado's State Highway Access Code, or more informal guidelines establish where and in what fashion driveways may be constructed

II. General concepts of eminent domain and the police power

A. U.S. Constitution, 5th Amendment and Colorado Constitution, Article II, Section 15 protect private property from being taken for a public use without the payment of just compensation. Virtually all states have a similar constitutional provision, or a variation thereof, and all states (and other public entities) must pay just compensation when private property is taken for a public use.

1. The power of eminent domain (condemnation) is granted by statute to various entities for various public purposes

2. All state transportation agencies have the power of eminent domain for purposes of constructing and maintaining state highways.

B. Apart from the state's eminent domain power, but often exercised concurrently with the eminent domain power, is the state's police power. The police power is the authority to regulate activities for the public health, safety and welfare.

1. Proper exercise of the police power does not require the payment of compensation to private parties.

2. Regulatory activities undertaken by the states are numerous. One area of regulation is access control for the state highway system. In Colorado this police power has been recognized by statute, 43-2-147, C.R.S., and has been further defined by state regulations entitled the State Highway Access Code.

C. Focus of this presentation will not be access control under the written regulations (Access Code) but rather the concurrent exercise of the state's police power in the context of condemnation litigation or in project related modifications to existing or proposed access.

III. Nature of the property right of access

A. U.S. and state constitutions protect the taking of private property for public use without payment of just compensation. Access to property is recognized as one of the "bundle" of rights that comprises property ownership. Nature of the right of access varies among the states.

1. Some states (not Colorado) recognize a special property interest for a landowner whose property abuts roadways. These so-called "abutter's rights" jurisdictions hold that while an abutting landowner is not entitled to completely unrestricted access to all abutting streets or highways, if access to any abutting street or highway is eliminated, there is a taking of a property right and compensation is due as a matter of law. See, Department of Transportation v. Harkey, 301 S.E.2d 64 (N.C. 1983); Narloch v. Department of Transportation, 340 N.W.2d 542 (Wisc. 1983); Department of Transportation v. Whitehead, 317 S.E.2d 542 (Ga. 1983)

In these cases, even though the landowner retained other access, the 1088 of access to any abutting street was considered a compensable loss of a property right without an examination of the reasonableness of the remaining access. In these jurisdictions, presumably, if a property were bounded on all 4 sides by streets/highways and access was denied to one of the four streets (by turning a street into a limited access highway, for instance) there would be a compensable loss of access even though the property retained excellent access via the remaining 3 streets.

B. Arguably, early Colorado cases followed the "abutter's rights" rule. See Denver v. Bayer, 7 Colo. 113, 2P. 6 (1883); Minnequa Lumber Co. v. Denver, 67 Colo. 472, 186 P. 539 (1919); Denver Union Terminal v. Glodt, 67 Colo. 115, 186 P. 904 (1919). However, the more recent Colorado cases make it clear that an abutting landowner has no inviolable right of access to all abutting streets or highways. Rather, Colorado and many other jurisdictions focus on whether reasonable access to the property remains or whether there has been a *substantial impairment* of access to the property as a consequence of the highway project.

Troiano v. Colorado Department of Highways, 463 P.2d 448 (Colo. 1970), holds that "Right of access is subject to reasonable control and limitation. So long as a landowner retains a reasonable means of access to and from his property partial loss of access is not compensable." See also, Gayton v. Department of Highways, 149 Colo. 72, 367 P.2d 899 (1962) (if property has reasonable access to the street system, there is no compensable damage) and Shaklee v. Board of County Commissioners, 491 P.2d 1366 (1972) (access maybe reasonably limited so long as access is not substantially interfered with). State Department of Highways v. Davis, 626 P.2d 661 (Colo. 1981) states that the right of access is the right of a landowner who abuts a street or highway to reasonable ingress and egress. That right of access may be reasonably regulated under the police power and the landowner is entitled to compensation only where the limitation or loss of access substantially interferes with the means of ingress and egress. Department of Highways v. Interstate-Denver West, 791 P.2d 1119 (Colo. 1990), holds that elimination of access to one of two abutting streets does not constitute substantial impairment but, rather, is a valid exercise of the state's police power under the facts of the case. However, where access is substantially impaired the police power regulation of access goes "too far" and becomes a taking of access rights requiring the payment of compensation.

These Colorado cases make it clear that, generally, control of access is a legitimate exercise of the state's police power (requiring no compensation) but that if the regulation goes "too far" such that reasonable access does not exist or access is substantially impaired, the constitutional requirement of just compensation is triggered because the regulation has become a taking of a property right.

IV. Examples of access control in projects or project related litigation

A. Installation of solid raised median limiting former full movement access to right-in/right-out access. Thornton v. City of Colorado Springs, 173 Colo. 357, 478 P.2d 665 (1970) and Hayutin v. Colorado Department of Highways, 175 Colo. 85, 485 P.2d 896 (1971) hold that the construction of a raised median resulting in inconvenience or more circuitous route is not a compensable taking or damaging of property. Rather, such action is a valid exercise of the state's police power because reasonable access remains (right turns in and out) and no substantial impairment of access has occurred.

B. Construction of elevated roadways making access to property at grade more circuitous and inconvenient. Troiano v. Colorado Department of Highways, supra, and Radinsky v. Denver, 159 Colo. 134, 410 P.2 644 (1966) hold that property which retains reasonable access to the general street system is not entitled to damages even though construction of viaducts result in greater inconvenience and circuity. In these cases, the property retained access at grade although the improvement routed the majority of traffic away from the at-grade roads.

C. Creation of a limited access highway from an uncontrolled access road. Shaklee v. Board of County Commissioners, supra holds that limiting a property to 2 accesses on its frontage to highway is not compensable. State Department of Highways v. Davis, supra, holds that even though there is a taking of land accompanied by a limitation of access (land was taken for construction of a frontage road--property which formerly had direct access to highway was to have access only to frontage road) the landowner is not entitled to compensation for the limitation of access. The concurrent exercise of the state's police power (eliminating direct access to highway) was not compensable even though it accompanied a compensable taking of real property.

D. Conversion of city street to pedestrian mall. City of Boulder v. Kahn's Inc., 543 P.2d 711 (1975), holds that construction of a pedestrian mall limiting vehicular access to an alley in back of a store was not a compensable taking of access rights.

E. Loss of access to one of two abutting streets. Interstate-Denver West v. Department of Highways, supra, held that the taking of property and the construction of a freeway which eliminated all access to one of two streets abutting parcel did not result in substantial impairment of access under the facts of the case. Since property had reasonable access via the remaining street, loss of access was not a compensable taking but, rather, was a valid exercise of the state's police power in connection with a taking.

V. Conclusion

A. Providing reasonable access and not substantially impairing access is the predominant legal concept behind access control. How the courts of a particular jurisdiction interpret reasonable access and substantial impairment may vary significantly.

B. In Colorado and most other jurisdictions, construction of medians and limitation of multiple accesses to a single access on an abutting highway can be accomplished without the payment of compensation so long as reasonable access remains. Similarly, construction of viaducts and elimination of direct access and the attendant creation of greater circuity of route are generally viewed as non-compensable police power acts.

C. Payment for the limitation of all access to an abutting street may or may not be required depending on the law of the jurisdiction in question. In some jurisdictions, such limitation creates the right to compensation regardless of the quality of the remaining access to the property. In Colorado and most other jurisdictions, the test is whether the property retains reasonable access or if the access has been substantially impaired. In such states, the loss or limitation of access is not a constitutional taking of access rights if reasonable access remains. The concurrent exercise of the state's police power is justified even in the context of a taking of real property (which requires compensation) if the loss or limitation of access does not substantially impair the remaining access.

A Legal Perspective on Colorado's Experience with Regulatory Control of Highway Access

Randall W. Sampson
Assistant Attorney General
State of Colorado

Introduction

Since case decisions involving access usually revolve around the issue of whether a limitation on access is compensable or can be accomplished as a non-compensable exercise of the police power,[1] any contemplated *regulatory* (i.e., "police power") program of access management[2] will be defined, in no small part, by the case law of the jurisdiction. Judicially-created law on highway access, and the extent of the "right" of access, varies greatly from state to state and, within some states, from era to era.[3] A perpetual dichotomy seems to exist in the law, however, which stems from a fundamental question as to the nature of access, itself. One school of thought holds that access "rights" are but one of the bundle of rights incidental to a parcel of real estate.[4] Its focus is "needs-based," and defines the limits of the right as no more than "reasonable access" to and from the general street system. The other "rights-based" school of thought views access as a compensable property interest, distinct and apart from the land to which it relates, and usually refers to this special property interest as an "easement of access" to and from the highway immediately appurtenant to one's property.[5] Within each school are innumerable cases sounding additional variations on the theme, highly dependent upon their specific facts and often confusing in their use of "shibboleths," meant to explain the particular holding of compensability or non-compensability but, in reality, devoid of much meaning.[6]

Such diversity and confusion makes difficult any more than broad generalizations about the state of access law and the prospects for regulatory access management programs across the various jurisdictions. Laying the groundwork for a comprehensive, legislatively-endorsed regulatory program of access management in a given state should, of course, include a careful analysis of that state's judicial decisions relating to access, but also entail an assessment of the proposal's prospects in the legislature and the risks inherent in offering up proposed legislation to lawmakers with varied and, perhaps, indiscernible constituencies and motivations. Despite such sobering considerations, it can be stated with relative confidence that the case law of the vast majority of states does not, *itself*, prevent the enactment of a substantial and effective regulatory program of access management. While in some states, for example, a transportation agency might be unable to close an existing driveway, absent the payment of compensation, or "reasonable access" is interpreted more liberally to favor the landowner, traditional regulatory measures such as design requirements, median installations, and turn limitations remain available to almost every jurisdiction.[7] Such measures can provide the substance of an effective regulation-based program of access management, particularly when combined with functional highway classification schemes and the like.

To those contemplating such a program, a brief look at Colorado's experience, from a legal perspective, may provide some insight.

Colorado's Experience

With regard to matters of access, Colorado courts wrote early[8] and often.[9] Its long history of judicial decisions arguably might conjure up the *Sauer*[10] court's description of access law,[11] but, in reality, a clarifying series of decisions, including *Troiano* and *Shaklee, supra*, and culminating in *State Dept. of Highways v. Davis*, 626 P. 2d 661 (Colo. 1981), set the stage for Colorado's foray into legislatively-endorsed, comprehensive regulatory control of highway access,[12] under the limiting banner of "reasonable access to the general street system."[13]

Colorado's enabling legislation, section 43-2-147, C.R.S., carried into statute the concept of a limited right of access, so evident in the state's judge-made law. The broad grant of authority[14] to the state department of highways (now, by statute, known as the department of transportation) to regulate vehicular access itself declared that its provisions "shall not be deemed to deny reasonable access to the general street system"[15] and directed that the criteria of the access code (to be adopted by the highway commission as a rule and regulation[16]) be based upon a consideration of , among other things, "the availability of vehicular access from local streets and roads rather than a state highway, and reasonable access by city streets and county roads."[17]

The view of highway access as a limited right, appropriate for comprehensive regulation and subordinate to the traveling public's interest, finds its strongest voice in the State Highway Access Code, 2 CCR[18] 601-1, the rule and regulation adopted pursuant to the access statute, section 43-2-147, C.R.S. Intended to implement the broad mandate of the statute, the access code represents the foundation and framework of Colorado's access management program, laying out the procedural requirements for permit applications, suspension actions, and hearings, creating functional highway classifications which serve to determine how much, and what kind of, access will be allowed, and defining design and construction standards for those access points.

Thousands of access permit applications have been processed under Colorado's access management program during the twelve years that the code has been in effect and, perhaps, a comprehensive assessment of the operation of the code, from administrative and engineering standpoints, is timely. Such an effort, however, is beyond the scope of this modest work, which seeks merely to suggest, from a narrow legal perspective, a basis for the program's success[19] in sustaining determinations rendered under the access statute and access code. After all, the most comprehensive and innovative program to regulate access is only as successful as its ability to sustain, when challenged, decisions made under it.

By way of background, twelve years of statute and regulation-based access management have yielded twenty-three cases[20] which moved beyond department-level administrative action to a full, evidentiary "appeal."[21] In 70 percent of those cases, the action precipitating the subsequent hearing before an administrative law judge was the department's denial of an application for new access (52%) or its denial of a request to modify an existing access or otherwise change the status of an access permit (18%). The remaining 30 percent involved department-initiated access closures or efforts to suspend or revoke permits. In a surprising 70 percent of the appeals, the landowner/applicant was represented by legal counsel, a product, no doubt, of the importance which landowners and developers generally attach to maximizing access to their properties, particularly commercial parcels. The hearings, themselves, often were extensive and usually involved testimony from traffic engineers.[22] More than a third of the hearings lasted longer than a day, with four hearings continuing into a third day. Finally, in 30 percent of the appeals, including the first four, the landowner/applicant claimed that the department's action amounted to an unconstitutional taking of a property interest. Appendix A provides a statistical synopsis of the twenty-three cases. A legal summary of some of the more noteworthy decisions can be found in Appendix B.

Of the twenty-three decisions,[23] twenty-one sustained the action of the department (made at the district office level after review of the application and, usually, an applicant-supplied traffic study).[24] This 91 percent "success" rate is influenced, no doubt, by many hard-to-quantify factors, such as the quality of witnesses at the hearing or the quality of the review process, itself, within the district office. Four distinct legal elements, however, seem to constitute the cornerstones on which has been built the department's success at making its regulatory decisions under the access code "stick."

First and foremost is Colorado's "background" law on access. Those whose duties require them to apply and enforce the access code work with a regulation enabled, and given force, by the access statute's wide-armed embrace of the concept of access regulation as a legitimate and *necessary* exercise of the police power for the public good.[25] Coupled with this *legislative* endorsement, and largely predating it, is the aforementioned *judicial* stamp of approval, consistently applied since, at least, the early 1960's.[26] Such a limitation-friendly environment rightfully can be presumed to have lent credence to access-limiting actions taken by the department and challenged before an administrative law judge. More importantly, however, that backdrop allowed for the "presumptive slant" evident in the access code's drafting, which leads to the second cornerstone.

The burden of proof, by virtue of that presumptive tilt away from the allowance of access, is on the landowner/applicant at the department level when new access is being sought. An applicant for an access permit to a Category 3 highway, a category comprising over 80 percent of the state's highways,[27] must meet certain thresholds in order to qualify for direct access,[28] overcome the limitation to right turns only,[29] or receive more than one access.[30] A landowner/applicant who fails to meet that burden in the determination of the department, but who then appeals, is accompanied on his appellate adventures by a continuing burden in that the access statute, section 43-2-147(6)(c), mandates that the appeal hearing be conducted in accordance with the state administrative procedure act, section 24-4-105(7), C.R.S., which, in turn, provides that "the proponent of an order shall have the burden of proof . . . ."[31] This second, or appellate, burden, however, comes with a twist. As important as the two-tiered burden of proof has been in the department's success, it is this twist which leads us to the third and, perhaps, most important cornerstone in the development of a history of consistent confirmation of the department's access management decisions.

While the merits of the access application, and its consistency with the access code, are "front and center" issues during the departmental review of the application, the focus shifts on appeal. What is *allowed* to be proven by the landowner/applicant changes. On appeal before an administrative law judge, the landowner/applicant must prove, not conformity with the code's criteria, or that a "better" conclusion or solution exists than that reached by the department. Rather, in order to have the department's determination overturned, the landowner/applicant essentially must prove that the department was unreasonable or arbitrary and capricious in reaching that determination. If the burden of proof *tilts* the playing field against the party upon whom it is placed, a deferential "standard of review" can be viewed as *narrowing* the field significantly -- in a real sense, limiting the challenge that can be mounted. In theory, at least, the opportunity to show, by engineering evidence, that a second access would be "significantly beneficial to the safety and operation of the highway,"[32] for example, is lost.

This standard, or "scope," of review sounds, of course, like the traditional "judicial review" standard,[33] and essentially is-- with one important exception. On appeal of access determinations by the department of transportation, administrative law judges, without exception, have taken evidence, sometimes extensive evidence, as if conducting a *de novo* proceeding.[34] Having done so, however, they then have applied (again, without exception) a limited and deferential standard to that evidence, phrased in various ways, but best described as "whether or not the action taken is among the reasonable alternatives available to a prudent administrator under the circumstances."[35] This "hybrid" standard of review, though not statutorily mandated, seems appropriate in light of the somewhat unique position in which the administrative law judge is placed. Without technical expertise, and though taking evidence from both sides, the administrative law judge essentially "reviews" the actions and determinations of department personnel (who *do* have the technical expertise) and subsequently takes, in the form of his or her decision, "final agency action."[36] The application of a deferential standard to the evidence taken is roughly analogous to a court's giving special deference to an agency's construction of its own regulations, especially when agency expertise or technical knowledge is involved.[37] Additionally, the review to determine whether or not the action taken was among the reasonable alternatives available meshes well with the doctrine that when a governmental body provides a right of appeal, but sets no standards, a general standard of reasonableness will be implied.[38] By the same token, though, the taking of evidence, thus placing the administrative law judge in the position that the department occupied when it acted, arguably better positions the judge to determine whether, in fact, the action taken was among the reasonable alternatives available. The standard of review employed has contributed to the history of consistent confirmation of departmental access determinations, while providing the landowner/applicant protection from arbitrary and capricious, or otherwise unreasonable, action.

Finally, the legal status of Colorado's access management program is an easy-to-overlook element in the program's success rate on appeal. Unlike an in-house "policy" or guideline, Colorado's access code was adopted by the department as a distinct and formal rule and regulation, after an extensive review process.[39] The access code thus has had the force of law behind it[40] and has carried with it (presumably into any appellate forum) the weight and credibility of the enabling legislation's broad regulatory mandate.[41] In addition, and much like the deference accorded the department in its *actions* under the code by virtue of the standard of review employed, the code's status as an agency rule and regulation itself has provided the department with a significant measure of deference in its *interpretation* of the code.[42] Also, it seems reasonable to surmise that the access code's status as the law of the state, easily pointed to, has insulated, to some degree, the district office decision-makers from "piecemeal" pressure (either from within, or outside, the department) to provide a "break" to an applicant or otherwise compromise operable access standards. Thus, the clear legal basis of the code has worked to insure a more uniform and predictable application of the code, minimizing both the number of appeals and the likelihood, on appeal, that arbitrary and capricious departmental conduct would be found.[43]

Conclusion

Colorado enjoys a comprehensive highway access management program, given voice in the State Highway Access Code, 2 CCR 601-1. The program's success, in protecting both the public's health, safety and welfare and its substantial investment in the state highway system from the detrimental effects of uncontrolled access, is, in part, derived from and dependent upon its proven ability to sustain the department's case-by-case efforts to implement the code. That ability, evidenced by favorable administrative rulings over a period of twelve years, is built upon a solid legal foundation comprised of four "cornerstones:" (1) *favorable "background" law* which recognizes the limited nature of the "right" of access and the appropriateness of its regulation under the police power, (2) *placement of the burden of proof* on the party seeking to "degrade," from an engineering standpoint, the highway system, (3) *a limited and deferential scope of review*, giving due recognition to agency expertise in technical matters, but insuring the landowner/applicant's right to reasonable departmental action, and (4) the weight and credibility and deference that a *formal regulation*, having the force of law, carries.

Administrative and engineering modifications to the code have occurred and, in all probability, will occur in the future in that change represents a needed flexibility and vitality in any law. The legal cornerstones of the code, however, will continue to contribute mightily to its effectiveness in protecting both the public's health, safety and welfare and its substantial investment in the state highway system.

ENDNOTES

[1] The police power has been described as "the power of the government to act in furtherance of the public good, either through legislation or by the exercise of any other legitimate means, in the promotion of the public health, safety, morals and general welfare, without incurring liability for the resulting injury to private individuals." *Smith v. State Highway Commission*, 185 Kan. 445, 346 P. 2d 259 (1959).

[2]"Access management is the process that provides or manages access to land development while simultaneously preserving the flow of traffic on the surrounding road systems in terms of safety, capacity needs, and speed." F. Koepke and H. Levinson, *Access Management Guidelines for Activity Centers*, NCHRP Report 348, p.1, Transportation Research Board, Wash., D.C.: National Academy Press, 1992

[3]"The right of an owner of land abutting on public highways has been a fruitful source of litigation in the courts of all the States, and the decisions have been conflicting, and often in the same State irreconcilable in principle. The courts have modified or overruled their own decisions, and each State has in the end fixed and limited, by legislation or judicial decision, the rights of abutting owners in accordance with its own view of the law and public policy." *Sauer v. New York*, 206 U.S. 536, 27 S. Ct. 686, 51 L. Ed. 1176 (1907).

[4]*See Nick v. State Highway Commission*, 109 N.W. 2d 71 (Wis. 1961) (concurring opinion).

[5] *See People v. Ricciardi*, 23 Cal. 2d 390, 144 P. 2d 799 (1943).

[6]*See* E. McKirdy, "Compensation for Impairment of Rights of Access," *1988 Institute On Planning, Zoning, And Eminent Domain* 13-1, 13-4.

[7]*See 8A Nichols On Eminent Domain* 16.03[2] (Rev. 3rd Ed. 1993).

[8]*See, e.g., City of Denver v. Bayer,* 7 Colo. 113, 2 P. 6 (1883); *Gilbert v. Greeley*, S. L. & P. Ry. Co., 13 Colo. 501, 22 P. 814 (1889).

[9]In the three-year period, 1969-1971, *see, e.g., Troiano v. Colorado Dept. of Highways,* 170 Colo. 484, 463 P. 2d 448 (1969); *Majestic Heights Co. v. Board of County Commissioners*, 173 Colo. 178, 476 P. 2d 745 (1970); *Thornton v. City of Colorado Springs*, 173 Colo. 357, 478 P. 2d 665 (1970); *Hayutin v. Colorado Dept. of Highways*, 175 Colo. 83, 485 P. 2d 896 (1971); *Shaklee v. Board of County Commissioners,* 176 Colo. 559, 491 P. 2d 1366 (1971).

[10] *See* Footnote 3, *supra.*

[11]Note the court's effort, in *Dept. of Highways v. Interstate-Denver West*, 791 P. 2d 1119 (Colo. 1990), to reconcile earlier decisions.

[12]While what is known as Colorado's access statute (Sec. 43-2-147, C.R.S.) was passed in 1979, the access code, a regulation adopted pursuant thereto, did not become effective until August, 1981. The *Davis* case was announced in April, 1981.

[13]As to the standard of "reasonable access to the general street system" by which the "right" of access has been measured, see also *Gayton v. Dept. of Highways*, 149 Colo. 72, 367 P. 2d 899 (1962); *Radinsky v. Denver*, 159 Colo. 134, 410 P. 2d 644 (1966).

[14]Sec. 43-2-147(1)(a) provides that "[t]he state department of highways and local governments are authorized to regulate vehicular access . . . in order to protect the public health, safety, and welfare, to maintain smooth traffic flow, to maintain highway right-of-way drainage, and to protect the functional level of public highways. In furtherance of these purposes, all state highways are hereby declared to be controlled-access highways . . . ."

[15]Sec. 43-2-147(1)(c).

[16]*See* Sec. 43-2-147(4).

[17]*supra*.

[18]The Code Of Colorado Regulations.

[19]Considered as a whole, and not limited to the legal perspective, at least one research effort has concluded that "[i]n terms of overall access management codes, the Colorado experience is viewed as the most successful effort to date." F. Koepke and H. Levinson, Footnote 2, *supra*, at p. 21.

[20]Over that period of time, numerous other cases were set for hearing and later were either unilaterally dismissed by the landowner/applicant or otherwise resolved.

[21]Sec. 43-2-147(6)(c) provides that "[a]ny party who has received an adverse decision by the department. . . may request and shall receive a hearing before the transportation commission or before an administrative law judge from the department of administration . . . ." The transportation commission (previously known, by statute, as the highway commission) routinely has delegated hearing duties to an ALJ.

[22]Appraisers and an economist also have testified.

[23]Twenty-one of the rulings were rendered by administrative law judges (previously known, by statute, as hearing officers) from the department of administration, division of administrative hearings, and two were the products of a municipality, acting as the issuing authority under sec. 2.7(5) of the access code.

[24]Of the twenty-one favorable rulings, two were appealed further. One was appealed to the district court, where it was reversed, and another to the district court and subsequently to the court of appeals, both courts sustaining the ALJ's favorable decision. The reversal was based upon a procedural due process claim of lack of notice as to the closure of two driveways during a highway improvement project. Since the landowner had reasonable access to a sidestreet, and presumably realized the unlikelihood of ultimately prevailing (in the sense of regaining his direct highway access), he did not pursue the matter on remand.

[25]*See* Footnote 14, *supra*.

[26]*See Davis, supra,* and cases cited in Footnotes 9, 11, and 13, *supra. See also City of Boulder v. Kahn's , Inc.,* 543 P. 2d 711 (Colo. 1975).

[27]*See* Appendix A, *infra*.

[28]"Private direct access . . . shall be permitted *only when* the property in question has no other reasonable access to the general street system or if the local authority and Department determine and agree that denial of direct access to the state highway and alternative direct access to another roadway would cause unacceptable traffic operation and safety problems to the overall traffic flow of the general street system." Sec. 3.6(3), 2 CCR 601-1 (emphasis added).

[29]"An access *shall* be limited to right turns only *unless,* (1) the access does not have the potential for signalization, (2) a left turn would not create unreasonable congestion or safety problems and lower the level of service and, (3) in the determination of the issuing authority, alternatives to the left turn would cause unacceptable traffic operation and safety problems on the general street system." Sec. 3.6(3)(c), 2 CCR 601-1 (emphasis added).

[30]"No more than one access shall be provided to an individual parcel . . . *unless it can be shown* that: (1) additional access would be significantly beneficial to the safety and operation of the highway, or (2) allowing only one access would be in conflict with local safety regulations." Sec. 3.6(3)(b), 2 CCR 601-1 (emphasis added).

[31]With the exception of department-initiated petitions to suspend or revoke an access permit, administrative law judges consistently have viewed the landowner/applicant as the proponent of an order. The order which has been sought, of course, is an order overturning the department's determination.

[32]*See* Footnote 30, *supra*.

[33]*See, e.g., City and County of Denver v. Board of Assessment Appeals,* 802 P. 2d 1109, *cert. denied* (Colo. App. 1990) (Reviewing court may only set aside the decision of administrative agency on ground that it is arbitrary and capricious or it is unsupported by competent evidence).

[34]"A trial *de novo* is commonly understood as a new trial of an entire controversy, and it includes the taking of evidence as if there had been no previous action. [citations omitted] Thus, de novo proceedings ordinarily afford the same parties an opportunity to try a controversy anew and to present such evidence as could have been presented in the initial forum." *B. C., Limited v. Krinhop,* 815 P. 2d 1016 (Colo. App. 1991).

[35]*In The Matter of the Appeal of Vincent Randazzo,* Case No. HW 86-08, Department of Administration, Division of Administrative Hearings (1986) (on file with the Colorado Department of Transportation).

[36]Sec. 43-2-147(6)(c) provides that "[d]ecisions by the . . .administrative law judge shall be considered final agency action." Prior to a July 1984 amendment, however, such decisions were "initial decisions" under the State Administrative Procedure Act, Section 24-4-101 et seq., C.R.S.

[37] *See, e.g., Roberts Construction Co., Inc. v. U.S. Small Business Administration,* 657 F. Supp. 418 (D. Colo. 1987).

[38]*See, e.g., Carpenter v. Civil Service Commission, 813 P. 2d 773, cert. denied* (Colo. App. 1990).

[39]*See* Sec. 43-2-147(2), (3), and (4).

[40]Sec. 43-2-147(5)(a) provides that "[a]ccess permits shall be issued only in compliance with the access code and may include terms and conditions authorized by the access code."

[41]*See* Footnote 14, *supra*.

[42]*See Roberts Construction Co. Inc. v. U.S. Small Business Administration, supra. See also Aspen Airways, Inc. v. Public Utilities Commission,* 453 P. 2d 789 (Colo. 1969).

[43]*See* F. Koepke and H. Levinson, Footnote 2, *supra*, at p. 23.

APPENDIX A
What Does the Typical Access Appeal Look Like?[1]

*Landowner/Applicants Represented by Attorney:		70%
*Surrounding Land Use Characteristics:		
	Urban/Urbanizing	39%
	Small Town	35%
	Rural	26%
*Category of Highway:		
	Category 3	83%[2]
	Category 2	9%
	Category 4	9%
*Hearings Including Traffic Engineer Testimony:		79% (N=14)
*Average Number of Witnesses (total, both sides):		7 (N=13)
*Average Number of Exhibits (total, both sides):		17 (N=12)
*Type of Action:		
Application for new access		52%[3]
Department-initiated (closure, revocation, etc.)		30%
Application to modify access or change permit status (temporary to permanent, etc.)		18%
*Appeals in which Unconstitutional "Taking" was Asserted:		30%
*Administrative Decisions based wholly or partially on existence of "other reasonable access":		43%
*Length of hearing:		
	one day or less	14
	up to 2 days	5
	up to 3 days	4
*Length of time from hearing to ruling:		
	average	62 days
	range	17-179 days
*Typical issues:		
reasonableness of other access		
reasonableness of department's determination		

[1] Number of access appeals from which figures are derived is 23, unless otherwise noted (N=sample size). Percentages may not total 100% due to rounding or inclusion within more than one classification.

[2] Approximately 7,500 miles, or 82%, of Colorado's highways are designated category 3.

[3] Of applications for new access, 25% included a request for variance.

APPENDIX B

NOTEWORTHY ADMINISTRATIVE DECISIONS UNDER THE ACCESS STATUTE (SEC 43-2-147, C.R.S. 1981) AND THE STATE HIGHWAY ACCESS CODE (2 CCR 601-1)

In Re Appeal By Gore Range Corp. (Nov. 1981)

An appeal from the denial of an application for new access, this decision set the pattern for future decisions by placing the burden of proof on applicant, creating the "arbitrary and capricious" standard of review, emphasizing broad safety factors under the statute in upholding the denial, and by drawing the connection between statutory or regulatory control of access and emerging eminent domain caselaw on "reasonable access" (citing State Dept. of Highways v. Davis, 626 P. 2d 661 (1981)). The Hearing Officer also recognized the concept of "cumulative effect" in finding that "the relative safety of a single access point [being requested] is not the controlling factor."

In Re Appeal By GB&L Investment Co. (Oct. 1983)

An appeal from the denial of an application for new access, the decision relied upon the access code's subordination of private access service to highway traffic movement (Access Code, sec 3.5) to conclude that a fire lane easement across adjoining property to a local side street and, thence, to the state highway was "reasonable access to the general street system." It also cited the access statute (sec. 43-2-147 (1)(c)) and extensive case law from the field of eminent domain to reject the landowner's novel (to Colorado) argument that those abutting a state highway have a special right of direct access thereto. Colorado's Supreme Court, seven years later, confirmed the absence of such a right in Dept. of Highways v. Interstate-Denver West, 791 P. 2d 1119 (Colo. 1990)

Appeal of Green Mountain Management, Inc. d/b/a/ Ramada Inn Foothills, (April 1986)

A decision by a municipality, as issuing authority under the access code (sec. 2.10(7)), this ruling stemmed from the Highway Department's closure of one of two direct access points to a state highway. The landowner had claimed that the access statute (sec. 43-2-147(6)(b)) allowed only for reconstruction or relocation of an access point, and not closure. In dictum, the Hearing Officer pointed out that the actual requirement of the statute was to reconstruct or relocate to conform to the Access Code, and went on to find "that where combination of access points is necessary to bring the access into conformance with the Access Code, relocation of access includes combination of two access points into a single access point."

In the Matter of the Appeal of Gates Land Company,
Case No. HW86-12 (Jan. 1987)

In the Matter of...Everitt Enterprises Limited Partnership,
Case No. HW88-02 (Aug. 1988)

Two decisions, one favorable and one unfavorable, involved the concept of "deeded access rights," as referenced in section 3.3 of the Code. In Gates Land Company, the Hearing Officer opined that the most important circumstance in weighing the Department's reasonableness in denying an access application from Gates (at a point not involving deeded access) was Gates' right to access at the less safe point of deeded access. The Hearing Officer, in other words, saw the matter of access as a tradeoff - the Department could avoid unsafe, "deeded" access by agreeing to access as applied for. "Viewed in this light," according to the Hearing Officer, "outright denial of any permit is not a reasonable alternative." The decision mistakenly interpreted the document conveying to the Department the landowner's rights of ingress and egress except for two openings (i.e. the "access deed") as creating in the landowner an absolute right of access, in the nature of an easement, immune from the police power and regulatory control under the access code.

In Everitt Enterprises, the Department was found to be under no obligation to grant, or even consider, access under the access code at a point where it had earlier acquired access rights by deed (an "access control line").

In the Matter of the Revocation of...[Permit], B.R. Griffin, Permittee,
Case No. HW86-13 (July 1987)

This revocation initiated by the Department for failure to comply with a term or condition of the access permit, simply involved the legal interpretation of that condition - "If 9th street is developed between "R" Ave. and U.S. 24, the south drive (1) shall be closed so that the entrance is off 9th street." The question, then, was whether 9th street was, in fact, "developed" so as to trigger the requirement that direct access to the state highway be closed. The Hearing Officer found that it was, even though it was unmarked by a city street sign, partially paved with its remaining length gravel, and subject to heavy use for parking purposes by large trucks. The case points up the need for clear, concise, unambiguous language in an access permit.

In the Matter of the Denial of Access Permit to Connie W. Lindsey,
Case No. HW88-01 (Sept. 1988)

Landowner subdivided her property, which had 3 "grandfathered" access points to an abutting state highway. The Town's approval of the subdivision was conditioned upon compliance with any access requirements of the Department of Highways. Seeking to validate the continued use of the 3 access points, landowner filed an application for access permit, which was denied by the Department based on nonconformance with the access code. It was the Department's position that a required conformance with the code (and loss of the grandfathered status) was due to (1) a change in use resulting in a 20 percent increase in access use (sec. 2.10 (3)(A)) and (2) subdivision of the property (sec. 43-2-147 (1)(b)). As to the change in use issue, the Hearing Officer held that the Department's circumstantial evidence of increased traffic (i.e., due to the property's current minimal usage, a commercial development would necessarily increase vehicular volume by 20%) was insufficient to meet the change in use criteria of the code. The Hearing Officer, however, found that, while not specifically stating so, the subdivision language of the access statute was intended to apply to all access points, including those otherwise grandfathered.

In the Matter of Appeal By Dale L. Majors,
Case No. HW88-11 (April 1989)

Landowner's property abutted both a city street and a state highway, with temporary, right-in-only access to the state highway until such time as an internal street system on an adjoining property (and intended to serve the subject property) was completed. Landowner's application for permanent right-in, right-out access was denied based on other reasonable access to the general street system, even though no access existed to the city street, in that landowner had not applied for such. (The City testified on behalf of the Department that it would grant such access if landowner applied for it.) The Hearing Officer upheld the denial, concluding that "[a]ppellant cannot base a claim of absence of reasonable access on his own lack of application for a permit for reasonable alternative access [to the city street]." The Hearing Officer also hinted that the City could not deny access to its street, so as to leave no alternative but highway access, since a city is subordinate to the state in matters of statewide concern, such as access control to state highways.

In the Matter of Appeal by Kim Magness,
Case No. HW89-06 (April 1990)

Landowner appealed the limitation of his access permit, granted after application, to right turns only under sec 3.6 (3)(c) of the access code. The Hearing Officer found that the landowner failed to prove, under that section, that "a left turn would not create unreasonable congestion or safety problems and lower the level of service" and "in the determination of the issuing authority, alternatives to the left turn would cause unacceptable traffic operation and safety problems on the general street system." Most significantly, the Hearing Officer stated that, even if all requirements of section 3.6 (3)(c) had been met, it remained discretionary with the Department as to whether to allow for left turns. In other words, meeting the requirements only places the applicant in a position that allows the Department to consider left turns; it mandates nothing. Additionally, the Hearing Officer concluded that the issuing authority (a municipality), while approving the application itself, did not, by doing so find "alternatives to the left turn" (i.e., right turns only) unacceptable, as required by sec. 3.6 (3)(c) before left turns could be allowed.

This case is also the only administrative decision on access to be appealed beyond the District Court to the Court of Appeals, where it was held that the Department is not a "rubber-stamp" when it comes to its review of access permits issued by local authorities and that different treatment for private and public access does not violate the equal protection clause of the Constitution.

Discussion Period - Sessions 1 and 2

Moderated by Philip Demosthenes, Colorado DOT

The following is a summary of discussions held at the question and answer period for the speakers from the Plenary Session and Sessions 1 and 2. The speakers present were Philip Demosthenes, Arthur Eisdorfer, Gary Sokolow, Dane Ismart, Bob Gorman, Bob Johnson, Charles Guenzel, Harry Morrow, and Randall Sampson. Except where noted, comments are not verbatim. Where possible, the speaker to whom the question was directed is identified.

Q: [to Demosthenes] Describe how the developer, city, and state interact in the access management application process.

A: In Colorado, the Department of Transportation has full responsibility and liability for the entire state highway system. A developer can go through a city to obtain an access permit. If the access is on a state highway, the city will process the application in accordance with State rules, and will then pass it on to the State for final approval. The state can either approve or deny the access regardless of the city's recommendations. If the state denies access, any appeals must be filed with the state; however, if the city denies the access, then appeals must be filed with the city.

Q: [to Demosthenes] How does the private citizen know whom to talk to for an access permit?

A: The private citizen should simply contact their local government and ask, "What do I do?". They will be directed to a state DOT regional office.

Q: [to Eisdorfer, Sokolow, and Demosthenes] How do New Jersey, Florida, and Colorado compare in terms of the size of their roadway systems and the number of access management staff?

A: New Jersey has about 24,000 miles of roads, about 2400 miles of which are in the state highway system. It currently has about 50 people working in access permitting. Florida has roughly 40 permitting staff. Colorado has approximately 9200 miles of state highways and 9 full time staff members (plus some additional part-time employees) working on access permitting.

Q: [to Demosthenes, Sokolow, and Eisdorfer] In developing your new access regulations, at what points in the process did the attorney general, the legislature, and the public become involved?

A: In Colorado, the attorney general was involved in developing the access codes from the beginning. Members of the legislature were consulted to obtain their input and convince them of the importance of the legislation. Revisions were made to the draft legislation and six months later the statute was approved. The public became involved during the subsequent rule making process, which lasted nearly two years. In Florida, the legal office was brought in at the very beginning. The public was involved through MPO meetings. The public can provide a lot of good inputs and legitimate criticism. In New Jersey, the legal staff was also involved from the very beginning and all the way through the development process. New Jersey spent a great deal of time educating the public on what the new regulations meant before holding formal public hearings. This was very effective and allowed them to have informed discussions with people about the code once the hearings started.

Q: [to Morrow] When you acquire right-of-way for a road, do you also acquire limited access rights?

A: Not necessarily. That may be the case in urban areas, but there are many cases in rural areas where access rights are not acquired because they are not necessary. It is usually up to the project official to make that decision.

Q: [to Sampson] Do you have cases in Colorado where you will not permit any access to a property?

A: If you deny all access to a property, you are either going to have to buy that property or at least compensate the owner for the loss in value of the land. In Colorado, however, you can not deny reasonable access to a property through regulation, you must go through eminent domain proceedings. One compromise position is to reach an agreement with the landowner to downsize the intended land use. Alternatively, the state could purchase an easement to provide access to the lot via another road.

Q: [to Demosthenes] One compromise alternative to denying access has been to permit right-in/right-out access. Has there been any research on the safety and capacity impacts of right-in/right-out access?

A: There has been very little research on this topic. Safety will certainly improve, since it has been shown that 70% of all access-related accidents involve left turns, and those are eliminated with right-in/right-out. The capacity impacts are less clear, but the capacity of a roadway is usually determined by the signalized intersections and not by access points. One needs to be careful with this type of access, though, that one does not create a "hot spot" downstream as vehicles that would have turned left try to reverse direction.

Q: [to Eisdorfer, Sokolow, and Demosthenes] Do any states have regulations which can prevent the creation of new lots which will require new access along an arterial?

A: New Jersey has spacing standards for traffic signals. If a developer is proposing an access point that does not meet those standards, they are immediately informed and the application is not considered. Florida has no real laws to prevent the creation of new lots, but it does consider multiple adjacent properties under one owner as a single property and approves access on that basis. This is partially effective, but can be easily circumvented (the owner could transfer the title of one of the lots to a family member, thus making it a separate property). Colorado is in a similar situation, with no real way to prevent the creation of new lots. The best way to deal with this is to work closely with the local government so that they only approve developments that conform to the access management plans.

Q: [to Sampson] In appealing access denials, many people have argued that it is the right of a property owner to develop his land to its "highest and best use". Is this legally true?

A: It varies from state to state. In Colorado, a property owner does not have an explicit right to develop land to its highest and best use, as long as some other "reasonable use" exists. In some other states, the owner must be compensated if the highest and best use is lost.

Q: If a state has purchased access rights for a specific property, and then decides to permit additional access to that property, can it require the property owner to reimburse the state for that access.

A: Nebraska does charge for access when the state owns access rights to the property. Michigan charges only if the access is for private use, not if it is for public use. Many states have regulations that prohibit them from giving away anything of value. It varies from state to state.

Q: [to Demosthenes] The threat of legal action by developers often scares state officials into providing access that they would not have otherwise permitted. Many state officials argue that they simply do not have the resources to counter these court challenges and must therefore cave-in and permit some questionable accesses. Is there any ammunition for governments?

A: Governments may think that they are avoiding costly lawsuits by caving in to developers, but this can often backfire. There was a case in Arizona where a shopping mall developer threatened to sue the state for denying access. The state, fearing a court battle, relented and permitted an unsafe access. A serious accident resulted and the state was sued for a very large sum. The short term savings can very quickly be outweighed by long term liability problems. It is better to do your job and not be intimidated by lawyers.

Q: [to Demosthenes] Assume that Colorado has purchased access rights for a property. If the owner changes the use of that property, does the state charge additional money for access rights?

A: If the owner has simply expanded the present use or increased the use of the access through normal growth, then that is simply a traffic engineering issue and the state does not charge anything. If the owner wants to change the deed (e.g., from a farm access to a commercial access) then he would be charged additional money.

Q: [to Gorman] The U.S. is developing a national highway system and Canada is considering a similar system for its roads. Is the Federal Government coordinating with Canada on the NHS project or does it prefer that the states deal directly with the provinces?

A: The Federal government has not dealt directly with the Canadian government. The U.S. NHS will consist of approximately 4% of the total highway system while Canada's will be about 3% of its system. The U.S. system should have more mileage and should connect with all of Canada's national highways plus some other roads as well.

Session 3A

Establishing and Administering an Access Management Program

Moderated by Arthur Eisdorfer, New Jersey DOT

This administrative session focused on the steps required to develop, implement, and administer an access management program. Four speakers discussed the importance of access management in preserving mobility and presented overviews of access management programs in New Mexico, New Jersey, and Oregon.

The first speaker was Herb Levinson. In the paper he coauthored with Bud Koepke, "Access Management - Key to Mobility," he discussed the importance of access management in addressing three common problems: traffic congestion, safety, and visual blight. He presents basic definitions of access management, describes the necessary legal foundations, discusses access classification, and outlines some basic design concepts.

The next speaker was John Nitzel from the New Mexico Highway and Transportation Department who presented a paper entitled, "New Mexico's Access Management Program." Nitzel provides an overview of New Mexico's access management program with a focus on the difficulties involved in starting a program from scratch. He describes some basic requirements for setting up an access management program and stresses the importance of training, public education, and interdepartmental cooperation in establishing a successful system. He then provided some examples of access management in practice in New Mexico and discussed some of the issues that will face the program in the future.

The third speaker was Gary Sokolow of the Florida DOT who gave a presentation entitled, "Practical Considerations for Beginning a Comprehensive Access Management Program." He made some key points about deciding which access features should be managed, including interchange spacing, driveway spacing, signal spacing, and median openings, and he discussed the importance of having a simple classification system. He then covered the issues of variances, land subdivision, and permit fees.

The final speaker was Del Huntington of the Oregon DOT. In his paper, "Oregon's Access Management Program," he discusses the origins and evolution of Oregon's access management program. He describes how changing land use and development patterns have contributed to congestion on major arterials and how the 1991 Transportation Planning Rule is attempting to address this problem by recognizing the tie between land use and transportation facilities. Oregon is currently developing an Administrative Rule on Access Management which will define the classification system standards, and permitting and variance procedures.

This session was attended by approximately 70 persons. Questions and answers for the speakers are summarized in the discussion section for Sessions 3A, 4A, and 5A.

Access Management - Key to Mobility

Herbert S. Levinson
Transportation Consultant
and
Frank J. Koepke
Metro Transportation Group

Our national landscape has changed dramatically over the last six decades. In the 1930's our cities were compact. Homes, shops, and work places were clustered tightly along rail, trolley and bus routes. Traffic congestion was concentrated in the city center, and the roads leading to the suburbs and country carried relatively little traffic.

These conditions no longer exist. We have experienced a dramatic change in our life styles and travel patterns as people, shops, industries and offices have moved outward along our major suburban and intercity highways. We have become a "drive-in culture" with our drive-in banks, restaurants, and theaters. Our "edge cities" have rivaled our city centers in terms of size, activity and vitality.

Major freeway interchanges and arterial road junctions are focal points for new shopping centers, industrial parks and office complexes. Urban and suburban arterial roadways are now lined with strips of roadside developments. The examples are many, and the scale is national. The road sides along the Beltways around Baltimore, Houston, Washington, and many other cities; along radial freeways such as the Long Island Expressway and Santa Anna Freeway; and along arterial highways such as Sunrise Highway in New York, Skokie Highway north of Chicago and Routes 1 and 9 in New Jersey, illustrate the scale, character and impacts of the surrounding developments.

At first, the new developments were seen as a means of strengthening suburban growth and expanding the local tax base. Some projects were well planned with respect to roadway access, internal circulation and building arrangements. But for the most part -- from the Boston Post Road in Connecticut to Colfax Avenue in Colorado and Ventura Boulevard in California, the new developments have adversely affected traffic flow. Their many points of entry and exit have increased volumes and conflicts, reduced safety, and decreased speeds. Traffic congestion has spread from city centers to urban and suburban settings.

Why Manage Access?

Our streets and highways are an important resource and represent a major public investment that should be preserved. This calls for their efficient operation -- for effectively "managing" the access to and from adjacent properties.

Traffic and transportation engineers have found many ways to improve flow along city streets, rural highways, and expressways over the past decades. They have shown how good roadway design and traffic operations can reduce delays, cut accidents, and increase capacities. They have shown how traffic signal systems, curb parking restrictions, turn lanes, and intersection channelization can work together to achieve these objectives.

Access problems are sometimes addressed by local governments working closely with developers. Many public agencies have established design standards for roadways and driveways, and have prescribed permit procedures for new or expanded developments. Traffic impact studies are widely used to assess the consequences of new developments, determine the needed improvements, and establish funding responsibilities.

But traffic operational techniques alone do not offset the effects of poorly located, planned, or designed access to neighboring land. Nor can they always accommodate the large increases in traffic superimposed on existing roadways by major new developments that are placed without regard to the traffic carrying capabilities of approach and surrounding roads.

Moreover, design criteria, driveway permit procedures and traffic impact analysis requirements fall short of maintaining desired levels of services on the affected roadways. Too often, traffic impact studies are done separately for specific projects and fail to consider the impacts of nearby or closely spaced developments. The broader system implications of an additional driveway or traffic signal are too often overlooked.

Because of the general lack of effective access control along our streets and highways, our communities are often faced with a chain of events that requires constant investment in roadway improvements and/or relocation. There is, in effect, a business growth and roadway improvement cycle in which increased business activity results in increased traffic which leads to roadway improvements, and, in turn, more business activity.

Figure 1[1] *illustrates this development/roadway cycle.* As business activity increases, there is a corresponding increase in the number of conflict points, and traffic flow is eroded despite continued improvements. The absence of well defined access policies result in numerous driveways and curb cuts that make it difficult to enter and leave developments. Access management increases the public's tolerance range and thereby lengthens the time in which a roadway will have to be rebuilt or relocated because of increased development.

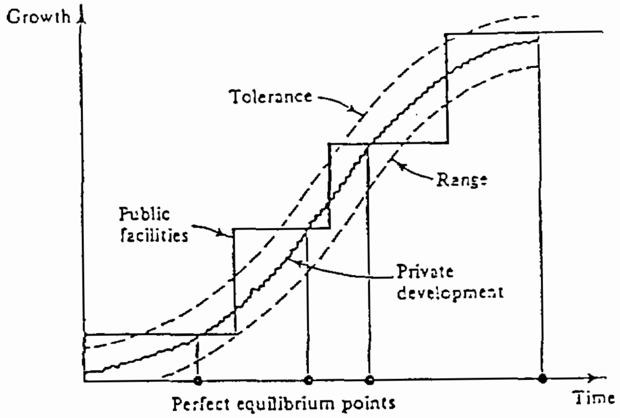


Figure 1. Development vs. Roadway Improvements[1]

These problems are most acute along arterial roads. Freeways are designed with complete control of access and are largely protected from adjacent land developments. Local residential streets emphasize property access rather than movements. However, arterial streets and highways and collector roads must serve both access and movement needs. It is along these roads where the major problems of driveway access and traffic congestion are found -- where political pressures too often take precedence over engineering and planning decisions. It is here where the emphasis on access management must be placed. It is here, where access management can preserve capacity and safety. (Several studies have found that each commercial driveway adds between 0.1 to 0.5 accidents per year. There is a 1% reduction in capacity for every 2%-per-mile of traffic turning into and out of driveways.[2])

What Is Access Management?

Access management provides an important means of maintaining mobility. It calls for improvements in access control, spacing and design to preserve the functional integrity and operational viability of our street and road systems.

Access management is the process that provides (or manages) access to land development while simultaneously preserving the flow of traffic on the surrounding road system in terms of safety, capacity and speed. Thus, it extends traffic engineering principles to the location, design, and operation of access drives serving activities along the highway. It evaluates the suitability of a site for development from an access standpoint. It also identifies the need to allow a roadway to serve through movement. It is, in many respects, an effective application of transportation system management where the town planner, traffic engineer and developer can work together. But it is far broader for it addresses the basic question -- when and where should access be provided or denied, and what legal or institutional changes are needed to enforce this decision? It is a way of anticipating and preventing congestion.

Access management sets forth a new philosophy of access control that applies to all roads -- one that attempts to balance the movement and access functions. Its key elements include: (1) defining the allowable access and access spacings for various classes of highways, (2) providing a mechanism for granting variances when reasonable access cannot be provided, and (3) establishing a means of enforcing standards and decisions. These requirements -- along with appropriate design standards -- are best included in an Access Code that provides a systematic and supportable basis for making access decisions.

Transportation management and land use controls are, of course, actions that should complement access codes in specific settings. Access management is, in a sense, a new element of roadway design. Traditional roadway design addresses general geometric design features such as number of lanes, treatment of medians, and provision of curbs, gutters, or shoulders. Access design and location recognizes that access control elements, just like traditional geometric elements, must progress in a logical manner that leads to improved travel capacity, safety, and speed.

Several simple, yet fundamental. principles underlie access management.

1. Different roads serve different purposes (Figure 2[3]). Freeways for example emphasize movement and do not provide direct access to property while local streets emphasize access to property and not through traffic movement. It should be noted that the Strategic Arterial has been added to the typical list of roadway types.

2. Direct property access should be limited (or even prohibited) along higher type roads whenever possible.

3. Signalized access points should fit into the overall traffic signal coordination plan (Travel speeds decrease as the frequency of signals increases).

4. Median openings and unsignalized intersection locations should complement the signal coordination plan.

5. Unsignalized driveways should be located and designed to minimize accidents and friction.

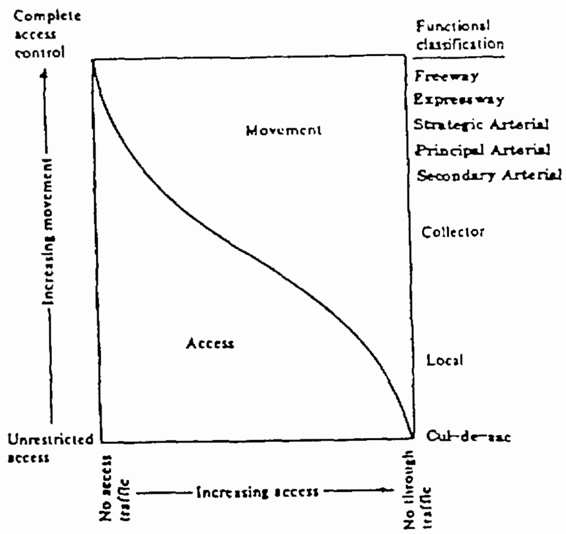


Figure 2. Functional Classification

The extent of access management will depend upon the location, type and density of development, and the nature of the road system. Access management actions involve both the planning/design of new roads and the retrofitting of existing roads and drives.

In some ways, there is nothing new about access management that was not known in past decades. What is new is the decision to extend the concept of access control to arterial roadways by committing to higher standards and by establishing the necessary legislative authority to implement them. Three state legislatures - Colorado, Florida and New Jersey have already enacted access management codes to protect their highway investments. What is new, is the growing recognition of access management as a rational way of coordinating transportation and land development.

Program Development

An access management program should have a legal and regulatory basis that specifies its authority and scope, contains technical guidelines for permitted access spacing and design, and specifies means of enforcement. Related activities by local jurisdictions include zoning regulations; subdivision approval; site plan review development ordinances; driveway, building, and occupancy permits. Communities may find it desirable to prepare an access management plan that shows developers - by map and narrative - how access can be provided, now and in the future.

The legal basis for access control has been well established. Access control is mainly implemented through two basic legal powers - police power and eminent domain. Police power allows a state to restrict individual actions for the public welfare. Eminent domain allows a state to take property for public use if an owner is compensated for his loss. Police power provides sufficient authority for most access control techniques associated with highway operations, driveway locations, driveway designs and access denials. Eminent domain must be cited when building local service roads, buying abutting property, acquiring additional right-of-way, and/or taking access rights. However, direct access usually may be denied by police power when alternative reasonable access is available.

States generally have adequate authority to manage access as long as reasonable access is provided to property. Coordinating access policy into a clear and definite regulation makes it easier to use the police power.

Legal bases and interpretations vary from state to state. Therefore, each state should evaluate its legal powers for controlling access; certain access techniques may not be legally feasible in a state that has neither the policy nor precedent to uphold them. Colorado's decade old access management program - perhaps the most restrictive to date - has withstood the test of time in this regard. The amount of home rule given to local governments also varies among states.

Access Classification

The access classification system defines when and how access can be provided between public highways and private driveways. It relates the allowable access to the roadway's purpose, importance, and functional characteristics.

The types of allowable access between public highways and surrounding developments covers a broad spectrum. Seven basic access categories "or levels" can be applied to any state, county, or local road system. They range from (1) full control of access (Level 1), as applied to freeways to (2) access control only for safety reasons (Access Level 7) as normally applied to local streets. Access levels 2 through 6 apply to various kinds of "controlled access" arterial roads.

These seven access categories should be related to the functional classification system of an area's highways, such as shown in **Table 1**. The resulting access classification system then provides the basis for defining the access allowed on any road, and, in turn, the spacing standards.

Table 1. Access Classification System (Access Levels Keyed to Roadway Type)

ACCESS LEVEL	DESCRIPTION OF ALLOWABLE ACCESS	ROADWAY CLASSIFICATION	GENERAL ROADWAY DESIGN FEATURES
Level 1	Access at Interchanges only (Uninterrupted Flow)	Freeway	Multi-Lane, Median
Level 2	Access at Public Street Intersections or at Interchanges Only (Uninterrupted Flow)	Expressway	Multi-Lane, Median
Level 3	Right Turn Access Only (or Access at Interchange) (Uninterrupted Flow)	Strategic Arterial	Multi-Lane, Median
Level 4	Right and Left Turn In and Right Turn Out. Left Turn Lane Required (Interrupted Flow in One Direction)	Strategic Arterial Principal Arterial	Multi-Lane, Median
Level 5	Right and Left Turn with Left Turn Lane In and Out Required (Interrupted Flow - Both Directions)	Other Arterial	Multi-Lane or 2-Lanes
Level 6	Right and Left Turn In and Out with Left Turn Lane Optional - In and Out (Uninterrupted Flow - Both Directions)	Collector	2-Lanes
Level 7	Right and Left Turn In and Out (Safety Requirements Only)	Local/Frontage Road	2-Lanes

The specific access classification system will, of course, vary from place to place. What applies in Colorado may not in Connecticut; what works in New Jersey, may not in New Mexico.

Direct property access should be discouraged or denied from strategic and principal arterials, except where no alternative access exists, or where it is in the public interest to do so. This is generally possible in undeveloped areas, but it may be more difficult to achieve in urban or suburban settings. Where access must be provided from these roads, it should be limited to right turns to and from the roadway (Access Level 3), and to right-and-left turns from the arterial roadway and right exits from the intersecting driveway (Access Level 4).

The allowable access and the associated access spacing requirements should be included in an expanded access application review process.

Access Spacing

Access spacing guidelines should be keyed to the access categories, roadway speeds, traffic operations, and the environment. They should apply to new development, and to significant changes in the size and nature of existing development. Driveways should be viewed as intersecting roads rather than as curb cuts. Their spacing does not have to be consistent with the existing practice.

The spacing guidelines should minimize the need for variances or exceptions while simultaneously protecting arterial traffic flow. Access to land parcels that do not conform to spacing criteria may be necessary when there is no alternative reasonable access. However, the basis for such variances should be clearly indicated.

Spacing guidelines should cover (1) interchanges, (2) signalized intersections, (3) unsignalized intersections, and (4) median openings. While specific guidelines may vary from place to place, some basic principles can be established. These should apply to both public streets and private driveways.

Grade Separations - Grade separations may be appropriate where: (1) two expressways cross (i.e., access level 2) or where an expressway crosses arterial roads (access levels 3,4 or 5); (2) strategic or principal arterials cross (access levels 3) and the resulting available green time for any route would be less than 40 to 50 percent of the signal cycle; (3) an existing at-grade signalized intersection along an arterial roadway operates at level of service "F", and there is no reasonable way to provide sufficient capacity; (4) a history of accidents indicates that a significant reduction can be realized by constructing a grade separation; (5) a new at-grade signalized intersection would result in levels of service "E" in urban and suburban settings and level of service "D" in rural areas; (6) signalization of the access point would adversely impact the progressive flow along the roadway and there is no other reasonable access to a major activity center; (7) a major public street at-grade intersection is located near a major traffic generator and effective signal progression for both the through and generated traffic can not be provided; and (8) the activity center is located along a major arterial where either direct access or left turns would be prohibited by the access code or otherwise would be undesirable.

Signalized Intersections - Traffic signal spacing criteria should apply to both intersecting public streets and access drives. They should take precedence over unsignalized spacing standards where there is a potential for signalization. Ideally, locations of signalized intersections should be identified first. Unsignalized right and left turn access points then should be selected based upon existing and possible future signal locations.

Traffic signal spacing requirement for each class of road can be specified in terms of distance (as in Florida) or in terms of band width (as in Colorado and New Jersey). However, the spacing criteria can be relaxed when only one direction of travel is signalized.

The goal is to limit signals (especially for access drives) to locations where the progressive movement of traffic will not be impeded significantly, and there is no loss in through band width for the prevailing cycle length and speed.

Cycle lengths should be as short as possible, since excessively long cycle lengths result in long overall intersection delays, and indicate a need for corrective actions such as interchanges, rerouting left turns, or improving the secondary street system to reduce left turn volumes.

Unsignalized Driveways - There is a wide diversity of opinion and practice regarding the spacing of unsignalized driveway. Some agencies base standards on safe stopping sight distances, operating speeds, or overlapping right turn requirements. Some base spacing standards on the size or type of traffic generator. Others use a "rule of thumb" that spaces driveways at five times the driveway width.

Ideally, spacing guidelines should reflect (1) access categories, (2) roadway speeds, and (3) size of traffic generator. Suggested spacing guidelines incorporating these factors are set forth in NCHRP Report 348.

Median Openings - Median openings should be provided at signalized intersections and at unsignalized junctions of arterial and collector streets. They may be allowed where necessary at unsignalized locations, but should be designed to minimize the impacts on roadway flow. Ideally, their spacing should permit future signalization. Median openings at driveways should be subject to closure where traffic volumes warrant signals and signal spacing criteria cannot be met. Storage and deceleration for left turning vehicles should be adequate where openings are provided. Suggested minimum spacings range from 330 to 660 feet in urban and suburban areas, and 1,320 feet in suburban and rural areas.

Design Concepts

Access planning and design should coordinate the three components of the access system -- the public roadway, private roadway and the activity center site itself. All three must be treated as part of an overall system since neglecting one would merely transfer rather than alleviate problems.

The specific techniques are simple and straightforward. They call for sensible, sensitive, systematic and creative application of established traffic engineering and roadway design principles. These include (1) limiting the number of conflict points, (2) separating conflict areas, (3) reducing acceleration and deceleration impacts at access points, (4) removing turning vehicles from through travel lanes (5) spacing major intersections to facilitate progressive travel speeds along arteries, and (6) providing adequate on-site storage. The key is to apply these techniques in a coordinated way that preserves the integrity of arterial traffic flow while providing essential access to developments. There are many opportunities for the creative

Critical intersections along the public road system on the approaches to an activity center should be improved to avoid transferring problems from one location to another - to avoid just transferring problems from the immediate site environs to other locations along key arterial roads. Freeway (and expressway) interchange and service road designs should be integrated into the overall site access system, to maximize site access, better distribute site traffic, minimize delay, and maintain roadway speed. In all cases, however, the integrity of mainline traffic operations must be maintained.

Access design should permit the safe and efficient processing of cars, service vehicles and buses from public roadways onto access drives and into parking areas. This involves establishing adequate length and taper of auxiliary turning lanes, driveway turning radii, width and storage, and the appropriate traffic controls. Sensible application of established standards is necessary to assure safe and orderly traffic flow and to protect public agencies from tort liability. Flexibility in application is desirable to avoid precluding viable operational solutions, especially in retrofit situations.

The design and arrangement of commercial activities can enhance access management. Multi-use activity centers that integrate retail, office, residential and recreational activities can reduce vehicle trips since many workers do not have to go elsewhere to shop or live. They provide opportunities for transit and pedestrian friendly design. Clustering activities, in contrast to traditional strip developments, can result in fewer more carefully designed access points, reduce vehicle trips between proximate activities, and foster pedestrian and transit trips.

LESSONS LEARNED

The application of access management techniques varies widely throughout North America. Most public agencies apply some form of access control to their street and highways, and many have retrofitted or upgraded existing roads. All agencies control access along freeways; a few, such as Santa Clara County, California - provide "partial" access control along expressways or arterials. Three states - Colorado, Florida, and New Jersey now have comprehensive access codes.

A review of contemporary practice indicates that each setting is different, both physically and politically. Access management standards, therefore, will vary from place to place; each setting adapting the basic principles to its particular needs. New York City, for example, limits property access from North-South Manhattan Avenues, whereas San Diego builds high-type arterials.

Colorado - as illustrated by the in-depth studies of Parker and Araphoe Roads outside Denver[4] - indicate that access management guides should be implemented in advance of development whenever possible. This makes it possible to use higher standards, have minimum impact on existing developments, and achieve maximum benefits in maintaining through traffic flow. The two Colorado access-managed highways (1/2 mile spacing between median breaks) carry more traffic per lane then many other arterials at double the peak-hour speeds and with half the accident rate of uncontrolled arterials such as Federal Boulevard and Colfax Avenue.

Retrofit actions have also proven beneficial throughout the country. The provision of a continuous median on Oakland Park Boulevard in Ft. Lauderdale, Florida with half-mile openings resulted in 32% fewer mid-block conflicts and 30% less delay per mile than nearby Sunrise Boulevard that has frequent (every 300 to 400 feet) median openings. The accident rate was 10% lower than before the project was implemented. Accidents along Memorial Boulevard in Gwinnett County, Georgia, declined 44% after a physical median replaced a two-way painted left turn lane on a six-lane arterial. Similarly, the accident rate on Jimmy Carter Boulevard, also in Georgia, was 40% lower after a "New Jersey" median replaced a painted two-way left turn lane. Accident rates on several New Jersey highways were cut in half after left turn lanes were installed.

However, all changes in traffic operation are not on the positive side. Limiting left turn access along an arterial street places greater traffic pressures on the remaining intersections along this street. Left turns off of the arterial tend to be transferred to the nearest median opening. This calls for capacity enhancement and creative handling of left turns - especially at public road junctions. In some cases, as for a large generator, left turn access from the artery into the activity center may be desirable, even along strategic arterials where they might be prohibited by an access code.

Over the long run, access management tends to encourage larger planned developments and discourage roadside strips. Medians appear to impact small businesses, especially those that rely on intercepting drivers (for example, liquor or grocery store that is located on the to work side of a road or a breakfast restaurant located on the home-work side of a road). On going research is further assessing these types of impacts.

Access management improves traffic conditions along a road. Equally important are effective and innovative land use controls that govern the types and designs of roadside activities. One promising approach involves establishing zoning envelopes along new highways in rural and undeveloped areas where the adjacent land is zoned for a specified distance beyond the highway (as in Newfoundland).

LOOKING AHEAD

An expanding national economy will place greater development pressures on tomorrow's street and road systems. This growth poses challenges to both the public and private sector. Do we allow roadside development to continue unabated and unguided? Do we become unduly restrictive and thereby inhibit the development we want to attract? Or do we find realistic and reasonable ways to balance development, access and mobility.

Access management provides the key. It is essential if we are to preserve the capacity and safety of our road system and provide efficient access to the properties that lie along it. The time is now - before the next national wave of economic development takes place.

Modern access management, in broad perspective, is both a land-use and traffic issue. It calls for land-use controls and incentives that are keyed to the development policies of the community, and the capabilities of the transport system. The planning challenge is not how to provide drive-ins or driveways or how to design roadways, storage areas or parking. It is not how to limit new development to expedite traffic flow. Rather, the challenge is to develop access standards that achieve a balance between land development and the functional integrity of the road system. It is how to transform our roadside environment, into attractive, accessible, and vital areas in the years ahead.

The challenge was well stated by Tunnard and Pushharev some three decades ago in their classic Man Made America.

"All this implies a change in our social values, as well as a corresponding re-allocation of resources. It has become fashionable in recent years to talk of goals for Americans, in recognition of this country's obligations to its citizens and to the rest of the world. A not inconsiderable task among these goals, and one that will require a dedicated national effort with an extensive mobilization of talent and energy, is the creation of surroundings in which our civilization can flourish and the ideals of human dignity be upheld. Our free economy prides itself in its efficiency, rarely stopping to think of "efficiency for what?" For processing and discarding and reprocessing more and more materials, merely to keep the economic system running? Or for creating machines and artifacts to delight the spirit? As the freedom from want and fear is increasingly taken for granted, our society will stand or fall on the question: Freedom for what?

Freedom for making the richest country the ugliest in the world? Or freedom, among other freedoms, for shaping an environment worthy of man?"

---

[1] Source: Robert M. Winick, "Balancing Future Development and Transportation in a Highway Growth Area", Compendium of Technical Papers, Institute of Transportation Engineers, 1985.

[2] Source: Herman S. Haenel, "Traffic Management", in Traffic Engineering Handbook, 4th Edition, Institute of Transportation Engineers, Washington, D.C., 1992.

[3] Source: F.J. Koepke and H.S. Levinson, NCHRP Report No. 348, "Access Management Guidelines for Activity Centers", Transportation Research Board, 1992.

[4] Colorado Access Control Demonstration Project, Colorado Department of Highways, 1985.

[5] Christopher Tunnard and Borris Pushkarev, Man Made America, Chaos or Control, Yale University Press, 1963.

NEW MEXICO'S ACCESS MANAGEMENT PROGRAM
A STATE PERSPECTIVE

John J. Nitzel
New Mexico State Highway and Transportation Department

ACCESS MANAGEMENT IN NEW MEXICO

The development and refinement of access management policies,guidelines and practices has occurred in an evolutionary manner over the years in New Mexico. Efforts to address the issue have historically been divided into two areas -- access controlled facilities and non-access controlled facilities. Until recently the management and development of procedures for non-access and access control has been overseen by different entities.

For over 20 years New Mexico had a "driveway manual" which provided information concerning the acquisition of driveway permits as well as some criteria regarding basic design standards. A few years ago it became apparent that an updated driveway manual" was needed. A consultant was retained to conduct research concerning current standards and practices for non-access controlled facilities. They were also instructed to prepare a draft of a new manual for non-access controlled facilities which would replace the driveway manual.

In 1989, the new "Regulations for Driveways and Median Openings on Non-Access Controlled Highways" (1) went into effect. This document was prepared under the supervision of traffic engineering staff including this author. The development of procedures and regulations for access controlled facilities took a different course. New Mexico has over 19,000 kilometers (12,000 miles) of roadway under its jurisdiction. Currently, over 1900 kilometers (1200 miles) are access controlled routes, including both freeway and non-freeway routes. At this time, a number of projects with limited access control are either under construction or in planning/design stages. In fact, almost all of the new routes planned or under construction in New Mexico are limited access facilities, are in urban areas, and will primarily serve as bypass facilities. In New Mexico's case, given the significant mileage of full or limited access facilities there will continue to be an important need to properly manage their planning, design, and operation.

Over the last five years New Mexico has established a wide range of policies, guidelines and procedures for the management of facilities with either full or limited access control. It was recognized some time ago that limited access facilities provide superior transportation both in terms of safety and efficiency. However, as experienced almost in all jurisdictions in the United States, the quality of these facilities also enhances the attractiveness of adjacent properties both in urban and rural areas, particularly at locations where access breaks (interchanges or signalized intersections) occur. The attractiveness of property at locations such as interchanges has increased the demand to develop these sites, particularly as population centers have grown towards interstate facilities which might have been rural when the route was constructed. The role of local entities -- municipalities, counties and in New Mexico's case, Native American entities, have frequently been a primary factor in access issues. Typically, local entities are very enthusiastic about increasing economic activities and are very supportive of development. At times this has created conflicts since our role as a highway and transportation department is to provide safe and efficient transportation for the general public on our facilities and not to simply promote the enhancement of economic activities. To consider both sets of needs, in the short term and the long term, the Department beginning in 1988 adopted, or significantly modified existing policies, procedures and guidelines relating to its access management program. Details of what currently is in effect is discussed below.

ACCESS MANAGEMENT PROGRAM

New Mexico's Access Management program is based on three elements: whether the facility has some degree of access control, if the route is a state maintained highway and to some extent, functional classification. Roads not under state jurisdiction are not subject to our regulations. An exception is that non-state roads which connect to state routes, if they have an impact on state facilities, can be subject to our regulations -- at least at points of access. The relationship of functional classification to access and traffic movement has long been an important consideration in transportation. Figure 1 (2) illustrates a traditional view of the concept. Using the route classifications shown in Figure 1, the basic framework of New Mexico's access management program can be illustrated.

As shown in Table 1, New Mexico more or less has a traditional access management program at least in terms of what is access and non-access controlled. Freeways (Interstate Routes) are access controlled. Because of past agreements which in some cases were the result of lawsuits, a few driveway access points remain on interstate routes. Some major arterials have limited access control. This includes routes with a mix of interchanges and high-type signalized intersections with no other access permitted. Another group includes facilities with high-type signalized intersections and intermediate limited access points, e.g., right-in, right-out intersections (typically located at one-quarter mile intervals). Typically these type of routes occur in urban/suburban areas. Frontage roads, if necessary, connect adjacent intermediate properties to access points. Access management of non-access controlled state routes is subject to our "Regulations for Driveways and Median Openings on Non-Access Controlled Highways" (Driveway Regulations).

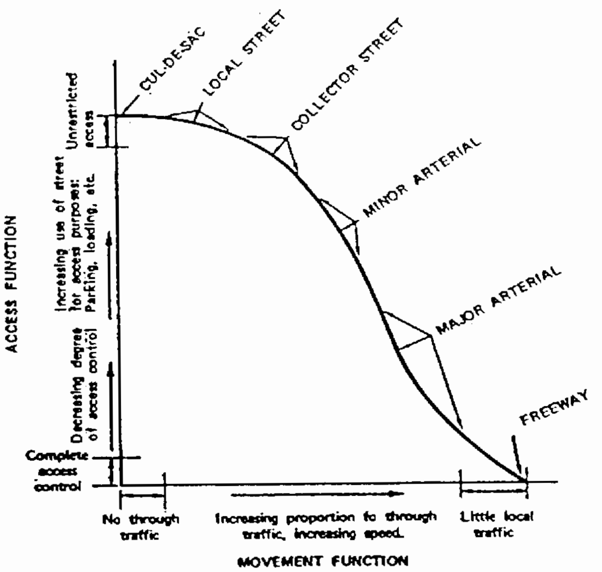


Figure 1. Movement Access Function of Roadway Types

Table 1. Relationship of Functional Classification to *New Mexico's Access Management Program*

Classification	Full or Limited Access Control	Non-Access Control-- Regulations for Driveways & Medians
Freeways (Interstate Routes)	X	
State Routes		
Major Arterials	X[a]	X
Minor Arterials		X
Collectors		X
Non-State Routes, includes arterials, collectors, local streets		X[b]

New Requests for access, or the modification of existing access points are also covered by regulations in this manual. Local entities are also subject to the Driveway Regulations - at their access points to state routes, if a proposed development or change in use is determined to have a significant impact on the state route.

Regulatory Process

Access management is based on a range of regulatory practices which are described below. These practices are not unique to the access management process but are applied to all state regulatory efforts. They are briefly described in order of their legal impact and effect.

Statutes

All states probably have legislation enacted by representative bodies which provide enabling authority to the agency to manage access. In New Mexico, the State Highway Commission is the designated policy body of the State Highway and Transportation Department. The State Highway Commission has the authority by statute to designate and regulate a state or federal highway as a controlled access route, in part, or in its entirety. Statutes also stipulate access control may be acquired by reasonable purchase or condemnation. For non-access controlled facilities the State Highway Commission is the authorized regulatory authority (3).In New Mexico, state government entities may establish Rules. Rules are regulations which for all practical purposes have the same effect as law. To establish a Rule, public hearings must be held to obtain input. In the case of transportation facilities, after considering input from the hearing process, the State Highway Commission can approve a Rule. The rule is then filed with the State Records and Archives Department. For non-access controlled facilities, a Rule has been established to regulate their operation -- these are the Driveway Regulations mentioned earlier.

Commission Policies

The State Highway Commission has the authority to enact policies for state transportation facilities. Typically these are general directives which may be supplemented by procedures and guidelines. variations from commission policy must be approved by the commission. Access to interstate highways and other limited access highways are governed by a commission policy entitled "Interstate Access" (4,5).

Administrative Memoranda

These are considered guidelines which typically provide substantive detail to supplement policies. They are submitted to the State Highway Commission by staff and are ultimately approved by the Department Secretary (chief of agency). For interstate highways, an Administrative Memorandum entitled "Interstate Access" is in effect (6).

Procedure
The Department Secretary has approved procedures which define responsibility for the management of access controlled facilities. This includes designation of an Access Control Review Committee to recommend and review access management issues and requests for access to these facilities.

ACCESS CONTROLLED FACILITIES

Program Structure
All evaluations, changes or establishment of new access are submitted to the Access Control Review Committee. All of these must be submitted via department staff or local government entities whose jurisdiction includes the subject area. No direct requests are permitted from private parties. Requests for access changes or modifications are classified as either major, minor or intermediate (See Figure 2).

Major Impacts
Major impacts include requests for new interchanges, significant modifications or impacts to existing interchanges such as new ramps. For this type of impact, a feasibility study by a private consultant is required if the request is not from the Department. The study is paid for by the requester. An Interstate Access Study Team is established to review the study. The committee, at a minimum, is composed of a member from the Department, the requesting agency and a representative from the FHWA. The feasibility report must address issues such as, access impacts, current and future traffic, distance to communities/activities, need, design configuration, alternatives, safety , impact on land uses, and any other relevant issues. Other important factors are -- the change must be supported in writing by local entities including the Metropolitan Planning Organization and a recommended funding source must be identified.

The final draft report is submitted to the Access Control Review Committee for comment. It is then sent to the Secretary and State Highway Commission for approval. If approved, then it is submitted to the FHWA for approval. If approved by the FHWA, it is placed in the Department's Five Year Construction Program. Intermediate Impacts. Current procedures indicate that a Traffic Impact Assessment (TIA) is required if either impacts or costs are intermediate. Typically,a TIA has been the minimum study required for establishing breaks when a request has been received from a developer to modify the access control line for a crossroad, or for minor changes to interchange ramp geometrics, e.g., change the radius of a ramp within an access controlled area.

Minor Impacts
If the impact of the request is considered to be minor, then a study is not required. The requester is required in all cases to provide specific information concerning location, purpose, cost, and the proposed change. If the impact is minor, the Access Control Committee will act on the request.

Access Control Review Committee
The purpose of the committee is to review all access control requests. The committee has the authority to deny access related requests. Approval of a request by the committee constitutes a recommendation for approval to the Secretary and State Highway Commission. If disapproved, the request is sent back to the committee for notification to the requester. Access requests denied by the committee can be appealed to the Secretary of the Department.The committee has eleven voting representatives and two non-voting representatives from various entities throughout the Department. Areas having representation include right of way (two), traffic engineering (two from central office, one from district), District Engineer, drainage, highway design, maintenance, advance planning, and preliminary design engineer if the request is project related. The two non-voting representatives are from the legal office and the FHWA.

Temporary Requests
Requests for temporary access breaks for construction projects are incorporated into design plans. The Access Control Review Committee does not consider such requests. Any other request that is temporary is submitted to the committee. The committee may approve or disapprove the request. If approved, it goes directly to the FHWA. Appeals of denials by the committee are directed to the Secretary. Administrative Determination. This is a document prepared by the Access Control Review Committee which specifies the proposed request. If approved by the committee it is signed by the Department Secretary once other Department approvals are received. When considering any access related request, the committee must consider at a minimum: 1) is access available which does not require a break; 2) what is the impact on the access controlled route; 3) is a frontage road to a non-controlled point a feasible alternative; 4) were damages paid to the original land owner to establish access control; and 5) what is the appraisal difference that must be repaid to the state and FHWA if a break is permitted? Waivers/Variances. There is no formal process for waivers or variances except the appeal process to the Secretary.

Inventory
A permanent inventory of access control actions is retained in the Right-of-Way Bureau in the central office in Santa Fe. Districts have limited information in terms of a data base and must forward all requests to the central office. There have been a few instances in the past where a district mistakenly gave an access permit in area that was access controlled. Improved communication of access management procedures to the district has helped to alleviate this. Fees. New Mexico does not charge a permit fee for any type of breaks whether they are access controlled or not. As indicated above, if the impact of an access request is major,

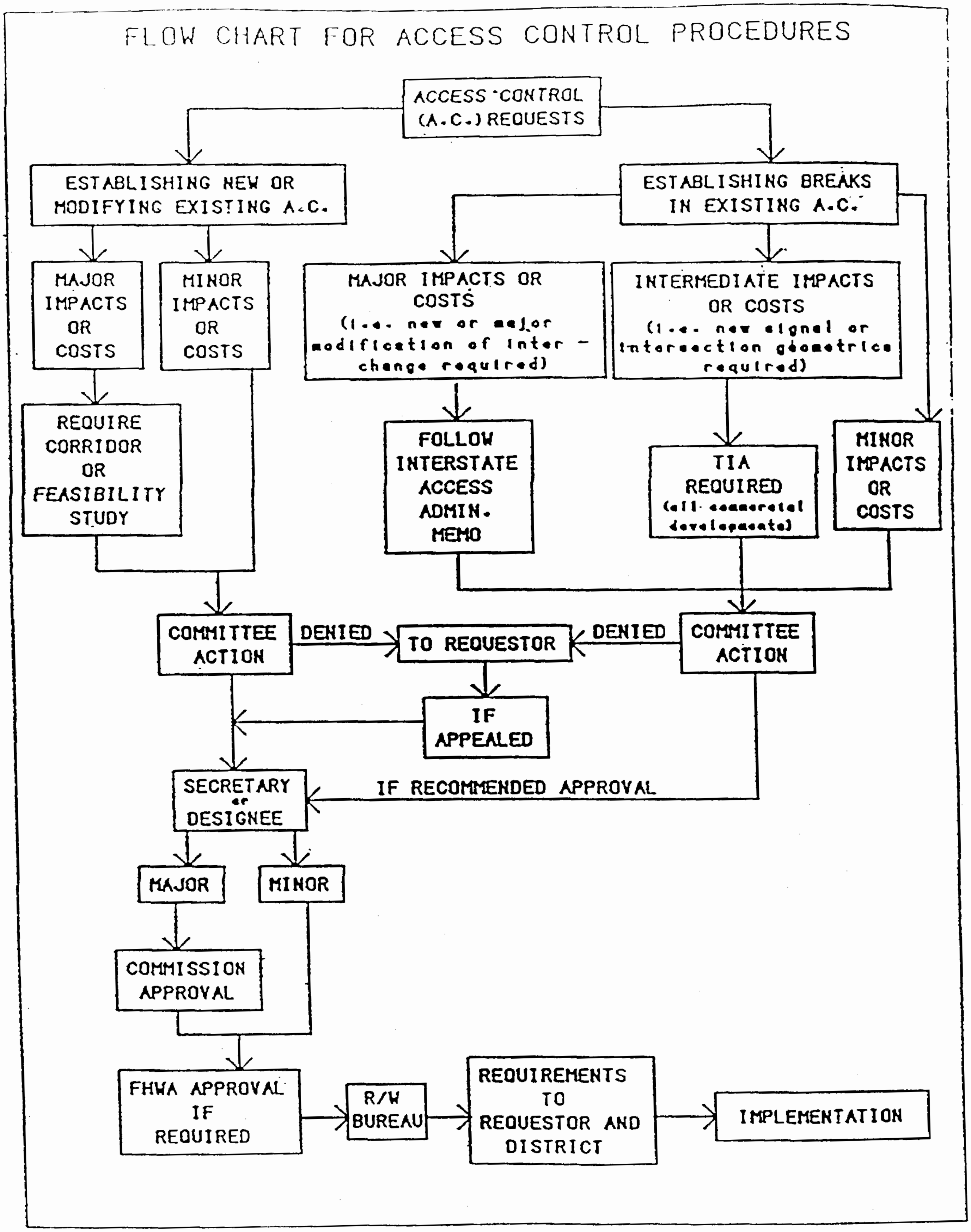


Figure 2. Flow Chart for Access Control Procedures

Ref. (7)

the local entity is required to pay for the cost of a feasibility study. Local Entity Participation. As stated above, local entity concurrence is required for major access control requests. A representative of the local entity is on the study team and contributes significant input. Participation and input from local entities have generally proven to be of great value as they provide valuable insights into local issues and concerns. With the increased prominence of MPO's, we have tried to expand the process to include their input and, in many cases approval, prior to Access Control Committee action. While they are not formally in the process this inclusion has been beneficial and, in some instances, a requirement from the local perspective.

NON-ACCESS CONTROLLED FACILITIES

The access management program procedures are outlined in "Regulations for Driveways and Median Openings on Non-Access Controlled Highways" (Driveway Regulations) (1).

Program Structure

All requests for access to state routes are submitted to district offices. Applications for an access permit may be made by property owners, their authorized representative, or local entities. The minimum information that can be submitted is a completed permit form (See Figure 3). Other supplemental material may be required which could include drawings, a description of work, or in complex situations, a Traffic Impact Analysis (TIA). If approval of the permit is granted by the District, in normal cases, construction must be under way within six months of the permit otherwise it is void (unless stipulated otherwise in the permit). If the owner makes changes or improvements to the access point, the use changes in intensity or use, a new permit is required. An existing permit can be revoked by the Department if it is determined that a safety problem occurs.

Traffic Impact Analyses

TIA's are required to evaluate situations where the impact to highway facilities could be significant in terms of either safety of traffic volume. TIA's are required for all median opening applications, commercial and industrial driveway access applications, and for residential developments if they generate a significant amount of traffic. At this time the threshold for requiring a TIA is quite low -- 100 vehicles per day generate traffic. Local entities are also required to provide the Department notice of any development the would directly of indirectly impact a state highway. For those conditions a TIA may also be required. All TIA's are initially submitted to the Districts. Complex TIA's are usually forwarded to the central office and a coordinated review is conducted with the District typically taking the lead.

Cost of Participation

Geometric and traffic control improvements must be borne by the permittee. This includes traffic signals and could include an interchange. For signals, maintenance and energy costs are the responsibility of the local entity. The Driveway Regulations provide for a permit fee but none has been implemented to date. variances and Appeals. If a permit is denied an appeal or variance can be requested. These are sent to the District Engineer who then forwards it to the central office Chief of Traffic Design for review. For the appeal to be approved or denied, the District and Traffic Design office must agree. If no agreement is reached then it may be forwarded to the Division Director level for a final decision. To date, no appeals have ever been forwarded to this state.

Design Elements -- Access.

The regulations have specific criteria for a number of design elements for driveways, medians, lanes and intersections. All of the criteria is consistent with AASHTO guidelines contained in the 1990 Policy on *Geometric Design of Highways and Streets* (8). We believe this is important as this is the primary reference used by the Department in its design activities. Utilizing the same standards maintains a consistency of design practice and minimizes the potential impact of private development on state facilities. Utilizing AASHTO criteria did not prove popular with permit applicants as this represented a significant change in requirements. The two primary reasons for this objection were that costs borne by permittees increased since higher design standards were in effect and the control of access points became much more defined. While no studies have been conducted to verify the safety benefits of the new design standards, we have noted few, if any, operational problems. Exceptions have been in situations where a permittee has agreed to a design but has failed to construct what was agreed.

The Driveway Regulations provide extensive design detail for situations compared to the past manual. We felt this was important for a number of reasons. 1) The Driveway Regulations are published in a free standing document that is provided to applicants. This allows users to have a complete reference at least for relatively simple situations. 2) Department staff also finds this document useful since it provides a complete reference. In New Mexico, district permit reviewers are usually senior technicians. Typically they do not come from a design background but more from maintenance. A comprehensive set of criteria provides a package for their use. 3) Typically, the major concerns of a permit applicant are related to geometric design issues. It seems that by providing detailed criteria it shows the applicant what is expected. Perhaps this has been a factor in having relatively few requests for variances and appeals. 4) Obviously, all situations cannot be covered in any manual, especially one that is intended for public use. To provide supplemental information, a list of 13 references is provided. It is stated that the most recent edition of each reference is to be used. The design criteria shown in the Driveway Regulations is primarily oriented toward rural applications. Both staff and applicants that are not familiar with urban design practices have had difficulty at times

NEW MEXICO STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

APPLICATION FOR PERMIT TO CONSTRUCT DRIVEWAY OR MEDIAN OPENING ON PUBLIC RIGHT OF WAY

Department Use Only

District No. ____________	Permit No. ____________	State Highway No. ____________
Project No. ____________	Station No.(s) ____________	Mile Post(s) ____________
Posted Speed ____________	Highway ADT ____________	Sight Distance ____________
Type of Vehicle ____________		Est. Driveway ADT ____________

TO: New Mexico State Highway and Transportation Department
ATTN: District Highway Engineer
( )Deming ( )Roswell ( )Albuquerque
( )Las Vegas ( )Santa Fe ( )Milan , New Mexico

Application is hereby made by ______________________, ______________________
(Owner of Property) *(Mailing Address)*

______________________, for the purpose of ______________________, with the estimated driveway
(Type of Business or Residence)

ADT as listed above, for permission to construct ( ) driveway(s), or ( ) median opening(s) at the following described location: ______________________

____

____

in ________ County, on State Highway No. ________ in accordance with the attached plan or sketch. Work will commence on or about ______________ and will require approximately ______________ days.
(Date)

The proposed driveway or median opening must be located, designed, and constructed in accordance with the *Regulation for Driveways and Median Openings on Non-Access Controlled Highways*. A Gate ( ), Cattleguard ( ), Additional Fence ( ), Drainage Structure ( ), will be required which owner agrees to furnish and hereafter maintain in good repair and closed to livestock. **The applicant shall submit a construction traffic control plan for approval.** The owner will protect, indemnify, defend, and hold the New Mexico State Highway and Transportation Department harmless from any injury or damage caused the owner, or third parties, by owner's failure to comply with the above. If this permit is granted, owner further agrees to comply with all the conditions, restrictions, and regulations, of the State Highway and Transportation Department. If not constructed, this permit will expire six months from date of issue unless otherwise noted and approved. The permittee shall notify the District Engineer of pending construction at least 72 hours prior to any construction, and upon completion of construction which shall be within 45 days of initiation of construction.

Place ______________________

Sworn to and subscribed before me this ____________

day of ______________ 19______________

My commission expires ______________________

____
(Notary Public)

____
(Owner's Signature)

By ______________________

Title ______________________

Owner's Phone No. ______________________

Permission granted this ____________ day of ______________________, 19______________

Subject to the above stated conditions and the following additional requirements: ______________________

____

____

Deviation from the stated conditions or the approved sketch may be grounds for revocation.

Distribution
Original-G.O.Files
Copies-District Eng.
Applicant
Traffic Serv. Engr.

NEW MEXICO STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

By ______________________
(District Engineer or Designee)

Title ______________________

Figure 3

using the regulations in urban environments. We have attempted to resolve this by conducting training sessions, staff meetings with Districts and maintaining good communication.

Design Features
The new Driveway Regulations have added significant emphasis to safety-related features such as speed-change lanes. The regulations provide specific criteria that stipulates under what circumstances these design features are required. Figure 4 illustrates requirements for a right-turn deceleration lane. The requirement is based on the posted speed limit, right turning volumes in to the access point and traffic volume on the mainline (in the same direction as the turning traffic). If a lane is required then the regulations provide design information. Four types of speed-change lanes are shown in the regulations -- deceleration lanes for right and left turns; and acceleration lanes for right and left turn lanes.

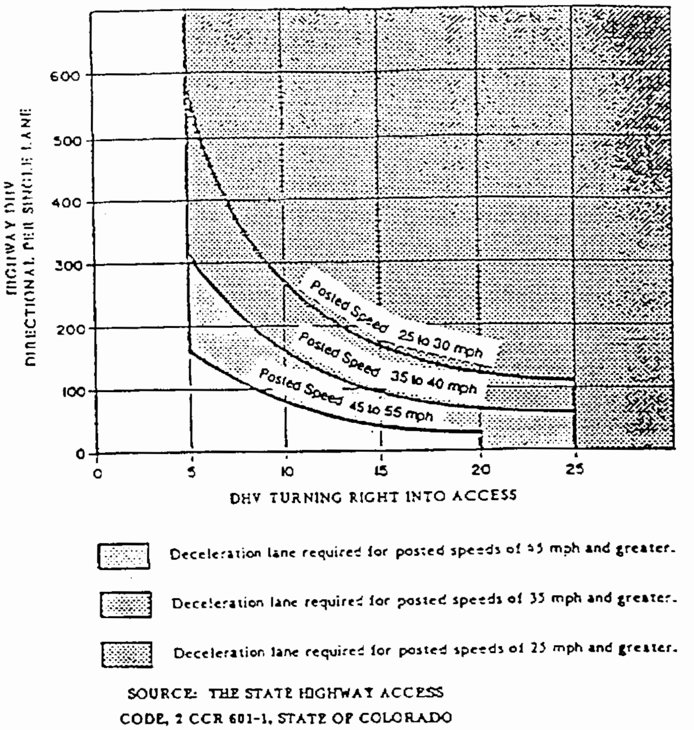


Figure 4. Deceleration Lanes for Right-Turning Vehicles

NOTE: 1MPH=1,609 Km/hr. Ref. (1)

Implementation of Driveway Regulations
Implementation of any program such as this is not a short term effort. For all practical purposes this process is still occurring. Based on our experience, these are a few of the major steps that have occurred. 1) Determine there is a need for a new or revised access management program or element of the program. What this really implies is there needs to be at least initial support for change from decision makers and staff performing this function. Otherwise the effort will not be successful. In our situation there was staff support -- political support was tentative. It is likely that politicians were not aware of the magnitude of the changes that were proposed -- some staff were not either. 2) Prepare new procedures, regulations. One important consideration is to obtain as much input as possible from all affected groups. To large degree, those preparing the regulations are not completely knowledgeable about all of the issue or some of their details. 3) Prior to implementing the regulations have an extensive staff training program. Besides staff, invite other potential users. In our case we had a training session prior to finalizing the draft regulation -- this another means of obtaining input. Because the regulations were to become a rule, we also had a public hearing/written comment period which was beneficial. 4) Prior to implementation or at implementation, send copies to all affected public agencies. In our case we sent a copy to all municipalities, counties and public land agencies such as the National Forest Service (New Mexico has extensive public lands). Also send copies to any government agency that develops facilities such as the post office. Do not forget to distribute internally and include consulting engineers. 5) The Public. Informing the public is an ongoing process.

Until an individual has a need for an access permit they are usually not aware of such procedures. When a new program is implemented the public may not necessarily appreciate the benefits but instead may compare new requirements to what others have done in the past. A frequent comment we receive is, "this is not what the store down the street has." Inventory of Data. Each District maintains its own inventory of permits and correspondence. The central office has very limited information. Some Districts are implementing a PC based inventory of permits on a route basis. Inventory information is typically not available for design efforts.

NEED FOR FUTURE EFFORTS
Over the past few years the complexity of access management has grown as has the level of effort. We have found that many of the issues are multifaceted -- they involve street system planning, local government input, environmental considerations, safety, drainage, maintenance requirements, right of way and traffic inputs. The last two items, right of way and traffic have proven to be the most significant. Many issues have involved complicated and expensive right-of-way transactions. The traffic impacts of access change have to large extent determined if the change should be approved, what changes to access would be needed, and what geometric improvements are necessary of possible. Another issue is the design of access controlled facilities must consider to a greater extent the ultimate development of adjacent non-access controlled facilities. In the past there has been a tendency to not provide proper protection of an access controlled facility. With the growing complexity of access management issues, the expertise of staff that handles the day-to-day decisions has

not always kept up. The result is potentially uninformed decisions or arbitrary actions. Constant training and communication with support staff is important to provide a quality decision making process. Finally, the perception of the access management process by the general public, developers, local entities and state political decision makers is important. We must communicate the rationale for our decisions/procedures, successes, and policies so that individuals outside the process have an appreciation of the need to preserve the quality of our transportation facilities.

CONCLUSION

An access management program is an important tool for transportation departments in their effort to maintain a high level of safety and operation for their highway facilities. In New Mexico's case, over ten per cent of the state routes are access controlled -- new routes are being added. The remaining portion of the state system has to be carefully managed to provide safe and efficient access.

REFERENCES

1. "Regulations for Driveways and Median Openings on Non-Access Controlled Highways," New Mexico Highway and Transportation Department, 1989.

2. "A Policy on Design of Urban Highways and Arterial Streets" AASHTO, 1973.

3. "New Mexico Statutes 1978 Annotated and 1992 Cumulative Supplement", State of New Mexico, 1992.

4. "Interstate Access", New Mexico State Highway Commission Policy 88-123, 1988.

5. "Access Control", New Mexico State Highway Commission Policy, December 17, 1964.

6. "Interstate Access", New Mexico State Highway & Transportation Department, Administrative Memorandum 160-89, June, 1989.

7. "Access Control Procedures", New Mexico State Highway & Transportation Department, July 1992.

8. "A Policy on Geometric Design of Highway and Streets" AASHTO, 1990.

PRACTICAL CONSIDERATIONS FOR BEGINNING A COMPREHENSIVE ACCESS MANAGEMENT PROGRAM

Gary H. Sokolow
Florida Department of Transportation

ABSTRACT
This paper provides guidance to state and local governments on practical considerations when considering the institution of a comprehensive access management program. Questions addressed are:

1. What access features will you manage?
2. How will you develop a classification system for your roadways, or should you develop one at all?
3. How will you handle variances to the standards?
4. How will you deal with land that has been subdivided into small lots?
5. Who will administer your program?
6. Should you charge fees?
7. What sort of permit types will you have?
8. How will you handle "grandfathering" and land uses that re-develop?

Practically all states and urban governments have some sort of access management program. A comprehensive access management program is one that attempts to manage many forms of access to the highway systems through and publicly developed and adopted standards.

This comprehensive access management program will also have detailed guidance on managing access that will enhance safety, the environment, and protect capacity on our public roadways. One of the major differences between the many driveway control ordinances and the truly comprehensive access management program is that with the comprehensive access management program, you are frequently telling applicants "NO." This simple fact leads to the necessity of having much more well thought-out standards and procedures. Colorado, Florida and New Jersey have established the United State's first comprehensive access management programs. In this presentation, I will set out what these states have done in some critical areas.

I will show some of the pitfalls and opportunities with choices each government makes. The major issues to be discussed are:

1. What access features will you manage?
2. How will you develop a classification system for your roadways, or should you develop one at all?
3. How will you handle variances to the standards?
4. How will you deal with land that has been subdivided into small lots?
5. Who will administer your program?
6. Should you charge fees?
7. What sort of permit types will you have?
8. How will you handle "grandfathering" and land uses that re-develop?

What Access Features Will You Manage?
Of the three states that are being studied, Colorado, Florida, and New Jersey, all have varying degrees of standards for the following features:

1. Interchange spacing (for freeways).
2. Traffic signal spacing.
3. Median opening spacing.
4. The provision of restricted medians.
5. Driveway spacing.

Even though most states with a comprehensive access management program regulate standards for these features, the emphasis has been different in each of the states.

Interchange Spacing
In Florida, the interchange spacing standards and the approval of new interchanges is handled in a detailed Interchange Justification Report (IJR) with more detail than the Federal requirements. The details of what needs to be in the IJR are found in Florida Department of Transportation's Procedures.

In addition to the usual traffic analysis, a very detailed land use and economic analysis is necessary. It is also necessary to specifically study alternatives to direct freeway interchange access. Long ago, Florida DOT has reached the conclusion that having developers completely pay for interchanges is not enough to favor adding a new interchange.

Restrictive Medians
Florida is heavily encouraging restrictive medians on its higher designed at-grade arterial roadways. The Florida DOT has just mandated that all multi-lane projects with design speeds of 40 MPH or greater be designed with a restrictive median. Both Florida and New Jersey have required restrictive medians for some of their arterial roads. Colorado does not specifically require restrictive medians on its at-grade arterials. However, this may be due to the necessity of making it easier for snow removing equipment in Colorado. Both Florida and New Jersey do not consider two way left turn lanes a restrictive median.

Should Median Type Be Part of Your Access Management Classification System?
Florida and New Jersey make the provision of a restrictive median an integral part of its access management classes. This classification may not reflect the existence (currently) of a restrictive median. How this works, is that if a road is currently classified for a restrictive median and it currently does not have one; when it is reconstructed or improved it shall be constructed with a restrictive median. The benefits of this, are that residences and businesses along these corridors are made aware of the future plans for this roadway.

Of course, there are some drawbacks to this approach; 1) Since improvement may be a long way off, or may never happen, you may unnecessarily upset the business interests along a particular corridor, 2) Some flexibility is also gone for your own design engineers in their planning.

The decision to require a restrictive or nonrestrictive median is obviously a complex decision. In an urbanized area analysis of this decision includes an analysis of land uses, turning movements, and existing right of way and natural features. These cannot be studied in detail when you are going through the process of classifying your entire road system. Therefore, you should build some flexibility into your system that allows access management classifications to be changed right before a design or construction where a change in the features are necessary. In Florida, we have a reclassification public hearing at the same time as the public hearing on the road design.

Signal Spacing
Colorado, in its management of arterial access, has made signal spacing one of the strongest features that it manages. This is an important feature to manage that is often overlooked by states with more simple access management programs. Recent research backed up by the "Highway Capacity Manual," (Special Report No. 209) reflects the importance of maintaining approximately half mile signal spacings to achieve the most efficient progression on major arterials (Stover, Demosthenes, 1991). Colorado's access management code requires that traffic signals along its major arterials be programmed for between 90 - 120 second cycle lengths and travel speeds of 40 MPH. It also requires that the analysis use a desirable band width of 40 percent but no lower than 30 percent. New Jersey has some of this direction in its access management code, but Florida currently does not.

Allowed Turning Movements
Colorado, Florida, and New Jersey also manage the allowed turning movements from driveways. Though Florida also has specific median opening standards for what we term as "directional median openings." Directional median openings are those median openings that allow only specific turning movements, usually left turns into property.

How Will You Develop A Classification System For Your Roadways?
Given that there is a hierarchy of public roads, each with their own purposes and functions, it may be necessary to provide a classification systems to help guide the level of access management on each type of roadway. Society needs highways that move traffic long distances, but also needs highways that provide convenient access to properties. There is, of course, an entire spectrum of roads with a balance between moving traffic and providing access. Therefore, we would not have the same access management standards for those roads that we have chosen for moving long distance travel and those that we have for providing access to businesses.

The following shows the number of access classifications for the state highway systems of Colorado, Florida, and New Jersey.

- Colorado - 5
- Florida - 7
- New Jersey - 6

How Many Access Management Classifications Should You Have?
Experience in Colorado, Florida, and New Jersey says that you should have the minimum number necessary to fulfill your access management needs. This can only be determined by discussions with representatives from your Permitting, Design, and Planning divisions, as well as with the public and local governments. Florida with seven access management classifications has the most classifications of the three states studied.

An important thing to consider is that classifying a roadway corridor according to access management need not be particularly difficult. Though determining the dividing line between access management levels is very difficult and can be controversial. This difficulty is due to the amount of judgement necessary to separate, with one line, where the character of a corridor changes. So, the more classifications you have, the more "dividing lines" that will be controversial and difficult.

Why Not Use Functional Classification As Your Basis For Access Management Classification?
Colorado, Florida, and New Jersey have decided to use functional classification as one of the inputs in the determination of access management classification, but all three states have rejected the notion of using functional class as the strict basis for access management classification. Because the reality of producing an access management

classification system necessitates the use of the following principle:

"The more a corridor is developed, the less options you will have for strict access management standards."

This means you need to have an access management classification system that is sensitive to current development levels on the corridor. Functional classification is not sensitive to these levels of developments and you will find principal arterials going through not only rural areas, but right through some of the more developed suburban and urbanized areas. This fact makes the use of most functional classification systems limited as access management classifications.

Should You Have Access Management Classifications At All?

During the difficult job of establishing access management classifications for the state highway system in Florida, we wondered many times whether an access management classification system was necessary at all. When Florida established access management standards in 1991, we realized that it would be a few years before this classification process would be in place. Therefore, Florida established interim standards based on posted speed limit. This allowed standards to be in place immediately for the entire state highway system. They are as follows:

TABLE I

INTERIM ACCESS MANAGEMENT STANDARDS

Posted Speed (mph)	Connection Spacing (feet)	Median Opening (feet)		Signal Spacing (feet)
		Directional	Full	
35 or less Special Case	125	330	660	1320
35 or less	245	660	1320	1320
36-45	440	660	1320	1320
Over 45	660	1320	2640	1320

They have worked fairly well except they have been criticized as being "too tough" for roads over 45 MPH. Though there are real benefits to a well thought-out classification system, you might also want to consider not having access management classifications at all. You could do this by establishing access management standards based on readily available roadway features such as posted speed limits. Though, using this method ignores the fact of varying levels of access need for roads with similar speed limits.

How Will You Handle Variances to the Standards?

No matter how well you plan, there will be a significant number of developments that cannot, or say they cannot meet the standards you have set. You must then have in place a procedure for handling variance requests. Colorado, in its Access Management Code, provides that variances will be considered if:

- there is an exceptional and undue hardship on the applicant,
- the variance will not be detrimental to public safety and welfare,
- a variance is reasonable necessary for the convenience and welfare of the public.

New Jersey, in their code provides for variances (they call them "waivers") in a number of instances. They include:

- existing substandard conditions,
- existing social, economic, or environmental constraints,
- location in an enterprise zone,
- conflicts between other state, Federal, and regional regulators, and
- others.

Florida does not currently have any specific variance procedure though it is currently rewriting its permit procedures which would allow applicants to submit variance requests if they produce an acceptable traffic analysis that shows that their plan better serves the DRIVING PUBLIC and not just the applicant's clients or customers. We are also proposing that the rule contain the statement that in the review of these traffic studies, that issues of <u>traffic safety</u> will be given more weight than the issues of <u>traffic efficiency</u> or convenience. This is an important feature because many times the control of driveways and turning movements will lead to more concentration of turns at traffic signals. Therefore, an applicant may attempt to show efficiency gains by a looser management of access.

In all three states studied, variances need to be approved by high ranking transportation engineers within their Departments.

How Will You Deal With Land That Has Been Subdivided Into Small Lots?

Even though a standard for driveway separation along a corridor might be 660 feet, there will often be many 80 feet and 100 feet lots with no alternative to direct access to the road. What do you do? Florida's access management code allows the "smaller than the standard" property with no other alternative access to get one direct driveway. In

Florida, there is currently not much more guidance than this. However, in New Jersey there are very detailed procedures for the handling of these "nonconforming lots." The essential idea behind these detailed procedures is to have a standard approach that minimizes the effect of the connection of these smaller lots on to the state highway system. One of the major features that sets New Jersey apart is its ability to tie trip generation with the approval of access. New Jersey may limit the land use to a size where the trip generation would not have a big impact. Colorado handles small parcels on a case by case basis. They take into account, the roadway access classification, and availability of other access.

One of the factors that has limited the authority of the State of Florida in the handling of nonconforming lots is the recent change in the law on access management in Florida. This law change, brought about, in part, by development interests, now assures direct access to all properties fronting state arterials unless there is a specific safety or operational property backed up by an engineering report.

Another important consideration is land subdivision review authority. Both Colorado and New Jersey have direct review responsibilities on subdivision decisions. Florida does not currently. This review of proposed land subdivisions could be one of the most important features of a comprehensive Access Management Program.

Who Will Administer Your Program?

Of the three states studied, each handle permits in a very different way. Florida has seven regional districts and almost thirty maintenance offices within these districts. Permit handling is essentially done in the maintenance offices with the larger developments (over 1200 trips per day) being handled in the district offices primarily in Traffic Operations Divisions rather than Maintenance. In New Jersey, all major developments (over 600 vehicles per day) are handled in the Department's Central Office by their special access management staff. In Colorado, all permit approvals are done in their six Regional Offices specifically by their permit engineers.

In Colorado copies of all permits, once they have been approved by the District Permit Engineer, are sent to the Denver Central Office for review and quality assurance. In Florida, the Central Office Access Management Staff does not get involved in any permit decisions unless asked specifically by the District staff.

In deciding the level of centralization necessary you must have a good idea of the number of permits that are handled and the general size of the developments coming in for permits. Florida, being a very high growth state handles over 2,000 applications per year. The administration decided to carry out access management a decentralized fashion.

The following Table 2 gives an overview of the administration of permitting in the three states.

Table 2. Summary of Administration

STATE	PERMIT TYPE	PRIMARY REVIEW DIVISION	DEGREE OF CENTRAL CONTROL
Colorado	All	Right of Way	Medium
Florida	Under 1,200 Trips/Day	Maint.	Low - Handled in Maintenance Offices
	Over 1,200 Trips/Day	Traffic Operations	Medium - Handled in District Offices
New Jersey	Minor - Less Than 500 Trips/Day	Maint. Regional Office	Low
	Major - Over 500 Trips/Day	Bureau of Major Access Permits (3 review teams- Planners and Traffic Engineers)	High - Handled in Central Office
	Major - Over 500 Trips + 200 Peak Hour Trips	Bureau of Major Access Permits (3 review teams- Planners and Traffic Engineers)	

Colorado chose to have its access management program administered in the division of Right of Way for a number of reasons. One of the most important reasons is they wanted the large and experienced legal staff from the division of Right of Way to be available to work on access management issues. The other reason is to allow access management policy to be established "closer" to the actual production process. This can be a real benefit.

As you can see, the states studied have varying levels of central authority on the larger developments. Primarily, the larger the proposed development, the more the need for traffic operations and planning analysis. An important decision needs to be made as to what your thresholds are for the larger developments. Again, because Florida is a high growth state, the tendency for these points to be at a much higher level than New Jersey.

Should You Change Fees? If So, How Much?
Currently, Florida and New Jersey charge application and/or permit fees. Table 3 shows a comparison of the fee structure of the three states.

Table 3. Fees for Application and Permit (Dollars)

Example Land Use	Colorado	Florida	New Jersey
Single family home	50	50	50
Barbershop	100	1,000	350
Service Station	100-200	1,000	5,000
Convenience Mkt/Gas Pumps	100-200	2,500	5,000
Community Shopping Ctr (150K SqFt)	600-1200	4,000	12,000
Regional Mall	1200-1800	5,000	12,000

Colorado's estimates are based on the fact that Colorado only changes fees on the permit not the application. Colorado also bases its fee on the number of driveways permitted. Colorado has three major fee categories:

- Single family homes/ field entrances - $50 per connection
- Small use - no road changes - $100 per connection
- Larger use - with road improvements - $300 per connection

New Jersey has established fees not only by size of development, but by the place within the process, separating both application and permitting fees. However, Florida has one application fee which is valid through the entire process.

Once you start collecting fees, there are a number of issues that you must consider:

- You should have a procedure for the handling of fees.
- You should have a procedure for returning part of the fees if it were based on incorrect calculations.
- Next, consider putting in law that these fees are non-refundable even if the access is not permitted.
- Be aware that when you move from a free application process to one based on a fee (especially if it goes up to a high fee), that the expectations of the applicants will be higher for the professionalism of your staff.
- Be aware that basing fees and permit categories based on trip generation that the ITE Trip Generation Report does not cover every land use that you will need to administer. Florida and New Jersey has attempted to handle this lack of knowledge with these two strategies:
    1) Support and study "popular" land uses that are not adequately covered in the ITE Trip Generation Reports.
    2) In your regulations, use the term "Generally Accepted Professional Practice." When there is a lack of information on any subject, then within your regulations you can say alternatives based on "generally accepted professional practice" will be considered by the Department or permitting authority and approved if acceptable.

How Will You Handle "Grandfathering" and Land Uses That Redevelop?
Essentially, Colorado and New Jersey use a ten percent increases in traffic to be considered a significant change in order to bring new or expanded developments into the permitting process. Florida has chosen to go with a 25 percent increase significant change and only if it is over 100 additional trips per day. This is to prevent the single family home that adds another single family home to a large lot and increases the trips by 100 percent, but only approximately ten trips a day. Florida went with an extremely high number of 25 percent additional trips to assure the development interests that our intent was not to overburden existing developments and try to "get" every small development that added a few tables to their restaurant or added some new parking to their facility. One of the problems with the high 25 percent number has been the fact that regional malls can add an anchor store of over 100,000 square feet and many times not "trip" the significant change definition in Florida regulations.

Summary of Main Points/Checklist

1. Decide what features of access you want to manage and produce spacing and construction standards for them.
2. Vary the spacing standards by the traffic moving/access serving nature of each class of highway your agency regulates.
3. Keep your classification system simple.
4. Determine how you will handle variance to your standards. Try to make this as non-discretionary as possible.
5. Consider having the access management function of your agency close to the "production side" of your agency to allow the greatest ease of getting the appropriate information to the staff that make the most important decisions.

Access Management and Facility Planning in Oregon

Del Huntington
and
Richard McSwain
Oregon Department of Transportation

The Oregon Department of Transportation (ODOT), like many other state transportation agencies, is looking to access management to improve the performance and longevity of its highway system. Our methods in the past have under-used regulatory authority and tended to treat access as a right of way issue. The result has been the predictable tendency for state highways to succumb to the demands of roadside development.

This is changing as ODOT is looking to upgrade its approach to access management. A proposed system has been developed by consultants that would overhaul the current system. It is clear from their efforts that there is much to be gained from the pioneering work in a number of other states, most notably Colorado, Florida and New Jersey.

This paper will not go deeply into the fine points of the system ODOT is considering as, for the most part, ODOT is using methods developed by other states. Also, there hasn't been resolution on a number of key elements. ODOT's approach may be more of interest in its ties to planning at state and local levels. Access management will be integrated into a comprehensive program involving state system planning, corridor planning, and local area comprehensive planning. This paper will emphasis these aspects.

The Early Vision

Samuel Hill was the man responsible for the dream and subsequently the building of a magnificent highway through the Columbia River Gorge in Oregon in the early 1900's. The result was a truly spectacular roadway that received world acclaim. Samuel Hill believed that the roads and highways define the civilization of those that build them.

Glorious visions for what roads could be did not end there in Oregon. The state passed a 'throughway' law in 1947 that was unique in the nation at the time for its understanding of what a highway system could be, and the forces that worked against achieving those goals. The purpose of the law among other things was the "protection of highway traffic from the hazards of unrestricted and unregulated entry from adjacent property".

In spite of these noble beginnings, we have not always kept a clear focus of how the highway system should function.

What Went Wrong

The building of highways and roads across this nation over the past 100 years has proven the statement over and over that "If we build it, they will come". We have built the finest, most extensive system in the world - and development and congestion have often followed, sometimes so closely that it appeared simultaneously. That development and congestion have usually offset the benefits the system was built to provide.

In many areas of our society, we have come to expect instant response to meet our needs, both real and perceived. We have everything from drive-in restaurants, to drive-in divorce lawyers. Our present roadway system has encouraged mobility and instant gratification. Motorists can travel any distance they desire, and for any purpose they wish. Our highways certainly do define our civilization.

Highways have become a center of attention, serving not only to link towns, but also in more and more cases, to anchor each town's economic and social makeup, however it has not come without costs. These costs include vast seas of asphalt and concrete, traffic congestion, poor levels of service, and air pollution.

Opportunities to build new highways are decreasing. Environmental concerns, rising costs of right of way, and possible tightening of funds all contribute to the need to protect and maximize benefits from the existing roadway system. For agencies charged with the responsibility of managing highways, the challenge is to look for new and innovative remedies to these modern problems.

Access Management promises to be a large component of the solution, however it is often diametrically opposed to what much of society has come to expect. In addition access management alone cannot solve the problem. Land use activities, and political and economic pressures can frustrate the most well designed access programs.

There must be a well accepted vision for the purpose of the highway system, who it serves, and how it is to function, built into the plans at both state and local levels. The vision enables development of logical steps to reach the established goals.

The Way Towns Have Grown

Highways have exerted a great influence on the way urban areas have developed, particularly smaller communities faced with other geographical constraints. There are many examples in Oregon, where such constraints as the ocean, rivers or mountains have made it both easier and less expensive to develop linearly along the main highway.

One community in Oregon has a population of 6500, yet is built along seven miles of the coast highway. Many business are located adjacent to the highway with direct access in order to capture the tourist market. The lack of an adequate supporting city street system forces many local motorists to use the highway in order to reach their destination for their daily activities. This combined with the longer distance highway traffic and tourist activities in the summer can place tremendous pressure on the state highway.

There are other cities that do not have physical constraints to influence growth yet also develop along highways. Several have seen the main commercial sector pick up and move from the traditional town center out to a major highway or freeway interchange. This is a pattern that is increasing in momentum as more national 'big box' retail chains and factory outlet centers move into the state.

The reasons for these development patterns are many. Land use pressures, lack of planning, and politics are among them. Two that must concern ODOT are first, our past inconsistency in clearly setting out the function, purpose and standards for its facilities and second, ODOT didn't actively participate in the local planning processes. These steps are necessary if the ambitious visions established years ago are to have any chance to be realized.

What Oregon is Doing About It

Oregon, like many states, is undergoing a renaissance in thinking about planning for and protecting its facilities. To that end it has undertaken some initiatives in the area of planning and access regulation which promise to help. These initiatives are well positioned to take advantage of the state's land use law and, more significantly, a new rule on transportation planning promulgated by the state's land use agency. A description of that rule and the major ODOT initiatives is provided below.

The Transportation Planning Rule

Oregon has had an aggressive land use planning program since the early 1970's. The laws behind this program set requirements for development of statewide planning goals. They further require that all jurisdictions develop comprehensive land use and public facility plans that meet the goals. Urban areas under the program have had to establish urban growth boundaries. All jurisdictions must periodically review their comprehensive plans and update them.

The transportation planning rule was developed in 1992 by the Department of Land Conservation and Development, the state's land use agency, with the assistance of ODOT. Its main purpose is to implement the statewide planning goal for transportation. That goal is to bring about a multimodal transportation system that encourages less reliance on the single occupancy automobile. In addition, the rule requires local governments to recognize the stated function, purpose and standards for state transportation facilities, balance land use plans with transportation services, and limit access in rural areas.

More to the point of this paper, the rule requires local governments to amend their comprehensive plans to be consistent with the following points.

- *Local governments must plan a network of arterials and collectors to meet transportation needs.*
  This will be the first step in developing interconnectivity of local streets. As streets are connected, it will reduce the burden on the principal arterials, and shorten travel distances for local trips. Also, cycling and walking will become more viable options for local trips.

- *Local governments must regulate land uses, streets and highways to be consistent with their function.*
  This should have the effect of limiting land uses along arterials, so that the roadway can function as it was intended. Access management and development of internal traffic circulation will be key components of this requirement.

- *The comprehensive plans must recognize the tie between land use and transportation facilities.*
  This means that land use decisions on proposed plan changes need to be consistent with transportation plans. Also, transportation plans are to be developed so that reasonable levels of mobility will be present when the land is developed in accordance with the comprehensive plan. Changes to land use designations can be made only when the transportation plan is amended to provide adequate service. Also, land use decisions cannot be made apart from transportation decisions.

The Oregon Transportation Plan

The purpose of this statutorily mandated 20 to 40 year plan is to guide the development of a "safe, convenient and efficient transportation system" which promotes the economy and liveability. It is the highest level plan for the state's transportation system, providing for all types of transportation from air travel to telecommunications. The plan recognizes that local land use plans are crucial to the success of any transportation system.

The Oregon Highway Plan

The Oregon Highway Plan is a 20 year highway system plan under the umbrella of the Oregon Transportation Plan

(OTP). It includes policy which functionally classifies the state system into four 'Level of Importance ' classes. Policy has also been developed to address access management and prescribe standards for the most important highways.

Administrative Rule on Access Management

Oregon is working to develop a fully integrated access management program. This effort has been heavily reliant on the work of the leading states in this area. Draft language for an administrative rule, or state code, has been prepared by a consulting team and is currently being reviewed by general ODOT staff.

The key components in the system as proposed will include:

- Descriptions of the four 'Levels of Importance' which have been assigned to the state system. These describe the system by function and purpose. The highest level is to operate as a freeway, the lowest being largely for local circulation and land access.
- Six access categories have been developed which prescribe spacing standards for public and private road connections, signal locations, use of closed medians and the like. The current version of these categories is provided in Figure A.
- A permitting system is to be the main mechanism to regulate access. Access permits will be required of new and changed uses. The consultant has recommended the Colorado method of having permits issued by local governments subject to state review and approval. Much ground needs to be covered to assure that local governments are up to the task and to convince key ODOT operating staff that this method will work.
- An exceptions process will be provided based on the requirement of 'clear and convincing' evidence to prove the need for exceptions to standards.
- An advance conceptual review process is included to allow an opportunity for developer and agency to talk about plans in a non-binding forum.
- Interchanges will require management plans for the area around the interchange. Plans will need to address the function and purpose of the interchange, access spacing on the cross street, signal and traffic controls, and traffic circulation needed to serve the land uses in the area.
- Specific access management plans for particular areas can be developed. This provision will allow for variance from standards provided the function and operational standards for the highway facility can still be met.
- A graduated fee structure will be examined which will provide a means of paying for impartial traffic impact studies associated with access applications.

Corridor Planning

ODOT is faced with significant requirements set by the Oregon Transportation Plan, the transportation planning rule, Highway Plan policy and the proposed administrative rule. To respond, ODOT is pursuing long range corridor plans for its major facilities and coordination of state facility plans in local area comprehensive plans. This effort recognizes the need to help communities become less dependant on the state highways for local needs. It will take considerable time and constant attention if this goal is to be realized. Since the state still has a relatively small population; most opportunities will lie in protecting those transportation facilities facing pressures posed by future growth.

Corridor plans will achieve certain key objectives with respect to access and facility management. They will clearly lay out function and purpose of the facilities and assign access categories. They will identify locations for local street intersections, signals and interchanges. They will also provide a way to develop specific area access management plans. Perhaps their greatest value will be in helping ODOT make maximal use of the transportation planning rule to establish what the state facilities are for and how they are to be managed in each local comprehensive plan.

In addition to the immediate state facility needs, ODOT must remember that it is dealing with a corridor. Generally, if the state facility is to be preserved, the rest of the community's transportation system must be working. This will involve planning for local circulation patterns including working parallel streets. It also involves pursuing less automobile intensive development patterns along major highways.

Corridor plans will be a basis for determining future facility improvement needs. They will also point the way to preservation strategies such as protective buying of right of way.

Summary

This is an ambitious program but there is growing support for it at many levels in the state. It recognizes that the role state facilities play in local structures is not wholly determined by access management measures alone. The ability of local street systems to circulate local traffic, and the type and orientation of land uses along state facility corridors are also key factors. Moreover, to be fully effective, state access standards must be built into local comprehensive plans. To this end, Oregon will be investing a lot of effort over next few years in coordinated planning with local jurisdictions.

Figure A. Access Management Classification System.

Category	Access Treatment	LOI (1)	Urban / Rural	Intersection				Signal Spacing (4)	Median Control
				Public Road		Private Drive (3)			
				Type (2)	Spacing	Type	Spacing		
1	Full Control (Freeway)	Interstate/ Statewide	U	Interchange	2-3 Mi	None	NA	None	Full
			R	Interchange	3-8 Mi	None	NA	None	Full
2	Full Control (Expressway)	Statewide	U	At Grade/Intch	1/2-2 Mi	None	NA	1/2-2 Mi	Full
			R	At Grade/Intch	1-5 Mi	None	NA	None (5)	Full
3	Limited Control (Expressway)	Statewide	U	At Grade/Intch	1/2 - 1 Mi	Rt Turn	800 '	1/2-1 Mi	Partial
			R	At Grade/Intch	1-3 Mi	Rt Turn	1200 '	None (5)	Partial (6)
4	Limited Control	Statewide / Regional	U	At Grade/Intch	1/4 Mi	Lt/Rt Turn	500 '	1/2 Mi	Partial/None (7)
			R	At Grade/Intch	1 Mi	Lt/Rt Turn	1200 '	None (5)	Partial/None (7)
5	Partial Control	Regional District	U	At Grade	1/4 Mi	Lt/Rt Turn	300 '	1/4 Mi	None
			R	At Grade	1/2 Mi	Lt/Rt Turn	500 '	1/2 Mi	None
6	Partial Control	District	U	At grade	500 '	Lt/Rt Turn	150'	1/4 Mi	None
			R	At grade	1/4 Mi	Lt/Rt Turn	300 '	1/2 Mi	None

NOTES:

1) The Level of Importance (LOI) to which the Access Category will generally correspond. In cases where the access category is higher than the Level of Importance calls for, existing levels of access control will not be reduced.

2) The basic intersection design options are as listed. Special treatments may be considered in other than category 1. These include partial interchanges, jughandles, etc. The decision on design should be based on function of the highway, traffic engineering, cost-effectiveness, and need to protect the highway. Interchanges must conform to the interchange policy.

3) Generally, no signals will be allowed at private access points on statewide and regional highways. If warrants are met, alternatives to signals should be investigated, including median closing. Spacing between private access points is to be determined by acceleration needs to achieve 70 percent of facility operating speed. Allowed moves and spacing requirements may be more restrictive than those shown to optimize capacity and safety.

4) Generally signals should be spaced to minimize delay and disruptions to through traffic. Signals may be spaced at intervals closer than those shown to optimize capacity and safety.

5) In some instances, signals may need to be installed. Prior to deciding on a signal, other alternatives should be examined. The design should minimize the effect of the signal on through traffic by establishing spacing to optimize progression. Long-range plans for the facility should be directed at ways to eliminate the need for the signal in the future.

6) Partial median control will allow some well defined channelized breaks in the physical median barrier. These can be allowed between intersections if no deterioration of highway operation will result.

7) Use of physical median barrier can be interspersed with segments of continuous left-turn lane or, if demand is light, no median at all.

Session 3T

Engineering Issues I

Moderated by Dane Ismart, FHWA

This technical session was the first of two sessions that focused on engineering issues related to access management. Four speakers discussed engineering aspects that included spacing standards, delay estimation, and rural access management.

The first speaker was Phil Demosthenes from the Colorado DOT. He gave a presentation entitled, "Linking Engineering to Regulations." In it he discussed the process for selecting access management standards and the importance of including them in the regulations so that they are enforceable. A summary of Mr. Demosthenes' presentation is provided here.

The second speaker was Mark Vandehey of Kittleson & Associates, Inc. who made a presentation for Wayne Kittleson entitled, "New Techniques in Estimating Delay and Capacity for Unsignalized Access." The presentation discussed the inability of the current Highway Capacity Manual procedures to accurately predict capacity and LOS at unsignalized intersections and highlighted some of the features of an improved procedure being developed for the 2000 Highway Capacity Manual.

The third speaker was Gail Yazersky-Ritzer from the New Jersey Institute of Technology who presented a paper for George Fallat entitled, "New Jersey's Use of Access Spacing Standards for Access Management - A National Comparison." The paper compares standards for unsignalized driveway spacing in six states. It discusses the basis for each set of standards and highlights the different approaches that the states have taken.

The final speaker was Jack Foster of the Texas DOT who gave a presentation titled, "Developing a Rural Access Management Program for Texas." He described the Texas Trunk System, a network of over 10,000 miles of rural highways, which will be the test bed for Texas' first access management program. He discussed the goals and objectives for the Texas program and the status of the development process. A summary of Mr. Foster's presentation is provided here.

This session was attended by approximately 80 persons. Questions and answers for the speakers are summarized in the discussion section for Sessions 3T, 4T, and 5T.

LINKING ENGINEERING TO REGULATIONS

Philip Demosthenes
Colorado Department of Transportation

Phil Demosthenes discussed the importance of linking engineering and design standards into a regulatory environment created by State statute. He discussed some principles in development of standards to use in implementation of an access management program at the State level. These are highlighted below:

- Involve State engineers at all levels (Chief Engineer, District Engineer, Resident Engineer) when you develop the standards for the access management program. This will assure consistency with other administrative, planning, design, operation, and maintenance directives.

- When you select the standards be specific and consistent with the overall DOT program. Focus on factors such as volume, speed, distance, capacity, sight distance, etc. Relate these to elements and warrants to achieve the functions of a particular roadway classification. Keep in mind that the factors are key versus the functional class. The standards should be aimed at the broad goals of safety and mobility.

- When choosing between minimum versus desirable standards developed by AASHTO or others, use desirable. This gives you potentially longer benefits.

- Make sure that any standard that you adopt is enforceable. This will be discussed later by Randall Sampson of CDOT's legal department.

- Make the standards workable with citizens and the professional staffs reviewing the applications. Set out the process so that the design engineer of the applicant has to make an objective case by requiring them to go for a variance.

- Variance requests should be supported by specific criteria such as signs of hardship, public safety, maintenance, traffic operations, and others tied to the access program goals and objectives.

- Make sure when implemented that everyone follows the rules so that there is equal treatment under the State statute.

- Keep in mind that individual decisions on applications are important. 53% of accidents can be tied to access based on our Colorado experiences - 20,000 access related accidents.

Overall, let's work engineering design standards to give managers and supervisors the support needed to implement the access management regulations.

New Jersey's Use of Access Spacing Standards for Highway Access Management A National Comparison

George A. Fallat
New Jersey Institute of Technology

Introduction

There is a strong consensus on the need for an effective highway access management program. For applicants, there are clear established guidelines outlining requirements for state highway access, and the unanticipated procedures so often associated with government permitting processes can be eliminated. For state highway officials, access management provides not only safer, more efficient highways, but simplifies staff training and review.

The New Jersey State Highway Access Code as written covers a wide range of topics including the administrative procedures, and various technical aspects such as spacing standards for traffic signals and median openings, and design guidelines for driveway and street openings. While the foregoing are fairly straightforward, or have been established by the American Association of State Highway Transportation (AASHTO), or the Institute of Transportation Engineers (ITE), there is no national consent regarding unsignalized driveway spacing standards, and treatment of sites not meeting these standards. These issues alone, however, can have a significant effect on adjacent highway development. New Jersey, for example, limits the number of permitted trips if the site cannot meet the established highway frontage spacing standards. Other states' practices include requiring combined access, granting temporary access with limited trips, or complete denial of access.

It is important, therefore, that methods for determining driveway spacing be carefully reviewed and evaluated. In the following text, New Jersey's guidelines for unsignalized accesses and treatment of sites not meeting these criteria will be discussed and compared to current practices throughout the United States. Clearly, these issues are pertinent in the context of land use planning and have considerable legal ramifications. These relationships will also be discussed briefly.

Driveway Spacing Standards for New Jersey and Nonconforming Lots

The development of New Jersey's State Highway Access Code came about through legislation which recognized the need to establish statewide standards for state highway access. Adopted in 1989, the "State Highway Access Management Act" called for extensive administrative and technical guidelines aimed at preserving the existing State highway system, and solicited participation of both government agencies and the private sector. Provisions contained in the Act called for the right to reasonable access "to the general system of streets and highways in the State, but not to a particular means of access" (Chapter 32, Laws of New Jersey, February, 23, 1989) yet intended to achieve a balance between "regulation for the purpose of protecting public health, safety, and welfare" (ibid.).

Prior to the adoption of the State highway Access Management Act, legislation was initiated to integrate the role of counties and municipalities in the transportation planning processes. The Bill referred to as "Transplan", attempted to collectively address State highway access, mitigation of transportation improvements, and county/municipal planning policies. Due to the comprehensive nature of this legislation, and the decision that it could be more readily implemented if segments were broken out, Transplan was divided into three separate pieces of legislation pertaining to the following: Transportation Development Districts (TDD's); County and Municipal Planning; and State Highway Access Management. Bills regarding Transportation Development Districts and State Highway Access Management have been enacted, and are currently being implemented.

It is important to recognize that while the regulations set forth under the New Jersey State Highway Access Code have been written to meet the general requirements of the State Highway Access Management Act, specific design criteria were developed after promulgation of the Act. For example, in accordance with the enabling legislation the Code was intended to establish standards for "minimum and desirable spacing of driveways and intersections" (ibid.). However, the Act does not suggest what standards should be used. With regard to sites not meeting required standards, the legislation requires issuance of a permit if denial would leave the property without "...reasonable access to the general system of streets and highways..." (ibid.).

However, for nonconforming lots, the State Highway Access Management Act stipulated that vehicle use be limited: "Every nonconforming lot access permit shall specify limits on the maximum permissible vehicular use of any driveway constructed or operated under that permit" (ibid.).

After extensive efforts, Urbitran, the consultant hired by the New Jersey Department of Transportation (NJDOT) to develop a comprehensive guide for access management, had

succeeded in publishing the first proposal of the New Jersey State Highway Access Code in April of 1990. In order to achieve greater acceptability among concerned professionals, a formal working group consisting of developers, attorneys and traffic engineers reviewed the proposed Code and recommended several modifications. Members of the group would undoubtedly agree that the most significant, controversial issues were the proposed lot frontage requirements, and treatment of nonconforming accesses. It should be noted that the Code did not establish standards for spacing of unsignalized access points, but rather utilized site highway frontage and posted highway speed to determine lot conformity. The basis for the standards set forth by Urbitran, however, were derived from vehicle acceleration and deceleration requirements and are applicable in the context of actual access location. For the purpose of recommending changes to the proposed spacing standards, therefore, it was necessary for the working group to discuss acceptable access spacing standards.
While there was no consensus on how access spacing should be determined, the working group finally agreed on spacing distances which were substantially less than the 1990 proposal. Furthermore, a method for determining maximum vehicle usage for nonconforming lots was proposed and incorporated into the final draft of the Code.

Driveway spacing standards originally proposed by the Department's April 1990 proposal were consistent with those adopted in Colorado's access regulations (See Table I). Both in the 1990 proposal, and that which is currently being used, conformity is determined by measuring the distance from the centerline of the lot frontage along the highway to the centerlines of the adjoining lots. If either distance is less than the required spacing, then the lot in question is nonconforming (See Appendix A for further details).

TABLE I
New Jersey State Highway Access Code, 1990 Proposal, Conforming Lot Frontage Requirements

Posted Speed Limit, MPH	30	35	40	45	50	55
Required spacing distance in feet	200	250	325	400	475	550

Many argued, however, that the spacing criteria would create an undue hardship, and while appropriate for Colorado, were perhaps excessive for urban New Jersey. In accordance with the 1990 proposal of the New Jersey Access Code, if alternate access to either county or municipal roadways or adjoining properties could not be accomplished, access to that site would be denied. NJDOT realized that as a result of this policy, the State would be required to pay for property having nonconforming access, and mitigate any damages. Therefore, the impacts of implementing the spacing standards as originally proposed would have to be seriously considered. At that point, the working group discussed both reducing the proposed spacing standards and dealing with nonconforming lots.

Several recommendations were put forth. Highway frontage requirements, for example, were significantly less than the April 1990 proposal. It was also suggested that for nonconforming lots, credit be given for adjacent lot frontages. Of the several formulas for maximum permissible vehicular use which were suggested, the one most acceptable to the working group allowed nonconforming lots with a base 50 peak hour trips in addition to credits for adjacent lot frontages, and the area of the lot being considered (See Appendix A).

In its determination of spacing standards for final proposal, the Department reviewed the recommendations of the external working group and also evaluated over two dozen techniques for determining unsignalized access spacing standards. These methods included the calculation of stopping sight distances with reaction times varying from 1.5 to 2.5 seconds, and considered wet and dry pavement conditions for acceleration and deceleration. The final version of the Code utilized standards consistent with those of Tri-County Michigan. It should be noted that these distances are significantly less than the original proposal, but were comparable to those suggested by the external working group. The formulae recommended by the external working group for nonconforming lot permissible trip generation rates were incorporated into the final proposal. Consistent with the original 1990 proposal, the Code allows a 15 percent increase in the permissible trip generation rate if there is either shared or alternative access. A maximum of two 15 percent bonuses is permitted.

Other State Practices
Review of other state highway access management techniques shows a relatively consistent treatment of signal spacing standards, sight distance requirements and other geometric design practices. However, unsignalized spacing standards and treatment of lots unable to meet these requirements greatly varies. In the next section, other states' highway access management techniques relating specifically to these issues will be discussed.

Colorado
Colorado was the first state to formally adopt and implement a comprehensive highway access management program. The Colorado State Highway Access Code and Access Category Assignment Schedule was placed into effect in 1981, and later updated in 1985. It should be

mentioned that the Colorado Code has withstood over 30 court challenges in the past eleven years (**1**).

Similar to the provisions of New Jersey's Access Code, Colorado has assigned each segment of State highway with an access category based on both existing and projected roadway volumes, functional classification and surrounding land use patterns. Colorado has established five access categories based primarily on the roadway's function and capacity, and vary in degree of access limitations. Category One roadways have physical medians and only permit access via interchange. Roadways classified as Category Two must be designed to accommodate posted speeds of 55 MPH. Direct access is permitted, but is limited primarily to right turn ingress and egress. Only under certain conditions, will left turns be allowed. For Category Three roads, right turn access is preferred but there are fewer restrictions on left turn ingress and egress than the previous Category. Also, while roadways which fall into Category Three must be designed to achieve 55 MPH posted speeds in rural areas, urban signalized segments may be designed to accommodate posted speeds of 45 MPH. Category Four roadways are intended to be designed for posted speeds no less than 35 MPH. Provisions for right and left turn access are similar to those for Category Three. Category Five roadways are designated as service and frontage roads, and are intended to satisfy local access needs. All movements are permitted to and from accesses on Category Five roads, and the existing posted speed is used to determine design decisions.

Although Colorado and New Jersey have separate and distinct requirements for assigning their respective highway segments, both states have developed driveway spacing standards based on posted highway speed. Under Colorado's regulations, spacing of unsignalized access points, regardless of Access Category, must meet AASHTO design criteria for stopping sight distance (assuming wet pavement) for the highway posted speed. If both access and highway volumes are at a certain level, construction of acceleration lanes, deceleration lanes and corresponding tapers is required, in addition to storage length for queuing vehicles. These guidelines are also adjusted for ingress and egress speed, and highway grade.

For sites which are unable to meet Colorado's access design requirements, the applicant is denied access. However, the decision for denial can be appealed to the Colorado State Highway Commissioner. This process, which somewhat parallels a variance, permits the issuing authority to consider several factors such as undue hardship on the applicant, and "land use plans, policies and local traffic circulation operation of the local jurisdictions" (**2**). It is important to note that access is permitted on the basis of public safety. These proceedings may result in allowing access, but limit permissible trip generation from the site.

While access regulations adopted by Colorado are among the most stringent in the country, they have been effective because of their simplistic approach in establishing actual design criteria for highway access. This differs significantly from New Jersey's Code which applies spacing distances derived from engineering standards to lot frontage along the State highway.

Florida

Similar to Colorado and New Jersey, the Florida Department of Transportation (FDOT) has legislative support for its highway access management program. Under provisions of the State Highway Access Management Act of 1988, Florida is required to adopt regulations to control vehicular ingress and egress to and from the State highway system, and assign access classifications and standards for State highways. In conformance with the enabling legislation, all State highway segments have been assigned an Access Class which indicates the type of ingress and egress and the function of the roadway. Connection spacing distance which is measured from adjoining access points of tangency to the state highway, is a function of both posted speed and Access Class; however, required distances between connections vary for only two ranges of posted speeds: those greater than 45 MPH, and those less than or equal to 45 MPH (See Table II).

Florida, also similar to Colorado and New Jersey, recognizes the need to assign access restrictions and roadway function to all State highway segments. Access Class designations range from One, which is the most restrictive, to Seven which permits all ingress and egress movements, and is generally applicable to urban roadways where there is "little intended purpose of providing for high speed travel" (Koepke, Frank J. and Levinson, Herbert S., "Access Management Guidelines for Activity Centers", Appendix B, NCHRP Report 348. Washington, D.C.: Transportation Research Board, 1992, p. B-21).

Although access regulations adopted by Florida require minimum distances between connections, there is no design criteria for acceleration/deceleration lanes. It is to be expected, therefore, that some level of degradation to safety and capacity to the State highway system will occur, since vehicles are permitted to make turning movements from through travel lanes.

In contrast to New Jersey and Colorado, it is difficult to say how Florida's spacing standards were derived. Since only three spacing distances are incorporated into Florida's Access Code, there appears to be little correlation between the connection spacing standards and values derived from traffic engineering data.

Florida's access management code will permit access for lots which are unable to meet the spacing guidelines set forth, but allows the State to impose restrictions on maximum vehicular use, and requires alternate access if available. If no access is or cannot be made available, it is required that a conforming connection be constructed when there are future means of alternative access. Florida, unlike New Jersey, does not specify to the extent at which access will be limited if it is unable to meet the required connection spacing standards. Therefore, it will undoubtedly be difficult for FDOT to impose vehicular use limitations, since provisions have not been set forth for same.

Table II
Connection Spacing Standards for Florida State Highways

Access Class	Minimum Connection Spacing >45 MPH / less than or = 45 MPH Feet
2	1320/660
3	660/440
4	660/440
5	440/245
6	440/245
7	125

SOURCE: Sokolow, Gary. Highlights of the Access Management Classification Systems and Standards Rule. Growth Management Short Course presentation to The Florida Chamber of Commerce by the Florida Department of Transportation, March 13-15, 1991.

Nebraska
Some states throughout the country have adopted driveway spacing standards which are not only a function of highway environments, but also utilize existing Average Daily Traffic (ADT). Specifically, the Nebraska Department of Roads lists minimum spacing standards for both rural and suburban environments, and treats urban roadways on a case by case basis. For rural and suburban categories, Nebraska's minimum driveway spacing utilize an ADT of 1500 as a boundary in determining spacing criteria. As an example, if a rural highway has an ADT less than 1500, the minimum access spacing is required to be 800 feet, with no more than 4 unrestricted access points per mile on each side of the highway. For a rural highway which exceeds 1500 ADT, the minimum spacing distance increases to 1320 feet, and no more than 3 unrestricted access points per mile are permitted on each side of the highway. Access criteria for suburban highways is as follows: for roadways with an ADT less than 1500, the minimum spacing distance is 660 feet, and the number of unrestricted access points per mile on each side of the highway is 6; for roadways with an ADT greater than 1500, the minimum spacing distance is 990 feet, and the number of unrestricted access points per mile on each side of the highway is limited to 4. Nebraska's spacing standards are summarized in Table III.

While the trend to have greater minimum spacing requirements for rural rather than urban areas is reasonable and consistent with other state practices, the standards adopted by Nebraska appear to be somewhat arbitrary. This is evident since the required distances between access points bear no relationship to posted speeds, and the spacing distances for both rural and suburban environments are simply eighth and sixteenth divisions of a mile. For example, the minimum distance for suburban highways with ADT's less than 1500 is 660 feet or one-eighth of a mile. The spacing requirement for suburban highways with ADT's greater than 1500 is 990 feet or three-sixteenths of a mile. Without engineering data to substantiate these standards, it is questionable whether the criteria adopted by Nebraska can withstand inevitable court challenges.

If an access is unable to meet the minimum spacing requirements, it is defined as "restricted". Under these circumstances, ingress and egress may be permitted, but the number of movements cannot exceed 10 per hour. An access from which the number of vehicle trips exceeds this use limitation may be permitted to remain in use; however, an application must be made to change the access classification from restricted to unrestricted and must therefore conform with appropriate standards. A temporary access may be granted, but would only extend for a one year period.

With regard to driveway spacing requirements and treatment of sites not conforming to adopted standards, Nebraska and New Jersey vary significantly in some respects. Unlike Nebraska's guidelines, New Jersey makes no distinction in its lot frontage requirements for highway ADT, or highway environment. Also, New Jersey utilizes highway posted speeds. Nebraska does not.

While there are vast differences in criteria for access spacing, both states agree that highway access should be treated differently depending upon highway environment. New Jersey is consistent with Nebraska's policy which applies stricter access standards to less developed highway conditions. Consider, for example, two nonconforming lots requesting access to a New Jersey State highway. One site intends to enter a highway designated as rural, the other to a highway designated as urban. Both have the same amount of highway frontage, acreage, and adjacent lot frontages. According to the New Jersey State Highway Access Code, fewer trips are permitted to and from the site which access the rural highway. While Nebraska does not make any distinction between permissible trip generation in rural and suburban areas, required spacing between access points is greater in the latter environment type. Furthermore, Nebraska has adopted stricter access spacing standards for highways with higher ADT's.

Through its use of rural and suburban highway classifications, and standards which incorporate highway ADT volumes, Nebraska realizes that both highway environment and the ability of the roadway to accommodate additional vehicle movements, as determined by highway ADT, must be considered.

Table III
Nebraska's Spacing Standards for Rural and Suburban Unrestricted Access Points

	HIGHWAY ENVIRONMENT TYPES			
	RURAL		SUBURBAN	
	<1500 ADT (feet)	>1500 ADT (feet)	<1500 ADT (feet)	>1500 ADT (feet)
Unrestricted Access Spacing	1320	2000	1000	1320
Minimum Distance to Existing Road, Public or Predetermined Access	800	1320	660	990
Number of Access Points, Each Side of Highway per Mile	4	3	6	4

SOURCE: Koepke, Frank J. and Levinson, Herbert S., "Access Management Guidelines for Activity Centers", Appendix B, NCHRP Report 348. Washington, D.C.: Transportation Research Board, 1992, p. B-43.

Ohio-Kentucky-Indiana Regional Council of Governments
In March of 1988, a model ordinance was prepared by the Ohio-Kentucky-Indiana (OKI) Regional Council of Governments which contained elements including minimum spacing of driveways and treatment of access points not meeting adopted regulations. The ordinance required that the Planning Commission assign Access Classifications to all roadway segments under its jurisdiction. Access Classifications range from I to III and are designated based on function, travel speed, and access requirements. Class I and Class II roadways have the most restrictive access standards, and function to serve through traffic. Access needs take priority for roadways designated Class III, and unlike the former Access Classifications, Class III roadways have no minimum spacing requirements. The spacing distance for Class I and II highways is measured from near edge to near edge of adjacent access points, and is a function of posted speed. These criteria were adopted from a FHWA report and are shown in Table IV. These distances assume a 1.64 second driver reaction time, and AASHTO braking distances based on dry conditions. The ordinance also requires that distances between access points be as uniform as possible.

Similar to practices by other regulating agencies, the OKI Regional Council of Governments utilizes specific design criteria to establish access locations, setting spacing requirements on the basis of posted speed limits. However, highway environment is not considered.

As a practical necessity, every government entity regulating highway access must have provisions for lots which cannot meet established standards. The Regional Council has therefore established a procedure for treating access which cannot meet the provisions of the model ordinance. An access which does not comply with the provisions of the ordinance, including the spacing standard requirements, will be designated as "temporary". When at such time alternate access is made available, the temporary access can either be eliminated, or certain movements restricted. In addition to these measures, the ordinance allows any of its requirements to be waived or modified if deemed appropriate. In this way, the necessary flexibility to make exceptions, if deemed reasonable, is provided.

Table IV
OKI Regional Council of Governments
Minimum Spacing of Adjacent Driveways

Posted Speed Limit, MPH	20	25	30	35	40	45	50
Required spacing distance in feet	85	105	125	150	185	230	275

SOURCE: Adapted from "Access Management for Streets and Highways", Report IP-82-3, Federal Highway Administration, Washington, D.C., June, 1982)

Tri-County Regional Planning Commission (Lansing, Michigan)
After review and evaluation of numerous guidelines for access spacing, the New Jersey Department of Transportation adopted those currently used by the Tri-County Regional Planning Commission. In reviewing spacing standards utilized by New Jersey, therefore, the Commission's Driveway Standards for Corridors are of particular interest.

The spacing standards used by the Planning Commission are a function of posted speed limit, but do not consider either highway environment or roadway ADT. The distances, which are measured from driveway centerlines, were adopted from a FHWA Research Report FHWA-RD-76-85 and "are based on average vehicle acceleration and deceleration rates and are considered necessary to maintain safe traffic operation" (Bishop, Kirk R. "Designing Urban Corridors." Planning Advisory Service Report Number 418. American Association of Planners, p. 38.). These values the same used by OKI Regional Council and are shown in Table IV above. Since the access design standards assume less driver reaction time and higher terminal speeds, spacing distances are significantly less than AASHTO requirements for Stopping Sight Distance.

It should be noted that driveway spacing distances adopted by the Commission are used to determine actual spacing of unsignalized access points. Lot frontage, while an important factor in achieving required spacing standards, is not considered in Tri-County Regional Planning Commission's access spacing guidelines.

While New Jersey limits the number of trips from nonconforming lots, the Regional Planning Commission requires applicants unable to meet the spacing standards to seek a variance from the zoning administrator. However, the allowable reduction in spacing must meet the standards for speeds of the next lower 5 MPH speed limit. For example, if the highway posted speed is 40 MPH, the required driveway spacing is 185 feet. However, if this spacing cannot be met, a reduction to 150 feet, the standard for the 35 MPH posted speed, would be permitted. No further reduction of driveway spacing is allowed.

Summary

Several states have adopted and developed guidelines for managing access to state highways, which are either reflected in highway design standards, or have become separate, distinct regulations. It is apparent that a wide range of spacing standards is currently used based upon assumptions of driver behavior and vehicle characteristics. Colorado, for example, makes use of posted speeds and depending on both highway and access traffic volumes, and under certain traffic conditions, requires construction of speed change lanes. Nebraska, in its determination of driveway spacing, considers both highway environment type and ADT, but elects not to use posted speed limit. Florida considers only four ranges of posted highway speeds to determine driveway spacing. Overall, it can be said that no one criteria for determining driveway spacing is used, and that there are reasonable justifications for use of highway environment, posted speed limit and highway ADT.

An important matter to also consider is treatment of lots which do not meet the required access spacing standards. By allowing such access, regulating agencies forfeit some degree of highway capacity and safety. Ultimately, the benefits gained by denial of nonconforming access must be balanced against the economic, political, and legal ramifications of such action. Based on the foregoing discussions regarding treatment of sites not meeting established access guidelines, governmental agencies have strived to maintain this equilibrium through several approaches including limiting the number and/or type of ingress-egress movements, allowing temporary access, and requiring alternative access.

Compared to highway access regulations adopted by other states and planning commissions, however, the New Jersey State Highway Access Code is not only cumbersome, but fails to utilize spacing standards in their proper context. Every highway regulating agency discussed except New Jersey requires specific spacing distances between accesses. Furthermore, New Jersey inappropriately applies Tri-County Michigan's spacing standards which are based on reasonable assumptions of driver behavior, and vehicle performance, to highway frontage. Since the spacing distances adopted by New Jersey do not apply to actual driveway locations, minimizing disruptions to through traffic and providing safe efficient access may never be achieved under the current regulations.

For sites not meeting the New Jersey Access Code highway frontage requirements, access is still permitted, but the number of peak hour trips is limited. This is consistent with policies of other states, such as Florida, Colorado, and Nebraska. However, for a nonconforming access to a New Jersey State highway, the allowable number of trips is comparably much higher. In Nebraska, for example, only 10 vehicle trips are permitted from a restricted access versus 50 allowable peak hour base trips plus bonuses for lot area and adjacent lot frontage. Considering uses which generate the base 50 peak hour trips: a 2,000 SF walk in bank; an 80 unit apartment complex; a development of 40 single family houses; a 19,000 SF office building (3), the permissible trip generation to New Jersey highways from nonconforming lots, even without the additional allowances for lot area, and adjacent lot frontages, is believed to be excessive. Furthermore, unlike other states' practices, New Jersey makes no provisions which require a nonconforming access to be eliminated if alternate or combined access is available at a later time.

Unquestionably, there is a strong consensus nationwide on the need to provide effective highway access regulations. Based on a review of other state practices, however, there is serious question, whether New Jersey, under the current provisions of the State Highway Access Code, will be able to maximize safety and efficiency of its existing highway system.

Recommendations and Conclusions

With enactment of Clean Air legislation, increasingly greater environmental constraints, and public opposition to road widening and new alignments, alternatives which utilize the existing system of streets and highways are preferable. Transportation professionals have found that managing access to streets and highways is a more practical option compared to costly and often controversial highway construction projects. In order for access management programs to be effective, however, standards must be developed from sound, reasonable assumptions of driver behavior and vehicle performance characteristics, and policies need to provide flexibility in implementation.

In New Jersey, lot conformity (which determines allowable trip generation) is a function of lot frontage and highway posted speed, and while other states' regulations require that spacing standards be utilized to determine access location, New Jersey does not consider proximity to adjacent lot access in determining conformity. Through its inappropriate application of access spacing requirements to lot frontage, New Jersey has failed to established safe and legally defensible guidelines for highway access. Furthermore, the excessive number of allowable trips from lots not meeting the New Jersey's highway frontage requirements will do little to encourage either private developers or local planning boards to consolidate highway access.

Based on review of both current practices of several states, and research efforts applicable to driver behavior, and vehicle performance characteristics, the following text is intended to substantiate recommendations for unsignalized access spacing standards, and treatment of nonconforming sites.

The effect of vehicles entering access points can reduce highway capacity, and decrease safety. To optimize highway efficiency, therefore, turning movements must be properly segregated from through traffic, which is best facilitated by constructing speed change lanes. In determining the length of the lane, the speed at which vehicles are able to enter the access and the comfortable rate of deceleration must be considered.

Assuming that roadway grades are less than 2 per cent, and vehicles come to a full stop, AASHTO requires minimum deceleration lengths to be 235, 315, and 435 feet for design speeds of 30, 40 and 50 MPH, respectively (4). Under most conditions, however, a complete stop is not required. According to research conducted by Stover and Koepke, vehicles typically are able to achieve a 13 MPH ingress speed with entrance turning radii of 35 feet (5). These findings are also consistent with standards adopted by Tri-County Michigan, which recommend deceleration distances based on 15 MPH ingress speed.

Rates of deceleration are also critical to determining lengths of deceleration lanes. AASHTO standards for stopping sight distance utilize required braking distances for passenger vehicles to come to a complete stop under wet pavement conditions. While use of these rates may be applicable under emergency situations, ITE recommends use of 10 ft/sec^2 under normal conditions. Since motorists typically anticipate entering a site and expect a comfortable reduction in speed in doing so, recommended deceleration rates for normal conditions are appropriate, and should be considered in access design standards. It should be noted that computations for vehicle clearance intervals (yellow + all red) at signalized intersections also use deceleration rates of 10 ft/sec^2.

Although some states, such as Colorado, require acceleration lanes, the ability of vehicles to adequately be removed from the through traffic stream is more critical for purposes of maximizing highway safety and capacity. While acceleration lanes are often required for two high volume, high speed roadways to safely merge, they may not be appropriate for driveway or local street access, from which drivers typically are required to stop and wait until an acceptable gap in traffic flow is available. It is suggested, therefore, that regulating agencies focus on requiring deceleration lanes, and consider acceleration lanes where either gaps in traffic flow on the highway cannot facilitate egress from a stop condition, or traffic volumes are such that interchange ramps are necessary to access the highway.

An important component in determining access spacing is driver reaction time which AASHTO places in two categories: braking reaction time, and decision sight distance. The former refers to the time required for a driver to perceive a hazard in the roadway and begin to the apply the brakes, while the latter assumes more complex evasive maneuvers and/or driving conditions. The corresponding distances are much greater for decision sight distance than braking distance (See Table V). Reaction times, in general, increase where the hazard is unexpected, and other factors such as poor visibility, and driver fatigue are prevalent.

Table V
AASHTO Braking Distance and Decision Sight Distance versus Posted Speed

Design Speed (MPH)	Stopping Sight Distance (ft)	Decision Sight Distance (ft) Condition Type A	B	C	D	E
30	200	220	500	450	500	625
40	325	345	725	600	725	825
50	475	500	975	750	900	1025
60	650	680	1300	1000	1150	1275
70	850	900	1525	1100	1300	1450

Condition Type A: Stop on a rural road
Condition Type B: Stop on an urban road
Condition Type C: Speed/path/direction change on a rural road
Condition Type D: Speed/path/direction change on a suburban road

Condition Type E: Speed/path/direction change on an urban road

SOURCE: A Policy on Geometric Design of Highways and Streets, Washington, DC: American Association of State Highway and Transportation Officials, 1990.

There has been a great deal of discussion and debate over the appropriate value for reaction time. While AASHTO recommends 2.5 seconds for calculating braking distances, it suggests "it is not adequate for the most complex conditions encountered by the driver" **(6)**. Research conducted on this subject suggests use of higher values ranging from 3.2 seconds to 3.5 seconds **(7)**. In any case, it is recommended that caution be exercised in assuming reaction times for design of roadways and traffic control devices.

With regard to access spacing standards, appropriate driver reaction time must be considered. In order to minimize driver unexpectancy (and thereby increase reaction time), access must be clearly delineated, and furthermore, uniformly spaced. In determining reaction times, drivers presumably have general knowledge of their destination, and therefore access should not be considered "unexpected". Also, ingress to a site or side road is a relatively simple maneuver. Based on these assumptions, reaction times used to determine decision sight distance are not applicable when developing highway access spacing standards. While somewhat disputed, the AASHTO recommendation for brake reaction time, 2.5 seconds, while disputed, is considered appropriate, and has therefore been utilized to calculate recommended spacing of access points.

In some locations it may not be necessary to construct deceleration lanes based on either low highway or low access volumes. In accordance with Colorado's practice, criteria should be established for the amount of traffic generated from both an access and a highway and the necessity to construct deceleration lanes.

Based on the foregoing, the following recommendations for unsignalized access spacing assume deceleration rates of 10 f/s^2, a driver reaction time of 2.5 seconds, the approach speed equal to the posted speed, and an ingress speeds of 13 MPH. These distances are measured from adjacent the upstream driveway point of tangency
to the downstream driveway point of curvature. These values are shown in Table VI below.

Table VI
Recommendations for Access Spacing

Posted Speed (in MPH)	Calculated Distance (in feet)	Rounded for Design (in feet)
55	502	525
50	431	450
45	365	375
40	304	325
35	240	250
30	189	200
25	143	150

It is recommended that for facilities which generate primarily truck traffic, such as warehouse or industrial complexes, spacing distances and deceleration lanes, if required, should be increased accordingly to account for lower rates of vehicle deceleration.

Undoubtedly, some sites will be unable to meet the proposed spacing standards, and while the regulating agency has a responsibility to protect the public's safety, denial of access without due compensation contradicts a property owner's rights under the Fifth Amendment of the United States Constitution. However, the alternative of condemnation proceedings and land acquisition can become extremely costly. Therefore, as a practical matter, there must be provisions which allow access not meeting established standards without compromising highway safety and capacity. In roadway design, for example, when standard AASHTO curve radii for normal crown sections cannot be used because of physical constraints, other approaches, such as use of superelevation or placement of advance warning signs may be used. Just as such modifications are used to accommodate existing conditions, driveway entrances can be reconfigured to allow a higher entrance speed, and thereby reduce the required deceleration distance. For example, the recommended spacing distances assume a deceleration distance based on a 13 MPH entrance speed. The entrance radius could be increased to accommodate higher ingress speeds. In doing so, neither highway safety nor capacity is compromised.

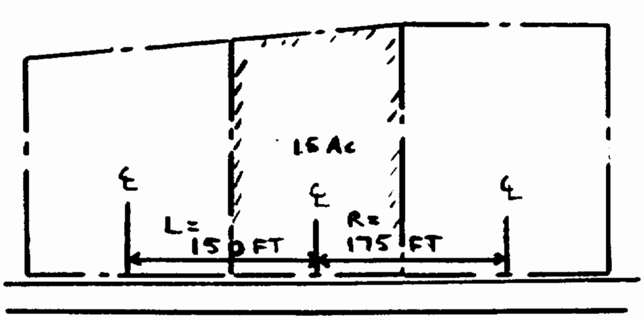
Allowances may also be made for sites generating a very low number of vehicular trips. Nebraska, for example, will allow ten trips per day from an access not meeting highway spacing standards. According to New Jersey' Access Code, a lot either presently used or vacant and zoned for one single family dwelling is considered to be conforming, regardless of highway frontage, adjacent lot frontages, or area. Since a single family dwelling unit generates on average ten trips per day, there appears to be some consistency between the two states in what is believed to be a minimum allowable trip generation rate. Agencies which regulate access should consider both projected development and highway volumes for limiting the number of trips to and from a particular site if the access is unable to meet spacing requirements.

Regardless of what adjustments are necessary for access which cannot achieve the recommended spacing distances, a procedure should be established whereby a body of designated officials reviews the application (similar to obtaining a variance). This would be similar to the current provisions under Colorado's Access Code, which allows nonconforming access permits to be reviewed by the Highway Commission, a separate entity from the issuing agency. This allows some flexibility in the access regulations which cannot practically address all site conditions. It is also recommended that regardless of what restrictions may be placed on the permit as a result of the board's decision, a nonconforming access, if permitted, should be considered temporary and valid for a specified time period. Prior to expiration of this temporary permit, the applicant would be required to either find alternate access, or make the necessary provisions to make the access conform with design standards.

Finally, local planning boards, responsible for development approvals, reviewing master plans, and developing zoning ordinances, must be active, not reactive, participants in efforts necessary for effective highway access management. Not only should the requirements set forth by state highway agencies be adopted by local governments, but lot circulation elements and provisions for combining access must be incorporated into master plans and land use regulations. This is especially true in New Jersey, where road widening projects are no longer feasible, and the integrity of the existing system of state highways must be, as a minimum, maintained. Comparing a six lane roadway with unrestricted access, to a four lane roadway with managed access, Colorado estimates a 34% cost saving per mile, which does not include increased saving through accident reduction (**8**). Unquestionably, by implementing effective highway access regulations, safety can be significantly improved, and the expenditures necessary for major highway reconstruction can be substantially reduced.

APPENDIX A

Example 1



Urban State Highway
Posted Speed = 40 MPH
Required Lot Frontage, S = 185 ft

Lot Area, A = 1.5 Ac

Adjacent Lot Spacing Left,
Measured from Lot Centerlines, L = 150 ft
Adjacent Lot Spacing Right,
Measured from Lot Centerlines, R = 175 ft

L + R = 325 , 2 * S = 370

since both L & R < S, the lot is nonconforming

Permissible vehicular peak hour trips, V

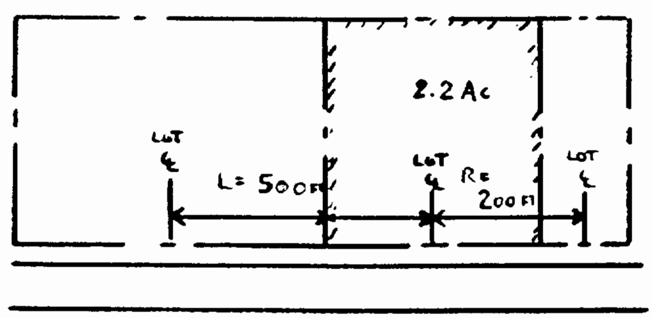
Formula for permissible vehicular peak hour trips for an urban highway:

$V = 50 + \{[(L + R)/(2*S)]^\wedge 2\} * A * 100$

V = 165

Note: L or R cannot exceed S, A cannot exceed 3.0 for urban highways and 2.0 for rural highways

Example 2



Rural State Highway
Posted Speed = 50 MPH
Required Lot Frontage, S = 275 ft

Lot Area, A = 2.2 Ac

Adjacent Lot Spacing Left,
Measured from Lot Centerlines, L = 500 ft (275 ft is used to determine V)

Adjacent Lot Spacing Left,
Measured from Lot Centerlines, R = 200 ft

L + R = 475 , 2 * S = 550

L > S but since R < S, the lot is nonconforming

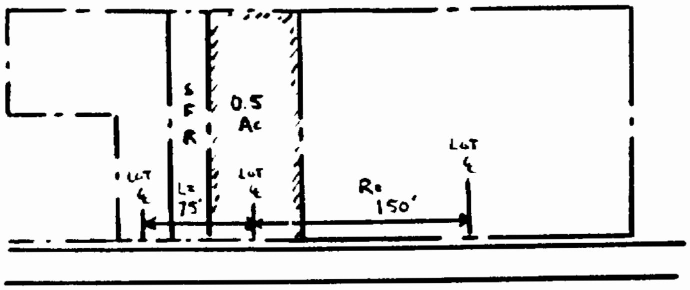
Permissible vehicular peak hour trips, V

Formula for permissible vehicular peak hour trips for an urban highway:

V = 50 + {[(L + R)/(2*S)]^2} * A * 100

V = 214

Example 3



Urban State Highway
Posted Speed = 30 MPH
Required Lot Frontage, S = 125 ft

In this situation, the adjacent lot to the left is zoned as a single family dwelling unit, and therefore L includes this 25 foot frontage.

Lot Area, A = 0.5 Ac

Adjacent Lot Spacing Left, Measured from Lot Centerlines, including SFDU lot frontage L = 75 ft

Adjacent Lot Spacing Right, Measured from Lot Centerlines, R = 150 ft(125 ft is used to determine V)

L + R = 225 , 2 * S = 250

since L + R < 2 * S, the lot is nonconforming

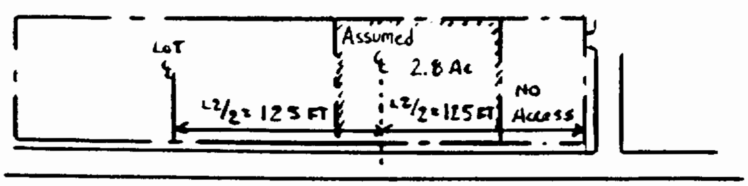
Permissible vehicular peak hour trips, V

Formula for permissible vehicular peak hour trips for an urban highway:

V = 50 + {[(L + R)/(2*S)]^2} * A * 100

V = 91

Example 4



In this example, the adjacent lot to the right is a corner lot with no access to the state highway, and a highway frontage of 50 feet. The lot in question has a frontage of 100 feet. The lot to the left has a frontage of 200 feet. Conformity is determined by the distance from the right end of the corner lot frontage along the highway to the centerline of the left lot. For the sake of this discussion, this distance will be called L2. If L2/2 < S, then the lot is nonconforming, and V, for the conditions specified below, would be determined.

Rural State Highway
Posted Speed = 45 MPH
Required Lot Frontage, S = 230 ft

Lot Area, A = 2.8 Ac

Frontage of
Distance from right end of corner lot to the centerline of the left lot, L2 = 250 ft

L2/2 = 125, S = 230

since L2/2 < S, the lot is nonconforming

Therefore,

Permissible vehicular peak hour trips, V

Formula for permissible vehicular peak hour trips for a rural highway:

V = 50 + {[(L2)/(2*S)]^2} * A * 70
V = 108

Uses That Generate 50 Peak Hour Trips
2,000 SF WALK IN BANK
80 UNIT APARTMENT COMPLEX
40 SINGLE FAMILY UNIT HOUSING DEVELOPMENT
19,000 SF OFFICE BUILDING

References

1. Koepke, Frank J. and Levinson, Herbert S., "Access Management Guidelines for Activity Centers", Appendix B, NCHRP Report 348. Washington, D.C.: Transportation Research Board, 1992, p. B-2.

2. State Highway Access Code, State of Colorado 2CCR 601-1, Revised 1985.

3. Trip Generation Handbook, 4th edition. Washington, D.C.: Institute of Transportation Engineers, 1987.

4. A Policy on Geometric Design of Highways and Streets. Washington D.C.: American Association of Highway and Transportation Officials, 1990, p. 828.

5. Stover, V.G., Guidelines for Spacing of Unsignalized Access to Urban Arterial Streets, Bulletin 81-1, Texas Engineering Experimental Station, January, 1981.

6. American Association of Highway and Transportation Officials, p. 828.

7. Traffic Engineering Handbook, 4th edition. Washington, D.C.: Institute of Transportation Engineers, 1992, pp. 6-7.

8. Koepke, Frank J. and Levinson, Herbert S., p. B-13.

New Techniques in Estimating Delay and Capacity for Unsignalized Access

Mark Vandehey
Kettelson & Associates, Inc.

Mark Vandehey, a Senior Engineer with Kettelson & Associates, Inc., in Portland, Oregon made a presentation on the new techniques for estimating capacity and delay at unsignalized intersections that will be incorporated in an update to Chapter 10 of the 1985 Highway Capacity Manual. The Chapter 10 updated was prepared by members of the Unsignalized intersection Subcommittee of TRB's Committee A3A10: Highway Capacity and Quality of Service. The update is planned to be published in late 1994. The new Chapter 10 will include both a Two-Way and All-Way.

Nor formal paper was submitted. The following is an overview of the key points of Mr. Vandehey's presentation.

- An update to Chapter 10 was considered a high priority by the Unsignalized Intersection Subcommittee due to numerous complaints from the user community regarding the procedures inability to accurately predict capacity and LOS at unsignalized intersections. A recent user survey revealed a general consensus that the procedure typically predicts a worse level of service than is actually observed in the field. The same user survey revealed that many practioners use the LOS results in evaluating traffic signal warrants. It is therefore felt that the existing overly conservative procedure may be leading users to install unnecessary traffic signals.

- The update to Chapter 10 will incorporate an improved Two-Way Stop Controlled (TWSC) analysis procedure, an improved All-Way Stop Controlled (AWSC) analysis procedure, and a new level of service definition that relates to delay. The AWSC procedure is essentially the same as is detailed in TRC 373, therefore, the presentation focused on the TWSC procedure.

- The revised TWSC methodology, which is an adaptation of the procedure that is used in Germany, is very similar to the existing Chapter 10 methodology, which is an adaptation of a German procedure that preceded the current German procedure. The primary differences are as follows:

  - Impedance factors are now calculated based on the probability of a queue-free state for the higher priority movements.

  - The capacity of individual movements are calculated using a different formula, but still rely on the critical gap.

  - Average total delays/vehicle are estimated for each stop or yield movement.

  - 95th percentile queue length are estimated for each stop or yield movement.

  - Level of Service is based on the average total delay/vehicle for the worst movement.

- The equation used to estimate the average total delay/vehicle for each movement is similar in form to the delay equation used in Chapter 9 (signalized intersections) of the 1985 HCM.

- The LOS delay threshold for LOS "E" and LOS "F" is lower than for signalized intersections. The primary reason for this difference is that drivers expect a different level of performance from a signalized intersection than from an unsignalized intersection.

- The overall LOS for the intersection is still defined by the worst movement, however the procedure also provides the analyst with the average approach and average intersection delay. This additional information should be useful when comparing the overall impact of different traffic control types such as all-way stop, or signalization.

- The 95th percentile queue length estimates are determined graphically and should be useful for both design and operational analysis.

- The University of Idaho, Kittelson & Associates, Inc., Ruhr University (Germany), and Queensland University (Australia) are currently involved in research to further improve the Chapter 10 procedures for TWSC and AWSC intersections. This work is being funded as part of NCHRP 3-46: Capacity Analysis of Unsignalized Intersections. The project began in January 1993 and will end in January 1995. A product of the work will be a new chapter on unsignalized intersections to be included in the 2000 Highway Capacity Manual.

- The new techniques for evaluating unsignalized intersections have several implications to Access Management:

  - Initial applications of the revised procedure show 1/2 to 1 1/2 Level of Service grade improvement over the current HCM procedure. It is hoped that the new procedure will help to reduce the tendency to install unnecessary traffic signals.

  - The new procedure allows users to compare delay by movement, approach, and the overall intersection for a number of different intersection control types.

  - Well designed, properly located unsignalized intersections are an essential element of any successful access management plan for an arterial street. Therefore, a more realistic comparison and evaluation of this access management tool should help practitioners that are involved in the development of access management strategies.

Developing a Rural Access Management Program for the Texas Highway Trunk System

Jack Foster
Texas Department of Transportation

The Texas Highway Trunk System is a program developed in 1988-90 to improve the mobility and safety of highway users on the rural highway system. The program specifically targeted the needs of intrastate and interstate travel in Texas. The program objectives were: to provide a rural four-lane divided or better highway network, to connect major activity centers within Texas, and to provide access to major points of entry to Texas.

The Trunk System consists of 10,230 miles of rural highways, including 2,400 miles of rural Interstate highways. Approximately 5,080 miles of highway will need to be upgraded to four-lane divided highways. The total cost of the Trunk System is estimated at $8.9 Billion in 1992 dollars. The completion of the Trunk System is anticipated by 2020.

To successfully maintain high mobility and safety, TxDOT recognized that access to the Trunk System highways had to be controlled. We also saw the Trunk System as a logical starting point for an access management program, since Texas had never had a comprehensive program concerning the control of access.

It should be noted that since Texans have historically been use to liberal access to the highway system, the emphasis of the access management program would be on enhancing mobility, rather than controlling access. In other words, the benefits of the program would be touted as opposed to the mechanism that caused the benefits.

The current structure of TxDOT divides the functions of an access management program among several divisions. The Division of Highway Design is responsible for basic design features such as medians, median openings, speed change lanes, pavements and shoulders, intersections, grade separations and interchanges. The Division of Maintenance and Operations is responsible for issuing permits for driveways (private, public access and commercial) and the regulations for the location of access driveways.

The Division of Right of Way is responsible for purchasing right-of-way and compensating adjacent property owners for changes in access rights. Finally, the Division of Transportation Planning is responsible for coordinating the development of the access management program for the Trunk System with the other divisions.

The access management program is not fully developed as yet, but several features have been tentatively determined. There will be three levels of ultimate facility types. The types range from a full access controlled freeway (similar to an Interstate) to a partial access controlled highway to a highway controlled only by driveway regulations.

In areas near large urbanized areas that are developing or already developed, access will be controlled by deed restrictions or design. The control of access may be provided only near intersections or continuously, depending on the traffic volumes, the degree of land development, and the availability of right-of-way.

Trunk System routes that intersect with other Trunk System routes will be grade separated, as will all railroad crossings. All other intersecting roadways will have traffic control strategies, such as stop signs, traffic signals and grade separation structures, as needed, to accommodate the traffic demand. Priority will be given to the Trunk System route.

There will be three types of median designs. The preferred design will be a four-lane divided highway with a depressed median. The next design will be raised barrier median. In some areas, it may be feasible to only have a flush median. The preferred median opening spacing is one-half mile or greater, but spacing down to one-fourth mile will be permitted.

Trunk System routes will bypass (also called a relief route) urban areas under 50,000 population unless the access can be controlled in the urban area or unless traffic studies indicated that an average speed of 45 miles per hour can be maintained on the existing route. The intent is to allow the local governments an alternative to a bypass. If a new location route is to be constructed, then it will be designated as a controlled access facility. Whenever possible, access control measures will be incorporated into existing relief routes.

The amount of right-of-way needed for the ultimate facility type will be determined by the appropriate District Engineer. If the ultimate facility is to be built in stages (such as first constructing two lanes of an ultimate four-lane relief route), then the right-of-way initially purchased should be for the ultimate facility. The early acquisition of ultimate right-of-way may be desirable, in certain cases.

There still remains a great deal to be done to complete and implement an access management program for the Trunk System. The program needs better coordination within the

TxDOT Divisions and Districts. Metropolitan Planning Organizations and other local officials need to be more closely involved also. We will develop a booklet of guidelines that present the access management program in clear, concise terms for the general public. Finally, the benefits of an access management program, namely increased mobility and greater safety, need to be presented to the general public and the local governments.

Session 4A

Land Use Planning and Public Participation

Moderated by Gary Sokolow, Florida DOT

This session focused on the importance of land use planning and public involvement in a successful access management program. Three speakers covered topics including the integration of access management with land use planning, access management and planning experience in Florida, and public education and involvement in an access management project in Florida.

The first speaker was Freddie Vargas of the Florida DOT who presented a paper entitled, "Access Control: Irate Public-Community Awareness." In it he describes how many public projects are delayed because the public involvement process is started too late. He outlines Florida's new public involvement process and presents a sample access management project where it was successfully used.

The second speaker was Richard Forester, an attorney with Dispute Resolution Services of Portland, Oregon. His paper, "Land Use Planning and Access Management in Oregon," describes how the land use planning process has been integrated with the transportation planning process in Oregon's Transportation Planning Rule (TPR). Forester presents in great detail many of the provisions of the TPR and the State Agency Coordination Program (SAC) which are meant to ensure that access management does not work in isolation from the rest of the comprehensive planning processes.

The final speaker was William Frawley of the Texas Transportation Institute. In his paper, "Access Management in Florida," he discusses the evolution and implementation of Florida's Access Management Program. He describes the goals of the program, the permits and standards rules, and the administration of the program.

The session was attended by about 50 people. Questions and answers for the speakers are summarized in the discussion section for Sessions 3A, 4A, and 5A.

ACCESS CONTROL AND IRATE PUBLIC-COMMUNITY AWARENESS

Freddie A . Vargas
Florida Department of Transportation

Since the early 1980's the Florida Department of Transportation has been implementing roadway safety improvements through the access control method. High crash segments of State maintained roads have been evaluated for safety improvements. Usually the most effective improvement is the reduction of the number of conflict points. These types of improvements, in general, will impact ingress and egress to and from roadways abutting properties. Access changes most likely will be rejected by property owners.

The public reaction to the access changes is a main part of our project development process. Effective interaction between the Department of Transportation and the public has become a significant factor in determining the parameters within which any highway project can be designed and constructed. There were times when a roadway project proposal was based wholly on engineering and design criteria. Today the planning process reflects a new element based on environmental and social awareness.

Accordingly, the Florida Department of Transportation District Four has developed guidelines to include public awareness as part of the planning process for the development of roadway improvement projects.

In November of 1987 the Community Awareness Plan guidelines were established. These guidelines cover the following areas:

- Establishment of the Community Awareness Plan review committee.
- Maintenance of Traffic Impact Evaluation
- Access Impact
- Definition of Public Involvement Levels
- Definition of Public Involvement Activities

The recent development of access management rules has created much interest in the implementation of acces control projects. These access management rules were mandated by the *1988 State Highway System Access* Management Act (F.S. 335.18). We will discuss the Access Impact portion of the Community Awareness Plan and our experience in the implementation of these kind of projects.

The Public Awareness Plan defines the levels of involvement depending on the type of project.

Level 1- Project is non-controversial because its impact causes negligible access changes and minimal traffic disruption. Examples are: work outside the roadway, simple rural repaving, signal work, pavement markings, etc.

Level 2- Project has public acceptance, little impact on access and a reasonable degree of traffic disruption. Examples are: railroad crossing repairs, urban repaving, median revisions without access control, and bridge repairs without detours.

Level 3- Projects may be controversial or will significantly impact traffic flow or will adversely affect access to several properties. Example are: interstate work, parking removal, closed and/or chanalized median openings, traffic signal removal, roadway widening, bridge replacements, major reconstruction and projects including detours.

Based on these levels of community involvement a series of activities are normally required. Table 1 lists the activities required for each level. These activities represent basic guidelines and do not replace good judgement.

Table 1 Public Involvement Activity Requirements

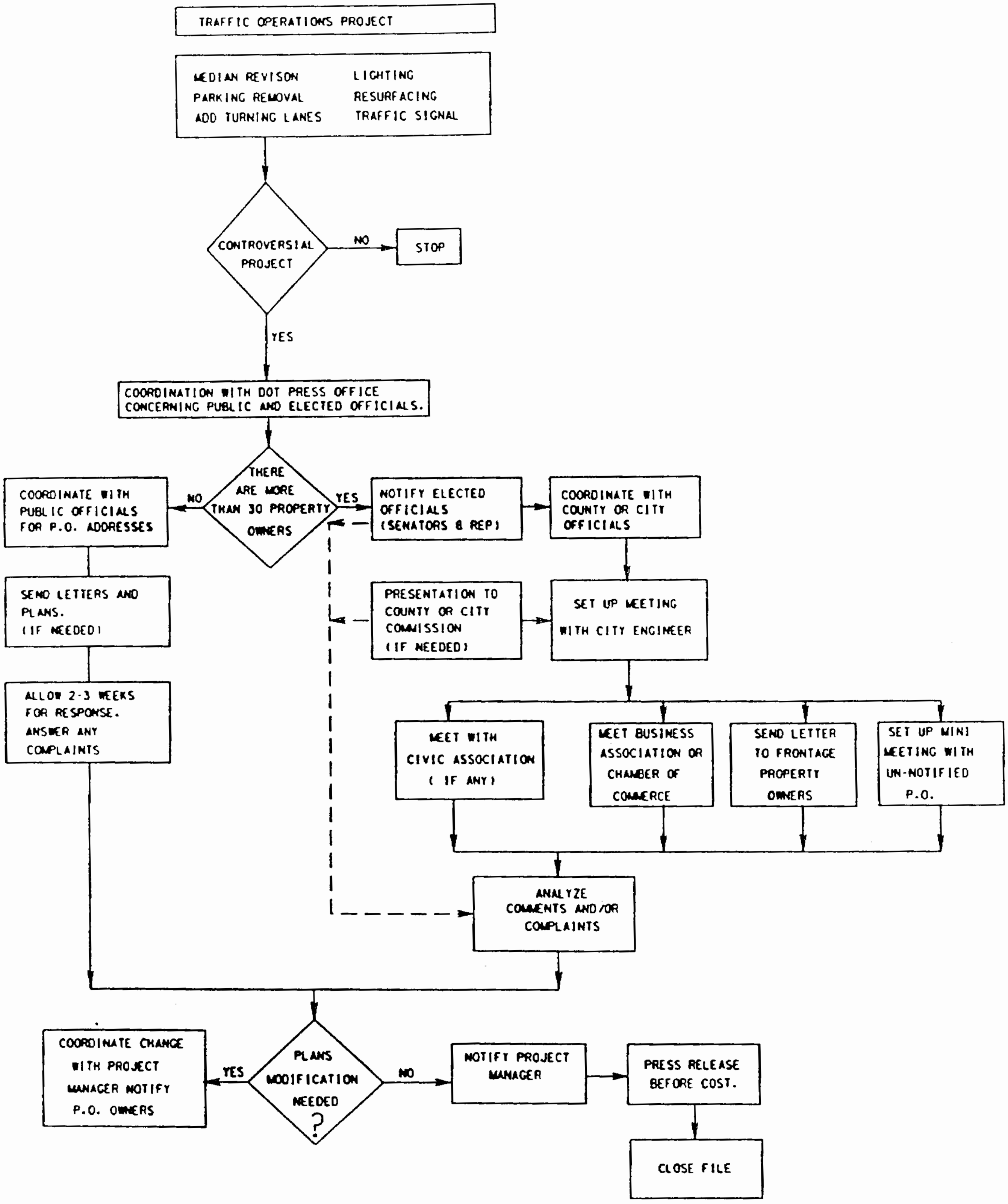
Activity	Level 1	Level 2	Level 3
Public Hearing	*	*	*
Notice of access impact to owners			x
Project Information workshop with City/Co. staff			x
Public information meeting			x
Comments request from City/Co.	x	x	x
Plans review from City/Co.	x	x	x
Presentation to City/Co.Comm., MPO	#	#	#
Dear neighbor letter			x
Pre-construction notice to City/ County	x	x	x
News Release	x	x	x

* Only as legally required.
# Generally only as requested.

From these activities I will expand on traffic operations projects in which access changes are proposed and are considered to have a public information level 3. A flow chart depicting a logic sequence of activities was developed as an additional tool to guide the engineer in the completion of this important element of the project.

After completion of an engineering study, local government staff is provided copies of the report and a meeting is scheduled. Our experience has revealed a variety of possible outcome from these meetings. The most common

COMMUNITY AWARENESS FLOW CHART



one is the acceptance of the proposed improvements by the local staff. City and/or county engineers and technical staff are more sensitive to facts and to statistically supported solutions than elected officials. Once this acceptance from the local government staff is obtained, additional input is needed from the political groups. Usually, elected officials respond to organized groups, from the impacted community, often disregarding the expected benefits to be generated by the project for the public good.

Based on the possibility for disagreements on the proposed improvements these meetings with city and/or county engineers should be initiated at least 18 months before the proposed construction letting dates. Due to the high potential for discrepancies and quick changes in previously agreed-upon issues, it is very important to maintain good written records of all the meetings.

Once a preliminary agreement between the project engineer and the city and/or county engineers is obtained the elected officials should be involved in the process. A complete package of information should be sent to the city/county commissioners, area state representative and senator. In some cases, the city commissioners have requested a workshop presentation in which their concerns are discussed and most of their questions are answered. At this workshop the engineer, most likely, will obtain the city's position regarding the project. If the city's elected officials support the project or do not oppose it, then the engineer will go on with the next step.

We have obtained a variety of results from these meetings. Some cities recently have shown great interest in beautification. Even when the proposed improvements include access changes to the business community they have expressed more concern for landscaping issues than the access impact. A common result from these meetings also is, a "status quo" decision. The elected officials request the state engineer to conduct public meetings to obtain public reaction before a position is taken by the commissioners. When this situation occurs, the public meetings are held without an official position from the local government. Once the public meetings are held and public opinion is known, the state engineer has to go back to the previous step to obtain a city's official position about the project.

The public meetings are conducted in different phases. If civic groups do exist within the limits of the projects and are going to be impacted by the proposed changes, separate small meetings are coordinated to present the project and to obtain these group's position and opinions. During these meetings we have obtained important information that, in some cases, has forced the Department to implement changes. Additionally, we have been able to clarify erroneous concepts that these groups have due to a lack of proper information and statistics. The engineer is also able to obtain the public view of the presented roadway problem. This information then is used to make decisions on future projects with similar characteristics. Usually the technical engineering solutions do not include the general citizen's point of view as a regular user of the roadway system.

Another important group is the business community. Often there are local business associations or the impacted group is part of a Chamber of Commerce chapter. Similar to the civic groups, a small meeting is coordinated. The project is presented and their input and concerns are obtained then. This is one important group in the public involvement process. Their support is crucial to the success of the implementation of the project. From our experience we have learned to incorporate most of their concerns early enough that can be addressed in our proposed solutions.

Some commercial sites require good access to be able to provide their services to the costumers. Also, in heavily competitive markets, business ingress and egress points are very important for business survival. Reasonable access points need to be maintained to ensure a solid business community and to obtain their support and acceptance for the project.

Each case will have it's own special access consideration. Sometimes we have business operators requesting some priority to ingress versus egress. They are willing to offer some solutions that may still be compatible to the access rules and may not jeopardize the goals of the project. The most important element in dealing with this group is the willingness of the project engineer to evaluate special requests and to respond with solid answers regarding that special request. Neverthless, we have had several confrontations with business groups due to stubborn positions on issues where we could show previous prositive results. Safety of the traveling public is our foremost concern.

After completion of all the small meetings, a public meeting involving all the imapcted groups is organized to present the project and to obtain any additional information that may require additional evaluations. Official letters are sent to all property owners and to all organized groups. Additionally, newspaper releases are published advertising the meeting. A logical place is selected for the meeting, normally in the city commissioner's chamber or at at local community centers. The meeting place should be as close as possible to the project site to encourage attendance.

The meeting format is very important for the succcess of the meeting. During the last several years we have been using different meeting formats. Originally we were using the public hearing format. However, due to the highly controversial nature of some of our original projects we started developing different meeting formats. We learned that even with an environment of general acceptance from the majority, this acceptance environment can be changed to one of rejection by a small, but vocal minority. THis problem, known as mass effect, can be minimized pby providing longer time for the meeting and changing its format. The most commonly used meeting format in our district for traffic operations projects division consists of three to four hours without a formal presentation. During these hours, the proposed plans and all relevant information are on display. Staff personnel with knowledge of the project are present at all times to ansower questions and to take notes of all unanswered ones.

This meeting format has been very effective in generating direct communication between the Department and the effected property owners, tenants, and residents along the project area. However, there have been some complaints from the most vocal groups. They found themselves loosing a forum opportunity to express their concerns and obtain support from others to help them in their cause. From our experience, the long meeting formats have given our office the opportunity to be in more and direct contact with the effected groups and enable us to control the meetings in a more productive way. Reently, one city has expressed their interest in conducting public meetings in a similar fashion in recognition of the mass effect problem experienced by them occasionally.

Another meeting technique that we are going to test in the immediate future involves a combination of one to one discussions and an open public forum. This method is in response to those groups in need of a public forum. The new technique includes the scheduling of short presentations at the top of each hour. In this way, the intention is target different groups at different hours and reduce the possibility for the concentration of big groups. For example: the meeting invitation letters will recommend that business groups should attend any of the first two presentations and that residents should attend any of the last two hours. Nevertheless, questions of all kinds will be answered any time. We hope that this new, untested format will provide the missing gap in the public meetings.

Our process continues by implementing any changes found necessary because of the public meetings and/or request from local government staff or political members. If the changes are large in nature a letter informing the effected citizens is sent. At this time, the public information process that involves the conceptual stage is completed. The construction office, with the design project managers, will continue with the last elements of the process. This last process includes before- and during-construction news releases to inform motorists about the different stages of the porject and the other activities listed in Table 1.

When the amount of people impacted by the project is small our process follows a different route. If the amount of impacted citizens are less than thirty, letters are sent with a reduced copy of the plans. In this letter, a general explanation of the project is given and a telephone number of the contact person is provided. A reasonable amount of time is given to the impacted people to express any concerns or diasagreements with the project. These responses, if any, are then handled by phone. From our experience, we have found this method very effective and reasonable for the public impacted by these controversial projects.

In summary, a good public information process is critical for the acceptance of any access control project. People's perception of these changes are frequently unfounded and will require the availablility of data in support of the proposed changes. Our experience indicates that a good project has to obtain a balance of technical solutions and real life experiences. We should not forget that we are providing a service to our community that is composed of a variety of groups with conflicting goals but with similar purpose, to provide a better place to live for all of us.

Land Use Planning and Access Management in Oregon

J. Richard Forester
Consulting Attorney

A. INTRODUCTION

When it adopted the Transportation Planning Rule (TPR) in 1991, the Land Conservation and Development Commission (LCDC), which oversees Oregon's land use laws took a major step in integrating land use planning and transportation planning. It is a heroic effort to overcome the first Mosaic (Robert that is) law of the relationship between transportation and development, to wit, if you build it they will come and replace it with we will let you build it, if you can keep them from coming. A corollary to that law, at least as applied to the facilities in Oregon which have the misfortune to pass through rural lands on their way to more spoiled living environments, appears to be, we will let you build it, if you pretend its not there.

There seem to be a few ways to attempt such a feat. The simplest one being to control and manage access to major facilities in manner designed to discourage the use of facilities for unintended purposes. A more complicated way, already alluded to, is not to permit local zoning to recognize the existence of facilities for upzoning or development which would seek to take advantage of the availability of such service. Oregon, not wanting to leave anything to chance, is doing it both ways. As a result access control and management have become major tools of land use and transportation planning in Oregon, in a complex and multi-layer program of regulations, policies and plans. To start down that path, the Oregon Transportation Commission (OTC) in 1992 adopted the Oregon Transportation Plan (OTP). Because of the highly legalistic planning framework, which will outline below, the OTP is more than just a documented wish. It carries with it legal authority to implement a strong administrative rule regulating access control and management.

Oregon Transportation Plan (OTP)

This is a statutorily mandated comprehensive, long range plan with the goals of assuring economic efficiency, orderly economic development, safety and environmental quality through our Transportation system. Within the statutory authorization, the OTP triggers Oregon Transportation Commission's (OTC) regulatory power to implement it. The OTP is related to and interacts with ODOT's State Agency Coordination Program (SAC-OAR 731-15), and LCDC's Transportation Planning Rule (OAR 660-12) and Periodic Review (OAR 660-19). It incorporates by reference the 1991 Oregon Highway Plan (OHP) and its successors. As such, by statute, it provides one source of authority for enactment of the OHP administrative rule in order to implement its goals and objectives that are related to its policies.

The key OTP policies, which are supported by the OHP Plan and its proposed regulations relate to levels of importance, level of service, access management and interchange policies. The Modal system element of the OTP calls for maintenance of minimum levels of service and minimum tolerable conditions and access management techniques as included in the OHP. The OTP requires and supports the proposed rule in that it calls for: support of corridor preservation, efficient pricing, safety, connectivity, conflict resolution, support of acknowledged comprehensive plans, planning and design of interurban corridors, limited interchanges, access control, minimum levels of service, improved traffic flow, effective standards for number, spacing, type and location of access, intersections and signals.

1991 Oregon Highway Plan Policies

The Level of Importance(LOI), Level of Service (LOS), Access Oregon Highway (AOH) Corridor Planning, Access Management, State Agency Coordination and Interchange Management form the foundation and provide the key text for the proposed administrative rule. Its minimum tolerable conditions (MC), should form a floor below which even an exception to any policy/regulatory requirement as implemented through certain design and spacing standards may not be granted.

This paper is an attempt to describe how these different pieces of the Oregon system work together. To that we will briefly describe Oregon's land use framework and two key rules that implement it - TPR adopted by LCDC and State Agency Coordination Rule (SAC), adopted for ODOT by the OTC. Both rules were cooperative and integrated efforts between the two commissions and two state agencies. The administration of state highways access is for now confined to the Oregon Highway Plan (OHP), which the author as a consultant for ODOT is transforming into an administrative rule.

B. OREGON'S LEGAL PLANNING FRAMEWORK

Introduction

The primary focus and responsibility for land use planning in Oregon reside with the cities and counties, with regional government overlays in MPO areas such as Portland, Eugene and Medford. It is the comprehensive plans of these jurisdictions that carry the principal burden of complying with the statewide goals. By law, state agency policy and actions need to be consistent with the acknowledged comprehensive plans.

While there are many ways to restrict access, such as limiting the types of land uses allowed along state arterials, or setting up access conditions for those uses, access control is achieved primarily through the comprehensive plan and zoning powers of local governments. In that setting, protection of arterial capacity is one of the many competing factors in deciding land uses that may be allowed along a facility.

Access control planning has a vital role to play in protecting and extending the useful life of state investments in highway projects, and it is about to become fully integrated into the land use system. That role is now recognized in the Department of Land Development and Conservation (DLCD) TPR (OAR 660-12) and the TSP, which is a system plan under that rule. This assures consideration of access control and protection issues in the long range planning of affected communities and should become part of a mental set that governs land use planning for highway projects.

Land Use Law

In 1973 Oregon created a new legal land use structure when it passed the now famous Senate Bill 100 (ORS Ch. 197). That law created the LCDC, an unpaid citizen commission. LCDC was charged to "prescribe planning goals and objectives to be applied by state agencies, cities, counties, and special districts throughout the state."[1] The DLCD was created to administer the statewide goals. [2]

The main objective of the new law was the advancement of statewide regional planning and state participation in land use decisions. Specific objectives are stated in the 19 goals adopted by LCDC which articulate statewide interests in such areas as housing, transportation, farmland etc. The system may be best visualized as a pyramid. At the top of the pyramid are the goals adopted by LCDC. Those goals are frequently implemented through extensive regulations. Beneath the goals are the programs of state agencies and the comprehensive plans of the cities and counties of the state. Under the plans are zoning ordinances, subdivision ordinances, development ordinances and regulations. At the next level in the pyramid are site specific decisions on such things as plans for subdivisions, planned unit developments, major and minor partitions, rezoning decisions. At the very bottom are site specific decisions such as permits for conditional use, variances, buildings, septic tanks, curb cuts and access. [3]

Goals

LCDC goals are mandatory requirements on the lower tiers of the pyramid to which local jurisdictions must conform.[4] Cities and counties are to exercise their planning and zoning responsibilities in accordance with the goals[5], and prepare, adopt, revise and amend comprehensive plans in compliance with the goals.[6] LCDC also issues guidelines as suggested approaches to aid in the preparation, adoption and implementation of local comprehensive plans.[7] Cities and counties are required to enact land use regulations to implement their comprehensive plans.[8] As to programs affecting land use, both state agencies,[9] MPOs and special districts are required to exercise their planning duties and to take action in compliance with the goals. [10]

Comprehensive plans

Local comprehensive plans are the principal products of this process and the chief instrumentality for applying the statewide goals. LCDC reviews these plans for compliance with statewide goals through the acknowledgement and continuance orders. The Land Use Board of Appeals (LUBA) can review LCDC decisions and Oregon Court of Appeals has exclusive jurisdiction to review LUBA decisions. Once a local government's comprehensive plan has been acknowledged by LCDC, the state's role in local planning decreases greatly.

The main difference between the pre-acknowledgement and post-acknowledgement phase is that before acknowledgement, each land-use decision (such as a zone change or a transportation system plan) must be reviewed against all of the statewide goals (19) as well as local plans and regulations. After acknowledgement, since the goals are embodied in each comprehensive plan, they need not be considered separately; however, local action affecting land use must conform to the comprehensive plan. Only if the jurisdiction seeks to amend the comprehensive plan or its implementation measures do the statewide goals come into play again. Politically and administratively, the acknowledgement process is the grand bargain between state government and localities. Once acknowledged, and the short appeal times have expired, a comprehensive plan or amendment cannot be questioned as to validity. Since few people understand or follow these wordy documents in abstract, potential criticisms tend to arise only when the plans are to be implemented, by then its too late .

Functionally, the comprehensive plan is intended as a city or county's overall guiding document for growth and development. Communities' concerns over future capacity, safety and effectiveness of a highway should be eventually reflected in its comprehensive plan's transportation element (TSP). ODOT's similar concerns relating to state highways should find expression in the local plans through the TSPs adopted under the TPR. Inclusion of access management policies, or specific corridor plans in the comprehensive plan creates a basis for site specific decisions to reduce direct access or mitigate effects of access through zoning, subdivision and partitioning approvals or site reviews.

Enforcement

LCDC has the power to enforce compliance with the statewide planning goals.[11] It may issue an order requiring a local government to take whatever action is necessary to bring its plan land use regulation or decisions into conformity with statewide planning goals and the rules promulgated thereunder. The enforcement process is made flexible, so that LCDC may limit or prohibit land use actions to the area where the problem exists. LCDC is also required to find that continued activity would aggravate a violation and the enforcement order is necessary to correct the same. The key LCDC power in this scheme is the power to acknowledge a comprehensive plan. Once acknowledged, a local comprehensive plan, no matter how bad or inadequate, cannot be challenged.

Land Use Board of Appeals (LUBA).
LUBA is a specifically established three person administrative tribunal that has exclusive jurisdiction to review land use decisions of local governments, special districts, and state agencies. The petitioner must exhaust all remedies that available to him by right, before LUBA can accept jurisdiction. All final LUBA decisions are subject to review by the Court of Appeals. The bulk of enforcement actions for goal or comprehensive plan compliance takes place through the appeal process that must be started within 21 days of the final land use action. The time limit is jurisdictional. There are extremely short time lines for petitioning, briefing and issuing decisions, all of which, except filing the notice of appeal, can be waived by parties.[12]

Post-acknowledgment
After plans have been acknowledged, they can be amended on a case by case basis (quasi-judicial for individual sites and quasi-legislative as part of a larger scheme) or as part of periodic review process. Local governments must give the DLCD director 45 days' notice of the adoption of plan or land use regulation amendments, unless the local government decides the goals do not apply.[13] DLCD then can comment on whether it finds proposed action consistent with the Goals. If DLCD finds no problem, and no one appeals within 21 days, the local government can proceed with its action. If the local government proceeds in face of DLCD's objection, DLCD can appeal that action to LUBA. If factors or changed circumstances unrelated to the amendment process affect unamended plan provisions, LCDC's periodic review is the only way to correct goal noncompliance resulting from changed circumstances after acknowledgement. [14]

Periodic Review
As the periodic review requirement has evolved, LCDC must schedule such a review not sooner than four years nor later than ten years from the date that LCDC last made a decision to approve a program or conducted previous review.[15] The DLCD must give local government notice of the deadline for adoption of a periodic review order. The locality then conducts a review of its plan and regulations following the factors listed in ORS 197.633 and ORS 197.646.

City or County must review its plan against four periodic review factors. In effect it must ask four questions:

1) Has there been a "substantial change of circumstances" - rapid or unforeseen growth, a new bypass - since acknowledgement - so that the comprehensive plan and land use regulations do not comply with the statewide goals?

2) Have the implementation decisions, or the effects of implementation decisions, made the existing plan inconsistent with the goals?

3) Are there issues of regional or statewide significance, intergovernmental coordination or state agency plans or programs affecting land use which must be addresses to bring the comprehensive plans and land use regulations into compliance with the provisions of the goals?

4) Are there any new or amended statewide planning goals, commission administrative rules and land use statutes that have become applicable to the jurisdiction?

If the answer to any of these questions is yes, then the city or county must amend their plans accordingly. DLCD then will review the local government's findings and will evaluate the amendment. If the local government or someone appeals, or DLCD is not satisfied, the matter goes to the LCDC. LCDC reviews the actions and makes a decision. LCDC order can be appealed directly to the Court of Appeals.

Coordination
As it occurs in the Oregon statutes and planning literature, this word means specifically the coordination that occurs between local governments and other agencies (federal, state, and local bodies and special districts). ORS 197.015(5) declares that a plan is coordinated 'when the needs of all levels of governments, semi-public and private agencies and the citizens of Oregon have been considered and accommodated as much as possible. Goal 1 states, 'Federal, state and regional agencies and special purpose districts shall coordinate their planning efforts with the affected bodies and make use of existing local citizen involvement programs established by counties and cities. Goal 2 requires that 'each plan and related implementation measure shall be coordinated with the plans of affected governmental units.'

There are two main components in coordination. One is state agency coordination (SAC), a program administered by DLCD. DLCD reviews the rules and programs of other state agencies to ensure that they are 'in compliance with the goals and compatible with acknowledged comprehensive plans. (ORS 197.180(7)). Formal approval by LCDC of such rules and programs is called certification. The other component is local coordination among cities, counties and special districts.[16] Certification in case of state agency results in a coordination agreement. ODOT's Comprehensive Planning Coordination Program.

The concept of coordination deserves emphasis and has particular relevance to statewide transportation planning. First, plans and actions of state agencies must be consistent with the comprehensive plans of cities and counties and with regional plans.[17] Although a plan is not viewed as coordinated unless it considers state agency plans or programs it is in the end the comprehensive plan that governs. ORS 197.646, as well as the TPR, make it clear that there is a hierarchy of planning authority in that special district plans are subservient to city, county or regional plans,[18] and that it favors regional over local planning.[19] TPR requires coordination wish OTP, and 197.646 and 197.180 together also achieve the result that ultimately will require that local plans address state transportation plans and regulations.

In effect when it comes to ODOT administering a statewide transportation system, the pyramid model did not work, until the transportation planning rule put some teeth behind this requirement. For this paper the key point is that the local comprehensive plans control are now the instruments of state policy.

C. TRANSPORTATION GOALS

Several LCDC goals and guidelines relate directly or indirectly to access management issues. The TPR explains how the Transportation Goal (12) relates to and interacts with Goal 3 (Protection of Agricultural Lands), Goal 4 (Protection of Forest Lands), Goal 11 (Public Facilities and Services) and Goal 14 (Urbanization). ORS 184.618[20] requiring adoption of the OTP ,specifically requires consideration of the economic objectives of the state, which are also embodied in Goal 9 (Economy of the State). That latter economic priority is reflected in Access Oregon Highway policy and program and as reflected in the OHP, with detail guidelines on corridor planning for highways determined to be of primary economic importance to the state.

Goal 9 - Economy of the State

The general objective of Goal 9 is to diversify and improve the economy. In 1983 the Legislature added to the economic development responsibilities of local governments by enacting ORS 197.712. Declaring that "the provision of adequate opportunities for a variety of economic activities throughout the state is vital to the health, welfare and prosperity of all the people of the state," the legislature directed LCDC to implement five requirements through goal amendment or interpretive rules. [21]

Plans are required to comply with the provisions of the statute by the first periodic review of each plan. [22] In 1986, LCDC adopted administrative rules to implement the first four of these requirements, OAR 660-09-000 to 025.

Under an access classification system, reliance on state highways to achieve some of these objectives, or to demonstrate availability of land for development may conflict with the larger regional or statewide function of a given highway. For example, reliance on transportation links to other communities for such things as distribution of goods or tourists can be inconsistent with using state highways for retail development.

Goal 12 - Transportation

The object of the transportation goal is to provide and encourage a safe, convenient and economic transportation system. These objectives relate logically to access management planning, and those connections are now made explicit in the TPR and OTP. The goal further requires that transportation plans be based upon an inventory of local, regional and transportation needs, that they facilitate the flow of goods and services to strengthen local and regional economy and that they conform with local and regional comprehensive land use plans. Until now generally amorphous and largely ignored Goal 12, has come fully developed and alive in the TPR. The TPR, brings closure to the circularity of the Oregon's land use framework. It works with the State Agency Coordination requirements, so that ODOT action has to be compatible with the local comprehensive plans, but those in turn, must be responsive to the OTP and the OHP policies which it incorporates. The mechanisms that we discussed before are set up to make that happen. The remainder of the Oregon's planning Goals will be discussed in the TPR discussion.

D. TRANSPORTATION PLANNING RULE (TPR)

Introduction

A coordinated effort by LCDC/OTC and DLCD/ODOT led to the adoption in 1991 of the Transportation Planning Rule (OAR 660-12). Only those aspects of the Rule that are relevant to the formulation of policy and directives related to access management will be discussed here. The TPR is also a source of legal authority for additional coordination requirements and represents the other side of the coin from the ODOT's State Agency Coordination Rule (SAC - OAR 731-15). As we already stated, in the former local governments must coordinate their planning efforts with the state transportation needs. In the latter ODOT decisions must be compatible with local comprehensive plans. Local coordination and cooperation are critical to effective access policy

Because the OTP and the OHP are adopted by ODOT first, before they can be coordinated into the comprehensive planning process through periodic review or the upcoming local transportation system plans, there is an administrative lag time in which the local plans are not reflecting state objectives. In the interim, during this lag time, ODOT has the responsibility and the task to ensure that its policies are not ignored at the local level. The newly amended state agency coordination statute (197.180 see discussion below) allows that to occur. The proposed OHP administrative rule may pose such a dilemma on occasion, where the intent and purpose of the rule will not be reflected in local land use policies for a time. Until the local planning jurisdictions have had a chance to coordinate their planning efforts with ODOT's, ODOT's administrative policies designed to preserve and protect the functional integrity of state highways should prevail over inconsistent local policies. Once the local plans have been coordinated and that coordination acknowledged, the local plans assume *primacy and the rules require* that ODOT actions must be compatible with such plans.

The interactions of transportation policy and planning with land use requirements are critical to access permit issuing decision. The corridor planning efforts which should decide specific access and interchange locations along designated corridors, are considered land use actions under ORS ch 197.[23]

LCDC's TPR requires ODOT to identify a system of transportation facilities and services adequate to meet identified state transportation needs and prepare a transportation system plan (TSP). The OTP, including the Policy and System Elements, and adopted modal (OHP) and facility (corridor) plans are intended to meet the requirements for state TSP. Simultaneously, the TPR triggers wide ranging, and in the MPO areas, politically difficult, planning efforts aimed at ensuring that transportation and land use policies do not work at cross purposes and that both efforts are integrated to preserve rural lands and limit urban sprawl.

Provisions

The purpose of TPR[24] is to implement Statewide Planning Goal 12 (Transportation) and to explain how local governments and state agencies responsible for transportation planning demonstrate compliance with other statewide planning goals. The rule places special emphasis on how transportation facilities are provided on rural lands consistent with the goals. The rule also sets requirements for coordination among affected levels of government for preparation, adoption, refinement, implementation and amendment of transportation system plans. [25]

OAR 660-12-010 (1) divides transportation planning into two phases: transportation system planning and transportation project development as defined above.

OAR 660-12-015 deals with the preparation and coordination of TSPs. Section (1) requires ODOT to prepare, adopt and amend a state TSP following ORS 184.618, its program for state agency coordination certified under ORS 197.180, and OAR 660-12-030, 660-12-035, 660-12-050, 660-12-065 and 660-12-070. The state TSP has to identify a system of transportation facilities and services adequate to meet identified state transportation needs and it must include the state transportation policy plan, modal systems plans (such as the 1991 OHP) and transportation facility plans (such as corridor plans) as set forth in OAR 731, Division 15, discussed below under state agency coordination.

Subsequent sections of this rule provide that where elements of the state TSP have not been adopted, the MPO or county or the city must coordinate the preparation of the regional TSP with ODOT to assure that state transportation needs are accommodated. This coordination requirement will affect the implementation of the proposed access management rule until local planning is completed.

OAR 660-12-020 defines key elements of TSPs including the need for a TSP to establish a coordinated network of transportation facilities adequate to serve state, regional and local transportation needs. TSP requires consistency in regional and local TSPs with functional classifications of roads in state and regional TSPs. TSPs also require an inventory and general assessment of existing and committed transportation facilities and services by function (Level of Importance or LOI), type (urban-rural), capacity (LOS) and condition (in our case access management conditions). That inventory may also be a critical element in the administration of access management policy. This rule further requires that the transportation capacity analysis must include information on:

- The capacities of existing and committed facilities;
- The degree to which those capacities have been reached or surpasses on existing facilities; and
- The assumptions upon which these capacities are based.

These three information elements are also important to the administration of access management. They should enable access category assignments and some permit decisions to be based on maintaining the LOS standard for LOI rural and urban segments of highways.

The rule assumes that for state facilities, the transportation capacity analysis shall be consistent with performance considered acceptable by the state (LOS and AOH policies). A TSP must include a description of the type or functional classification of planned facilities and services and their planned capacities and levels of service. It must describe the location of planned facilities, services and major improvements, and establish the general corridor within which the facilities, services or improvements may be sited. For our purposes the OHP and the OTP satisfy these requirements. This shall include a map showing the general location of proposed transportation improvements, a description of facility parameters such as minimum and maximum road right of way width and the number and size of lanes and any other additional needed description.

For ODOT, adoption of a TSP is a land use decision regarding the need for transportation facilities, services and major improvements and their function, mode, and general location. Findings of compliance with the applicable statewide planning goals and acknowledged comprehensive plan policies and land use regulations have to be developed with the adoption of the TSP.[26] Since the adoption of the OTP and its incorporation of the OHP policies as its modal elements for highways, the relevant administrative appeal times have expired. Therefore, compliance with these plans should satisfy ODOT's planning goal compliance needs and these plans cannot be further challenged on that basis, until they are amended.

OAR 660-12-030 (1) requires TSP to identify transportation needs relevant to the planning area and the scale of the transportation network being planned including, state, regional, and local transportation needs also needs for movement of goods and services to support industrial and commercial development planned for pursuant to OAR 660-09 and Goal 9 (Economic Development).

Counties or MPOs preparing regional TSPs and local governments in preparing local TSPs are required to rely on the analysis of state transportation needs in adopted elements of the state TSP.

OAR 660-12-035 requires the TSP, in evaluating potential impacts of system alternatives, to evaluate the impact of demand management measures on the need for new facilities.

Requirements - urban and rural

The transportation systems are required to support urban and rural development by providing types and levels of transportation facilities and services appropriate to serve the land uses identified in the acknowledged comprehensive plan. The most difficult part of this rule requires in MPO areas, for the TSPs to be designed to achieve reduction of automobile vehicle miles traveled (VMT) per capita for the MPO area. In that regard segments of the planning community in the METRO area and DLCD are suggesting lowering the LOS standards in urban areas to discourage automobile travel and encourage alternative modes of transportation.

OAR 660-12-045 requires each local government to amend its land use regulations to implement the TSP and identifies activities that do not need be subject to land use regulations.

If a highway project is permitted outright in the comprehensive plan or if it is subject to standards that do not require interpretation or the exercise of factual, policy or legal judgment, it is allowed without further land use review.[27] Otherwise the local government is required to provide a review and approval process that is consistent with OAR 660-12-050 and to provide for consolidated review of land use decisions required to permit a transportation project.[28]

Section (2) requires local governments to adopt land use or subdivision ordinance regulations to protect transportation facilities, corridors and sites for their identified functions and levels of service (LOS) and in doing so to notify ODOT when applications require public hearings, or involve subdivisions or partitions, or affect private access roads. Other states require DOT's approval of any subdivision dependent for access on a state highway and subdivisions cannot be approved unless they meet DOT's access standards.

OAR 660-12-050 connects the Transportation Planing Rule with the SAC Rule. Section (1) provides that for projects identified by ODOT pursuant to OAR 731, Division 15, project development shall occur in the manner set forth in that Division. Section (3) provides that project development involves land use decision-making to the extent that issues of compliance with applicable requirements remain outstanding at the project development phase.

Section (4) provides that where an Environmental Impact Statement (EIS) is prepared pursuant to the National Environmental Policy Act of 1969, project development shall be coordinated with the preparation of the EIS. All unresolved issues of compliance with applicable acknowledged comprehensive plan policies and land use regulations shall be addressed and findings of compliance adopted before issuance of the Final EIS.

OAR 660-12-055 governs the timing of adoption and update of TSPs. It provides for exemptions by the Director of DLCD in consultation with the ODOT on the need for transportation planning in the area, including measures needed to protect existing state transportation facilities.

OAR 660-12-060 (1) deals with amendments to functional plans, acknowledged comprehensive plans, and land use regulations that significantly affect a transportation facility as when there are changes to the functional classification of or planned transportation facility or when standards implementing a functional classification systems are changed. A transportation facility is also affected when types or levels of land uses result in levels of travel or access that are inconsistent with the functional classification or a transportation facility or would reduce the level of service of the facility below the minimum acceptable level identified in the TSP.[29]

Amendments that significantly affect a transportation facility need to assure that allowed land uses are consistent with the identified function, capacity, and level of service of the facility. This objective shall be accomplished by either:

(a) Limiting allowed land uses to be consistent with the planned function, capacity and level of service of the transportation facility;
(b) Amending the TSP to provide transportation facilities adequate to support the proposed land uses consistently with the requirements of this division; or
(c) Altering land use designations, densities, or design requirements to reduce demand for automobile travel and meet travel needs through other modes.

Determinations under this rule have to be coordinated with service providers and other affected local governments.[30] Section (4) provides that the presence of a transportation facility or improvement shall not be a basis for an exception to allow residential, commercial, institutional or industrial development on rural lands under this division or OAR 660-04-022 and 660-04-028. This regulation is a powerful tool for ODOT's intervention in seeking to prevent or to control unwanted or undesirable intensification of use based on an interchange or a new facility.

The remaining rules deal with transportation improvements on rural lands. Protection of rural lands is the *raison d'etre* of the Oregon land use experiment. OAR 660-12-065 (1) identifies transportation facilities, services and improvements that may be permitted on rural lands consistent with Goals 3, 4, 11 and 14 without a goal exception. Essentially, the Rule allows transportation facilities and improvements permitted outright or conditionally under ORS 215.213(1) or (2) or 215.283(1) or (2), and under OAR 660-06. The summary of facilities and improvements consistent with Goals 11 and 14 on rural lands, could be described as those that are not intended to contribute to road capacity.

Section (5) limits new local service roads to only two lanes of traffic, with intersections and private accesses consistent with rural uses and densities. It does not permit major realignments and connections are limited to built and committed areas or to reduce local access to and local traffic on a state highway. Access to farm and forest lands is limited.

Section (6) provides key policy guidance on access management policies on rural roads until local TSPs or ODOT corridor plans are implemented. It provides that major road improvements to state highways of regional or statewide significance have to reduce accesses to the minimum practicable and cannot exceed that which would be consistent with the function and operation of the highway considering traffic at buildout of nearby rural lands. Within the structure of this rule, the administration of this provision implies establishment of carrying capacity of a given highway at various levels of service and administering the facility in such a way as to maintain that carrying capacity. The reality of implementing this rule suggests that highway "shed" may need to be considered, not just adjoining properties and intersections.

The allowed improvements can accommodate local travel to the extent that it is not feasible to meet such needs on other existing roads or through improvements to other existing roads, including construction of local access roads in built and committed areas. New interchanges or intersections are also restricted:

- To connect to other state highways of regional or statewide significance;
- To replace existing interchanges or intersections; or
- To reduce and consolidate direct road accesses consistent with subsections (a) and (b) of this section.

Under subsection (d) direct private access to new facilities is permitted. Under subsection (e) median turn lanes are limited to correct a safety problem that cannot practicably be corrected through other measures.[32] Additionally, median turn lanes must be consistent with the function (LOI) and operation of the facility (LOS) considering traffic on affected roads and accesses at buildout of nearby rural lands.

Similarly, realignments cannot create new parcels of land that are provided direct access to the highway.[33] Subsection (g) requires that a bypass of all or part of an urban growth boundary can be permitted only if planned, designed and operated to limit use for trips between locations within the urban growth boundary to be less than a third of the average daily traffic on the bypass.

Subsection (7) defines which transportation facilities, services or improvements serve local needs, and are therefore allowed.[34]

OAR 660-12-070 provides for the exception process for transportation facilities and improvements that do not meet the requirements of OAR 660-12-065.

E. ODOT STATE AGENCY COORDINATION PROGRAM

STATUTORY REQUIREMENTS

As part of the amendments to the periodic review statutes, state agencies obtained a clarification of their requirement to act consistently with acknowledged comprehensive plans. ORS 197.180(2) has been amended to authorize state agencies to implement a "plan or program" that is inconsistent with an acknowledged comprehensive plan.[35]

ORS 197.180(1) requires state agencies to exercise their planning responsibilities in compliance with statewide goals and in a manner compatible with acknowledged comprehensive plans. The Attorney General has found the latter requirement unclear and ambiguous.[36] ORS 197.180(2) provides that State agencies need not act in a manner compatible with acknowledged comprehensive plans, if the comprehensive plan or land use regulations are inconsistent with a state agency plan or program relating to land use that was not in effect, at the time the local plan was acknowledged.

To qualify for this exemption from comprehensive plan "compatibility", ODOT must show that its inconsistent plan provision is in compliance with its certified SAC program and three other criteria:

(a) That the plan or program is mandated by state statute or federal law. The Highway Plan is mandated by ORS 184.618(2) to carry out Oregon State Highway Division's (OSHD) responsibility under the OTP.

(b) That the plan or program is consistent with the goals. Neither the OTP nor the Highway Plan has been timely appealed, and are therefore deemed consistent with the Goals. OTP is explicitly intended to assure compliance with the Goals and it expressly incorporates the 1991 OHP.

(c) That the plan or program has objectives that cannot be achieved in a manner consistent with the comprehensive plan and land use regulations. This aspect of the statutory authority can only be shown on a case by case basis. For example, an access decision based on the Access Management policy (category) in the OHP, may be implemented, even if inconsistent with the comprehensive plan, in the time period described. If the local policies are stricter than ODOT's, then at least pending TSP and periodic review cycle completion, the proposed rule should seek to enforce a stricter standard whenever a conflict exists and such policy should continue on a permanent basis.

Purpose and Application of the Coordination Program and Rule

The purpose of SAC rule is to establish the procedures to be used by ODOT to implement the provisions of its State Agency Coordination Program that assures that ODOT's land use programs are carried out in compliance with the statewide planning goals and in a manner compatible with acknowledged comprehensive plans, as required by ORS 197.180 and OAR 660, Divisions 30 and 31.[37]

The SAC program states that ODOT is interested in amendments to the transportation elements of city and county comprehensive plans. In addition, ODOT is interested in a number of types of city and county plan implementation and plan amendment actions that can affect transportation facilities.

As relevant to the proposed Administrative rule, the ODOT is required to receive notification and work with local governments on all actions affecting access to state highways and functional preservation.[38] Such actions include most land use actions on properties adjacent to or near state highways where the use of an existing highway access would change or a new highway access is being proposed.[39]

Also relevant to the proposed rule are actions that will increase traffic. Actions affecting LOS may impact or change decisions affecting additional access. The ODOT is interested in plan amendments and zone changes in the general vicinity of state highways that will significantly affect highway traffic volumes. ODOT is concerned about traffic generators that would overload highway intersections. This may include even relatively small zone changes where a substandard highway intersection would be affected or where a pattern of plan or zone changes is resulting in a substantial cumulative impact.[40]

Finally, actions that affect major transportation corridors and facilities, relate to OHP policies. The ODOT is interested in zone changes and plan amendments along major transportation corridors and around major transportation terminals. OAR 731-15-015 provides key definitions for the program.[41]

The SAC requirements apply to the following programs and activities relevant to the proposed Administrative Rule.[42]

(1) Adoption of the Transportation Policy Plan.
(2) Adoption of modal systems plans (The OHP).
(3) Adoption of transportation facility plans (Corridor and Access Management Plans).
(4) Adoption of project plans for Class 1 and Class 3 projects.
(5) Adoption of project plans for Class 2 projects which would involve any of the activities listed in 731-15-035.
(6) Carrying out operations, maintenance and modernization activities, except repair of damaged highways as authorized by ORS 366.445, which would involve any of the activities listed in 731-15-035.
(7) Issuing any of the following permits or licenses:
    (a) Road Approach Permits
    (d) Permits for Utility Use of Right of Way

OAR 731-15-035 further identifies activities undertaken by the ODOT which significantly affect land use and are subject to the SAC rule. Relevant for the proposed Administrative Rule are:

(1) Enlarging an existing transportation facility to increase the level of transportation service provided, relocating an existing transportation facility, or constructing a new transportation facility.
(2) Constructing a new accessory facility, enlarging an existing accessory facility, or significantly changing the use of an existing accessory facility.
(3) Changing the size of land parcels through the sale of property.
(4) Altering land or structures in a way that significantly affects resources or areas protected by the statewide planning goals or acknowledged comprehensive plans.

Coordination with comprehensive plan implementation and amendments
ODOT committed itself and is required to respond to local notices within the time prescribed in the notice. The ODOT is required to identify concerns and relate them to comprehensive plan and ordinance requirements, including what factual information is needed to address its concerns. ODOT is required to meet with planning officials and applicants in instances where there are significant conflicts.

a. Meet with planning officials and applicants and participate in the local decision-making process;
b. Request informal mediation by the ODOT of Land Conservation and Development; and
c. Appeal the decision.

What is missing is the option now available under ORS 197.180(2) for ODOT to proceed with its own Plan implementation based on its own goal findings (See the above discussion under ORS 197.180).

Incorporation of ODOT plans and programs into comprehensive plans and participation in periodic review
ODOT is required, to the extent possible, to attempt to incorporate its plans and programs into comprehensive plans in the following ways:

1. ODOT is required to request that affected cities and counties incorporate relevant portions of modal systems plans and facility plans adopted by the ODOT into their comprehensive plans. ODOT is required to assist local governments with the amendments.[43] For the purpose of the proposed rule incorporation of access management plans for segments and corridor would be very important.

2. As an early step in the project planning process for Class 1 and Class 3 projects, ODOT is required to request that the affected local governments amend their comprehensive plans and land use regulations to make them consistent with applicable modal system plans and facility plans.[44]

3. ODOT must be an active participant in the development of regional transportation plans for the state's metropolitan areas (i.e., urbanized areas, cities with populations of 50,000 or more along with surrounding urban areas).[45] AMP development is important here.

4. ODOT must work with cities and counties during periodic review to incorporate its plans into local comprehensive plans.[46] Again AMP development is important here.

Participation in Metropolitan Area Transportation Planning
Transportation planning for the five urbanized areas of the state, Portland, Eugene, Salem, Medford and Longview-Kelso-Rainier is done through a coordinated process involving ODOT, area governments and transit providers. ISTEA requires such planning in order to receive federal capital or operating assistance funds. The

purpose of this planning process is to assure that transportation planning in these areas is continuing, cooperative and comprehensive, and consistent with comprehensive land use plans.[47]

ODOT does the following to assure that it coordinates with the transportation planning process of the metropolitan areas of the state.[48]

1. The ODOT assists the MPOs in the development of planning work programs, regional transportation plans and transportation improvement programs. The ODOT has an obligation to identify issues of consistency with its transportation plans as early as possible while developing transportation plan alternatives.

2. The ODOT is required to participate on the policy and technical advisory committees of metropolitan planning organizations in the development and endorsement of transportation plans and transportation improvement programs.

3. The ODOT must be consistent with the adopted regional transportation plans when developing its capital improvement programs. The ODOT's capital improvement programs and the TIPs must be coordinated with one another.

4. The ODOT has an obligation to involve affected MPOs in the development of plans for transportation facilities within the metropolitan areas.

Periodic Review and Coordination with Local Public Facility Planning

Most of the ODOT's coordination with local public facility planning is likely to occur during periodic review.[49] Therefore, the procedures for carrying out such *coordination* have been combined with periodic review procedures. If a city or county adopts or amends a public facilities plan independent of periodic review, the ODOT is obligated to follow the procedures for coordinating with plan amendments combined with relevant portions of the procedures listed below.

ODOT has an obligation to notify the city or county of any concerns about possible conflicts with its plans and programs before the first local public hearing of which it receives timely notice.

ODOT has the following interests besides those listed at the beginning of this chapter:

a. Public facility plans should include relevant portions of adopted modal systems plans, regional transportation plans, facility plans, and project plans.

b. State facilities not be proposed to provide services that are contrary to their functions as set forth in state and regional transportation plans.

c. Planned local street systems be adequate to serve planned development and not increase usage of a state facility in a way that is inconsistent with its intended function.

d. Proposed improvements to state facilities be consistent with state transportation plans.

e. Short range improvements to state facilities not be proposed if they are not listed in the ODOT's capital improvements programs unless the public facilities plan recognizes that the improvements are not in the ODOT's capital improvements programs.

f. Improvements identified in the ODOT's capital improvements programs that are compatible with the acknowledged comprehensive plan be identified in the public facility plan.

g. Public facility plans identify facilities needed to serve commercial and industrial land.

In case of conflicts, the ODOT is required to offer to meet with local planning officials to resolve conflicts. The DLCD has the task of mediating unresolved conflicts. The ODOT is also required to notify the DLCD of conflicts that remain after a city or county has adopted its final periodic review order.

Local Government Reliance on ODOT Transportation Plans

ODOT encourages local governments to adopt relevant portions of the ODOT's transportation plans to comply with applicable provisions of Goal 12 pursuant to OAR 660-30-085. Except in the case of minor amendments, the ODOT must involve DLCD and affected metropolitan planning organizations, cities, counties, state and federal agencies, special districts and other interested parties in the development or amendment of a facility plan. An AMP is most likely such a facility plan, so that AMP regulations will need to reflect these requirements, as will the provisions for Access Management Category assignments.

ODOT plays a key role in meeting with affected planning representatives and communicating clearly and completely about its plans. In a key provision, if no reply is received from an affected city, county or metropolitan planning organization within **30** days of the ODOT's request for a compatibility determination, the ODOT shall deem that the draft plan is compatible with that jurisdiction's acknowledged comprehensive plan. The ODOT may extend the reply time if requested to do so by an affected city, county or metropolitan planning organization.[50]

If any statewide goal or comprehensive plan conflicts are identified, the ODOT shall meet with the local government planning representatives to discuss ways to resolve the conflicts.[51] These may include:

a. Changing the draft facility plan to eliminate the conflicts,

b. Working with the local governments to amend the local comprehensive plans to eliminate the conflicts, or

c. Identifying the conflicts in the draft facility plan and including policies that commit the ODOT to resolving the conflicts before the conclusion of the transportation planning program for the affected portions of the transportation facility.

If the comprehensive plan of an affected city or county contains no specific or general plan requirements which apply, the department may request that the city or county amend its comprehensive plan to incorporate appropriate requirements.[52]

ODOT shall evaluate and write draft findings of compatibility with acknowledged comprehensive plans of affected cities and counties, findings of compliance with all statewide planning goals which specifically apply as determined by OAR 660-30-065(3)(d). It must also make findings of compliance with all provisions of other statewide planning goals that can be clearly defined if the comprehensive plan of an affected city or county contains no conditions specifically addressing the state plan or facility.[53] The Transportation Commission has the final responsibility for adopting findings of compatibility with the acknowledged comprehensive plans of affected cities and counties and findings of compliance with the applicable statewide planning goals when it adopts the final modal or facility plan.[54]

The ODOT shall provide copies of the adopted final modal and facility plan and findings to DLCD, to affected metropolitan planning organizations, cities, counties, state and federal agencies, special districts and to others who request to receive a copy.[55]

New and Modernization Projects
Coordination Procedures for Adopting Plans for Class 1 And 3 Projects mirror system and facility planning requirements, except that the ODOT is required to rely on affected cities and counties to make all land use decisions necessary to achieve compliance with the statewide planning goals and compatibility with local comprehensive plans after completion of the Draft Environmental Impact Statement or Environmental Assessment and before completion of the Final Environmental Impact Statement or Revised Environmental Assessment.[56]

Also, if compatibility with a city or county comprehensive plan cannot be achieved, ODOT may modify one or more project alternatives to achieve compatibility or discontinue the project.[57] The Commission may delegate adoption findings of compatibility to its designee, such as hearing officer.[58] Finally, ODOT is required to obtain ministerial planning permits prior to construction of the project.[59]

OAR 731-15-085 governs coordination of Class 2 projects which would significantly affect land use in accordance with OAR 731-15-035. ODOT is required to attempt to avoid any identified compliance or compatibility conflicts as it develops its plans.[60] After communication about the plan with the local government, if no comments are received from an affected local jurisdiction within **15** days of the ODOT's request for a compatibility determination, the ODOT shall deem that the preliminary project plans are compatible with the acknowledged comprehensive plan for that jurisdiction. The ODOT may extend the reply time if requested to do so by an affected city or county.[61]

On these classes of projects, if any local planning approvals are required the ODOT shall either modify its project plans so as to not require approvals, or shall apply for the necessary approvals. If the affected city or county does not grant approval, the ODOT may:

(a) Modify the project plans so as to not require approval;
(b) Discontinue further work on the project; or
(c) Appeal the city or county decision.[62]

OAR 731-15-105 governs procedures when the ODOT determines that an operations, maintenance or modernization activity would significantly affect land use in accordance with OAR 731-15-035 unless compliance with the statewide planning goals and compatibility with acknowledged comprehensive plans has been established through application of OAR 731-15-075 or OAR 731-15-085 and it echoes provisions in 731-15-085.

Permits
OAR 731-15-115 is directly applicable to the daily administration of the proposed Administrative Rule. Its requirements are:

(1) The ODOT shall notify applicants for permits or licenses or renewals of permits or licenses listed in OAR 731-15-025 of their responsibility to demonstrate compliance and compatibility. In other words, the burden of proof is on the applicant.

(2) The ODOT shall not issue a permit unless certification of compatibility is demonstrated by the applicant. The ODOT may deny, condition or further restrict a permit that is compatible as necessary to carry out applicable ODOT rules and statutes.

(3) Certification shall be documentation that all local land use planning approvals have been obtained or a written statement by a planning official of the affected city or county that the application complies with the acknowledged comprehensive plan but no local land use approvals are needed.

These provisions raise the problem of circularity. While the rule provides that the permit issuance shall proceed after the applicant produces documentation of local planning approvals, to the extent that the applicant's local proposal relies on the availability of a state highway for his or her transportation services, such approvals should not be granted without assurances from ODOT that issuance of the permit is consistent with its modal (highway plan policies) or a corridor plan. On the other hand, the expense of securing a permit before local land use decision may be too onerous, since local government land use actions are fraught with random unpredictability and delay through appeals.

Until all the plans are coordinated and deemed compatible with ODOT's policies and plans, local governments should not grant land use changes depended on access to a state highway or the use of a state highway without some preliminary indication of ODOT that it may issue a permit, with or without conditions to be decided through site review and traffic studies where appropriate. New Jersey and Florida solve similar problems by issuing conceptual approval, which is then used by the local jurisdiction in granting its approval. After local approval, the applicant returns to DOT for the final permit. Without such preliminary indication, in the interim period, the local government may have no predictable basis for assuming that a permit will be given, unless it determines that the applicant meets ODOT requirements. If it does that, it might as well approve a permit, subject to ODOT review and final issuance.

Anticipating just such a hiatus OAR 731-15-125 provides that if a compatibility conflict persists after pursuing the compatibility procedures listed in 731-15-045 through 731-15-115, the ODOT shall request that the LCDC make a compatibility determination in accordance with OAR 660-30-070 (7) through (12). Nevertheless, it seems unlikely that access permit decisions should be determined by LCDC. Except for very large projects that does not seem to be a practical method for resolving land use/permit conflicts.

F. CONCLUSION

I have tried to give the reader some notion of the complexity and the detail of Oregon's transportation and land use coordination efforts, as they relate to access management. Elements of these policies may be used in other places, without necessarily replicating the very complex and circular administrative structure that characterizes the Oregon system. Each state has its own legal requirements and opportunities. I have also tried to show the burdens and the opportunities as they might relate to access management of state highways.

Within the Oregon system, the TPR and SAC represent a noble effort to ensure that state and local governments do not sabotage each other by working at cross-purposes, by created development and political pressures. An important piece of the puzzle, an administrative rule providing for standards and administration of access management is being prepared. As this conference convenes, it should be ready for its first public review. The planning and land use system described, is meant to insure that the administrative rules dealing with access management will not work in isolation, subject to never ending pressures for exceptions.

Whether the experiment works remains to be seen. The more controversial elements of the TPR, requiring specified reductions in the VMTs in the MPO areas, may not prove workable and result in radical changes or repeal of the rule. Its relationship to access should be much less controversial - unless it too gets connected to the VMT reduction effort. On its more limited, but still very ambitious scope, ODOT is banking on the simple proposition that It is hard to argue against protecting public investment by preserving the capacity of state highways to serve their intended purpose. By enacting the OTP within the legal framework we have described, ODOT has helped itself to legal authority to proceed on its own to enact new access rule to implement the plan. Other states may need express legislative authorization to proceed down this path..

NOTES

1. ORS 197.005

2. Mitch Rohse, Land-Use Planning in Oregon, Oregon State University Press 1987, p 3.

3. Land Use (Oregon CLE 1982 & Supp 1988), p 1-3

4. ORS 197.015 (8)

5. ORS 197.175(1)

6. ORS 197.175(2)

7. ORS 197.015(9)

8. ORS 197.175(2)(b)

9. ORS 197.180 (1)

10. Subdivisions and partitions are required to comply with the relevant comprehensive plans, ORS 92.044(6) as are all discretionary land use decisions of counties, ORS 215.416(4), and cities, ORS 227.175(4).

11. ORS 197.320

12. Among matters that LUBA does not have jurisdiction over are:
    1. Matters over which DLCD has review authority;
    2. State agency land use decisions in contested cases - these go to the Court of Appeals;
    3. Ministerial matters over which the circuit courts retain jurisdiction to grant declaratory, injunctive, or mandatory relief;
    4. Rules, programs, decisions, determinations, or activities carried out under the Forest Practices Act;
    5. Decisions reviewable by the Columbia River Gorge Commission;

13. ORS 197.610

14. Urquhart v Lane Council of Governments, 80 Or App 176, 721 P2d 870 (1980)

15. ORS 197.633

16. Rohse at 72

17. Land Use (Oregon CLE) at 2-15, and OAR 660-30-070(3):
    (3) In carrying out the compatibility requirements of this rule, a state agency is not compatible if it approves or implements a land use program or action that is not allowed under an acknowledged comprehensive plan. However, a state agency may apply statutes and rules which the agency is required by law to apply, to deny, condition or further restrict an action or program, provided it applies those statutes and rules to the uses planned for in the acknowledged comprehensive plan.

18. Jackson County v. Bear Creek Authority, 53 Or App 823, 632 P2d 1349 (1981)

19. Fujimoto v Happy Valley, 2 LUBA 280 (1981)

20. ORS 184.618(4) The director and members of the commission (OTC) shall give economic development and the provision of industrial site services priority in fund allocation decisions.

21. ORS 197.712(2): (a) Comprehensive plans shall include an analysis of the community's economic patterns, potentialities, strengths and deficiencies as they relate to state and national trends.
(b) Comprehensive plans shall contain policies concerning the economic development opportunities in the communities.
(c) Comprehensive plans and land use regulations shall provide for at least an adequate supply of sites of suitable sizes, types, locations and service levels for industrial and commercial uses consistent with plan policies.
(d) Comprehensive plans and land use regulations shall provide for compatible uses on or near sites zoned for specific industrial and commercial uses.
(e) A city or county shall develop and adopt a public facility plan for areas within an urban growth boundary containing population greater than 2,500 persons. The public facility plan shall include rough cost estimates for public projects needed to provide sewer, water and transportation for the land uses contemplated in the comprehensive plan and land use regulations. Project timing and financing provisions of public facility plans shall not be considered land use decisions.

22. ORS 197.712 (3)

23. at 83

24. OAR 660-12-000

25. Some key definitions of the TPR, OAR 60-12-005:

(1) "Access Management" means measures regulating access to streets, roads and highways from public roads and private driveways. Measures may include but are not limited to restrictions on the siting of interchanges, restrictions on the type and amount of access to roadways, and use of physical controls, such as signals and channelization including raised medians, to reduce impacts of approach road traffic on the main facility.

(3) "Committed Transportation Facilities" means those proposed transportation facilities and improvements which are consistent with the acknowledged comprehensive plan and have approved funding for construction in a public facilities plan or the Six-Year Highway or Transportation Improvement Program.

(10) "Preliminary Design" means an engineering design which specifies in detail the location and alignment of a planned transportation facility or improvement.

(11) "Refinement Plan" means an amendment to the transportation system plan, which resolves, at a systems level, determinations on function, mode or general location which were deferred during transportation system planning because detailed information needed to make those determinations could not reasonably be obtained during that process.

(15) "Transportation system management measures" means techniques for increasing the efficiency, safety, capacity or level of service of a transportation facility without increasing its size. Examples include, but are not limited to, traffic signal improvements, traffic control devices including installing medians and parking removal, channelization, access management, ramp metering, and restriping of high occupancy vehicle (HOV) lanes.

(20) "Transportation Project Development" means implementing the transportation system plan (TSP) by determining the precise location, alignment, and preliminary design of improvements included in the TSP based on site-specific engineering and environmental studies.

(22) "Transportation System Plan (TSP)" means a plan for one or more transportation facilities that are planned, developed, operated and maintained in a coordinated manner to supply continuity of movement between modes, and within and between geographic and jurisdictional areas.

(23) "Urban Area" means lands within an urban growth boundary or two or more contiguous urban growth boundaries.

26. OAR 660-12-025(1) and (3)

27. OAR 660-12-045(1)(b)

28. OAR 660-12-045(1)(c)

29. OAR 660-12-060(2)

30. 660-12-060(3)

31. (2) For the purposes of this section, the following definitions apply:

(a) "Access roads" means low volume public or private roads that provide access to property and travel within a built and committed area;

(b) "Local service roads" means collectors and arterials, but does not include state highways of regional or statewide significance;

(c) "Local travel" means travel within a built and committed area and a nearby urban area or rural community;

(d) "State highways of regional or statewide significance" means highways identified in ODOT's Highway Plan as interstate highways, Access Oregon highways, and highways of regional or statewide significance;

(e) "Major road improvement" means a major realignment; addition of travel lanes; and new interchanges and intersections. Major road improvements do not include replacement of an existing intersection with an interchange, the replacement of one or more intersections with another intersection to correct a safety deficiency, or the creation of an intersection for a log haul road;

(f) "Major realignment" means a realignment where the center line of the roadway shifts outside of the existing right-of-way for a distance of one half mile or more;

(g) "Realignment" means replacement of an existing road segment where the replaced road segment is either abandoned or is modified to function as an access road. New road segments which do not meet this definition are considered new roads for purposes of this section.

32. (i) Limited left turn refuges;
(ii) Construction or extension of local service roads as otherwise permitted by this section;
(iii) Median barriers; and
(iv) Reconstruction of existing road accesses or purchase of access rights.

33. OAR 660-12-060(6)(f)

34. (a) The facility, service or improvement serves the rural land uses identified in the acknowledged comprehensive plan; and

(b) The facility, service or improvement provides travel capacity and a level of service which is adequate but which does not exceed that required to serve travel needs in the rural area over the planning period. Travel needs in the rural area includes travel that would result from development otherwise anticipated to occur in the rural area consistent with plan policies including those which encourage new development to locate within urban growth boundaries.

35. Taken from 12 Government Perspectives #1, 1991 *State Agency Legislative Coup* 1992, Oregon State Bar

36. 45 Op. Atty Gen 98 (1986)

37. OAR 731-15-005

38. SAC 5-1

39. Frequently access actions have drainage related issues and the SAC also provides that the ODOT is interested in land use actions adjacent to highways that will significantly change the quantity or rate of runoff discharge to state ditches and drainage structures, or that may block a drainage way that conveys runoff from state drainage systems.

40. SAC 5-1

41. (1) "Accessory Facility" means a facility which assists the ODOT in administering, managing, maintaining and operating a transportation facility. Examples include office buildings, weigh stations, maintenance yards, equipment repair shops and quarries.

(2) "Affected city or county" means a city or county that has comprehensive planning authority over a site or area which is directly impacted by a proposed Commission or ODOT action.

(3) "Affected state and federal agencies" means state and federal agencies identified in the ODOT"s state agency coordination program.

(4) "Class 1 Projects" means projects meeting federal criteria for Class 1 Projects under the National Environmental Policy Act (NEPA) and federal agency regulations which carry out NEPA requirements.

(5) "Class 2 Projects" means projects meeting federal criteria for Class 2 Projects under NEPA and federal agency regulations which carry out NEPA requirements.

(6) "Class 3 Projects" means projects meeting federal criteria for Class 3 Projects under NEPA and federal agency regulations which carry out NEPA requirements.

(7) "Commission" means the Transportation Commission.

(8) "ODOT" means the ODOT of Transportation.

(9) "DLCD" means the ODOT of Land Conservation and Development.

(10) "Facility Plan" means a plan for a transportation facility such as a highway corridor plan and an airport master plan.

(11) "Metropolitan Planning Organization" means the organization designated by the Governor to coordinate transportation planning in an urbanized area of the state.

(12) "Modal Systems Plan" means a plan for a statewide system of one or more transportation modes that includes identification of system needs, classification of facilities, and establishment of policies.

(13) "New Transportation Facility" means a transportation facility that does not currently exist. It does not mean the realignment or expansion of an existing transportation facility.

(14) "Transportation Facility" means a facility and all of its parts which are used for conveying and managing the transportation of people and goods. It includes all associated structures and alterations that are necessary to protect public safety and mitigate the environmental effects of a transportation facility.

(15) "Transportation Policy Plan" means the policy plan for the state transportation system encompassing all modes of transportation.

42. OAR 731-15-025

43. SAC at 5-5

44. OAR 731-15-075(3)

45. OAR 731-15-055(1), OAR 731-15-065(1), OAR 731-15-075(1)

46. SAC at 5-5

47. SAC at 5-5

48. SAC at 5-6

49. SAC at 5-6 through 5-8

50. OAR 731-15-065(2)

51. OAR 731-15-065(3)

52. OAR 731-15-065(3)(b)

53. OAR 731-15-055(4) Final Modal System Plans and OAR 731-15-065(4) Final facility Plans

54. OAR 731-15-055(5) Modal Plans, OAR 731-15-065(6) Facility Plans

55. OAR 731-15-055(6) and OAR 731-15-065(7)

56. 731-15-075(3)

57. OAR 731-15-075(4)

58. OAR 731-15-075(5)

59. OAR 731-15-075(6)

60. OAR 731-15-085(2)

61. OAR 731-15-085(3)

62. OAR 731-15-085(4) and (5)

ACCESS MANAGEMENT IN FLORIDA

William E. Frawley, AICP
Texas Transportation Institute

ABSTRACT

Several years ago, the State of Florida realized the importance of managing access from private property to the State Highway System and began drafting legislation to govern access management. In 1988 access management legislation was adopted, Florida Statutes 335.18 and Administrative Rules 14-96 and 14-97. The State is currently in the process of updating these guidelines.

Several factors have been considered important to the success of the program. Public participation was incorporated into the process from the begining, during the creation of the standards. Input from the general public and involved property owners continues to be sought as the standards are revised and during the routine operation of the program. Another important element of the program is the access classification system. This system is similar in nature to the traditional functional classification and requires that each segment of every state highway be assigned a classification based on several factors. Florida's access management program is decentralized, with the usual operations of processing access permit applications being handled through Florida Department of Transportation Maintenance Offices around the state. With the goals of improving capacity and reducing accident rates on the state highway system, a successful access management program is beneficial to all travellers using the highway network.

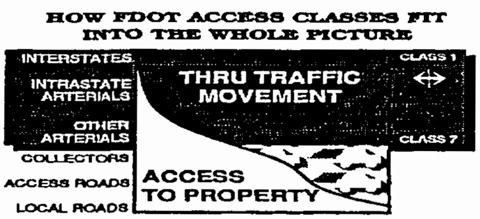
This paper discusses elements of the access management program in Florida. A brief history of the program is presented explaining the background of its development, as well as the goals of the program. Next, the Flordia Department of Transportation's administrative rules are outlined, which encompass the permit process, the standards, and enforcement flexibility. The paper also discusses obstacles to implementation of the access management program and the role of public involvement is briefly explained. Finally, the paper presents an example of access management being included in the design of a highway improvement.

INTRODUCTION

The purpose of this paper is to provide a brief overview of the structure of Florida's access management program and explain some of the associated regulations and procedures. The paper begins with a synopsis of the history of Florida's access management legislation and administrative rules. Following is a presentation of some of the goals which the Florida Department of Transportation established for the access management program. The next sections discuss the specifics of the administrative rules in greater detail and are followed by an examination of the flexibility of those rules. The public involvement process is presented in the next section of the paper, as well as being discussed briefly as it applies to the various subjects of other sections the paper. Examples of continuous implementation of access management are reviewed next. The conclusion of the paper summarizes the high points of Florida's access management program.

Throughout the discussion of access management, it is important to keep in mind that private driveway connections to public roads constitute intersections, just as do the connections of two public roads. Therefore, the regulations treat private driveway connections the same as public road intersections.

A brief review of the access/mobility diagram from functional classification of road networks shows that mobility is the primary function of the range of roads classified as arterials through freeways. Therefore, it is this group of roads which are the subject of access management practices on Florida's State Highway System (see Fig. 1).



Source: Florida Department of Transportation.

Figure 1

HISTORY

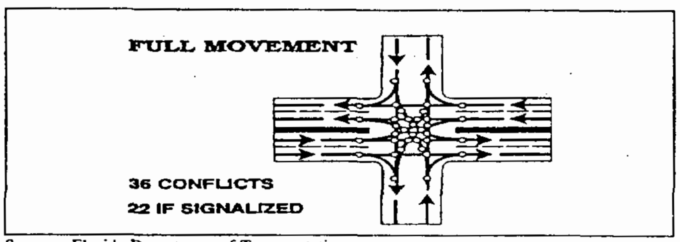
Several years ago, the State of Florida realized the importance of managing access from private property to the State Highway System and began drafting legislation to govern access management. As a result, in 1988 Florida Statutes 335.18 was enacted. Dubbed "The Access Management Act," this adopted legislation gives the program and its regulations an important legal foundation.

As mandated by this act, the Florida Department of Transportation (FDOT) adopted Administrative Rules, 14-96 and 14-97. The administrative rules provide standards, regulations, and an access management classification system, as well as a driveway connection permitting process (1).

A variety of sources were utilized during the creation of Florida's access management legislation and administrative rules. Previous research performed by the Institute of Transportation Engineers and the U.S. Department of Transportation was paramount in determining the standards for the program. Such research also helped provide an understanding of how comprehensive an access management program needs to be. Practical experience from the State of Colorado served as a real world example of an access management program being implemented. Successes, as well as problems, encountered in Colorado were taken into consideration during Florida's rule making process. The legal and right-of-way staffs of FDOT were heavily involved in the development of the legislation and standards. Additionally, FDOT conducted public hearings in order to gain valuable input from the general public (2).

GOALS

In order to keep the access management program focused through the developmental stages, FDOT established several goals for the program. One of these goals is to limit the number of conflict points through which drivers must pass at an intersection. Conflict points are the points at which vehicles' paths cross while maneuvering through an intersection. As seen in Figure 2, a typical four-leg intersection has as many as 36 conflict points if unsignalized, and 22 if signalized. Because a driver can only handle one conflict at a time, a related goal is to separate the remaining conflict points which cannot be eliminated.



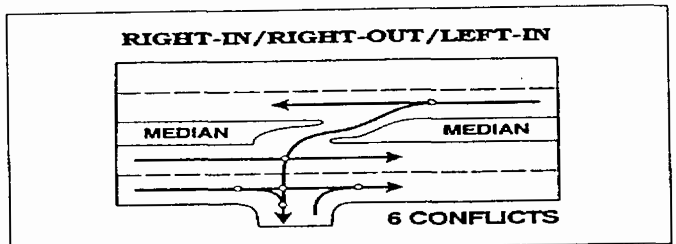
Source: Florida Department of Transportation.

Figure 2

There are several techniques which are used to separate conflict points, including the following:

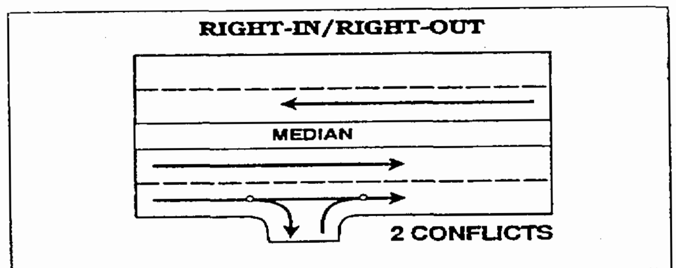
- Driveway Separation Standards
- Corner Clearance Standards
- Median Opening Standards
- Signal Spacing Standards.

By designing intersections with only three legs and restricted turning movements, the number of conflict points can be reduced to six (see Fig. 3). If an intersection has only right-in and right-out movements allowed, only two conflict points will exist.



Source: Florida Department of Transportation.

Figure 3



Source: Florida Department of Transportation.

Figure 4.

Another goal of the access management program is to remove turning volumes and queues from through movements on the roadways. A variety of design techniques, which if incorporated into developments and roadway construction, will help attain this goal. Examples of these techniques are:

- Turn Radii/Driveway Flare
- Driveway Width
- *Turn Lanes/Tapers*
- Internal Site Design.

Research utilized by FDOT shows that the design of features such as turn lanes and driveway approaches can be a major component of access management. For example, by increasing the turning radius and/or the driveway width, greater speeds are possible while completing the turns. Therefore, the turning vehicle can get out of the traffic stream quicker, which reduces the interruption to the flow of traffic on the street.

Of course, the reason to implement any rules or guidelines is for the benefit of the general public. Florida has recognized that there are a variety of benefits which can be realized from a successful access management program. Some of the benefits which the State lists when selling the program to the public are (1) operational, in that delay time in traffic is reduced; (2) environmental, because of improved fuel economy and reduced emissions; and (3) safety, with fewer and less severe accidents occurring (3).

RULE 14-96 - THE "PERMITS" RULE

As stated earlier, Florida's access management legislation set forth the establishment of two FDOT administrative rules. Rule 14-96, known as the "permits" rule, covers the following topics:

- Applications & Permits Procedure
- Closing & Redesigning Existing Driveways
- Local Government Coordination on Permits
- Traffic Study Requirements
- Non-Conforming Driveways
- Performance Bond Requirements

Florida's access permit process can best be described as decentralized. The permit process begins and ends at 30 FDOT Maintenance Offices located around the state. An applicant submits the application to the Maintenance Office for that area. An application fee is required at the time of submittal and ranges from $50 for simple requests to $5,000 for the largest developments. The Maintenance Office simultaneously sends a copy of the application to the District Office and begins its own review. The District Office conducts a review of the application and sends a report back to the Maintenance Office. This report will communicate an approval or disapproval of applications and may include suggested modifications. The Maintenance Office incorporates the District's report into its own review and is responsible for granting final approval or denial of the application. If the application is given final approval, construction of necessary improvements are inspected by the Maintenance Office to ensure compliance with the approved plans (4).

Permits are required for new developments which involve any driveway intersecting the State Highway system. Cooperation with local governments is very important in this aspect of access management. FDOT is working very hard to establish cooperative efforts with local governments in the creation of access ordinances and review processes. Permits are also required if expanded developments or significant land use changes require additional or modified access points (2).

RULE 14-97 - THE "STANDARDS" RULE

For its ruling purposes, Florida has defined access management as "the practice of managing the locations, number and spacing of connections, median openings, and traffic signals on the highway system." Administrative Rule 14-97 established the access management classification system, as well as the classification procedures and criteria.

Florida's program is based on its Access Management Classification System. Every section of road on the State Highway System is classified according to certain criteria. Some roads have various classifications along their paths due to changing characteristics, such as cross sections and adjacent land uses. Establishing the classification system and assigning a classification to each section of road involves a long and in-depth process. The final classification system is scheduled to be completed and implemented in 1993.

In order to implement access management practices in the mean time, interim standards were created and assigned while the final standards were being drafted and approved. The interim standards were based on posted speed limits. Figure 5 shows that roads were divided into three speed limit groups and a fourth "special case" group which is based on the average number of connections to the road per mile. The interim standards regulate the spacing of three basic types of access to the roads - driveway connections, median openings (full and directional) and traffic signals.

Final access classification standards were developed in a similar manner to traditional functional classification. There are seven access classifications for the State Highway System. Classification 1 includes the Interstate highways and all freeways. Therefore, it is primarily concerned with interchange spacing, as seen in Figure 6. This classification is divided into four area types ranging from central business districts (CBD) to rural areas. The interchange spacing requirements vary according to the density of surrounding development, from one mile in the CBDs to six miles in rural areas.

The remaining roads on the State Highway System are divided into six classifications, depending on their median types and the existence of service (frontage) roads. A classification of 2 indicates that the highway has service roads and restrictive medians, which physically prevent vehicles from crossing. Classifications 3 and 4 are assigned to roads which traverse undeveloped or recently developing land. The regulations for these classifications are basically the same, except with regard to median openings. Similarly, Classifications 5 and 6 encompass roads located in areas

Posted Speed (mph)	Connection Spacing (feet)	Median Opening Spacing		Signal Spacing
		Directional	Full	
35 or less Special Case	125	330	660	1320
35 or less	245	660	1320	1320
36-45	440	660	1320	1320
Over 45	660	1320	2640	1320

"Directional" Median openings only allow specific movements, such as left turns or "U" turns
"Full" Median openings allow all turning movements
Source: Florida Department of Transportation.

Figure 5. Interim Standards

Access Class	Area Type	Segment Location	Interchange Spacing Standard
1	Area Type 1	CBD & CBD Fringe for cities in Urbanized Areas	1 MILE
	Area Type 2	Existing Urbanized Areas other than Area Type 1	2 MILES
	Area Type 3	Transitioning Urbanized Areas and Urban Areas Other than Area Type 1 or 2	3 MILES
	Area Type 4	Rural Areas	6 MILES

Source: Florida Department of Transportation.

Figure 6. Interchange Spacings

which are generally developed. The lowest standards are in Classification 7, which is assigned to roads abutting urban/suburban strip development.

Every parcel of property abutting the State Highway System, where limited access rights have not been acquired, have a right to reasonable access to the State Highway System. While there is not a universal definition of reasonable access, Rule 14-97 contains the following definition:

The minimum number of connections, direct or indirect, necessary to provide safe ingress and egress to the State Highway System based on the access management classification, projected connection and roadway traffic volume, and type of intensity of the land use.

However, there is no landmark court case regarding reasonable access. Legal decisions have determined that this issue needs to be addressed on a case-by-case basis (3).

FLEXIBILITY

Florida's access management program is based on rules and regulations which must be consistently enforced. However, there are instances when an applicant, due to lot size or other development constraints, cannot meet the standards in Rule 14-97. Florida has recognized that there needs to be a degree of flexibility involved in such cases. It is up to the applicant "to justify and document why their plan better serves the driving public and not just their particular customers." Flexibility is considered in the following types of cases:

- Road improvement projects in built-out areas
- "Reasonable access" would be denied

Access Class	Medians "Restrictive" physically prevent vehicle crossing "Non-Restrictive" allow turns across at any point	Connection Spacing (feet)		Median Opening Spacing		Signal Spacing
		>45mph	<45mph	Directional	Full	
2	Restrictive w/ Service Roads	1320	660	1320	2640	2640
3	Restrictive	660	440	1320	2640	2640
4	Non-Restrictive	660	440			2640
5	Restrictive	440	245	660	2640/1320	2640/ 1320
6	Non-Restrictive	440	245			1320
7	Both Median Types	125		330	660	1320

"Directional" Median openings only allow specific movements, such as left turns or "U" turns
"Full" Median openings allow all turning movements
Source: Florida Department of Transportation.

Figure 7. Arterial Classifications and Standards.

- Proposed connection would carry less than five trips (2-way) in the peak hour
- Standards are very close to being met
- Applicant's property is located on a Class 7 corridor
- Applicant can prove an alternative plan is better for the driving public.

Under extraordinary circumstances, FDOT may require distances between driveways or intersections greater than what the standards mandate. In these cases FDOT must justify the additional requirements by documenting specific traffic engineering concerns (1).

IMPLEMENTATION OBSTACLES

Access management can be a very effective tool in transportation planning and engineering. Once in a while, there are conditions, such as land development patterns and ordinances, which can make implementation of access management very difficult.

There are some areas of Florida, especially in the southwest part of the state, which have an extraordinary number of vacant platted lots. This phenomenon can be traced back to period of time from the 1950's through the 1970's when land development companies would purchase massive areas of land and then plat the land into thousands of lots at a time. These lots were then sold in checkerboard patterns to people all over the country and around the world. For instance, in Charlotte County, which has a population of about 115,000, there are more than 250,000 platted lots, most of which are undeveloped. The majority of these lots are slightly less than a quarter-acre in size and intended for residential development. However, there is also a large number of even smaller 50-foot wide lots zoned for commercial development which abut State and County highways. Therefore, the potential exists to have driveways every 50 feet because every lot has a right of reasonable access to the abutting road.

In some cases the possibility of such frequent driveways is avoided because a single owner may hold two or more adjacent lots. In many of those cases, shared access among the lots is easy to accomplish. Shared access is also possible when adjoining property owners develop their lots cooperatively. However, shared access is not always attainable due to the frequency of absentee ownership and single-lot ownership, as well as an unwillingness to allow cross-access. It has been suggested at the local level that the efforts should be made to encourage consolidation of such lots and replatting of the land, but in many cases several of the owners cannot be located. It is important for local governments to learn from this situation and realize the impacts that land development practices can have on the transportation network.

Another impedance to access management arises from local ordinances. One such ordinance prohibits access to commercial property from the streets classified as local when a collector or arterial also abuts the property. Usually this type of regulation is an attempt to keep traffic out of residential neighborhoods, but does not give consideration to the fact that driveway connections to a major road could be eliminated if local street access is permitted. Education and cooperation between state and local governments can prevent these situations.

PUBLIC INVOLVEMENT

Public participation has played a crucial role throughout the process of establishing and implementing Florida's access management program. During the creation of the standards and the assignment of those standards to the State Highway System public involvement was facilitated through a series of public workshops and hearings conducted around the state. Input was received from local governments, property owners and interested citizens and groups. All public hearings were advertised ten days prior to each hearing in newspapers of general circulation serving the areas where the hearings were to be held. The final classifications are also published in newspapers.

Private or public entities may request that the access classification for any section of a State Highway be changed. In such cases, affected local governments and adjacent property owners and occupants are notified so their input may be considered in the process of determining whether or not the proposed change is approved (2).

Several booklets have been published and distributed by FDOT in order to give developers, property owners, local governments and the general public a better understanding of the access management program. These booklets vary in subject coverage and technical detail from a site planning development guide to a general question and answer edition. This literature has been very important in providing a better understanding of Florida's access management program to the public.

CONTINUING IMPLEMENTATION

Florida is continually implementing access management practices on new roads, as well as on existing roads when they undergo improvements. One example of retrofitting an existing road to the access classification standards is found on a 10-mile segment of U.S. Highway 41 in Charlotte County. This section of U.S. 41 is a four-lane divided facility with a non-traversable median. There are frequent median openings varying in size and turn-restriction along this route. Quite often these median openings are used as havens by drivers who are attempting to cross the highway, make a left turn or make a U-turn. At some intersections the median openings are wide enough for several vehicles to line up abreast waiting for a gap in the traffic. Because some drivers are more courageous or more impatient than others, the vehicles do not always enter the flow of traffic in the order that they entered the median opening. Several accidents and many more close calls may be attributable to these circumstances.

U.S. 41 is currently being improved through this corridor to a six-lane divided highway by FDOT. Access management played a primary role in the design of the highway's new cross-section as the median was re-worked for its entire length. Numerous median openings were closed and others were modified to allow only channelized, restricted movements. One common alteration involved completely closing existing full median openings, effectively creating two opposing 3-leg intersections where there was previously a functional 4-leg intersection. In cases where completely closing the median openings was not feasible, restrictive left-turn channels were installed to allow left turns into properties but not left turns out of those parcels. The U.S. 41 project also included the removal of one traffic signal and the installation of another signal for spacing purposes.

CONCLUSION

Florida has emerged as one of the leaders in the statewide access management movement. By adopting legislation requiring the establishment of access management rules and procedures, the State has a legal foundation for its program. Through its two administrative rules, the Florida Department of Transportation has the power to create and enforce the program through a permitting process and the access management classification system. The public has been involved throughout the procedure by means of public hearings and workshops and the public continues to be involved as the program evolves. The State has begun to establish cooperative efforts regarding access management ordinances and development regulations with local governments in order to preserve the mobility function of the State Highway System and the integrity of the access management classifications.

REFERENCES

1. Florida Department of Transportation. *Use of the Access Management Standards.*

2. Florida Department of Transportation. *Access Management on the State Highway System -Most Commonly Asked Questions.*

3. Florida Department of Transportation. *Access Management - An Important Traffic Management Strategy.*

4. Wes Mallard, District One, Florida Department of Transportation. Telephone interview to obtain information on access management permitting process.

Session 4T

Engineering Issues II

Moderated by Vergil Stover, Texas Transportation Institute

This was the second of two technical sessions which focused on engineering issues related to access management. Three speakers gave presentations on issues concerning the provision of turn lanes on two lane roads, access to shopping centers, and new design and operations guidelines for providing access.

The first speaker was Salvatore Bellomo, Principal of Bellomo-McGee, Inc. in Tysons Corner, VA. In his paper, "New Planning, Design, and Operations Guidelines for Providing Access to Transportation Systems," he presented an overview of a recent Federal Highway Administration project to update the current access management training guide. The paper highlights information to assist in project evaluation of the benefits and costs of access alternatives incorporating planning, operations, and design considerations.

The next speaker was Bud Koepke of the Metro Transportation Group, Inc. His paper, entitled "Guidelines for Turn Lanes on Two Lane Roadways," presents some guidelines for determining the need for turn lanes, selecting an appropriate design, and evaluating their effectiveness. He discusses the relative benefits of turn lanes and their impacts on capacity, delay, and safety. He also includes a discussion of the costs and cost effectiveness of providing turn lanes.

The final speaker was Herb Levinson who presented a paper entitled, "Retrofitting Shopping Centers: Concepts and Case Studies." In it he discusses methods for redesigning access to shopping centers which are deficient in design, safety, and storage capacity. The paper describes some of the traffic problems encountered in older shopping centers, suggests traffic design principles, and contains case studies of retrofit projects.

This session was attended by approximately 75 people. Questions and answers for the speakers are summarized in the discussion section for Sessions 3T, 4T, and 5T.

NEW PLANNING, DESIGN AND OPERATIONS GUIDELINES FOR ACCESS TO TRANSPORTATION SYSTEMS

Salvatore J. Bellomo
Bellomo-McGee, Inc.

ABSTRACT
This paper summarizes findings on the project "Providing New Access to Transportation Systems" undertaken for the Federal Highway Administration by Dr. Bellomo of Bellomo-McGee, Inc. (BMI). The paper highlights information to assist in project evaluation of the benefits and costs of access alternatives incorporating planning, operations, and design considerations.

The paper presents a summary of guidance to:

- Select the most appropriate access techniques for site access given the characteristics of the site and surrounding area.
- Assess the impact of new sites on the transportation system.
- Evaluating alternative functional plans for providing access to those sites.

The information and guidance in this paper updates to 1982 FHWA Publication entitled "Access Management for Streets and Highways". The paper supports state and local programs to better manage access on the street and highway system under their administrative control.

INTRODUCTION

The Intermodal Surface Transportation Efficiency Act of 1991 and the Clean Air Act Amendments of 1991 pose new challenges to the transportation engineering and planning community. There will be a need to think more comprehensively about the construction of new transportation facilities and the improvements to existing facilities. How we control and manage access to adjacent land uses along these facilities is an important element in the decision process and in congestion management systems. Many States and localities are appreciating the benefits of implementing and maintaining good access control particularly in newly developed areas. Access improvements are also being realized in areas of existing land use through retrofit actions.

In 1982, FHWA published a report entitled "Access Management for Streets and Highways" which offered the state-of-the-practice in access management at the time and which, also, identified a variety of access management techniques and provided guidance for their application. Since 1982, significant activity in the area of access management has taken place. Research has been performed, case studies and demonstration projects have been documented and most importantly a number of States and localities have embarked on comprehensive efforts to regulate access location, design and control through access management programs.

In support of access management programs, this paper presents an overview of planning, design and operations guidelines for new access to transportation systems prepared as part of a comprehensive report for the Federal Highway Administration (Ref 1). The paper highlights the process for access plan development, discusses the process and factors for access alternatives development including an illustrative example, presents evaluation methods, and illustrates application results.

PROCESS FOR ACCESS PLAN DEVELOPMENT

Exhibit 1 presents a process for access plan development. The process is interactive and broken into four parts. Part I is the driving force of the process and consists of goals and objectives, access management legislation, and the access management program. Part II represents a range of access techniques that can be used for providing new access or retrofits to existing access. These techniques are further discussed in Section 3 of this paper. Part III presents guidelines for development of access alternatives considering site and surrounding area characteristics, application guidelines and design guidelines. This new guidance provides information for state and local engineers/planners that can be used to develop alternatives for accommodation of new development or a retrofitting of existing or revitalized land uses. The material allows potential users of the document to develop a range of alternatives subject to further assessment and refinement. Part IV contains guidelines for impact assessment including methods for evaluating traffic and level of service, safety, design features, user costs, non-user considerations, project costs, and total costs. With respect to impact assessment, methods are referenced that can be used to assess the cost and effects of the alternatives. The new guidance notes whether manual or computer based procedures can be utilized in the assessment and evaluation of the various alternatives. Research in progress is also noted so that users of the document can keep up with new and emerging changes to access management assessment and plan development. This is highlighted in Section 4 of this paper. Part V illustrates the general format application results to provide decision makers with the costs and effects of the access alternatives with provision of a feedback loop to Park III as necessary. Section 5 presents further amplification of this part of the process through an illustration.

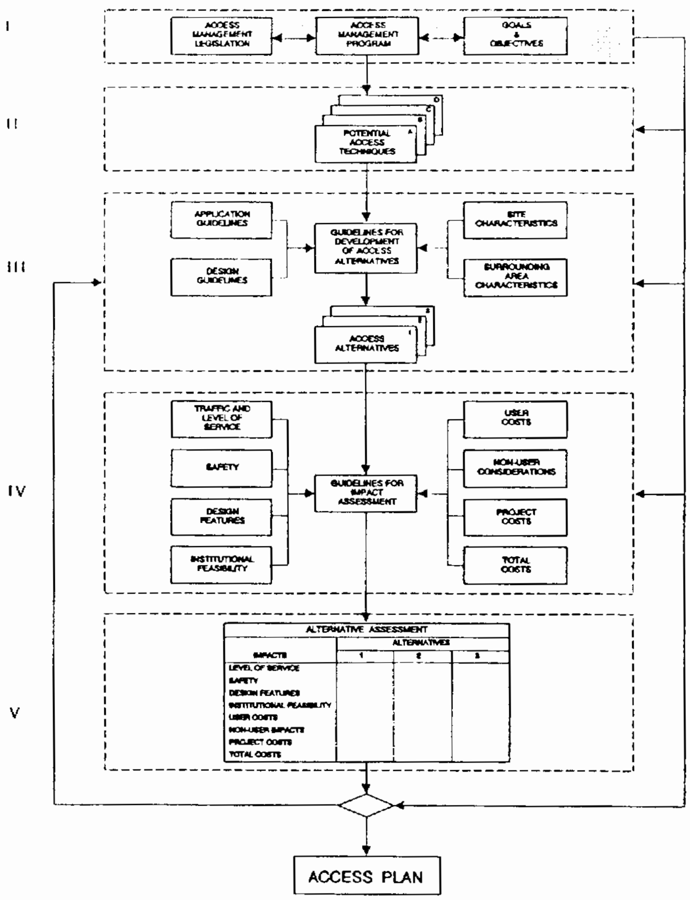


Figure 1. Process for Access Plan Development

DEVELOPING ACCESS ALTERNATIVES

The access plan development selection process shown in Exhibit 1 is general and can be applied to a wide range of situations from simple to more complex projects. Exhibit 2 highlights the parameters for defining the differing project situations from simple to complex situations. What is unique is that while the process is generally the same, the area to be considered and technical evaluation methods can be adopted to accommodate simple driveway access applications to more complex multimodal and intense land use applications in the development of access plans.

A wide range of techniques for access techniques were considered for incorporation into the new guidance material. The previous guidance presented about 66 techniques for access management oriented to physical treatments aimed at increasing capacity while considering

INFLUENCING FACTORS	LEVEL OF COMPLEXITY		
	SIMPLE	MODERATELY COMPLEX	COMPLEX
FUNCTIONAL CLASSIFICATION:			
Freeway	Rural	Urban	Urban
Expressway	Rural	Urban	Urban
Major Arterial	Rural	Urban/Rural	Urban
Minor Arterial	Rural	Urban/Rural	Urban
Collector	Urban/Rural	Urban	Urban
Local	Urban/Rural	Urban	Urban
SITE LAND USE:			
Residential*	275 DU at <5 DU/Acre	275-1000 DU at 5-20 DU/Acre	>1000 DU at >20 DU/Acre
Retail*	<25,000 ft²	25,000-200,000 ft²	>200,000 ft²
Office*	<175,000 ft²	175,000-900,000 ft²	>900,000 ft²
Industrial*	<300,000 ft²	300,000-1,000,000 ft²	>1,000,000 ft²
Regional Mall	N/A	<300,000 ft²	>300,000 ft²
Mixed Use	<200,000 ft²	200,000-1,000,000 ft²	>1,000,000 ft²
TRANSPORTATION MODES ACCOMMODATED	Walk Bicycle Auto	Walk Bicycle Auto Paratransit Bus	Walk Bicycle Auto Paratransit Bus Rail
DIRECTIONAL PEAK HOUR TRIP GENERATION	<275 vph	275-1,000 vph	>1,000 vph
ADJACENT STREET FRICTION:			
Driveways/mile	>30	30-60	>60
Signals/mile	≤2	3	≥4
Friction Ratio	<15%	15-30%	>30%

Exhibit 2. Factors Influencing Level of Complexity

safety. The improved techniques broaden the treatments to assist local and state planners in a number of ways including techniques which consider:

- Transportation demand management (TDM) of site traffic demand so as to reduce the single occupant vehicle (SOV) trip making in the peak hour and reduce overall vehicle miles of travel (VMT).
- Access in a multimodal context including provision for mass transit, pedestrian/bicycle/trail accommodations, and high occupancy vehicles (HOV).
- parking management issues related to onsite and offsite areas.
- Improvement of traffic flow and traffic safety including accident exposures.
- Reduction of user and non-user costs including business effects.

- Environmental effects including those related to air pollution, sound levels, visual quality, drainage, etc.

- Flexibility for incorporating flyovers and newer access solutions.

- Flexibility to accommodate new and emerging technologies such as those related to IVHS. Access management plans will need to be flexible to consider such new technologies. For ease of use, the specific management techniques have been grouped on a preliminary basis into four categories (A through D).

A. Management Elements
This covers 10 techniques for state policies, plans, programs, land use/zoning, TSM, TDM, TCM, provision for advanced technologies, etc. These are the basic local and state guidance tools and policies needed at the inception of the development of a site access management plan and are the "givens" for a specific assessment and evaluation.

B. Facility Design Elements
About 26 techniques for this covers new offsite construction (such as bypass facilities, flyovers, local service roads, reverse frontage roads, etc.). cross section/operation features (such as accommodations for left turns, right turns, median treatments, etc.), and surface mass transit (bus, light rail), pedestrian/bicycle accommodations.

C. Access/Driveway Design Elements
This includes about 8 techniques related to access spacing, process for adequate sight distance/corner clearance, and other techniques to reduce vehicle, pedestrian, bicycle, and other potential conflicts.

D. Traffic/Parking Elements
This includes over 10 techniques aimed at operational controls for traffic (including surface transit) and parking. The techniques are aimed at improving traffic flow, increasing capacity, and improving traffic safety.

On a preliminary basis about 54 techniques are in the new guidance document effecting a consolidation/refinement of techniques in the 1982 document and additional techniques in response to recent legislation and changes/new ideas emerging from the professional transportation community.

Each of the 54 access techniques was described using the format shown in Exhibit 3. As shown each technique is described in terms of its objectives, application guidelines, and design guidelines. A conceptual diagram is included to complement the text description where applicable. The objectives of the techniques are generally related to safety, improved traffic flow and/or access to land development. The application guidelines address a wide range of site and surrounding area characteristics. The friction ratio is introduced to provide a measure of the anticipated impact of a particular access location in terms of its generated traffic. A high friction ratio (> 30 %)), for example, is indicative of a development that will be generating high levels of traffic relative to the traffic on the adjacent facility. Design guidelines for the techniques are provided through references to the publications listed in the References. Design guidelines and specifications for many of the techniques can be found in AASHTO publications (Ref 2, 3, 4), the MUTCD (Ref 5), or in State and local manuals. In many cases, there could be a number of design alternatives available to the practitioner, who must implement a specific design alternative based on experience and local standards.

OBJECTIVES:	DESCRIPTION:

APPLICATION GUIDELINES:

	Area Type		Functional Classification (Adjacent Facility)		Site Land Use		Typical Section (Adjacent Facility)		Modal Accommodation
	Urban,CBD		Freeway		Regional Mall		Divided-2 lanes		Auto/Truck
	Urban, non-CBD		Expressway		Retail		Divided-4 lanes		Bus
	Activity Center		Major Arterial		Office		Divided-6+ lanes		Rail
	Suburban		Minor Arterial		Industrial		Undivided-2 lanes		Paratransit
	Exurban		Collector		Residential		Undivided-4 lanes		Bicycle
	Rural		Local		Mixed Use		Undivided-5+ lanes		Pedestrian

Design Speed-Adjacent Facility		ADT-Adjacent Facility		
Operating Speed-Adjacent Facility		DHV_1-Adjacent Facility		
Driveways/mile-Adjacent Facility		DHV_2-Site Development		
Signals/mile-Adjacent Facility		Friction Ratio(DHV_2/DHV_1+DHV_2)		

DESIGN GUIDELINES:

	AASHTO		MUTCD		State/LOCAL STANDARDS

Exhibit 3. Technique Description Format

To illustrate the guidance material results for Part II (Guidelines for Development of Access Alternatives), a moderately complex situation is presented in terms of alternatives and related access techniques. The context for this example is as follows. The area is suburban, near a transit station, and surrounded by commercial and high density residential. The adjacent facility is a collector with three signals per mile and 30 driveways per mile. The local government, the State, and the transit agency desire to have the collector operate at a high level of service to facilitate transit patron arrivals and departures. The techniques for this example were selected from the four (4) groups previously discussed. The alternatives were developed using screening criteria, and other guidance presented in the comprehensive report (Ref. 1). Exhibit 4 presents two alternatives for provision of site access. Exhibit 5 presents for Access Plan 2 related access techniques from the A, B, C, and D groups.

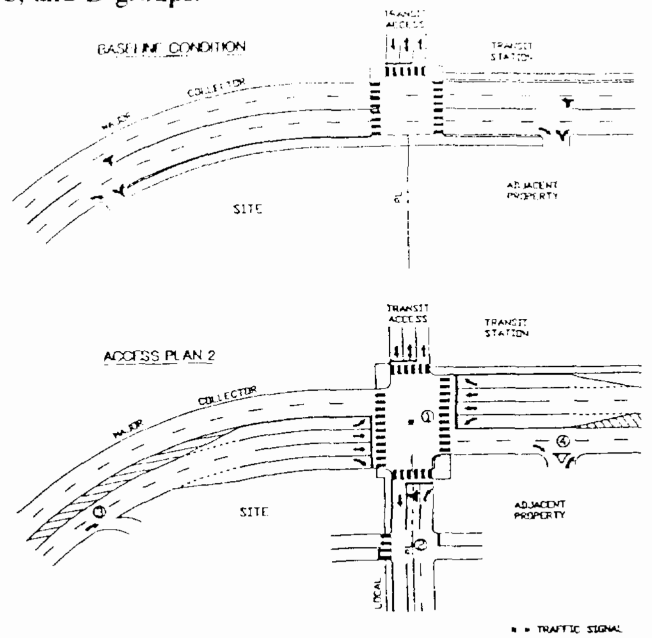
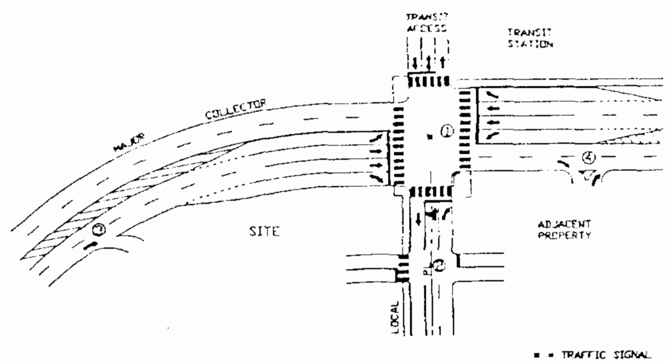


Figure 4. Selected Access Alternatives for Moderately Complex Example



LOCATION	ACCESS TREATMENT	RELATED ACCESS TECHNIQUES
1. Signalized Intersection	Provide for a 3-lane approach leg aligned with transit access and a signalized intersection with full pedestrian accommodation and install turn lanes on the major collector	B-9: Install Right-Turn Deceleration Lane B-15. Install Left-Turn Deceleration Lane B-17. Provide Pedestrian Accommodation B-18 Provide Bicycle Accommodation C-5: Install Additional Exit Lane on Driveway D-5: Locate New Driveway Opposite a Three-Leg Intersection of Existing Driveway and Install Traffic Signals Where Warranted
2. Intersection	Provide an unsignalized intersection to provide access to the adjacent property.	A-9: Consolidate Access and Improve Circulation B-17: Provide Pedestrian Accommodation B-18. Provide Bicycle Accommodation C-2: Control Driveway Design Elements
3. Driveway	Provide for a right turn in access only.	C-1: Control Driveway Spacing C-2: Control Driveway Design Elements C-3: Provide Adequate Access/Driveway Sight Distance D-2. Install One-Way Operations D-10: Prohibit Left-Turn Driveway Maneuvers on Undivided Highway
4. Driveway	Provide for right-turn in and right-turn out.	A-9: Consolidate Access and Improve Circulation B-17: Provide Pedestrian Accommodation B-18. Provide Bicycle Accommodation C-2. Control Driveway Design Elements

Exhibit 5. Access Techniques For Access Plan 2

EVALUATION METHODS

Once alternative site access plans were developed, the next step in the process (Part IV) is to evaluate the alternatives using the appropriate method for the level of complexity involved. Exhibit 6 presents for the various evaluation categories analysis methods correlated to the three levels of complexity (S-Simple, M-Moderately Complex, and C-Complex). Shown are nine (9) evaluation categories including traffic, level of service, design features, policy considerations, user costs, non-user considerations, project costs, and economic analysis. Correlated with each of these categories are various assessment methods documented in the literature or in practice. The comprehensive report contains a detailed description of each evaluation method including a description of the manual or computerized procedures and more detailed references.

EVALUATION CATEGORY	COMPLEXITY LEVEL	METHODS
1. Traffic Projections	S,M	Trend/Growth Analysis
	S,M	Trip Generation Analysis
	C	Four-Step Modelling Process
	S,M,C	NCHRP 255 Procedures
2. Level of Service	S,M	Critical Movement Analysis
	S,M,C	1985 HCM Procedures
	M,C	TRANSYT-7F
	C	TRAF-NETSIM
3. Safety	S	Conflict Point Inventory
	S,M	Weighted Conflict Point Analysis
	M,C	Accident Rate Analysis
4. Design Features	S,M,C	Design Consistency/Continuity Analysis
5. Policy Considerations	S,M,C	Conformity to State/Local Policy and Zoning
	S,M,C	Funding Considerations
6. User Costs	S	Conflicts/Construction Cost Analysis
	M,C	Accident Cost Analysis
	M,C	Travel Time Cost Analysis
7. Non-User Considerations	S,M,C	Fiscal Impact Analysis Economic Impact Analysis Social Impact Analysis
	M,C	Environmental Impact Analysis
8. Project Costs	S,M,C	Unit Cost Analysis Present Worth of Costs Method
9. Economic Analysis	S,M,C	Cost Effectiveness Analysis
	S,M,C	Benefit/Cost Analysis

Exhibit 6. Evaluation Methods

In presenting the evaluation methods it was recognized that through research and practice the analysis methods are being refined and improved. Rather than being prescriptive, the user can select the most appropriate method(s) for the case at hand and incorporate improvements as the state-of-the-art is improved. Also, the guidance is flexible with respect to absolute criteria or standards recognizing the State or local access management programs may vary in this regard throughout the United States. For example, local governments to encourage a particular land development pattern may prescribe varying level of service levels to areas and functional systems as part of an Adequate Public Facilities Ordinance or a state may do it by area and functional road classification.

APPLICATIONS

The bottom line of the process is an evaluation matrix comparing the various alternative access plans so that a selection or further refinement can be made. The report presents illustrative applications for three hypothetical case studies from simple to complex situations. Each case study is described in terms of the site and surrounding area characteristics, potential access alternatives, suggested methods to compare and evaluate the access alternatives, a matrix evaluation, and a summary of lessons learned.

To illustrate the format of the results in Part V of the process Exhibit 7 was prepared. This exhibit presents the evaluation of the moderately complex example. As indicated Alternative A-2 appears to be the most beneficial. It has the highest level of service, is institutionally feasible, has the lowest user costs, and has positive business effects. Most importantly it enhances pedestrian and vehicular access to the transit property, which was a key policy consideration. This particular application illustrates the importance of considering local concerns and developing alternatives to address more concerns while carrying out state policies on preserving the operation while providing for transit and pedestrian access to a transit property. The solution works well when there is cooperation among the affected private property owners.

CRITERIA	EXISTING	DESIGN YEAR (+2 years)		
		BASELINE (w/Development)	ALTERNATIVE 1	ALTERNATIVE 2
Traffic Projections				
Major Collector	1,700	2,570 vph	2,570 vph	2,570 vph
Local	-	-	570 vph	570 vph
Level of Service*				
1	A	-	D	C
2	-	-	A	A
3	-	F (NB left)	B	A
4	B	B	B	A
Safety (# Conflict Points)*				
1	12	12	16	10
2	-	48	48	48
3	-	12	12	1
4	12	12	12	2
Total	24	84	88	61
Institutional Feasibility	-	-	Feasible	Feasible
User Costs	-	Delay - High Safety - Moderate	Delay - Moderate Safety - Moderate	Delay - Low Safety - High
Non-User Considerations (Business Effects)	-	Adverse	Negligible	Beneficial

\- = not applicable
* = refers to locations identified in figures 15 and 16.

Moderately Complex Sample Evaluation

In summary, the new FHWA guidance material provides information useful to planners, engineers, operators, and administrators who must process access plans for site development(s) and meet state and local goals and objectives aimed at reducing congestion, improving safety, and addressing environmental concerns, and improving the quality of life in a cost effective manner.

REFERENCES

1. Bellomo, S.J., et al., "Guidelines for Providing Access to Transportation Systems," Draft, Prepared for Federal Highway Administration, Bellomo-McGee, Inc., Washington, D.C., August 1992

2. American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Streets and Highways*, 1990.

3. American Association of State Highway and Transportation Officials, *Highway Design and Operational Practices Related to Highway Safety,* Second Edition, 1974.

4. American Association of State Highway and Transportation Officials, *Roadside Design Guide,* Task Force for Roadside Safety, 1988.

5. *Manual on Uniform Traffic Control Devices for Highways and Streets,* Federal Highway Administration, 1988 Edition.

6. Flora, J.W., Kieth, K.M., *Access Management for Streets and Highways,* Report No. FHWA-IP-82-3, Federal Highway Administration, June 1982.

GUIDELINES FOR TURN LANES ON TWO-LANE ROADWAYS

Frank J. Koepke
Metro Transportation Group, Inc.

ABSTRACT
Intersections constitute a very small part of rural and urban street/highway systems, yet are implicated in over half of the motor vehicle accidents. Intersection elements which are related to intersection accident rates include geometric layout and traffic controls. This study concentrates on when separate turn lanes should be required and how they should be designed. The purpose of a separate turning lane is to expedite the movement of through traffic, increase intersection capacity, permit the controlled movement of turning traffic, and promote the safety of all traffic. Research that was reviewed for this study provides criteria for providing separate left or right turn lanes at both signalized and unsignalized intersections.

Warrants for providing separate turn lanes or the design details used to construct separate turn lanes are not consistent across the country. Conditions at a specific intersection may warrant the use of dimensions that exceed those in this report. It is also possible that local conditions are so restricted that design values less than desirable must be used to install the only feasible improvement. Although great care should be taken when using below recommended values, it frequently can be more beneficial to install a sub-standard left turn lane than not provide any separate turn lane.

INTRODUCTION

Intersections constitute a very small part of rural and urban street/highway systems, yet are implicated in over half of the motor vehicle accidents. Data from national statistics(') show that the percent of total motor vehicle accidents classified as intersectional has risen in the past 20 years. The rate of urban motor vehicle accidents classified as intersectional have increased 14 percent over the past 2 decades, and for rural areas, an increase of 5 percent.

However, high accident rates at these locations are to be expected. Intersections are concentrated conflict points between vehicles and between vehicles and pedestrians. They generally function at decreasing capacity and level of service as the frequency and severity of their conflicts increase.

Intersection elements which are related to intersection accident rates include geometric layout and traffic controls. Within the category of geometric layout, there are several features which collectively form an intersection's design, such as intersection type, sight distance, number/width of lanes, separate turn lanes and channehzation. This study concentrates on when separate turn lanes should be required and how they should be designed.

WARRANTS

The purpose of a separate turning lane is to expedite the movement of through traffic, increase intersection capacity, permit the controlled movement of turning traffic, and promote the safety of all traffic. This is accomplished by providing lanes that remove turning vehicles from the through-travel lanes.

Although separate turning lanes are frequently required at the intersection of two major streets or highways or at access driveway to major developments, they are not always required at minor local streets or for access to smaller developments. Whether a separate turning lane should be required or not is also a factor of whether the intersection, be it with a street or driveway, is to be signalized or unsignalized.

Research that was reviewed for this study provides criteria for providing separate left or right turn lanes at both signalized and unsignalized intersections.

Signalized **Intersections**

Left- Turn Lanes

The provision of left-turn lanes is essential from both capacity and safety standpoints where left turns would otherwise share the use of a through lane. Shared use of a through lane will dramatically reduce capacity, especially when the left turning vehicle is opposed by high volumes of traffic. One left turn per signal cycle delays 40 percent of the through vehicles in the shared lane; two turns per cycle delays 60 percent[2]. Because of this conflict and delay, rear-end accidents on shared lanes can be severe.

Two sets of guidelines for left-turn lanes are proposed for roadway approaches at signalized intersections. The first situation involves the necessary capacity for an intersectional approach to operate at an acceptable level of service. The second case relates to the need for storing left-turning vehicles on the approach lanes. Only one condition needs to be satisfied as a sufficient criterion for providing a left-turn lane on the intersectional approach under evaluation. These two warrants pertain only to the necessity for a left-turn lane and do not relate to the need for a separate left-turn phase.

The 1985 "Highway Capacity Manual"[3] recommends that an exclusive left-turn lane be provided at signalized intersections under the following conditions:

1. Where space permits use of a separate left-turn lane, it should be considered where peak-hour left-turn volumes exceed 100 vph regardless of opposing traffic volumes. Left-turn lanes may be provided for lower volumes as well, based on state or local practice. (Colorado regulations require that all new access connections provide a separate left-turn lane where the peak-hour turn volume exceeds 12 vph.)

2. Where fully protected left-turn phasing is to be provided, an exclusive left-turn lane should be provided.

3. Where left-turn volumes exceed 300 vph, the "Highway Capacity Manual" recommends that the provision of a double left-turn lane should be considered. (These lanes are essential at access points to major generators to reduce signal time requirements and spillback onto main travel lanes.)

Left-turn lanes also should be provided when delay caused by left-turning vehicles blocking through vehicles would become a problem. When the sum of left-turn and opposing volumes results in unacceptable left-turn delay, the provision of a separate turn lane would not only increase intersection capacity, but would also increase vehicle safety.

An alternate procedure is available for the determination of left-turn capacity on intersectional approaches with two-phase signal operation. A Federal Highway Administration report entitled "Guidelines for Signalized Left Turn Treatments"[4] presents capacity charts that can be used to determine the need for a separate left turn lane. **Figure 1A** can be used to determine the left-turn capacity of a one-lane approach roadway without a separate turn lane that is opposed by a one-lane approach. It can be compared with the values obtained from **Figure 1B** - the capacity of a one-lane approach with a separate left turn lane. If adequate left-turn capacity is not available in terms of the left-turn design hour volume, then a left-turn lane is warranted on that intersectional approach.

The left-turn capacity, as read from the appropriate chart, should be corrected for trucks and buses by the following equation:

$$Q_{lt} - Q_1 (100 - T)$$

where Q_{lt} - adjusted left-turn capacity, vph;
Q_1 - chart left-turn capacity, vph; and
T - left-turn trucks and buses, percent.

Table 1[5] can also be used as an additional warrant for providing a separate left turn lane.

Right-Turn Lanes
Criteria that separates warrants for right-turn lanes by whether the intersection is signalized or unsignalized are difficult to find. Most criteria or guidelines focus on reducing the speed differential between through vehicles and right turning vehicles - primarily at unsignalized intersections. At signalized intersections, the issue usually becomes a capacity consideration.

The 1985 "Highway Capacity Manual" [3] suggests that a separate right-turn lane should be considered when the right-turn volume exceeds 300 vph and the through volume also exceeds 300 vph.

Unsignalized Intersections
Left-Turn Lanes
Several studies have developed criteria for providing separate left-turn lanes at unsignalized intersections. Criteria include cases when the separate lane functions as a deceleration lane and when it becomes a storage lane. **Figure 2** [2] provides warrants for a left-turn deceleration lane, depending on the peak-hour volume on the intersection approach, the peak-hour volume of vehicles turning left, and the roadway operating speed.

AASHTO [6] compares the percent of left-turning vehicles in the advancing volume against the opposing volume. **Table 2** indicates the AASHTO guidelines for traffic volumes where separate left-turn lanes should be considered.

Probably the most frequently used criteria was developed in 1967. Warranting criteria for left-turn lanes at unsignalized intersections have been developed in accordance with the conceptual model proposed by M.D. Marmelink [7] for both two-lane and four-lane roadways. This work is based on a queuing model in which arrival and service rates are assumed to follow negative exponential distributions. Arrival rates are determined by the volumes of left-turning and advancing vehicles and by the time required for a left-turning vehicle to clear the advancing lane. For the approach that is being evaluated for a left-turn lane, "advancing" represents conditions on the leg of a major roadway at the intersection with a minor roadway that is regulated by stop or yield control. Service rates are functions of the traffic volume that directly opposes the left turn and of the time required for the left-turn maneuver.

An Institute of Transportation Engineers (I.T.E.) committee prepared a report [8] that extrapolated the Harmelink model and solved for design speeds from 30 to 60 mph (corresponding speed limits from 25 to 55 mph). Results are presented in **Figures 3** thru **6**. The warranting levels of advancing volumes in vehicles per hour are listed in the figures for various combinations of opposing volumes and percentage of left turns. Wide ranges of these two parameters were selected to cover most design situations. If the actual advancing volume equals or exceeds the designated curve, a left-turn lane is justified to provide an acceptable probability of traffic performance on the approach of the major highway at an unsignalized intersection. The probability levels represent the chances of a left-turning vehicle stopping on the major roadway to wait for an acceptable gap in the opposing traffic and range from 3.00 to 1.00 percent at 0.25 percent intervals for design, speeds from 30 to 70 mph at corresponding intervals of 5 mph.

Another study [9] considers three types of left turn treatment. These included turning radius only, a by-pass lane and a separate left turn lane. Criteria for the three treatments is indicated in **Figure 7**. Although list as a separate type, by-pass lanes are permitted only at "T" intersections. Further, when a by-pass lane is required but cannot be constructed due to operational conflicts, a separate left-turn lane is required.

Accident Record

The safety of the left-turn movement is related to the possibility that left-turning accidents can be reduced by the provision of special turning lanes. An accident guideline for a left-turn lane was developed from research activities that involved accident data collected in Lexington, Kentucky [5]. Traffic mishaps related to left-turning movements were based on the following situations:

1. Left-turn vehicle enters the path of an oncoming vehicle;

2. Rear-end collision results with a vehicle waiting to turn left; and

3. A vehicle passes another vehicle that is stopped for a left-turn maneuver.

For critical accident levels that correspond to a probability of 99.5 percent, the following guidelines relate to the provision of a special left-turn lane on an approach:

1. Unsignalized intersection - four accidents per year, and

2. Signalized intersection - five accidents per year.

In the application of this guideline, traffic accidents at an intersection are categorized by approach in accordance with the specified collision types that involve left-turning vehicles.

Right-Turn Lanes

Right-turn lanes remove the speed differences in the main travel lanes, thereby reducing the frequency and severity of rear-end collisions. They also increase capacity of signalized intersections and may allow more efficient traffic signal phasing.

The Colorado Department of Transportation[10] recommends providing a separate right-turn deceleration lane depending on the highway's single lane volume, the volume of right-turning vehicles, and the posted speed of the highway. **Figure 8** indicates when a separate right-turn lane should be provided. When the design hour volume (DHV) of the single lane highway and the design hour volume of right turns intersect at a point on or above the curve for the posted speed, a separate right-turn lane is required.

The Virginia Department of Transportation [11] also recommends providing a separate right-turn lane, depending on the roadways' single lane volume, the volume of right turning vehicles, and the roadways posted speed limit. The Virginia guidelines vary from those used in Colorado by recommending: (1) a full width turn lane with a taper; (2) a combination of taper and radius; or (3) requiring only a curve radius. **Figure 9** indicates when each design treatment should be used.

DESIGN ELEMENTS

As mentioned previously the turning vehicles either right or left turn, are provided with a separate parallel turn lane, a combination of a taper and curve, or just a curve. **Figure 10** illustrates the various elements of separate lane channelization.

In order to more easily define the various elements of channelization, the following set of definitions have been established:

1. *Approach taper (AT)* is from the point where all approaching traffic begins a lateral shift to the right, to the beginning of the bay taper.

2. *Bay taper (BT)* is from the left edge of the adjacent through-traffic lane to the beginning of the full-width left-turn storage lane.

3. *Departure taper (DT)* is from the point where through traffic beyond the intersection begins a lateral shift to the left, to the point where the

through lane is adjacent and parallel to the center line.

4. *Turn Taper (TT)* is from the edge of pavement where right turning vehicles begins a lateral shift to right in preparation of making the right turn. It ends at the point of curvature of the turn radius which is offset from the through lane by one lane width. It is recommended that the desirable minimum length of the turn taper be 150 feet.

5. *Storage length (SL)* is the distance from the end of the bay taper to the intersection nose or stop line.

6. *Maneuver Distance (MD)* is the distance that permits a turning vehicle to move laterally from the through lane to the separate lane while it is decelerating.

7. *Lane Width (W)* is the width of auxiliary lanes which normally varies between 11 and 12 feet, with a minimum width of 10 feet. However, in low speed urban settings with restricted right-of-way, and where the lanes are only used by passenger cars, a 9-feet wide lane may be used.

8. *Turn Radius (R)* the radius of the edge of pavement to facilitate the turning maneuver should be a minimum of 20 feet for passenger cars and 40 feet for trucks.

With respect to the various tapers, an ITE Committee [11] recommended the following criteria:

Approach taper: The rate of lateral transition of a vehicle approaching a channelized intersection should be the same whether the channelization is achieved by a painted or a curved section. The difference in the two methods should be the location of the point of beginning. If the cross-section is developed with painted lines, the approach taper should begin at the point of departure from the roadway centerline. If the section is developed by introducing a curbed median, the edge of the approach nose of the median should be offset a minimum of 2 feet to the left of the roadway centerline and the width of pavement opposite the approach nose should be W+3 feet. The location of the point of beginning of the approach taper would be in advance of the approach nose. A painted approach area should be introduced in advance of the barrier nose.

The taper should have a tangent alignment, but its derivation with respect to length varies depending on whether the storage lane is fully or partially shadowed. If the lane is fully shadowed, it is recommended that the length to width ratio be $V^2/60$ per unit of offset, where V is speed in miles per hour. If the lane is partially shadowed, the length should be the speed (V) in miles per hour times the width (W). The width and the length have the same longitudinal units (feet or meters). The minimum ratio for either full or partial shadow should be 10:1.

Bay taper: The bay taper is an element of channelization with the greatest dissimilarity of use throughout the nation. The use of reverse curves or a straight taper is almost evenly split, but the methods used to determine length vary greatly. When combined with a maneuvering area, which will be discussed later, it is recommended that a 10:1 bay taper be used to provide a full width turn lane for all posted speeds. A 10:1 bay taper, which is shorter than currently being used by most agencies, and a maneuvering area will allow for additional storage during short duration surges in traffic volumes.

Departure taper: The departure taper should begin opposite the beginning of the storage lane. The location of the end of the taper depends upon whether the channelization is painted or constructed with a curbed median. If it is a painted channelization, the departure taper should terminate at the point of beginning of the approach taper.

If channelization includes a curbed median, the edge of pavement taper should continue past the approach nose in a straight line until it intersects the edge of pavement of the typical roadway section.

STORAGE LENGTHS

The required length of vehicle storage for turning lanes depends on several factors. These include: (1) whether the lane is for left-or right-turning vehicles; (2) the type of traffic control, including the signal timing and cycle length; (3) the number of turning vehicles; and (4) the number of other vehicles on the approach.

Signalized Intersections. Where traffic is to be controlled by a traffic signal, the auxiliary lane ideally should be of sufficient length to either store turning vehicles or to clear all other traffic on the approach, which ever is the longest.

The total length of the separate turning lane and taper should be determined by either deceleration requirements, or the combination of turn lane or through lane queue storage plus the distance necessary to maneuver or transition into the separate lane, whichever is the greatest. The minimum maneuver distance assumes that the driver is in the proper through lane and only needs to move laterally into the separate turn lane.

1. The storage requirements for left-turn lanes should be based upon peak 15-minute flow rates. The average number of left turns per cycle can then be multiplied by a factor to account for random variations in arrivals. The length of the lane can be estimated, based on the length of cars, the mix of cars and other vehicles, and the vehicle arrival rate. This leads to the following formula.

$$L = VK\ 25(1 + p)/N_c \qquad [1]$$

where L = storage length, in feet; V = peak 15 minute flow rate expressed in vehicles per hour (vph); K = constant to reflect random arrival of vehicles; N_c = number of cycles per hour; p = percent of trucks or buses.

Where there are random variations in flow, a random arrival factor of 2 is normally applied to the left turns; this implies a failure rate of only 5 percent. However, where volumes increase toward saturation flow, or where movements are controlled by coordinated traffic signal systems, the random arrival factor can be decreased to 1.5.

2. The storage lengths for right-turn lanes can be obtained by using the "red time" formula. This formula determines the amount of storage space necessary to accommodate vehicles arriving at a signalized intersection during the red phase of the cycle. It is as follows:

$$L = VK\ 25\ (1+p)(1\text{-}G/C)/N^c \qquad [2]$$

where: L = storage length, in feet; V=peak 15 minute flow rate (vph); K=constant to reflect random arrival of vehicles, p=percent of trucks; G=green time in seconds; C=cycle length in seconds and N^c=number of cycles per hour. (Note that except for the "red time", (1-G/C), this formula is the same as Formula 1.)

A random arrival factor, K, of 2 should be used where right-turn-on-red is not permitted. Where right-turn-on-red is allowed, a factor of 1.5 can be used to determine the length of storage for right-turning vehicles.

The cycle length chosen to estimate the length of storage lanes should consider the possibility of longer cycle lengths in future years. Where the existing cycle length is less than 90 sec, storage requirements should be based on at least a 90-sec cycle. It is better practice, especially where space is not at a premium to add an additional 50 to 100 ft to the design initially.

3. The length of storage necessary to accommodate through vehicles that are stopped by a red signal can be determined by dividing the length obtained from Formula 2 using the through vehicle volume by the number of through traffic lanes.

4. Storage lengths at unsignalized intersections can also be determined by considering the left turning volume and the opposing volume. **Figure 11**[7] gives guidelines for estimating lengths for various storage combinations of traffic volumes.

TOTAL LENGTH OF TURN LANES

Although vehicular storage is a principal factor used to establish the full length of the separate turn lane, it may not be the actual determining factor. At off-peak traffic periods on higher speed roads, the lane will function as a deceleration lane.

The lengths required to come to a stop from either the design speed or an average running speed of a roadway are indicated in **Table 3**[6]. The lengths assume the roadway is on a 2 percent or less vertical grade. It is recommended that only the desirable length be used for left-turn lanes and that either the desirable or minimum length be used for right-turn lanes.

The total length of the separate turn lane and taper should be able to: 1.) provide sufficient length to store turning vehicles during stop conditions; 2.) provide sufficient length to permit turning vehicles to clear the queue of through vehicles and thereby enter the turn lane; 3.) function as a deceleration lane during high-speed low-volume periods; 4.) provide, in addition to the storage length, the distance necessary to maneuver or transition into the separate turn lane; and 5.) provide flexibility of design enabling the accommodation of peak traffic volume surges that, for short periods of time, exceed the design hour volumes. The total length should be whichever criteria provides the longest length.

The minimum maneuver distance assumes that the driver is in the proper through lane and only needs to move laterally into the separate turn lane. The maneuver distance permits a turning vehicle to move laterally from the through lane while it is decelerating. **Table 4** [12] presents minimum maneuvering distances for various posted speed limits.

It is recommended that a 10:1 bay taper be used to provide a full width separate turning lane for all posted speed limits.

The following steps should be taken to ensure adequate design of a separate turn lane:

1. Determine turning vehicle storage length by: (a) using Formula 1 for left turns and the "red time" Formula 2 for right turns and through traffic if the intersection operates under control of traffic signals; or (b) using the nomograph shown in **Figure 11** for unsignalized intersections.

2. Determine the probably queue length for all other vehicles on the intersection approach to a signalized intersection using the red time formula for an equivalent through lane volume.

3. Determine the length necessary to decelerate from roadway design speed either to a full stop or to a 15-mph exit curve (see Table 3).

4. Determine the length necessary to permit a turning vehicle to maneuver from the through traffic lane (see Table 4) into the turn lane plus the vehicle storage lengths (Step 1 above).

Whichever length or combination of lengths requires the greatest distance is the total length of turn lane that should be provided where conditions permit.

SUMMARY

As can be seen by data presented in this report, warrants for providing separate turn lanes or the design details used to construct separate turn lanes are not consistent across the country. Some details are relatively consistent while other details were found to be consistently inconsistent. The recommendations presented in this report represent what can be considered desirable minimum values. Conditions at a specific intersection may warrant the use of dimensions that exceed those in this report. It is also possible that local conditions are so restricted that design values less than desirable must be used to install the only feasible improvement. Although great care should be taken when using below recommended values, it frequently can be more beneficial to install a sub-standard left turn lane than not provide any separate turn lane. Each intersection is unique and must be analyzed using its specific conditions.

REFERENCES

1. National Safety Council, Accident Facts, 1968 and 1988 Editions, Chicago, IL

2. National Cooperative Highway Program, Research Report 348, Access Management Guidelines for Activity Centers, Washington, D.C., 1992

3. Transportation Research Board, Highway Capacity Manual, Special Report No. 209, Washington, D.C., 1985

4. Federal Highway Administration, Guidelines for Signalized Left Turn Treatments, FHWA-IP-81-4, Washington, D.C., 1981

5. Transportation Quarterly, Warrants for Left-Turn Lanes, Volume 37, Eno Foundation, 1983

6. American Association of State Highway and Transportation Officials A Policy on Geometric Design of Highways and Streets, Washington, D.C., 1990

7. Harmelink, M.D., Volume Warrants for Left-Turn Storage Lanes at Unsignalized Grade Intersections, Highway Research Record 221, 1967

8. Institute of Transportation Engineers, Guidelines for Left-Turn Lanes, Committee 4A-22, Washington, D.C., 1991

9. Lake County, Illinois, Highway Access Regulation Ordinance, 1988

10. Colorado Department of Transportation, State Highway Access Code, 1985

11. Institute of Transportation Engineers, Design Criteria for Left-Turn Channelization, Committee 5-S, Washington, D.C., 1981

12. V. G. Stover, Access Control Issues Related to Urban Arterial Intersection Design, unpublished

TABLE 1
Warrant for a Separate Left Turn Lane
at Signalized Intersection

CYCLE LENGTH	CYCLE SPLIT		
	70/30	60/40	50/50
120	650	550	400
90	700	600	500
60	750	650	550

TABLE 2
Warrant for a Separate Left Turn Lane
at Unsignalized Intersection

40-MPH Operating Speed Total Advancing Volume				
Opposing Volume	With 5% Left Turns	With 10% Left Turns	With 20% Left Turns	With 30% Left Turns
800	330	240	180	160
600	410	305	225	200
400	510	380	275	245
200	640	470	350	305
100	720	575	390	340
50-MPH Operating Speed Total Advancing Volume				
Opposing Volume	With 5% Left Turns	With 10% Left Turns	With 20% Left Turns	With 30% Left Turns
800	280	210	165	135
600	350	260	195	170
400	430	320	240	210
200	550	400	300	270
100	615	445	335	295
60-MPH Operating Speed Total Advancing Volume				
Opposing Volume	With 5% Left Turns	With 10% Left Turns	With 20% Left Turns	With 30% Left Turns
800	230	170	125	115
600	290	210	160	140
400	365	270	200	175
200	450	330	250	215
100	505	370	275	240

TABLE 3
Deceleration Distances - Feet

Design Speed (MPH)	Deceleration Desirable[1]	Distance (feet) Minimum[2]
30	235	185
35	270	240
40	315	295
45	375	350
50	435	405
55	480	450

(1) Assumes stop condition
(2) Assumes 15 mph speed differential

TABLE 4
Minimum Maneuver Distances

Speed (mph)	Minimum Maneuver Distance (feet)[1]
30	140
35	190
40	210
45	300
50	380
55	450

(1) Assumes a 4.5 fps^2 deceleration while moving laterally into turn bay at 3.0 fps^2 lateral shift and 9.0 fps^2 average deceleration thereafter.

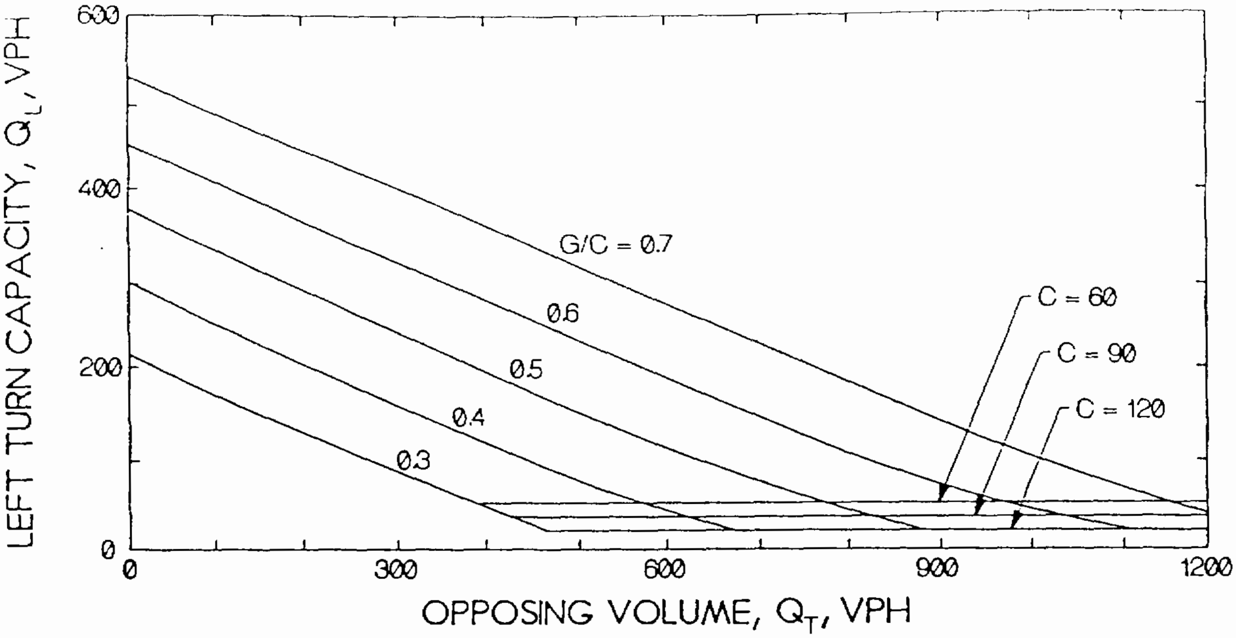


Figure 1A. Left Turn Capacity with No Separate Left Turn Lane

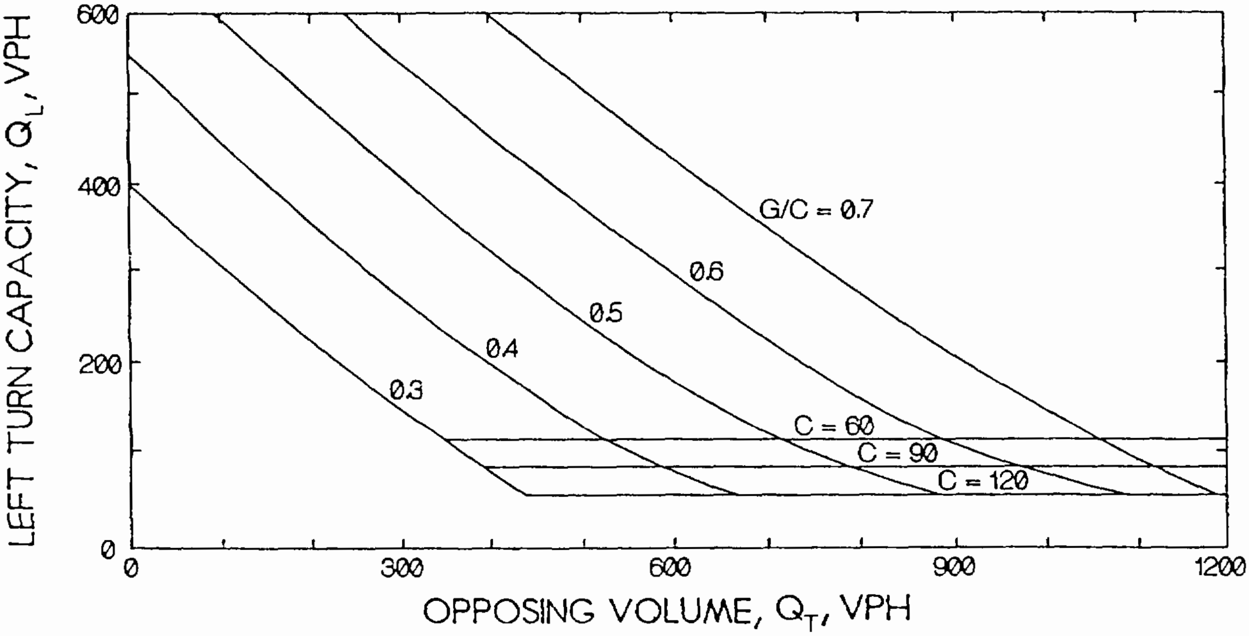
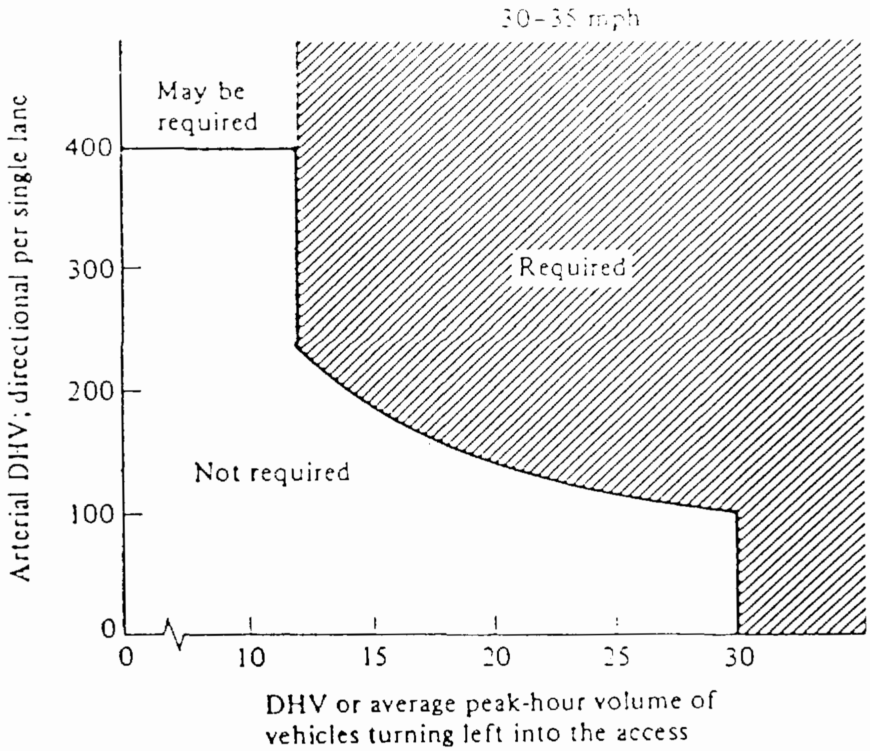
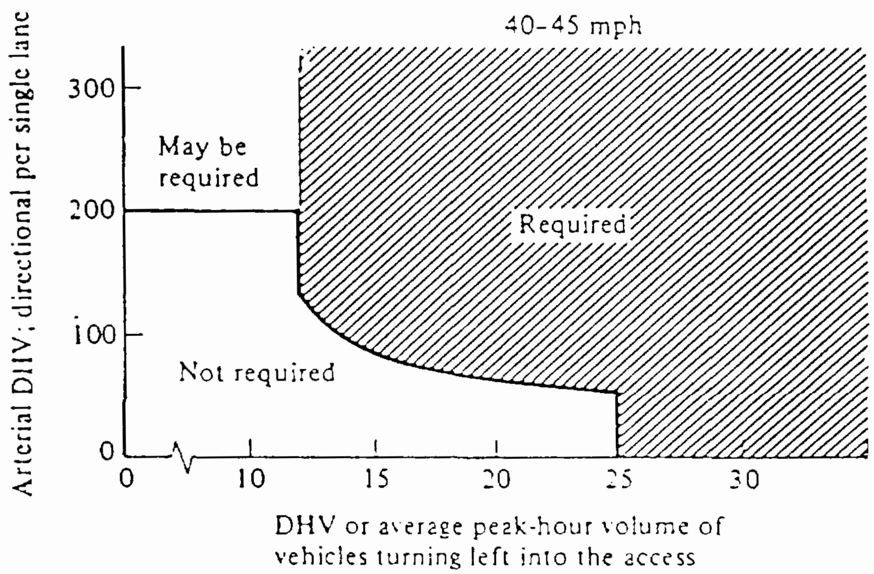


Figure 1B. Left Turn Capacity with Separate Left Turn Lane

Figure 1. Left Turn Capacity with One-Lane Opposing Traffic and Two-Phase Traffic Signal



30−35 MPH



40−45 MPH

Figure 2. Left Turn Deceleration Lane Warrant

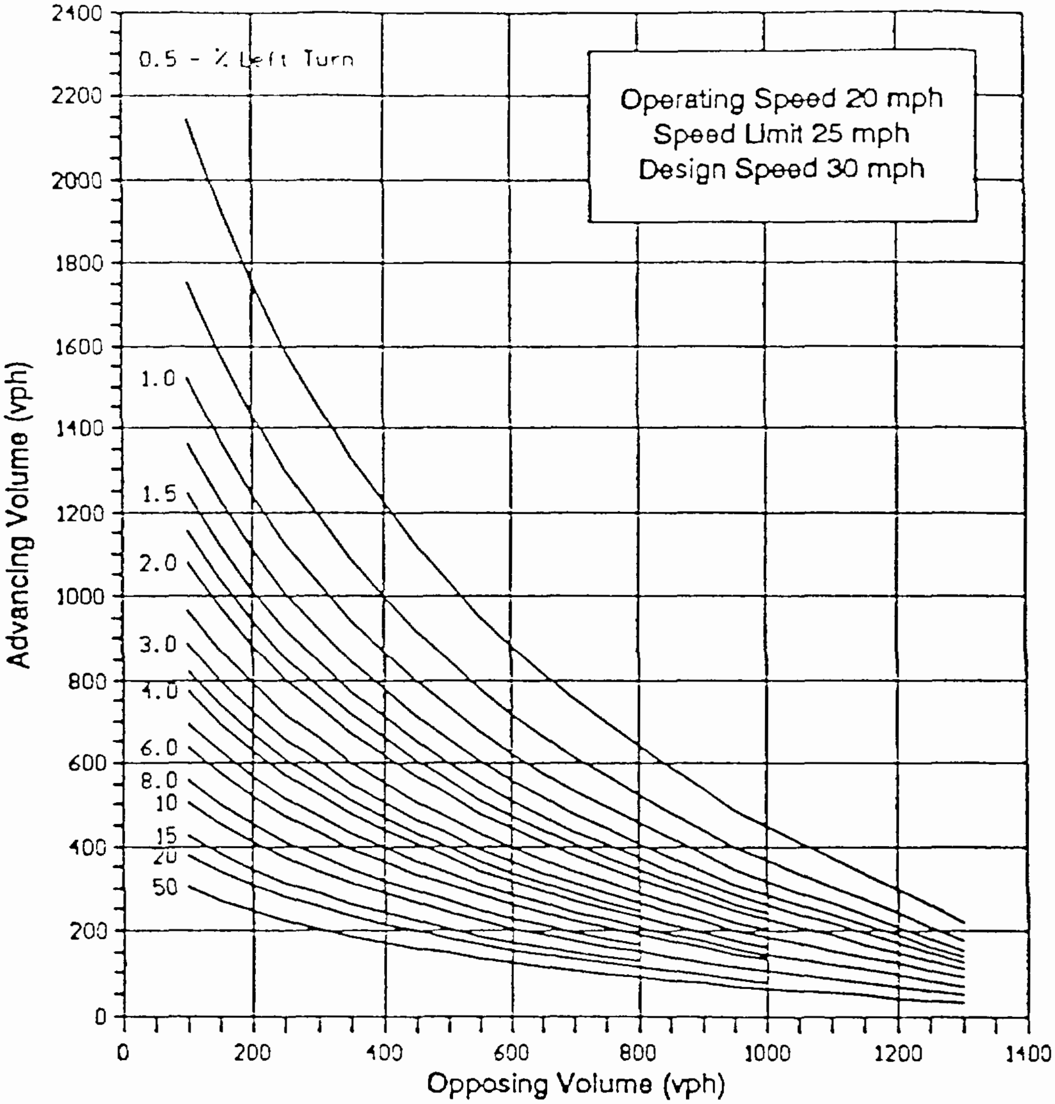


Figure 3. Guidelines for Left-Turn Lane Unsignalized Intersection Roadway Design Speed - 30 MPH

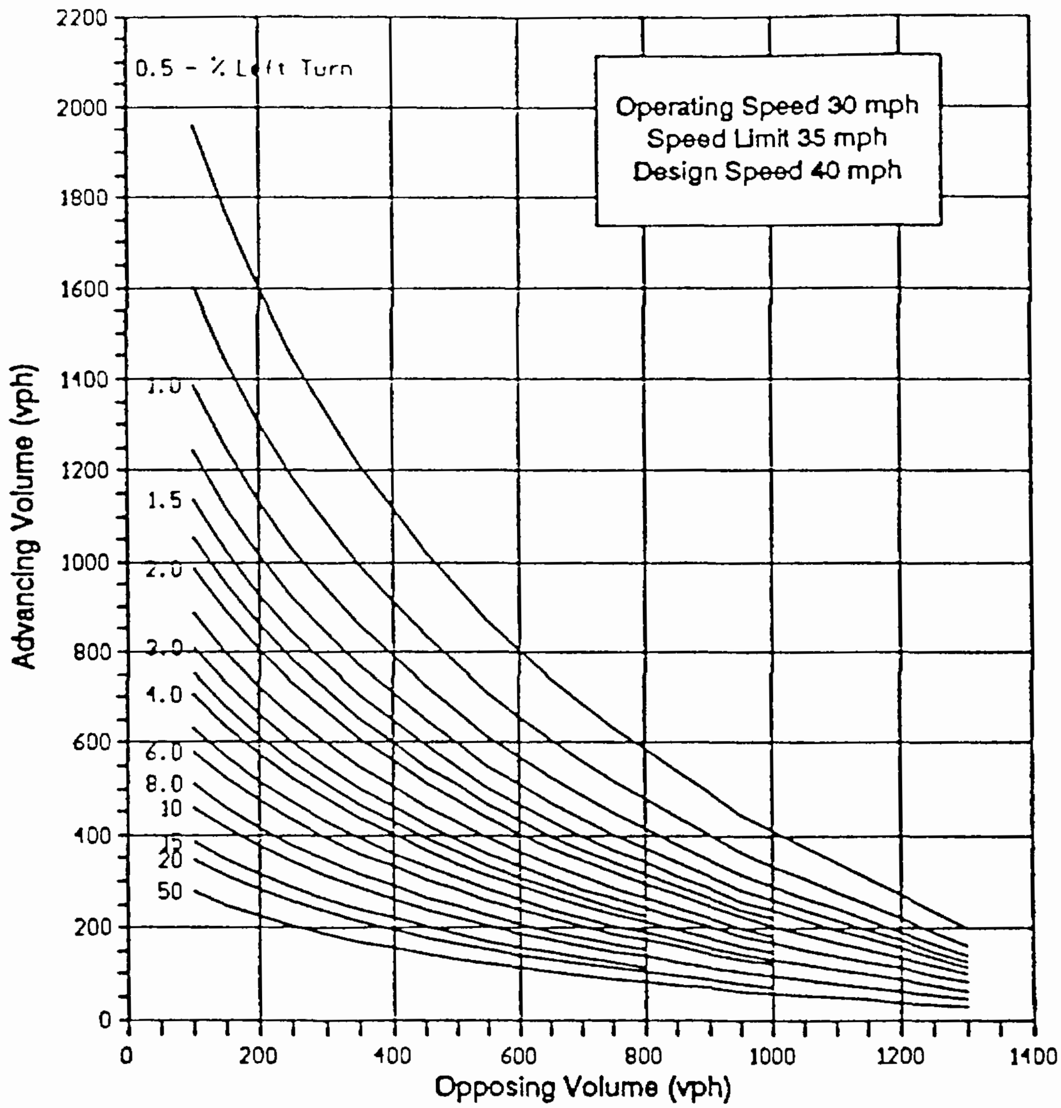


Figure 4. Guidelines for Left-Turn Lane Unsignalized Intersection Roadway Design Speed - 40 MPH

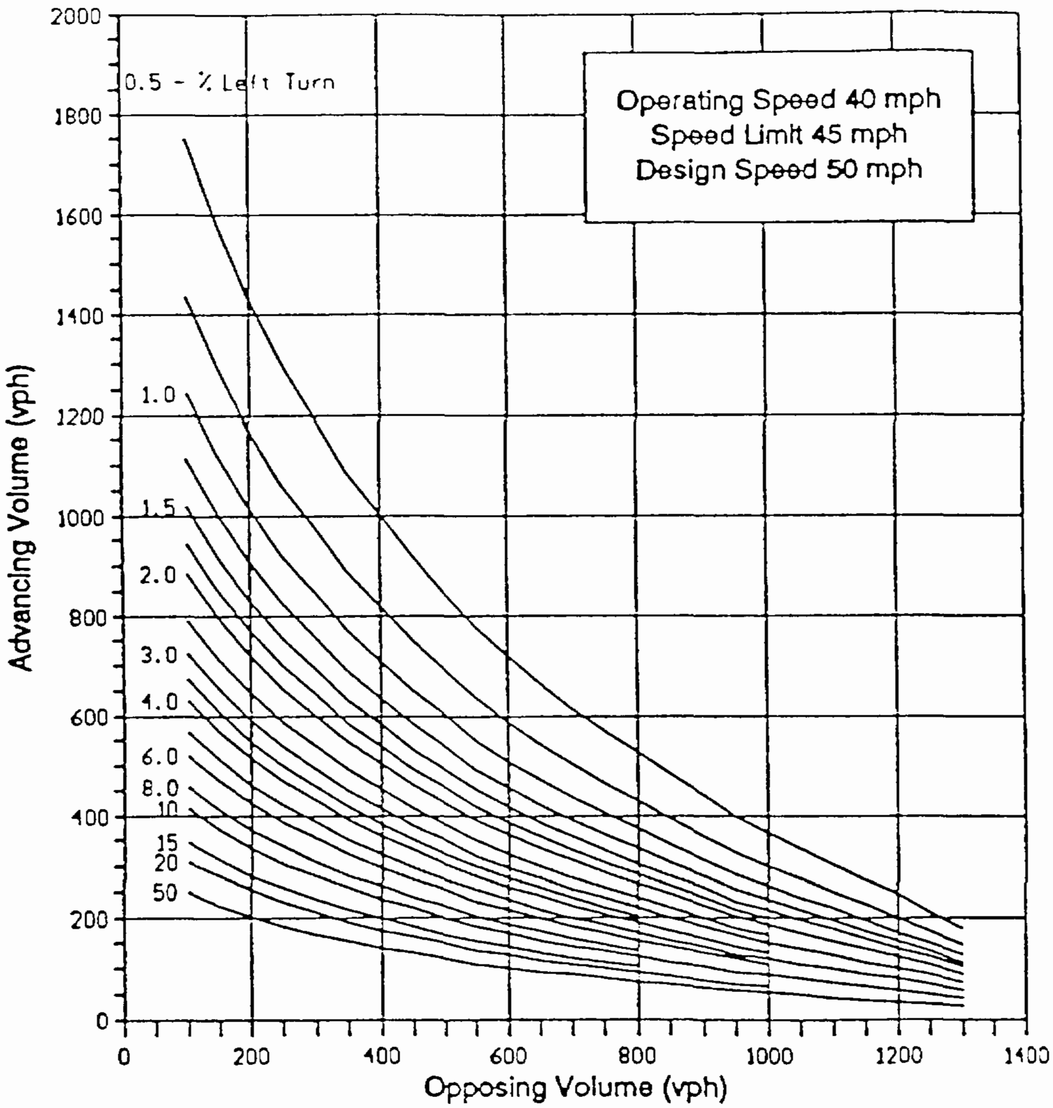


Figure 5. Guidelines for Left-Turn Lane Unsignalized Intersection Roadway Design Speed - 50 MPH

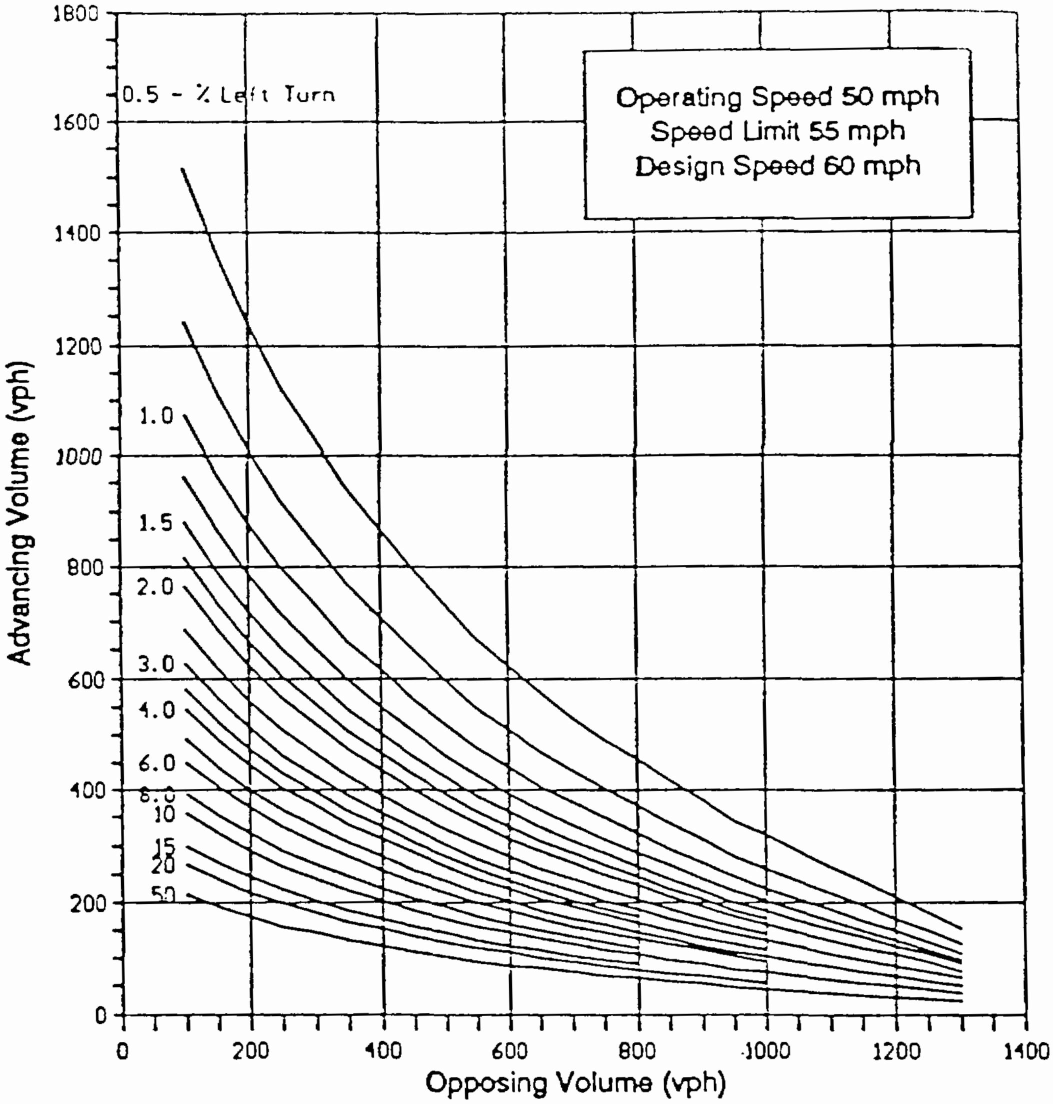


Figure 6. Guidelines for Left-Turn Lane Unsignalized Intersection Roadway Design Speed - 60 MPH

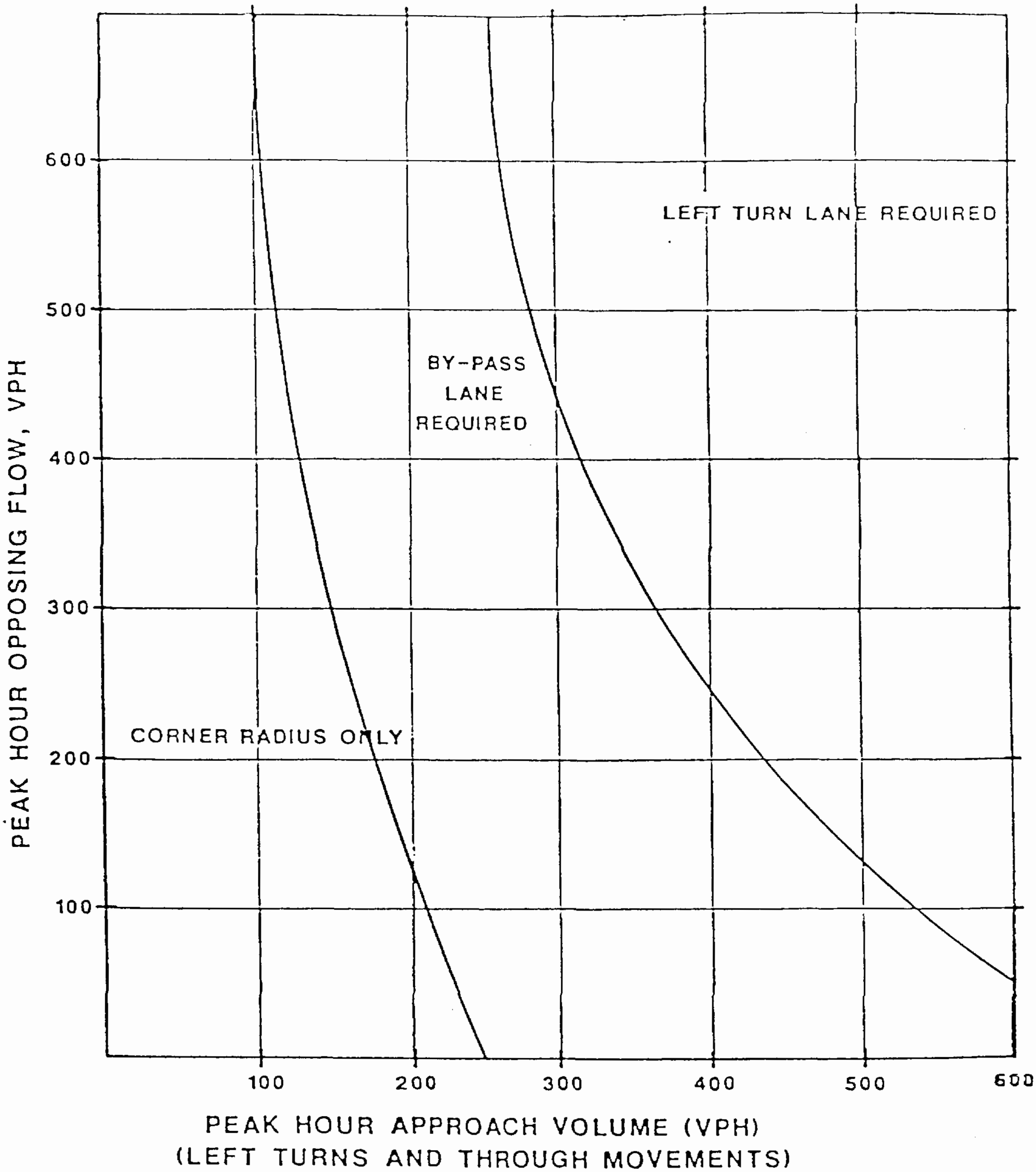


Figure 7. Left-Turn Treatments Lake County, Illinois

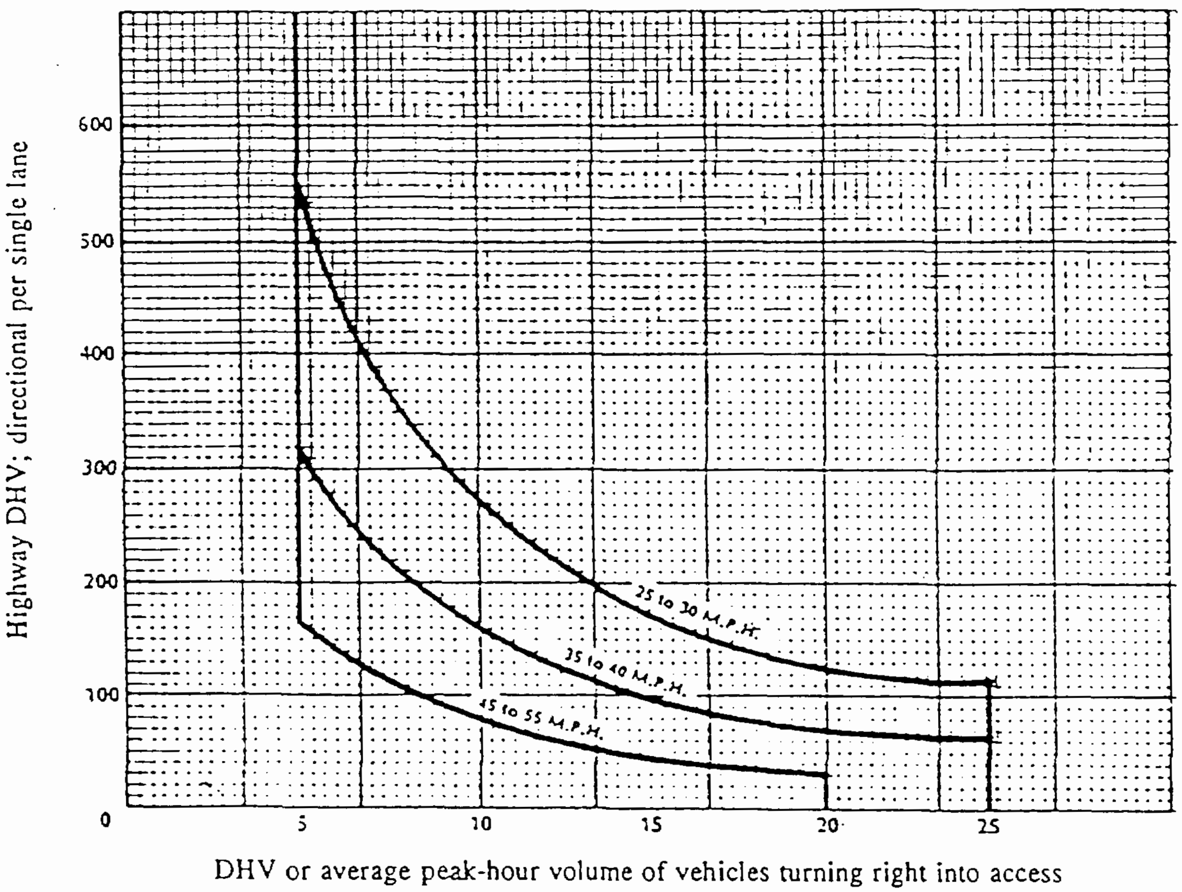
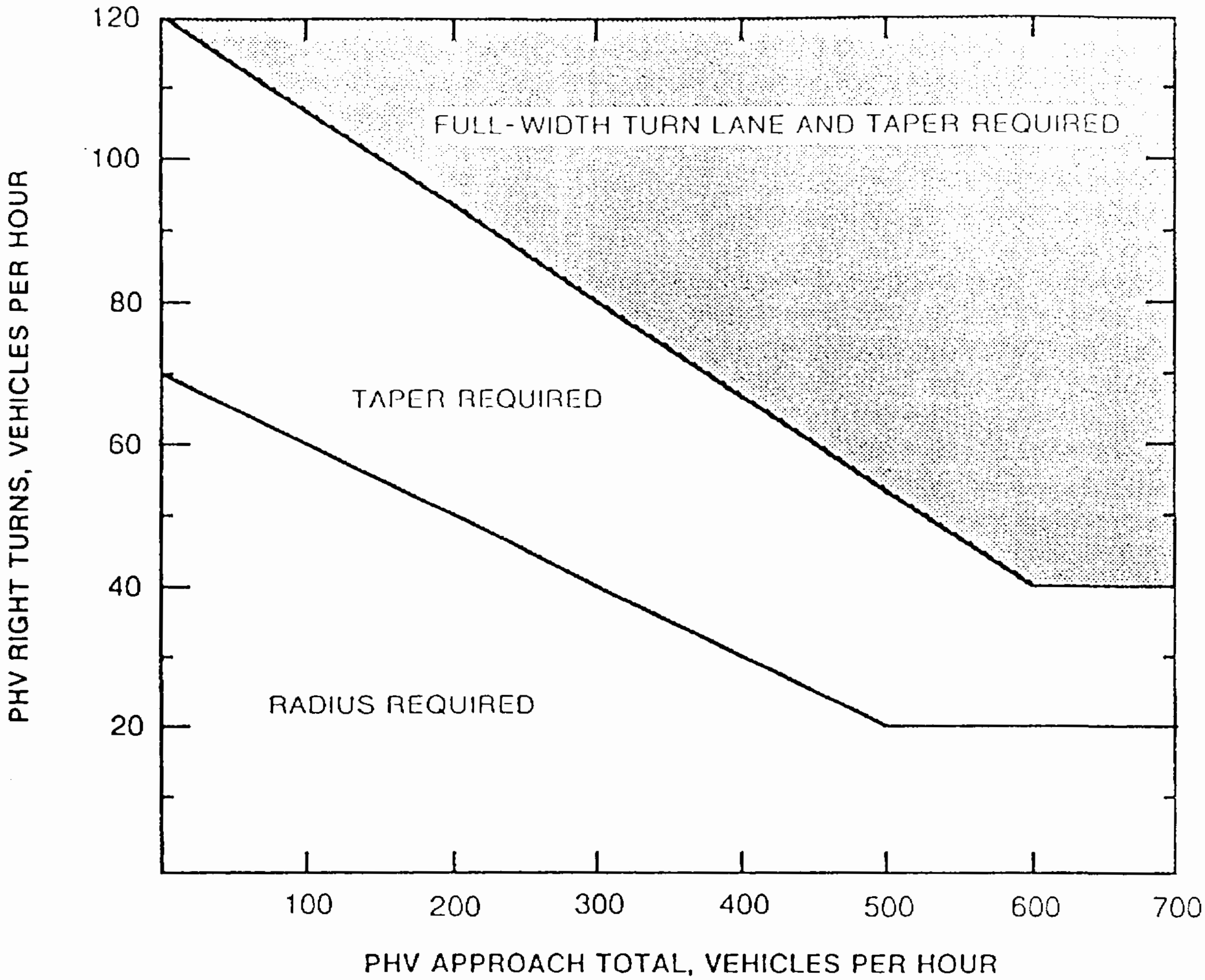


Figure 8. Colorado Right-Turn Lane Warrant



LEGEND

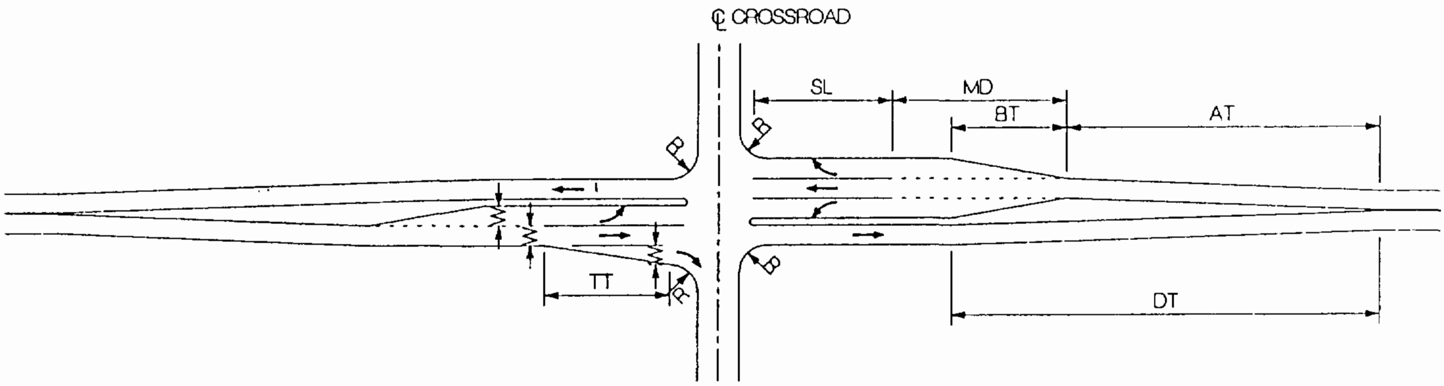
PHV - Peak Hour Volume (also Design Hourly Volume equivalent)

If PHV is not known use formula: PHV = ADT x K x D

K = the percent of AADT occurring in the peak hour
D = the percent of traffic in the peak direction of flow

Note: An average of 11% for K x D will suffice.

Figure 9. Virginia Guidelines for Right-Turn Treatments



AT - APPROACH LENGTH
BT - BAY TAPER
DT - DEPARTURE TAPER
TT - TURN TAPER
SL - STORAGE LENGTH
MD - MANEUVER DISTANCE
W - LANE WIDTH
R - TURN RADIUS

Figure 10. Channelization Elements

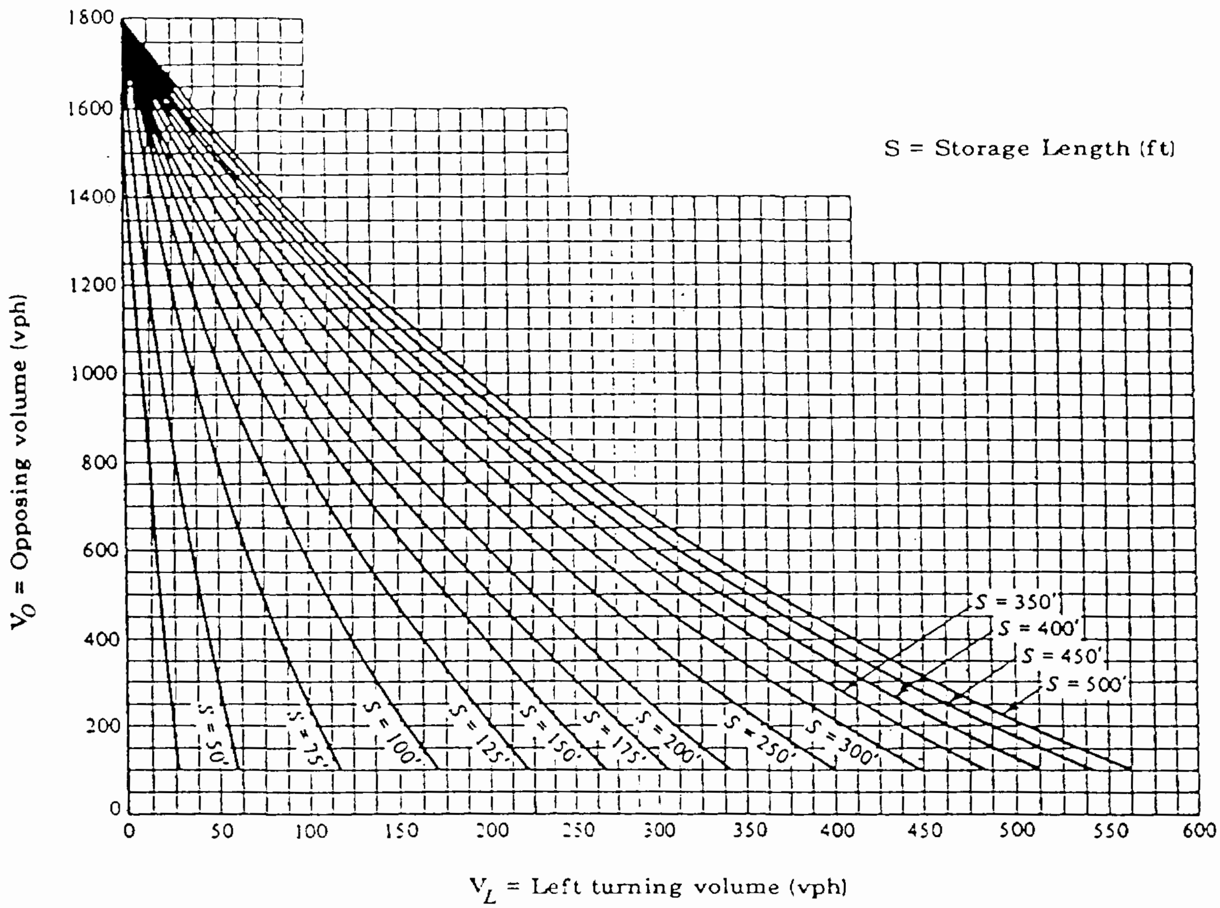


Figure 11. Left-Turn Storage at Unsignalized Intersections

Retrofitting Shopping Centers - Concepts and Case Studies

Benedict G. Barkan
Barkan & Mess Associates, Inc.
and
Herbert S. Levinson
Transportation Consultant

The principles of access management work well along highways in undeveloped or developing areas. In these settings, an access classification system can be readily superimposed on the highway network. The provision and spacing of access, in turn, can by keyed to the various types of highways.

In built-up areas, however, retrofitting roadways and activity center access will usually prove more practical. Installation of roadway medians, consolidation and upgrading of site access points, and improved internal circulation can help preserve arterial traffic flow, at the same time improving property access. Such "retrofit" are commonly applied at shopping centers when they are expanded and modernized. This paper describes some of the traffic problems encountered in older shopping centers, suggests traffic design principles and contains case studies of retrofit projects.

Opportunities for Shopping Center Modernization

Both in the United States and Canada, shopping centers first began to be built in substantial numbers in the late 1950's as one of the symptoms of post World War II suburbanization. The pace of new shopping center development accelerated during the 1960's and early 1970's. However, it has slackened since the later 1970's, particularly in the Northeast and Midwest.

Over 10,000 of the roughly 23,000 shopping centers in the United States are now at least 20 years old. Thus, there is a tremendous potential for modernizing and expanding the older centers. A growing number of older centers are being modernized revitalized or enlarged. Developers and major retailers first think in terms of new facades, skylights, landscaping, or enclosure of open malls. However, improved traffic, parking, and circulation systems, including the access to and from the surrounding roads, is equally important.

A number of situations prompt shopping center owners to expand and/or modernize. For example: a shopping center may be in a good location to serve its existing market but needs a general updating to stay competitive, especially if a new center is proposed in the same area. Perhaps an out-of-town department store chain wants to enter the market and prefers to move into a well-located established center.

Sometimes, an older center has a vast excess of parking, and there is a demand to develop office buildings, theaters, restaurants, or other uses in the underutilized parking area. Sometimes, expansion calls for and single or multi-level parking decks to serve the non-shopping uses.

Occasionally, external forces may dictate traffic changes. Highway projects adjacent to a shopping center provide the opportunity for correcting long-standing deficiencies in access or circulation design. Redesign of highways makes it possible to install physical medians, that restrict or restructure site access and correct site circulation and parking problems at the same time.

Typical Traffic Problems

A variety of traffic deficiencies are found at older centers. These include too many separate and poorly defined access points, inadequate storage spaces between public roads and the site parking areas, and improperly designed parking areas.

One frequently encountered program upon entering a shopping center is the abrupt change from the well-defined and regulated traffic pattern on the public street or highway to a wide-open undefined and unregulated, almost free-flow situation. The motorist who is used to marked traffic lanes, channelization islands, and standard traffic signs and pavement markings is often "turned loose" once inside the shopping center property. The driver is left to his or her own devices and may simply decide to "follow the leader" if the car ahead seems to be headed generally in the right direction. This translates into spill back and accidents on the public roads.

Where there are many separate poorly defined access points, the motorists decide that some are more important than others by selecting them as the preferred ingress or egress routes. These locations often become clogged, and conflicts between entering and exiting vehicles turning in various directions are common. Under these conditions, the principal access points often lack the needed depth to provide the required "reservoir" or storage length for entering vehicles before dispersing within the parking area, or for exiting cars attempting to leave the parking area.

The multiplicity of access points increases accidents and delays on the surrounding highway, and over the long run, reduces their levels of service. This is clearly an undesirable situation, since it undermines the initial investment in the highway network.

Internal circulation problems result from inadequate site design and ineffective coordination of internal roads and access drives. There are poorly delineated circulation channels within the property:

- Often there is no clearly defined perimeter roadway. Sometimes restricted travel paths funnel all entering traffic directly to the building front without letting cars disperse to the individual parts of the parking area. This concentrates vehicle traffic and creates conflicts in the areas of major pedestrian activity.

- Many centers, both old and new, are plagued by substandard curb radii that cars and trucks cannot negotiate properly.

- Sometimes older centers mix one-way and two-way circulation in the parking aisles; this is confusing and potentially dangerous to the unfamiliar driver, especially when coupled with inadequate or non-standard traffic signs and pavement markings.

- Delivery trucks and other service vehicles may not have clearly designated routings leading from the highway access points to the truck docks and receiving areas.

- Many older centers typically lack grassed or landscaped areas which, if properly designed, can help to channelize and delineate the circulation patterns and break up the "sea of asphalt".

Parking also needs correcting in older centers. Some centers were originally laid out with narrow stalls -- which can be changed fairly readily -- and also with narrow parking modules which are not easily changed due to the placement of the light poles. Some parking areas have been converted, in part, to diagonal spaces with one-way aisles, while other parts retain 90-degree parking stalls. This is confusing, disconcerting, and potentially hazardous, especially for those shoppers who are not regular visitors.

Traffic Design Principles

The basic traffic design principles used in redesigning older centers and in laying out newly planned shopping centers have an important bearing on the quality of flow on the surrounding road system. They apply to large and small centers alike.

Access Design - The proper design and spacing of access points is essential to maintaining efficient flow on public roads and access drives. Figure 1 shows the traffic problems that result when there is poor storage, no protected lanes for left turns from the arterial road, and inadequate curb radii. The lack of a suitable "throat" causes conflicts within the center in close proximity to the signalized intersection on the arterial street. The result is confusion and congestion.

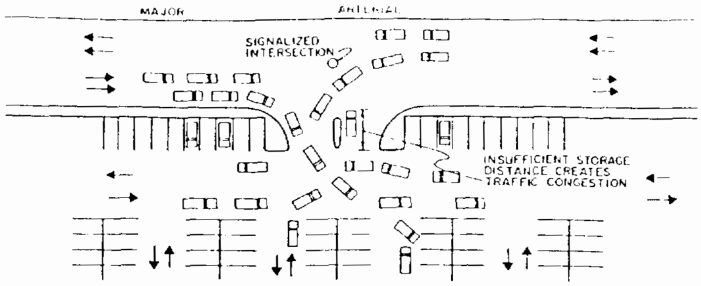


Figure 1. Access With Poor Storage

The correct treatment consists of a layout similar to the schematic plan shown in Figure 2. This concept provides a curbed and well-defined "storage" or "reservoir" distance of 150-200 feet or more, between the exterior street and the first internal intersection point. Major access drives should provide at least two lanes inbound and two lanes outbound, separated by a raised median divider.

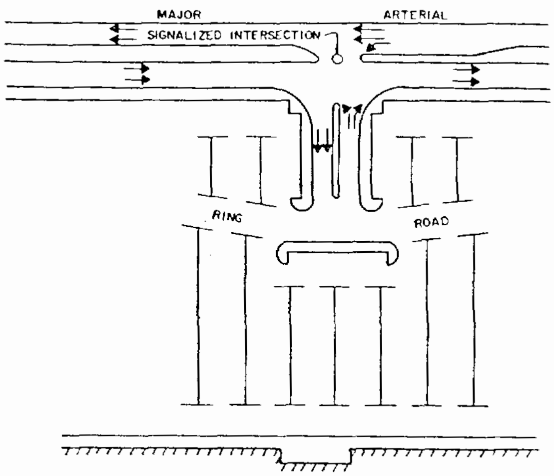


Figure 2. Access With Adequate Storage

It is better to provide fewer well-designed access drive-ways than numerous small curb cuts. Access points generally should embody the same geometric standards used in designing public street intersections. Ideally, signalized intersections should be placed where they fit into the time-space (progression) pattern along the major streets, and do not reduce the "through bands" on the arterials. While this may not always be attainable in retrofit settings, an effort should be made to locate signals where they will have minimum impact on the arterial traffic flow. Even if signals are not needed, public agencies usually will require the improved shopping center drives to line up with existing street or driveway intersections on the opposite side of the public roads.

There are a variety of ways for providing access between public highways and shopping centers. The choice will depend upon the types of roads involved, the size of the center, and the traffic expected to use each access point. While the access designs should be keyed to capacity requirements, design consistency along the major road should be encouraged and "surprise" designs should be avoided.

Figures 3 through 6 depict schematic treatments of the site access and boundary streets.

- Figure 3 shows a typical treatment along a divided highway where only right turns are provided and there is no break in the median divider. Access codes in Colorado, Florida, and New Jersey require this type of treatment for certain highway types.

- Figure 4 illustrates a standard widening treatment on an undivided highway to create a right-turn and left-turn lane at the access point. The road widening should be completed before opening the shopping center, although the right turn lane sometimes is provided after the center is in operation, depending on need. The right and left turn storage lane should be long enough to avoid spillback onto the main travel lanes during peak periods.

- Figure 5 shows how a left turn storage bay can be provided on a divided highway. Where dual left turn lanes are provided, as at many large centers, adequate width on the site entrance road is required to accommodate the turns. Usually 28 to 30 feet of pavement is needed to receive the two lanes of turning vehicles. This treatment normally requires a three phase traffic signal.

- Where traffic entering the shopping center is limited to right turns, only one direction of travel is signalized. This enables the signals to be effectively coordinated with other signals along the arterial highway. This "left-in" treatment has been increasingly applied along major highways in several states (ie. Colorado, Florida, Michigan). It requires left turn egress via adjacent public streets, or indirectly be means of "U"-turns.

- Figure 6 shows a "directional" treatment that facilitates the flow of traffic on the arterial street and permits two-phase signal control. However, this concept requires added directional signing within the shopping center since exiting left turns can be made only at one location. It also requires a 250 to 300 feet minimum spacing between the access points to minimize driver confusion within the shopping center.

- Figure 7 illustrates a "jughandle" treatment for making left turns into a shopping center. This scheme is common along divided highways in New Jersey and a few other states. It is advantageous where the left-turning volumes are large but where the highway cannot be widened to include storage lanes in the median. Jughandle should not be randomly interspersed with conventional left turn lane treatments along an arterial road.

- Figure 8 shows a grade separated "trumpet" interchange left-turn design. This scheme would be used only where the arterial highway traffic flow cannot be interrupted by a traffic signal. Sometimes an interchange is desired to reduce turning conflicts, increase capacities and reduce delays.

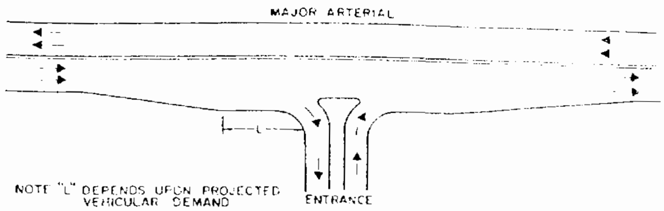


Figure 3. Right Turn Only Treatment

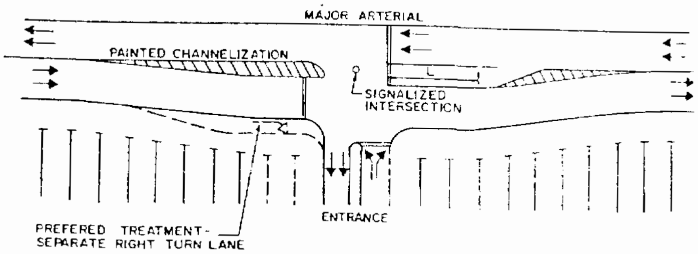


Figure 4. Left Turn Treatment of Undivided Highway Created by Widening Highway

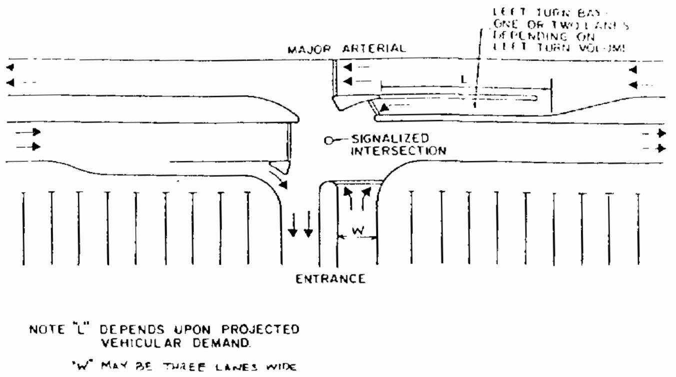


Figure 5. Left Turn Treatment of Divided Highway

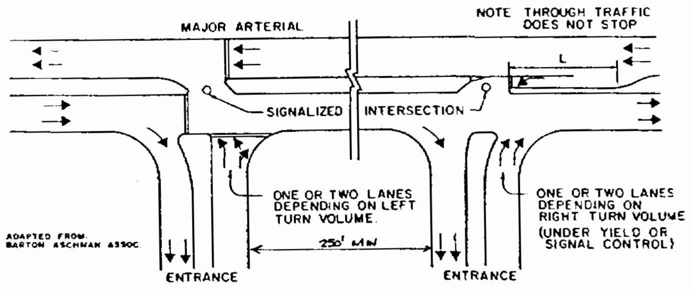


Figure 6. Directional Entrance Treatment of Divided Highways

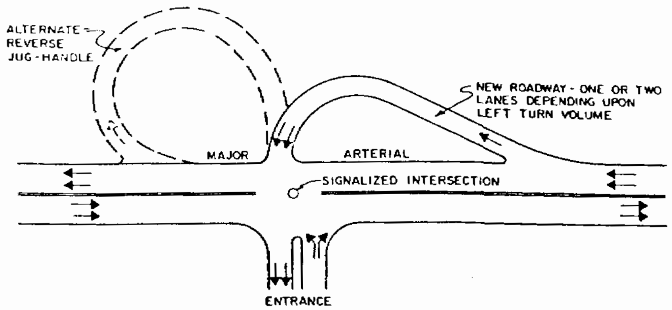


Figure 7. "Jug Handle" Left Turn Treatment

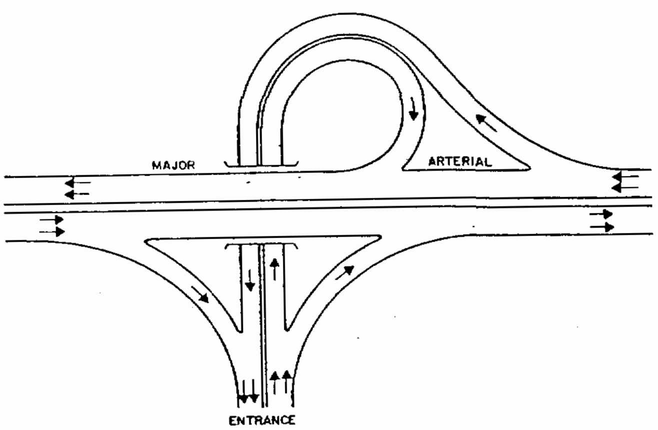


Figure 8. "Trumpet" Interchange Treatment

Ring Road - The most important internal circulation feature, especially in larger, mall-type shopping centers, is the continuous ring or circulation road. This roadway could vary in width from 30 to 48 feet, and may carry two, three, or four traffic lanes, along all or part of its length. It should offer the "path of least resistance" between the highway access points and the parking areas, truck service courts, and other internal points of destination.

The ring road should have a relatively free flowing alignment, without abrupt turns or changes of direction. In larger centers, it should permit speeds of perhaps 30 miles per hour. It should not necessarily follow the outer perimeter of the property, especially where the site boundary is irregular, since this would tempt drivers to take shortcuts diagonally across the often under-used parking areas. It is better to place the ring road about 350-400 feet outside the main shopping center building, thereby encircling the prime parking areas. Employee or peak season overflow spaces can be located outside the ring road.

The intersections of the access roads with the ring road should be treated as T-intersections rather than as four-way intersections. Near these T-intersections, several of the individual parking aisles should be blocked by curbed and landscaped islands, (sometimes called "canoes" because of their characteristic shape). These junctions should favor traffic entering the shopping center to preclude spillback onto boundary roads.

In larger centers, it is often desirable to create intermediate roadways or major aisles, defined by curbed landscaped dividers that link the ring road with the inner roadway adjacent to the shopping center building. These major aisles can be located where there is a change in the orientation of the parking aisles, or at a break in grade (or "berm") between the "upper" and "lower" parking fields common at two-level malls. Or, they may be used to divide an otherwise large expanse of parking into smaller more easily identifiable cells. The curbed dividers are also effective in forcing circulating traffic to stay on the ring road and prevent indiscriminate travel diagonally across the parking areas.

Building Road - In all centers, an inner roadway should parallel the curb line around the building envelope. This road or set of roads should be somewhat indirect in alignment and relatively narrow, to discourage speeds of more than about 10-15 miles per hour. Pedestrians should feel safe when crossing this roadway with small children or when carrying bags or packages. This road should generally be no wider than about 28-30 feet, although intermittent segments can be wider to accommodate pickup zones and perhaps bus or taxi waiting areas.

Service Facilities - Truck and service vehicle facilities are now given somewhat less emphasis than in the 1950's and 1960's. At that time, some large centers were built with continuous underground truck tunnels below the mall, often running the full length of the center. In general, only department stores, large discount stores, supermarkets, restaurants, and selected other stores need off-street servicing by tractor-trailer vehicles. Semi-enclosed, slightly depressed ramps or screened truck courts are frequently used for the service areas. Relatively direct routes and easy turns between the external access points and the service courts must be provided. Trucks should not be required to drive through the individual parking aisles.

Bus Transit - A bus stop or terminal area often should be provided within shopping centers. The stop should be located as close to the center as possible to minimize passenger walking distances. In smaller centers, the buses can use the roadway adjacent to the buildings, while in larger centers, a separate terminal and/or bus road system may be desirable. Buses should not be required to drive through individual parking aisles.

Sometimes a park-and-ride lot or timed bus transfer center is located on the site. In such cases, the bus terminal may be located father away from the mall entrances, closer to the perimeter of the site.

Traffic Controls - Uniform traffic control devices should be used inside the shopping center, compatible with those on public streets and highways. Nonstandard signs and pavement markings breed disdain and disregard by drivers and should be avoided.

Parking Area Design - The orientation of parking aisles should be directed to the fronts of the buildings served. This pattern enables drivers and passengers after they become pedestrians to walk in the aisles and be able to see and be seen by vehicular traffic.

Parking dimensions have changed over the years, reflecting both patron convenience and car design. Ninety-degree parking modules of 62 to 65 feet were used for many years. However, the downsizing of passenger cars now makes a 60-foot module feasible. Parking space widths of 9.0 to 9.5 feet are common, with 8.5 foot wide spaces in areas used for employee or overflow parking. Placement of lighting standards in existing lots usually makes downsizing modules difficult unless a major modernization is planned.

Case Studies

A few case studies illustrate how some of these principles have been applied in retrofitting older shopping centers to improve their access to public roads and internal circulation.

Hamden Plaza - Hamden, CT - The Hamden Plaza is located along Dixwell Avenue in Hamden, CT about four miles north of the New Haven Green. It is part of the "Magic Mile" of commercial development that extends from the Merritt Parkway (Route 15) to Skiff Street. The 350,000 square foot center, built some 35 years ago, is part of a commercial development that now contains over 1,300,000 square feet of floor space in two shopping centers (Hamden Plaza and Hamden Mart), a major discount store, Caldor, and a series of strip developments together known as the "Magic Mile".

Dixwell Avenue (Route 10) traverse through the Magic Mile. There are approximately 15 driveways along each side of the road - a consequence of the strip development that has occurred over the past several decades. The roadway was widened from two to four lanes in 1955 and was subsequently improved to provide protected left turn lanes. Figure 9 shows the types of strip development along the road and the queue of left turning vehicles trying to enter Hamden Plaza.

Traffic volumes on Dixwell Avenue in its busiest section just south of Hamden Plaza averaged 36,000 vehicles in 1992. The PM peak hour volumes approximated 1,300 vehicles in each direction of travel.

Figure 9. Views of Dixwell Avenue, Hamden, CT
Looking North

Over the years, traffic signals have been progressively improved along the roadway. Signals are coordinated on an 80 second cycle midday, a 90 second cycle during peak periods and a 70 second cycle overnight. They are set for a 35 miles-per-hour progression with a through based width of about 20 percent. This low band width reflects the large number of irregularly spaced signals along Dixwell Avenue some eight signals within the one mile area.

Figure 10 shows the Hamden Plaza design before the traffic improvement changes were implemented in 1980. Previously there were three signalized driveways along Dixwell Avenue, no defined parking for a large family restaurant in the southeast corner of the property, and a generally poor internal traffic pattern. Traffic spillback onto Dixwell Avenue and within the site was common. Moreover, the main left turn entrance resulted in queues along Dixwell Avenue as far as the adjacent intersection about 500 feet to the south. A large number of accidents were reported at the two southernmost driveways, as well as at an additional restaurant access to the south.

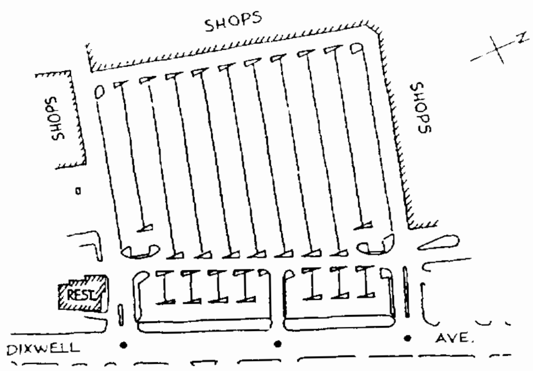


Figure 10. Hamden Plaza - Before

Figure 11 shows the access and circulation pattern after the 1980 retrofit. The southernmost driveway into Hamden Plaza was limited to restaurant access only and the traffic signal was removed. The center driveway was widened and a median island was installed. This increased the storage area for northbound left turns by several hundred feet. Figure 12 shows how the main access to Hamden Plaza was channelized from the internal parking areas.

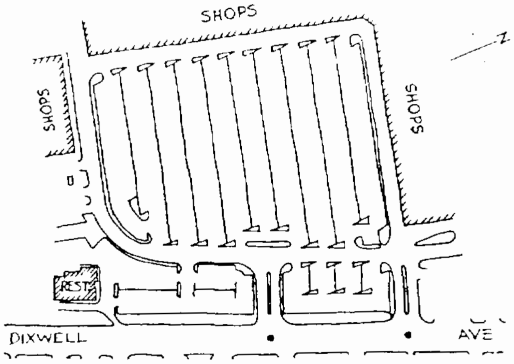


Figure 11. Hamden Plaza - After

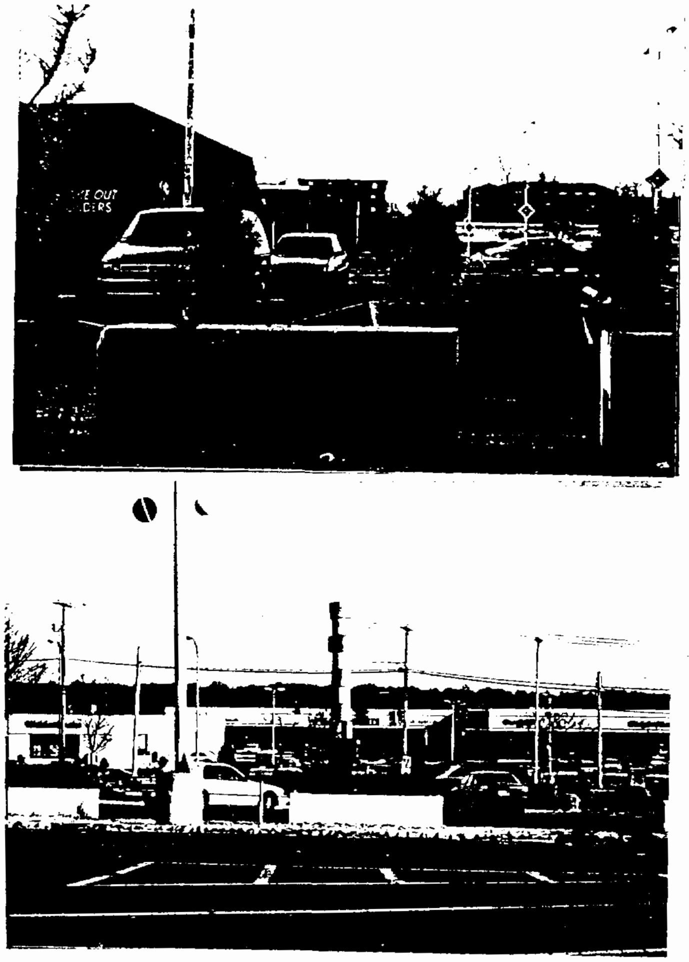


Figure 12. Channelization at Main Entrance
Hamden Plaza, Hamden, CT

A designated parking area was provided for the restoration and a well defined circulation pattern was established for the shopping center. Figure 13 shows how the former access to the Hamden Plaza was blocked by means of curbing and plantings.

Figure 13. Redesign of Former Access
Hamden Plaza, Hamden, CT

Despite these changes, there still remain problems of frequent curb cuts, traffic signals, and difficult inter-development access along the Magic Mile. If an access management plan had been available to guide development substantial traffic and site design improvements could have been achieved.

Colonial Plaza - Waterbury, CT - This shopping center is located near the Route 8 Expressway on the west side of Waterbury, Connecticut. The shopping center was successful commercially, but was characterized by a rather chaotic access and circulation pattern. As shown in Figure 14, there were four separate access drives from Thomaston Avenue in one short area. These had been designated for one-way flow but, in fact, each operated two-way. Figure 15 shows the changes that were implemented in 1982 to gain City approval to locate a small branch bank in the front parking area. There are now only two access drives, in place of four, with adequate storage depth on each one.

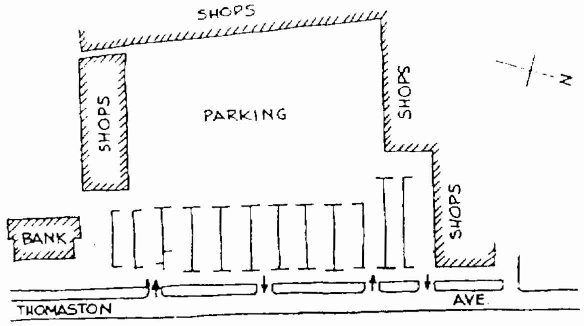


Figure 14. Colonial Plaza - Before

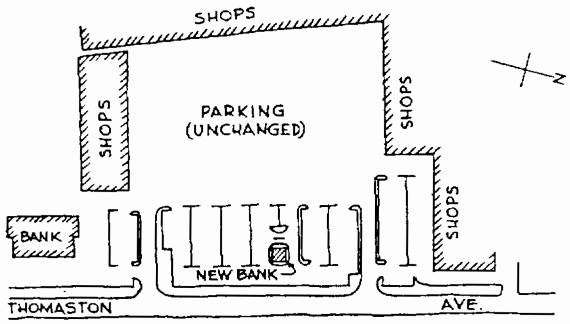


Figure 15. Colonial Plaza - After

West Shore Plaza - This strip center was built in Lemoyne, PA (near Harrisburg) in the 1960's and remained unchanged over the years. As shown in Figure 16 the access drive from Market Street had no storage depth and, was offset by about 200 feet from the T-intersection with 12th Street. This resulted in blockage during busy traffic periods.

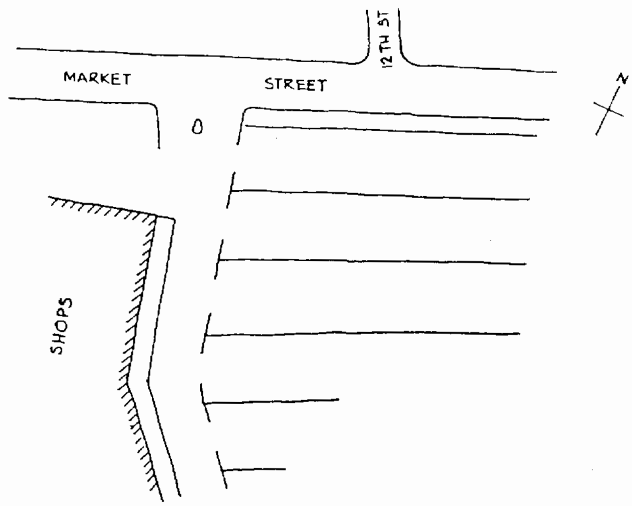


Figure 16. West Shore Plaza - Before

The Pennsylvania DOT wanted to rebuild and signalize the intersection of Market and 12th, and they insisted that the shopping center drive be moved and become part of the new four-way intersection. Figure 17 shows the circulation pattern as revised in 1981. A single access driveway with adequate storage area lines up with 12th Street. The intersection of Market Street with 12th Street was signalized. The vehicle and pedestrian flow patterns are now better defined.

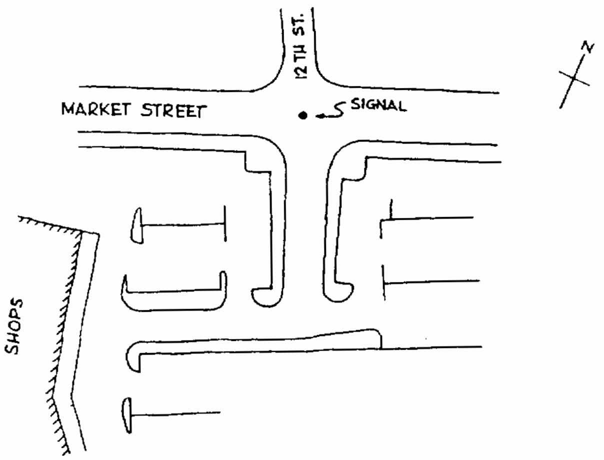


Figure 17. Colonial Plaza - After

Implications

The case studies illustrate some of the opportunities for retrofitting older shopping centers for today's traffic in ways that: (1) improve operations and safety on surrounding roads, and (2) better rationalize internal circulation. They show how established traffic engineering design principles can be applied when older centers are renovated, rehabilitated or expanded.

There is, of course, another approach to retrofitting activity center access. This involves installing median islands along major highways and limiting the number of left turn access points, especially exits from the developments. Examples in places as diverse as Atlanta, Denver, and Fort Lauderdale indicate that accident reductions and travel time savings can result from such actions.

In all cases, it is essential that site access and the internal road system be integrated. And in all cases, it is important to recognize that retrofitting should be done consistent with sound access management principles needed to preserve the functional integrity of the surrounding road system.

Luncheon Address

The Politics of Access Management

Hazel Frank Gluck
Public Policy Advisors, Inc.

The creation of public policy follows a generally prescribed route:

1) identification of a problem
2) development of suggested solutions
3) enactment of the preferred remedy

If you can keep these three steps before you as you undertake this enterprise you increase the odds of getting to your goal - without increasing your dress or suit size and loosing, or having your hair turn grey in the process!

Before I try to lay out for you what I hope to be the benefits of our experience in the Garden State, let me preface this presentation by saying that the fashioning of public policy is as much a feature of the environment in which it's developed as it is the specific merits of its various elements.

In 1986 when I was appointed Commissioner of Transportation and Chair of New Jersey Transit by then Governor Tom Kean, there were two things on my plate; internal to the Department was the access management draft legislation (as part of a 3 bill package known as TRANSPLAN) which was in its early stages of development by staff and the other was a "minor" external matter of having to raise the State's Motors Fuel Tax in order to refinance our Transportation Trust Fund.

Please trust me when I tell you that either one of those tasks alone is enough to put you in an early grave - the two combined was really double jeopardy. The issue of access management is such a heavy lift politically that I urge you, if at all possible, to take this on when you can devote the energy and resources toward its enactment that are needed. If you don't have the political courage to take this on you'll never get through it.

Now to return to the three steps:

(1) <u>Identification of A Problem</u>

In the public arena there are so many legitimate competing interests for the State's resources that unless a significant number of policy makers and the public at large view an issue as worthy of being addressed, it will never reach the front burner.

Mobility (the safe, efficient movement of people <u>and</u> goods) has always been viewed as a public good because of its relationship to commerce, public safety, and defense. Today its benefit is expanded to national and international competitiveness and even to environmental protection. The public and the politicians understood that congestion was overtaking mobility.

As one of the oldest States in the Union, and the most densely populated, we recognized that the basic pattern of our transportation system was not likely to change. In many ways we are more like some European countries than we are like our sister States.

I mention this not so that you can dismiss anything else I am about to say because your circumstances are different, but just the opposite - I you to pay close attention because most of you have the ability to apply foresight where we only had hindsight. If you are not faced with the kind of congestion we experience in the northeast corridor (from Washington, D.C. to Boston) you may suffer these problems in certain urban and urbanizing pockets of your State and, if left unaddressed, you will find yourself in our shoes in the not too distant future.

Transportation and land use planners had long recognized that the capacity of our existing system was being swallowed up faster than we would deal with it. At the same time, the cost of adding capacity dramatically increased. While the public didn't understand this from a technical standpoint, they knew it to be true in their daily driving experience.

This empirical circumstance brought us to the basic underpinning of the legislation and subsequent access code; expressed as a question we asked ourselves and others, "Are we going to pave over the State in an attempt to build our way out of congestion, or are we going to find better ways to manage our existing system?"

Raising that question actually provided the first series of supporters needed to move the proposal forward:

1) the environmentalists who saw new or bigger roadways as a direct threat - the field of dreams syndrome of "build them (roadways) and they (sprawl) will come."
2) fiscally responsible legislators who, on an annual basis had to confront the need to have a balanced budget, and who had other areas in which they wanted to invest; and

3) all New Jersey residents whom we reminded had a $50B investment in the existing system from tax dollars they had already contributed.

(2) Development of suggested solutions

Now, with an expanded base of support, interested parties were brought around the table to review and refine the initial drafts of the legislation. We also began to "run it by" those whom we expected to oppose such a move: Developers, highway construction unions, land speculators, etc.

We asked the legislature to conduct public hearings and we made the rounds of the editorial boards of every newspaper - large and small which would have us. And I began an 18 month dog 'n pony show literally "taking the show on the road" to build support for this concept.

This phase of the effort takes a great deal of time. I would caution any of you who are considering such a move in your respective jurisdictions to take a long, hard look at your personnel before this public stage begins. You need several persons who have the credentials to progress this proposal while at the same time possessing the people skills to be able to entertain new ideas from many different interest groups which are often presented in a less than collegial manner!

This is where the "art" over takes the "science" in political science. You must be absolutely clear about the basic principles you want embodied in you ultimate law. If opposing interests are too strong, your legislation will be meaningless - if, however, they have legitimate bases upon which to request changes, those changes may ultimately bring these people to the table and help build support.

Our tenets were:

1) that the right of the motoring public took precedent over the right of the individual property owner who abutted the State highway system.

2) we wanted every highway segment to have the best possible balance of the conflicting goals of "mobility" and "access".

3) we wanted a set of standards for the type and spacing of permitted access points, and

4) we wanted the ability to revoke or modify existing access where we felt it was in the public interest to do so.

This phase took us a little over two years; working internally, working with the legislature and interfacing with the public, often through the media.

At this point my tenure as Commissioner ended and I was succeeded by NJ's current Commissioner, Tom Downs.

3) Enactment of the preferred remedy

This final step as you can imagine is equally as important as the first two. Rules and regulations had to be proposed and adopted to implement the program in an equitable and consistent fashion statewide.

This you cannot do without an Art Eisdorfer - but hopefully you can do it in less than the three and one half years it took New Jersey!

If you live in a State where people don't have such a vested right in access, it may be easier to change the rules of the game. In New Jersey - with 21 counties and 567 municipalities, all of which have a history of strong home rule - this was very difficult.

To Commissioner Downs' credit, when the first proposal met with not only multiple, but also substantive proposals for change, he "pulled" the rules and regs and went back to the drawing board. A second proposal also generated substantial comment, but it was clear that the Department had found the middle ground between the extreme positions on the key issues.

The code was adopted in April of 1992 and became effective in September of the same year. The five month delay reflected the need to provide extensive education to all affected communities: DOT staff, engineers and planners (public and private sector), developers, etc.

And finally, be prepared for the court challenges. In less than seven months from adoption and application of the code, the first major legal challenge has been mounted against the Department's claimed right to alter existing access. No doubt this is the first of many suits whose outcomes may change the complexion of access management in New Jersey and, therefore, nationally.

Conclusion

I see by the reading of your program that much of your time spent here at the Vail Conference is devoted to the more technical aspects of highway access management. If I had to leave but one thought with you based on by experience, it would be to put as much time, money and other resources into the political effort as you do into the technical effort.

You are asking property owners and drivers to change their expectations as to the functioning of their access points and their roadways. You may have the soundest engineering data to support your position that, from a safety standpoint, no access point should be within 100 feet of a signalized intersection, but if gas station owners and/or fast food restaurants, for example, are told that they can have only one access point, and their pumps or drive through windows dictate a pattern of internal circulation incompatible with one access point, you will be besieged by opposition from some very powerful lobbies.

Landowners don't want government telling them how to design their sites - they may not believe that the marketing of their property will be as attractive with alternative access as it might be with direct, visible access from the highway.

And finally, drivers expect to find certain uses, configured in a familiar fashion, along state highways. In England you know that to get gas you must get off the highway - in America we head for the highway and generally on the corner with a right in, right out. In fact, many municipalities in their zoning, require gas stations to be on the State highway.

These factors, combined with the consensus building nature of the legislative process, demand that your communications, public affairs, and governmental relations persons be every bit as good as your technicians - If you don't have them on staff - hire consultant!

Finally, above and beyond the technical foundation and the ability to build support needed to implement access management you need to have a vision of what your transportation system will be - not just for today or the near term but for decades to come. The articulation of that vision, expressed through sound public policies, demands that you couple land use with transportation planning.

In New Jersey we now have a pretty good picture of what we want and don't want. We no longer accept the supposition that the straightest distance between two points is a paved highway. When we make preliminary judgments about the movement of people and goods we first look at getting the job done with the existing system (management). We also ask whether some means other than via highway would be a better alternative (e.g., via rail, sea, or air) and we ask ourselves whether we want to, or can afford to, build our way out of congestions.

For those of you starting from scratch you have an ally not available to us - the Clean Air Act Amendments of 1990 which have served to put people on notice that the status quo in air quality, and transportation management is no longer good enough.

I wish you well as you go forward. To paraphrase a famous New Jersey Congresswoman, Millicent Fenwich (whom many of you may know was Gary Trudeau's mode for Lacy Davenport in the Doonesbury Comic Strip); she said "Growing old is not for sissies". Likewise, Access Management is not for sissies!

Session 5A

Elements of a Comprehensive Access Management Plan

Moderated by Bob Cuellar, Texas DOT

This administrative session focused on the key elements of an access management program and some of its administrative aspects. Three speakers made presentations which included a prototype access management regulation, an overview of the access management permitting process, and a discussion of roadway classification systems.

The first speaker was Phil Demosthenes of the Colorado DOT. He presented a paper, "A Regulation Prototype at the State Level," in which he describes the basic issues and elements common to regulatory access control and management. His access management statute and regulation prototypes include sections on the elements of a basic model law, administration, access category standards, and design standards and specifications. A summary of Mr. Demosthenes' presentation is provided in this section.

The second speaker was Art Eisdorfer of the New Jersey DOT. In his paper, "Permit Processing - Beginning to End," Eisdorfer describes the entire access permit process in the state of New Jersey. He outlines a six step process used in New Jersey and describes each stage: (1) the establishment of regulations, (2) the pre-application process, (3) the application process, (4) the issuance of a permit, (5) access construction, and (6) access maintenance. He also discusses the issuance of variances and the necessity to educate all parties involved about the process.

The final speaker was Suzanne Catanese of the New Jersey DOT who was presenting a paper for John Jennings entitled, "The Importance of Access Classification of Highways." The paper discusses why access classification is important for funding, future planning, and serving the public. It describes some of the benefits of classification including improvements to speeds, capacity, and travel predictability, and presents different methods for classifying roads based on function, environment, speed, volumes, and adjacent land use. Finally it provides a brief overview of how New Jersey uses roadway classification in its land use planning process.

This session was attended by approximately 50 people. Questions and answers for the speakers are summarized in the discussion section for Sessions 3A, 4A, and 5A.

Statute and Regulation Prototypes

Philip B. Demosthenes
Colorado Department of Transportation

Mr. Demosthenes presented a paper that is currently in draft form and unavailable for release at the time that these proceedings were produced. An overview of the presentation is provided below.

The paper draws on access management program experience in Colorado, New Jersey and Florida to present a prototype outline of an access management regulation. Four standardized paragraphs concerning the justification for access regulations are provided that address the benefits of an access management program including the preservation of functional integrity, enhanced mobility, increased capacity and improved safety. These are followed by a summary of the regulatory elements necessary to establish the statutory authority for an access management program at the state level. These elements include purpose, responsible agency, permitting, enforcement, and an appeals procedure. A prototype regulation that would reflect such enabling legislation is presented as the last section of the paper.

ACCESS PERMIT PROCESS

Arthur Eisdorfer
New Jersey Department of Transportation

INTRODUCTION

Access management laws, regulations, policies, and guidelines do not improve transportation safety and efficiency. Enhancements to our roadways increase safety and efficiency. The key to improving safety and efficiency through access management is implementation of a program.

PERMITTING IN NEW JERSEY

Suggestions For An Access Permit Program

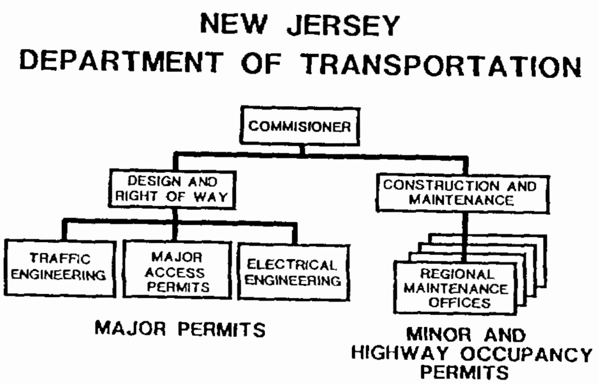
The administration of a comprehensive permit system addresses the following stages:

- Regulation or guideline implementation
- Preapplication activity
- Application submittal
- Application review
- Permit issuance
- Access construction and inspection
- Access use and maintenance

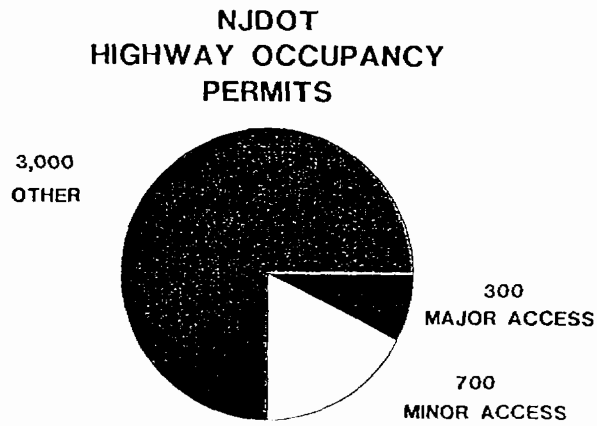
New Jersey History

New Jersey has had an access permit system for over 20 years. Within the past 2 years our regulations have changed substantially. However, the basic steps of our permit process have not.

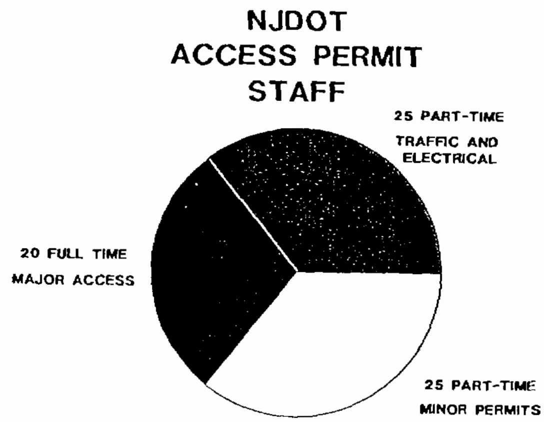
We use a hybrid system which is centralized for large traffic generators and decentralized for small traffic generators. Major access applications are handled by the Bureau of Major Access Permits. This bureau is part of Design and Right of Way and is housed in the headquarters complex in Trenton, our State capital. Minor access applications are handled by the 4 Regional Maintenance offices. They are part of Construction and Maintenance and are housed in regional offices.



The Department of Transportation issues about 4,000 highway occupancy permits per year. Approximately 1,000 of these are access permits, about 30 percent of which are considered major access permits.



There are approximately 45 employees who are engaged in permit-related activities on a full-time basis. About half handle access permits exclusively, and the remainder also cover other types of highway occupancy permits. Approximately 25 staff from our bureaus of Traffic Engineering and Electrical Engineering perform permit-related work part-time in conjunction with their other responsibilities.



My access permitting suggestions are derived from New Jersey's permitting history, which includes an intensive 3-year effort preparing our current access management regulations.

REGULATION AND GUIDELINE IMPLEMENTATION

How Extensive Should Access Regulations Be?

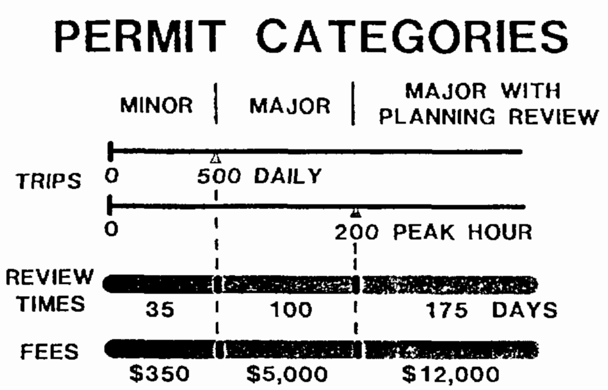
There should be written criteria governing when a permit is needed and when it is not and when access is permissible and when it is not. Publish these criteria and refer to them to support approvals and denials.

The regulations we prepared in New Jersey addressed almost every question which arose through the permit process during a 3 year period. This made our regulations very long. But the staff can apply the regulations consistently to almost every situation which arises in the future. We continue to monitor activity under the regulations and are now preparing our fourth package of changes to the regulations. Please note that our regulations have been fully effective since September 21, 1992.

How Should Permits Be Categorized?

The potential impacts of traffic attributable to a new development or redevelopment range from insignificant, such as for a single family residence, to substantial, such as for a regional shopping mall. It is advisable to separate permits into categories BASED ON TRAFFIC VOLUMES.

In New Jersey, access permits are divided into the following 3 categories:



An application for major with planning review includes a traffic impact study, which is not required for the simpler applications. The additional staff time needed to review these complex applications is the reason for the higher fees and longer review times.

How Many Permits Can There Be For One Lot?

Here Is How We View the World

A permit should cover one lot. Because a lot is the smallest unit of land which may be sold to another party, we require a separate permit for each lot which has access to a State highway. This enables a permit to be transferred when a change in ownership occurs. The permit is issued for access to a parcel of land, rather than issued to a particular owner.

Formerly, we issued a separate permit for each development. We then encountered administrative problems if only a portion of a development changed ownership. This was because the holder of the permit may not have had control of all of the access points, and the owner of some of the access points may not have been the holder of a permit.

Based on the same principle of one permit per lot, a permit should expire if a lot is <u>subdivided</u> or <u>consolidated</u> with another lot. Under either subdivision or consolidation, the original lot would no longer exist, therefore, the permit for the original lot cannot continue to exist.

Should Traffic Be Measured or Estimated?

New Jersey considered two options for which type of traffic volumes to use for access permits. The first was to use <u>actual</u> traffic counts and the second was to use <u>estimated</u> traffic volumes.

Measuring traffic is not possible for a development which is proposed. This creates a practical problem if an agency desires to treat new developments and redevelopments the same way. But even if measuring was always possible, the statistical validity of a given measurement poses other problems. Traffic volumes fluctuate based on the weather, the economy, the season, the competition, the skill of the bsuiness operator, etc. These variations render any particular measurement highly suspect, which means that it would be a poor basis for a permit. Imagine how difficult it would be to administer a permit system where a permit may be jeopardized if a crowd showed up for a sale. So we found a better system.

The Institute of Transportation Engineers "Trip Generation" manual contains average daily and peak hour traffic volumes for many land uses. Founding a permit system on average trip generation means that if the size and type of land use do not change, neither will the trip generation. Half of all sites should generate less than the average, and half should generate more than the average.

New Jersey has had success in relying on average trip generation. The level of accuracy is sufficient, it is quicker and less costly to determine than counting traffic, and it can be consistently applied. It is also readily handled by computer and has been incorporated into New Jersey's toll free access computer information system.

An agency should also decide which traffic volumes are important; peak hour or daily; average or highest; peak of the generator or peak of the street. New Jersey uses the highest average peak hour and daily traffic volumes in its permit system. We want to ensure that our highway system will operate safely and efficiently when the maximum demand is placed on it.

Why Should A Permit Have Traffic Volumes?

When an agency issues an access permit, the permit should show the size and type of development anticipated, as well as the projected daily and peak hour traffic volumes. The regulation of access by a transportation agency should focus on transportation factors such as traffic, access spacing, and driveway geometry. The amount of traffic generated by a site and when the traffic arrives and leaves the site should be the main concerns of a transportation agency. The land use and its size should be of less importance than the traffic.

If a property owner changes the use on their property, there should be no need for the approval of the transportation agency as long as the traffic generation does not significantly change and the access points from the former use can adequately service the traffic from the changed use.

What Should A Permit Authorize?
Many people believe that an access permit only authorizes the construction of an access point. But this is not the main reason why a property owner wants a permit. They want to be authorized to use their driveway. Accordingly, a permit should grant the ability to construct access, to use it, and to maintain it.

What Should Be Covered In A Traffic Impact Study?
A traffic impact study shold only assess impacts attributable to site traffic. But a developer should not be responsible for the impact of any vehicle up to the midpoint of its trip to the site or beyond the midpoint of its trip from the site. Otherwise there is a risk of double counting. An agency could then, inappropriately, assess both the origin and destination of a trip from the same impacts.

Many property owners commission traffic impact studies with the expectation that traffic from their site will have no significant impact on local conditions. At the same time many agencies look to make developers responsible for existing, poor conditions which the agency has yet to cure. Here are several suggestions for both parties to consider: .

1. Encourage travel demand management. It reduces traffic generation so the developer has diminished responsibilities and the agency has fewer new problems to contend with.

2. Provide shared access, alternative access, and connections between sites. All of these shorten travel distances and help spread the traffic load.

3. Address passby and internal site trips. These provide a more accurate representation of the traffic generation attributable to a site.

4. Determine the impacts of traffic attributable to a development and then determine who is responsible for mitigation.

What Are Some Other Good Access Permit Program Provisions?

1. Each agency should have a provision for coordinating multiple applications which affect the same section of highway. This is one of the most difficult challenges to handle successfully. Too often, the agency and the applicants are not aware that two or more applicants desire to add traffic to the same location at the same time. Also, *developers are not always willing to work together.*

   In New Jersey, the Department addresses these situations by performing its own traffic impacat study, based on information provided by each of the applicants. Then, we assign the responsibility for impacts among the applicants based on their proportion of the total added traffic.

2. Every connection to a highway. This includes streets, public and private, as well as driveways. Also consider access over an easement. Our Department requires the owner of the land on which the access is located to be responsible for all traffic using that access point. This creates transportation equity, and provides little distinction between the features just mentioned.

3. CHANGES BY APPLICANT ONLY IN RESPONSE TO DOT COMMENTS Consequently, we no longer have to hit moving targets.

PREAPPLICATION ACTIVITY

Who They Gonna Call?
An applicant needs a person they can call if they have any questions or if they want to know the status of their application. Make staff available to take calls and meet with potential applicants before they must make a formal submission.

What Does A Potential Applicant Need To Know?
If different rules apply to different locations, how will an applicant know which ones to abide by? Are there different standards for urban and rural locations and for different types of highways?

A potential applicant needs to know the rules. The agency must be predictable, consistent, and timely. PUBLISH ANSWERS TO:

- Who needs a permit?
- What are the requirements for obtaining a permit?
- When in the development process should an application be submitted?
- Where are applications submitted?
- Why are permits necessary?
- How much will a permit cost and how long will it take to get one?

What Is A Preapplication Meeting?
A preapplication meeting is an opportunity, provided before a potential applicant prepares an application, for a potential applicant and their representatives, usually traffic engineers and attorneys, to discuss elements of an application with the staff who will review the application and issue the permit. Our experience in New Jersey led us to require preapplication meetings for complex applications. The exchange of ideas, the consideration of alternatives, and the face to face contact between potential applicants and staff enable applicants to prepare better applications and enable the staff to review them in less time. It also gives the customer a better feeling by meeting real, live people who are concerned about the potential application.

The following is a list of information we require at least a week in advance of a preapplication meeting.

1. Lot location noting route, direction, milepost, municipality, and county;
2. Size and type of each different land use;
3. Access and highway improvement schemes under consideration;
4. Trip generation, distribution, and assignment for each land use and time period analyzed;
5. Opening date or staging for development;
6. Buildout year;
7. Involvement with a Department traffic signal or electrical facility; and
8. Suggested agenda for preapplication meeting;

APPLICATION SUBMITTAL

What Should Be Included As Part of An Application?
PUBLISH CHECKLISTS. An agency should decide in advance what information is necessary to evaluate to make an informed decision on approval or denial of an application. MARK BY APPLICANT AND STAFF

Shouldn't Applicants Have Deadlines Too?
Every request for information should include a reasonable deadline by which an applicant must respond. An applicant who fails to progress an application should be sent a notice of denial, or, as our notice indicates, that the application is considered withdrawn.

Who Should Review An Application?
Ideally, every discipline represented in an agency may need to have input into the decision regarding an application. However, for each additional individual involved, the agency must expend additional resources to enable the individual to become familiar with the application. It is more efficient to have a multidisciplined staff member review an application than to have multiple people from different disciplines review an application.

New Jersey has tried a number of arrangements of personnel for application review and has found a hybrid system works best. Minor applications are reviewed by Maintenance personnel, who also inspect the construction related to access permits. Major applications are reviewed by a team comprised predominantly of engineers. They each have expertise in at least one of the disciplines of design, planning, traffic engineering, and electrical engineering. One of the team members is designated the case manager for each application. That person is responsible for the application and permit, contacts with the applicant, and scheduling team meetings.

While we have been set up in this fashion only since the beginning of the year, the team concept has yielded the following benefits:

1. The staff are becoming versed in more disciplines, making them better rounded and more valuable employees.

2. More than one person knows the history and status of an application, so questions may be competently addressed, even if the case manager is unavailable.

3. Each team member gains more experience by participating in the review of a larger number of applications.

4. Having more heads at the review table provides a wider range of potential solutions to the problems associated with an application.

5. Results are more consistent than when one individual handled an application.

6. There is no paperwork flowing between Departmental units. Conflicting comments over the appropriate position for the agency are resolved face to face, rather than via dueling memos. There is also less chance of correspondence being misplaced.

What Are The Results of An Application Review?
There are three possible conclusions of a review:

1. Approval
2. Conditional approval
3. Denial

If a permit is to be denied, the foundation for the denial should be firmly established based on published requirements. Denials frequently lead to appeals within the agency and through the courts. Make the case for the denial as strong as possible from the outset and establish an orderly file on the application because hearing officers and judges usually decide a case based on such a record.

How Should Deviations From Standards Be Addressed?
Every permit system should have a provision for an applicant to request a waiver, exception, variance, or whatever else an agency cares to call a deviation from the standards. Such flexibility permits the agency and the applicant to address:

1. Unreasonableness of a strict application of the standards.
2. Existing substandard conditions which are not the responsibility of the applicant.
3. Existing environmental, economic, or social constraints.
4. Uniqueness of an applicant's situation.
5. Conflicts between the requirements of agencies having jurisdiction.

The courts have traditionally scrutinized agency actions and overturned the actions if they are found to be <u>arbitrary, capricious, unreasonable, or contrary to law</u>.

Because agencies are obligated to act consistently, any exception which is granted has the effect of lowering the standard. Staff should be wary of recommending approval of any exception which they are not prepared to grant every time similar circumstances arise. It is also critical that an agency <u>maintain a log of all exceptions</u> which have been requested, noting the disposition and reasoning behind the outcome of each one.

In practice, we have granted only a few waivers. Most of these have been in situations where an applicant proposed to redevelop a site with poor, existing access. We were placed in the difficult position of having to either approve a waiver and obtain some improvement in the access plan or not approve a waiver, have the applicant withdraw the application, and be left with the poor existing access.

Who Should Handle Appeals?
Every permit process should include an avenue of appeal. Two additional levels of appeal appear to be adequate to reach a final agency determination.

It is best if those who handle an appeal have not been directly involved with the application which is the subject of the appeal, yet they must be familiar with access law, regulation, and agency guidelines.

It is significant to note that any applicant who appeals to the Commissioner or other upper management member without going through the formal appeal process may jeopardize their legal ability to appeal. Since our administration and applicants have become aware of this, upper management involvement in the access area has declined from almost daily to infrequently.

CONCLUSION
The access permit process is only one aspect of access management. I believe that the primary means of implementing access management is through education.

Many agencies administer access management programs through permit systems managed by lower level employees, who also perform field inspections. This can only be successful if the staff is knowledgeable about:

Why access management is important
Law
Regulations
Agency standards, policies, practices, and guidelines

IMPORTANCE OF ACCESS CLASSIFICATION OF HIGHWAYS

John C. Jennings, AICP
New Jersey Department of Transportation

ABSTRACT
For States interested in developing an access management program it is important to understand the access classification of highways. Generally, the deliverability of transportation projects is based on the function of the road.

According to FHWA "functional classification is the process by which streets and highways are grouped into classes, or systems, according to the character of the service they are intended to provide." Functional classification covers three types of roadways from arterial, collector, and local roads. On arterials, mobility is primary and access is secondary. On collectors, mobility and access are balanced; and on local roads access is primary, mobility secondary.

From a planning perspective, the concept of roadway classification helps government agencies explain to the public differences in the need to maintain mobility and the degree of accessibility to State highways.

This paper focuses on New Jersey's experience in developing an access classification matrix to help protect the functional integrity of the highway for present and future generations. The classification system helps the State maintain its public trust to protect its investment in the transportation network.

A description of the access classification of Colorado, Florida, Oregon and Washington is included.

Better access management benefits include higher travel speeds, shorter travel times, fewer accidents, less congestion, generally more roadway capacity for each lane.

The paper explains the process of building a consensus for the classification system and provides a history of the classification system in New Jersey.

NJDOT's access classification matrix uses functional classification, roadway type (divided, multi-lane undivided, or two-lane), urban/rural location, and high or low speed facility. The matrix contains 55 cells and provides an objective method to determine the appropriate access level to each highway segment. An access level was assigned to each cell to show the types of turning movements that are permitted to lots along that highway segment.

An element of the access classification matrix, the Desirable Typical Section establishes a common target for the maximum number of through lanes for each highway segment. This provides predictability to developers and will help guide future infrastructure investments for NJDOT, municipal and county agencies.

Problem areas identified during the development of the access classification matrix and a means to answer these problems are addressed.

Issues concerning air quality in urban areas, transportation and land use integration, and State authority versa "home rule" need to be looked at during the development of access classification system and the regulatory development process.

INTRODUCTION
For States interested in developing an access management program it is important to understand the access classification of highways. When a State government or metropolitan planning organization evaluates two identical proposed transportation improvements on different classes of roads, generally the project on the road carrying more traffic and providing for higher vehicle travel speeds is given a priority over the other project on the road that carries less traffic and serves local short distance trips. Considering the limited resources available to government, planners and managers need to be well-informed about access classification to evaluate the comparable deliverability of transportation improvements

"Functional classification is the process by which streets and highways are grouped into classes, or systems, according to the character of the service they are intended to provide (1)."

The standard presentation of functional classification covers three types of roadways from arterial, collector, and local roads. The classical scales shown on Exhibit 1 illustrate the relative degree of access versus mobility provided by these three classes of roads (1). On arterials, mobility is primary and access is secondary. On collectors, mobility and access are balanced; and on local roads access is primary, mobility secondary.

From a planning perspective, the concept of roadway classification helps government agencies explain to the public differences in the need to maintain mobility and the degree of accessibility to State highways. Understanding the concept of roadway classification helps many people see why access management is important.

New Jersey's access law recognized the State highway system is a network of principal arterials, where access should generally be considered secondary to providing mobility for the majority of motorists using the road (2). Also, the State has the duty to protect the functional integrity of the highway for present and future generations. The State has a public trust to protect its investment in the transportation network.

In New Jersey the law specified that the classification system be based on four criteria.

"*The Access Code shall classify each State highway segment.* The classification system shall be based upon the following criteria:

1. the function that segments of State highway serve and are planned to serve within the State highway system and within the general system of streets and highways.

2. the environment within which highways are located, including but not limited to urban and rural environments,

3. the appropriate and desirable balance between facilitating safe and convenient movement of through traffic and providing direct access to abutting property, and

4. the desirable rate of speed and the degree to which through traffic should be protected from major variations in speed (2).

The law recognized that using these criteria, the NJDOT could develop access standards. Besides, a hierarchy of roads; the spacing of interchanges, intersections (both signalized and unsignalized), and driveways significantly impacts achieving the benefits of access management. Different level of service standards and traffic signal bandwidth requirements were established based on a highway segment's access classification. Better access management benefits include higher travel speeds, shorter travel times, fewer accidents, less congestion, generally more roadway capacity for each lane.

This paper will explain the development of the access classification matrix, discuss issues of concern and give a brief history of the classification system through the regulatory development process. Input from the Advisory Committee shown issues that needed to be discussed and items learned during the access classification process will be shared as considerations that other agencies may want to consider during the development of their own access management regulations.

DEVELOPMENT OF THE ACCESS CLASSIFICATION MATRIX

Other State's Experiences

In developing New Jersey's classification system, the transportation consultant reviewed the access classifications that other states' use (3).

Colorado

Colorado has a five access category system (4). The access category determines the degree to which access to a state highway is controlled.

COLORADO'S ACCESS CATEGORIES

Category	Highway Type	Speed	Volume	Trip Lengths	Design Standards
1	Interstate	High	High	Long	Ramps, interchanges
2	Arterials	High	High	Long/medium	Intersections
3	Minor Arterials	Medium/ High	Medium/ High	Medium/long	Maintain 45 mph/urban Maintain 55 mph/rural
4	Collectors	Moderate	Moderate	Medium/short	Maintain 35 mph
5	Frontage/ Service	Low	Low	Low	Reasonable and safe access

Florida

Florida was developing a system using seven access classes rather based on ten criteria contained in the Florida law rather than the four criteria contained in the New Jersey law (5).

When the law lists too many criteria for consideration in developing the access classification system, an agency will find it more difficult to develop an access classification system. Any state considering, access management legislation needs to focus on a limited amount of criteria that can be carefully articulated and understood by the public.

Florida's rule one covering the permit process was implemented with an interim classification system. The second rule contained the seven classification classes for which standards for spacing of medians, median openings, signals, and connections vary. The class considered concurrency of infrastructure systems and input from separate metropolitan planning organizations.

Other States

Two other states were looked at. Oregon has four categories based on level of importance, divided into rural or urban for level of service, and classified by the criteria of function, traffic character, and "sphere of influence" (6). Washington uses functional classification (3).

ELEMENTS OF NJDOT'S ACCESS CLASSIFICATION MATRIX

NJDOT's access classification matrix uses functional/access classification, roadway type (divided, multi-lane undivided, or two-lane), urban/rural location, and high or low speed facility to determine the appropriate access level. Conceptually, high speed divided arterials in rural areas need less access than low speed two lane urban collectors. Exhibit 2 shows the Access Classification Matrix adopted under the New Jersey State Highway Access Management Code.

The matrix provides NJDOT an objective method to determine the appropriate access level to each highway segment. The access level determines how turns are to be made to properties abutting the State highway. The six access levels are shown in Exhibit 3. The roadway mileage for each access level is shown in Exhibit 4.

Access level 2 applies to rural high speed highways that may be widened and divided by a median. Access will be permitted at streets only to protect the rural character of the area.

An element of the Access Code Matrix, the Desirable Typical Section establishes a common target of the maximum number of through lanes for each highway segment. This provides predictability to developers and helps guide future infrastructure investments for NJDOT, municipal and county agencies.

NJDOT used the FHWA-approved functional classification system to classify State highways and placed each highway segment in an urban or rural environment. Considering New Jersey's legislative time frame of one year to develop the access code, this was believed to be the most objective system available because the counties had participated in classifying the roads and drawing the urban/rural boundary. The functional classification had been developed pursuant to Section 134 of Title 23, U.S. Code.

When FHWA approved the functional classes and urban/rural boundary based on the 1980 Census data, the procedures followed called for the urban/rural designation to be based on future year classification for 1990. Exhibit 5 shows the urban/rural areas of New Jersey. For access purposes and based on development patterns from 1983 (when the functional classification was completed) to 1988, NJDOT Planning slightly increased the urban mileage of some state highway segments.

Two other criteria NJDOT used in developing the Access Classification Matrix related to the speed limit of the highway and the ultimate build-out of the highway.

Tests for the speed limit breakpoint for high and low speed facility were performed by the transportation consultant and discussed with the Advisory Committee. This sensitivity analysis
showed how much mileage was in each matrix cell using different speed limits for the break between high and low speeds. In rural areas speed limits tend to be higher and breaking the high speed at 40 or 45 miles per hour would leave little highway mileage in the low speed category. By assigning 50 mph and up for high speed in rural areas about 81% of rural highways are considered high speed. For urban areas where speed limits are lower, NJDOT considered both 40 and 45 mph. By using 45 mph, about 66% of the urban highways are designated as high speed. The Committee decided that having standards applied to this speed limit made more sense in the urban areas where speeds tend to be lower.

This build-out called the Desirable Typical Section (DTS) was based on input from other NJDOT offices including the four Regional State Highway Design Bureaus, the Division of Transportation Systems Planning, and Capital Programming staff. This long range plan was based on traffic studies, corridor analysis, environmental and fiscal constraints, and professional judgement whether more development is likely along a highway segment. The Desirable Typical Section (DTS) focuses on the ultimate number of through lanes on a segment without declaring a horizon year this will be achieved. An ideal right-of-way width needed to accommodate the improvement was also listed.

The advantage of having a common target for NJDOT, municipal agencies, county agencies and developers is that it helps establish predictability and guide future infrastructure investments. The DTS establishes the limits on a capacity based system. Local officials need to realize that NJDOT will not approve access that violated the capacity of the DTS as shown by the flowchart on Exhibit 6.

DISCUSSION ISSUES ABOUT NJDOT'S ACCESS CLASSIFICATION MATRIX

The matrix resulted in 55 cells. The Access Advisory Committee discussed whether both urban and rural local roads should be combined with urban collectors and rural minor collectors. This would have reduced the complexity of the matrix by eliminating two rows of the matrix. Afterall, less than 10 center lane miles were classified as "local roads" out of the 1838 center lane miles on the accessible State highway network. However, the access management law authorizes counties and municipalities to develop their own access codes for roads under their respective jurisdictions, so the Committee recommended leaving both categories.

Problems with Functional Classification

In New Jersey, two major probiem areas appear using functional classification alone to determine access classification. In addition, a third issue may deserve some attention for State's starting out on developing access management classification systems.

First, attempting to stay within the guideline percentages of road mileage in each category based on urban and rural locations didn't work well considering the averages are "National averages" and are not representative of New Jersey's small size and dense development. Therefore, developing access classification for small and densely populated areas, the arterial system contains a higher percentage of roadway mileage and carries more vehicle miles of travel (VMT) than the national averages.

Secondly, the use of functional class to determine funding source under the previous Surface Transportation Act may have resulted in the improper classification of a road segment. Funding availability may have driven functional classification in some cases.

Both of these problems are eliminated by the creation of the Highways of National Significance and flexible funding under ISTEA. Therefore, agencies embarking on access management systems choosing to create an access classification system based on new Federal requirements wouldn't encounter these problems.

Another issue that agencies may want to address is that many metropolitan geographic areas are neither "city-like" urban or rural in nature. Agencies may categorize and develop separate standards for suburban areas, if there is strong pressure to control traffic growth in outlying urban areas.

NJDOT's regulations encourage infill in urban areas. In suburban areas where speed limits are higher more restrictive trip limits are imposed on nonconforming lots. Furthermore, the Access Code has the potential to make a difference in more suburban-like areas where there is more vacant land, and the more positive benefits of access management through implementing an access management plan may be realized.

Any government agency developing access regulations should expect pressure from the development community to classify all state highways as urban and apply urban standards to mobility problems. There is strong resistance to any change in requirements or standards including the need to manage access. Certain groups sometimes distort the possibilities of managing access to try and build public support for regulations that are less likely to protect mobility on the arterial highway. Just as having no regulations at all is dangerous, an agency should be happy with incremental change whose benefits will accrue over several years. Access management is not something that makes a big difference overnight. Patience and perseverance to explain and educate the many groups affected is necessary.

Planners should always keep as a high priority openess to modifications to improve the regulations, in order to be responsive to customers affected by the regulations. However, the proof is in the pudding that is delivering on access applications in a timely manner is the goal that the development community desires most. When agency staff is shrinking, and demands created by the Access Code complex; it is increasingly difficult to effectively evaluate applications. In times when the economy is slow, the number of applications is down but the ability of applicants to adjust to off-site traffic improvements measured by their analysis is also more limited.

Any agency that is interested in developing a classification system and permit regulations needs to realize that adequate resources, both staff and equipment, will be a major expense that has a significant bearing on the success of the product. A strong commitment needs to be made by the agency to adequately implement the program. In New Jersey, besides developing a permit tracking system, a customer-oriented computer system allows anyone to test different development scenarios, and the organization was streamlined to eliminate some concurrent reviews. NJDOT also recognizes that NJDOT transportation improvements need to abide by the same standards to increase the safety and capacity of the State highway system.

BRIEF HISTORY

The New Jersey State Highway Access Management Act was signed into law on February 24, 1989 and became effective on May 24, 1989 (2). The law created an Access Code Advisory Committee to monitor the development of the access regulations. The implementing regulations known as the Access Code were adopted on April 21, 1993 and became fully effective on September 21, 1992 (7).

Role of the Access Code Advisory Committee

Composition

The Governor and Legislature were given the opportunity to appoint up to nine members to this committee. The committee's purpose was to review and evaluate NJDOT's development of the Access Code.

Traffic engineers, business groups, residential developers, office developers, and bankers served on the committee. The two engineers had many years experience with site plan approval, roadway design work, and metropolitan planning organization research and programs. Representatives of the Chamber of Commerce, commercial banking institutions, and the leading residential condominium builder in the state were participants on the committee.

NJDOT was represented by engineers, planners, and a transportation consultant. The primary participants were involved with highway design, planning, and site reviews of major State highway access applications.

Time frame
The legislation gave NJDOT one year to develop the regulations. The transportation consultant prepared four task reports that were discussed with the committee prior to drafting the regulations. These reports covered Access Classification, Access Standards, Nonconforming Lots, and Access Management Plans. The Committee also reviewed draft copies of the first proposal.

First Proposal
The first Access Code proposal was printed in the New Jersey Register on April 2, 1990 (8). Five public hearings were held including two before legislative committees. Because of extensive testimony and written comments, NJDOT agreed to redraw the regulations. Without a specific proposal on the table; many stakeholders were reluctant to engage in the rule-making process.

A lesson learned is that most people subscribe to the concept of access management; however its particular application to "my" property is more difficult to accept. Over 120 sources provided 537 comments to consider in drafting the reproposal (8). Especially vocal were the fast food industry, gas station representatives, and those associations interested in redeveloping shopping centers.

Nonetheless, NJDOT received no comments from municipalities concerning the access classification system. Either people accepted the idea, didn't understand the concept, or realized a process to change any highway segment's access classification was provided for in the Access Code.

Developing the Second Proposal
As part of the revision process, NJDOT supplemented the Access Code Advisory Committee with people who had provided comments on the first proposal called the External Working Group. A larger Internal Working Group and this External Working Group discussed reworking the April 1990 proposal. NJDOT conducted two special sessions to address planning concerns with a third group called the Planner's Roundtable.

Based on input from the Roundtable, NJDOT prepared and distributed over 400 packages to municipal clerks, county planning boards, and metropolitan planning organizations. The packages contained a letter and maps showing the desirable typical section (DTS), access levels, and access classification of each highway segment. Two one-half day workshops stressed the importance of access classification and asked municipalities to compare NJDOT's desirable typical section to their local master plans. Over 100 participants attended the two one-half day sessions. Monmouth and Somerset counties held additional workshops with their municipalities. Exhibit 7 shows results of the 1991 Municipal-County Outreach.

Many attendees felt their highways served only local traffic and their preference was to grant as much access as possible, yet leave the highway configuration alone. The DTS is used to indicate the limits of a capacity based system, and local officials need to appreciate that the potential under zoning and master plans exceeds that capacity. The municipal land use law requires that communities look at how their plans relate to regional plans, and requires that municipal zoning conform to the Access Code standards. Efforts to help municipalities synchronize their planning activities with the Access Code requirements are continuing.

Second Proposal

The Access Code was reproposed on March 25, 1991 (9) and the section dealing with each State highway segment was modified based on local comments on September 16, 1991 (10). These changes to the access classification system included developing a "no change" desirable typical section to accommodate many local comments. Princeton residents were concerned that Routes 27 and 206 through the downtown would be widened and the character of the center lost. Approximately 30 miles of state highway in centers throughout New Jersey were changed to address this type of situation. The Access Code was adopted including the access classification system on April 21, 1992 and became fully effective on September 21, 1992 (8).

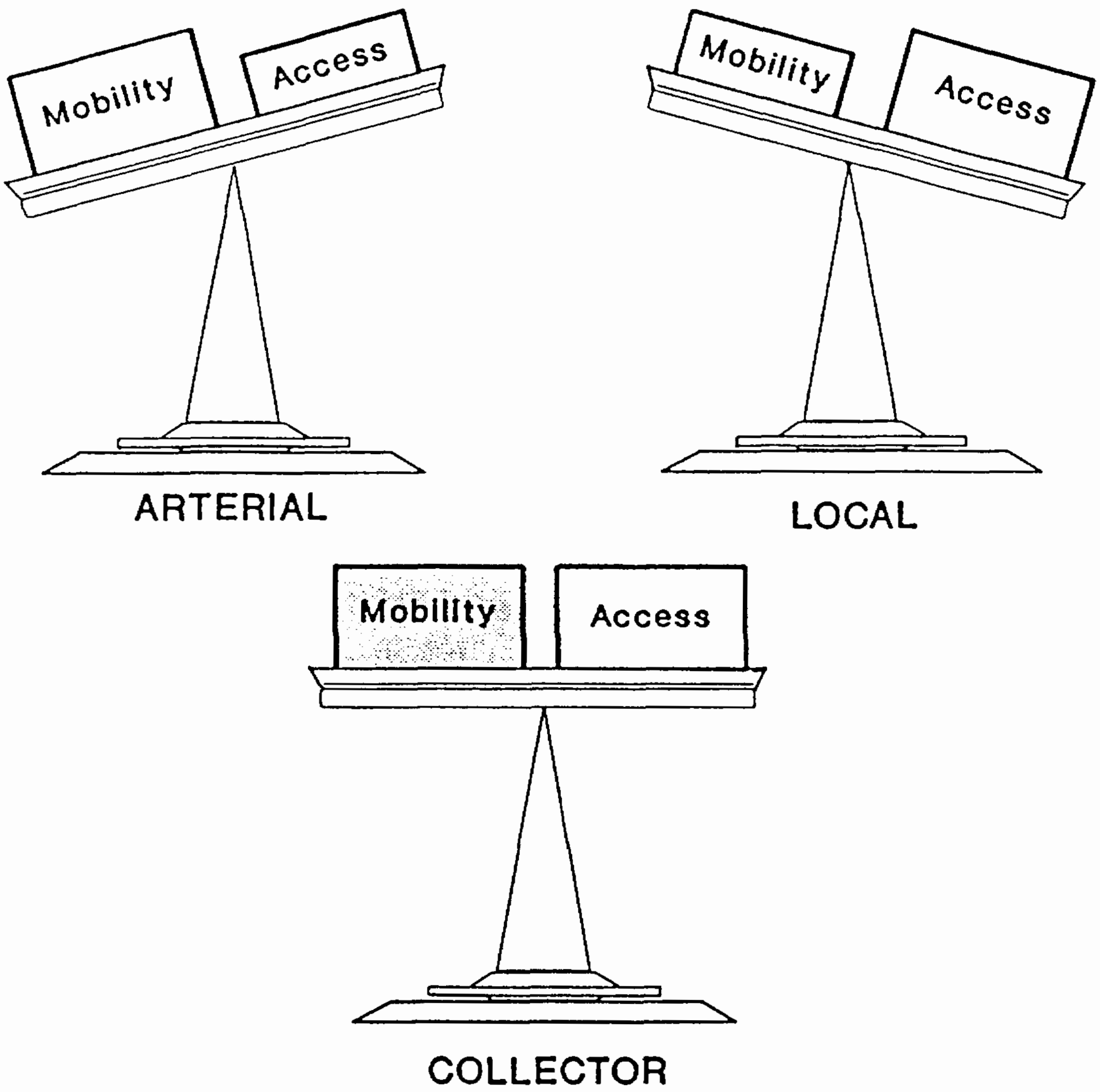
CONCLUSIONS
Of particular interest to urban areas is relating the long range plan contained in the Desirable Typical Section to the potential for air quality problems. Having developers suggest and contribute fair share traffic mitigation to capacity improvements may violate Clean Air standards and poses a dilemma for agencies giving approval based only on highway capacity.

The regulations and classification system need to address transportation and land use questions; however there is an uneasiness for a state agency to challenge "home rule" concepts. Although the law through the police powers of protecting health, safety, and welfare gives the State this authority; the State needs to actively seek local support and buy-in during the regulatory development process. An open dialogue with constant, careful explanations is a proven method to help an agency gain credibility and support from both local agencies and the development community.

SOURCES

1. U.S.D.O.T., FHWA, Highway Functional Classification, Revised March 1989, Washington DC.
2. N.J.S.A. 27:7 New Jersey Statutes, State Highway Access Management Act, Trenton, NJ, 1990.
3. Urbitran Associates, Inc., State Highway Access Classification System, February 9, 1990.
4. Colorado, The State Highway Access Code, 2 CCR 601-1.
5. Florida, Rules of the Department of Transportation, Chapter 14-97, Tallahasse, FL, December 1990.
6. Oregon, 1991 Oregon Highway Plan.
7. New Jersey Register, April 21, 1992.
8. New Jersey Register, April 2, 1990.
9. New Jersey Register, March 25, 1991.
10. New Jersey Register, September 16, 1991.

EXHIBIT 1



Philosophy of
Functional Classification

EXHIBIT 2

ACCESS CLASSIFICATION MATRIX
BASED ON DESIRABLE TYPICAL SECTIONS

URBAN CHARACTERISTICS												
	HIGH SPEED >=45 MPH						LOW SPEED <45 MPH					
	DIVIDED		UNDIV MULTI-LANE		2-LANE		DIVIDED		UNDIV MULTI-LANE		2-LANE	
ACCESS CLASS	ACCESS LEVEL	CELL	ACCESS LEVEL	CELL	ACCESS LEVEL	CELL	ACCESS LEVEL	CELL	ACCESS LEVEL	CELL	ACCESS LEVEL	CELL
ACCESSIBLE PRINCIPAL ARTERIALS	3	(1)	4	(2)	4	(3)	3	(4)	4	(5)	5	(6)
MINOR ARTERIALS	3/4	(7)	4	(8)	5	(9)	3/4	(10)	4	(11)	5	(12)
COLLECTOR ROADS	4	(13)	5	(14)	6	(15)	4	(16)	5	(17)	6	(18)
LOCAL ROADS	4	(19)	6	(20)	6	(21)	4	(22)	6	(23)	6	(24)

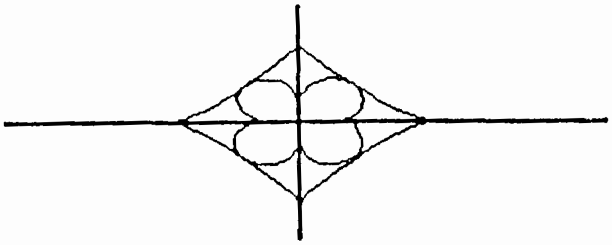
RURAL CHARACTERISTICS												
	HIGH SPEED >=50 MPH						LOW SPEED <50 MPH					
	DIVIDED		UNDIV MULTI-LANE		2-LANE		DIVIVED		UNDIV MULTI-LANE		2-LANE	
ACCESS CLASS	ACCESS LEVEL	CELL	ACCESS LEVEL	CELL	ACCESS LEVEL	CELL	ACCESS LEVEL	CELL	ACCESS LEVEL	CELL	ACCESS LEVEL	CELL
ACCESSIBLE PRINCIPAL ARTERIALS	2	(25)	4	(26)	4	(27)	3	(28)	4	(29)	5	(30)
MINOR ARTERIALS	2	(31)	4	(32)	5	(33)	3/4	(34)	4	(35)	5	(36)
MAJOR COLLECTORS	3/4	(37)	5	(38)	6	(39)	4	(40)	5	(41)	6	(42)
MINOR COLLECTORS	4	(43)	5	(44)	6	(45)	4	(46)	5	(47)	6	(48)
LOCAL ROADS	4	(49)	6	(50)	6	(51)	4	(52)	6	(53)	6	(54)

ACCESS LEVEL	DESCRIPTION
1	FULLY CONTROLLED ACCESS (ACCESS CELL 0)
2	ACCESS AT STREET INTERSECTIONS OR GRADE-SEPARATED INTERCHANGES
3	RIGHT-TURN ACCESS TO AND FROM AN ACCESS POINT WITH LEFT-TURN ACCESS VIA JUGHANDLE WHERE SIGNALIZED SPACING STANDARDS MET
4	RIGHT-TURN ACCESS TO AND FROM AN ACCESS POINT, LEFT-TURN INGRESS VIA A LEFT-TURN LANE, AND LEFT-TURN EGRESS FROM AN ACCESS POINT
5	ACCESS TO AND FROM AN ACCESS POINT LIMITED BY SPACING REQUIREMENTS AND SAFETY CONSIDERATIONS
6	ACCESS TO AND FROM AN ACCESS POINT, LIMITED BY EDGE CLEARANCE AND SAFETY CONSIDERATIONS

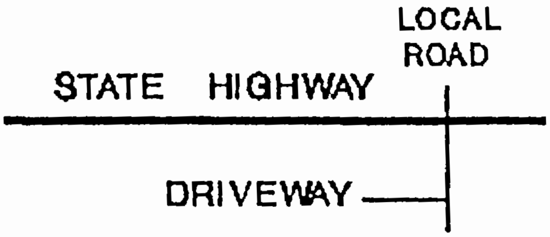
NOTE FOR CELLS WITH ACCESS LEVEL 3/4; ACCESS LEVEL WILL DEPEND ON DEPARTMENT PLANS FOR THE ROUTE. 4/91

EXHIBIT 3

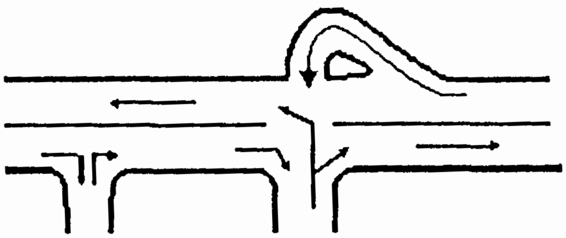
ACCESS LEVEL 1



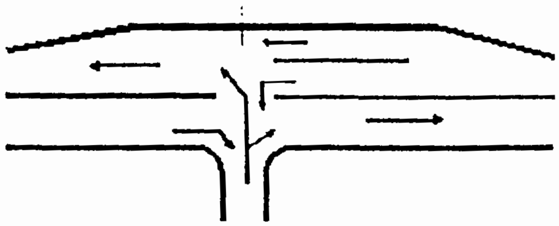
ACCESS LEVEL 2



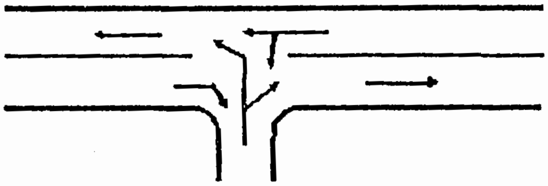
ACCESS LEVEL 3



ACCESS LEVEL 4



ACCESS LEVEL 5



ACCESS LEVEL 6

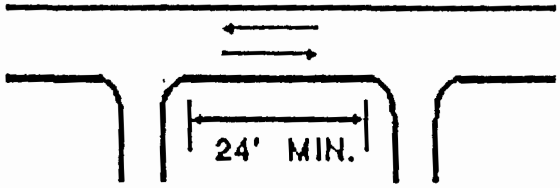


EXHIBIT 4

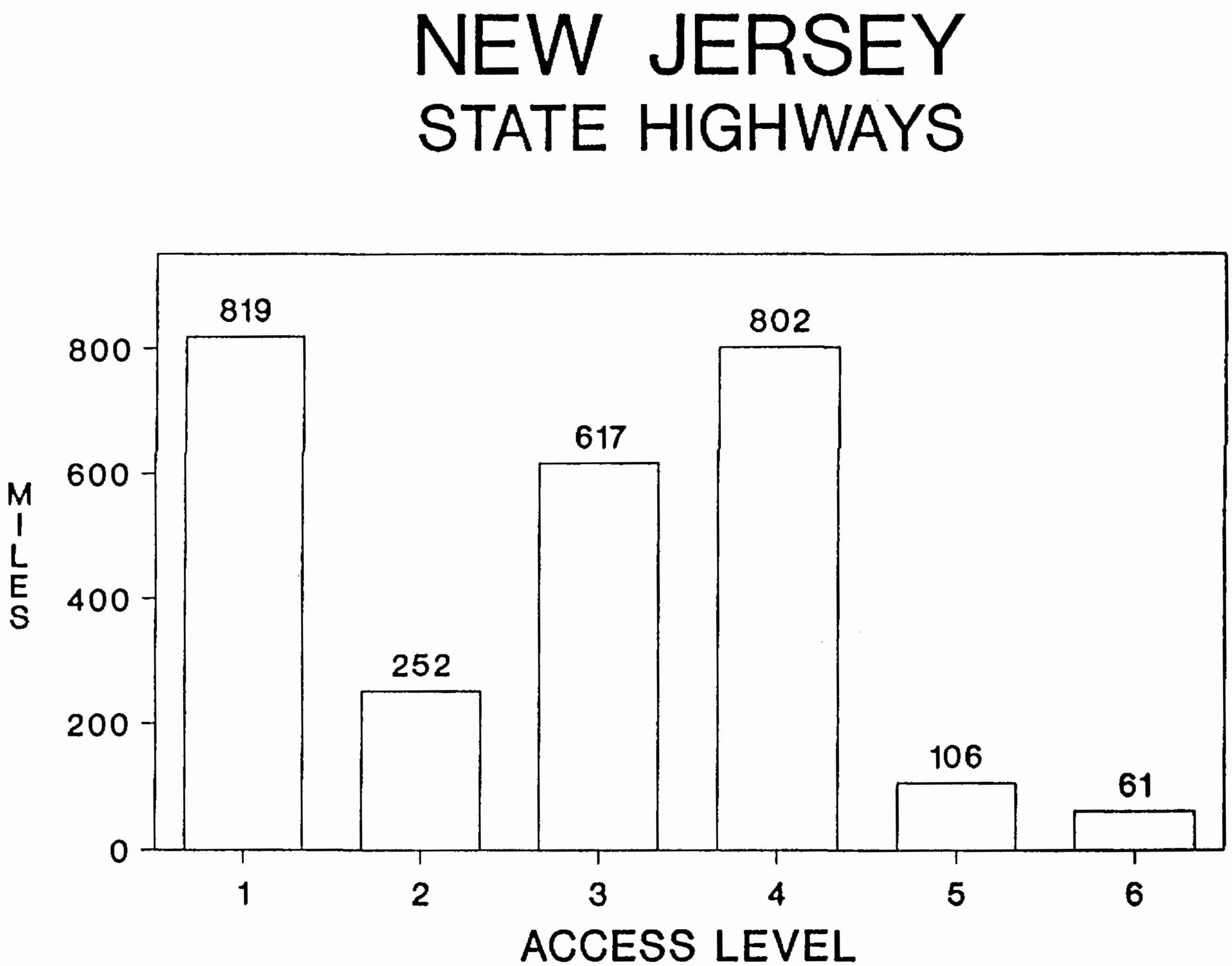

NEW JERSEY
STATE HIGHWAYS
819
802
617
252
106
61
800
600
400
200
0
MILES
1
2
3
4
5
6
ACCESS LEVEL

EXHIBIT 5

URBAN/RURAL BOUNDARIES

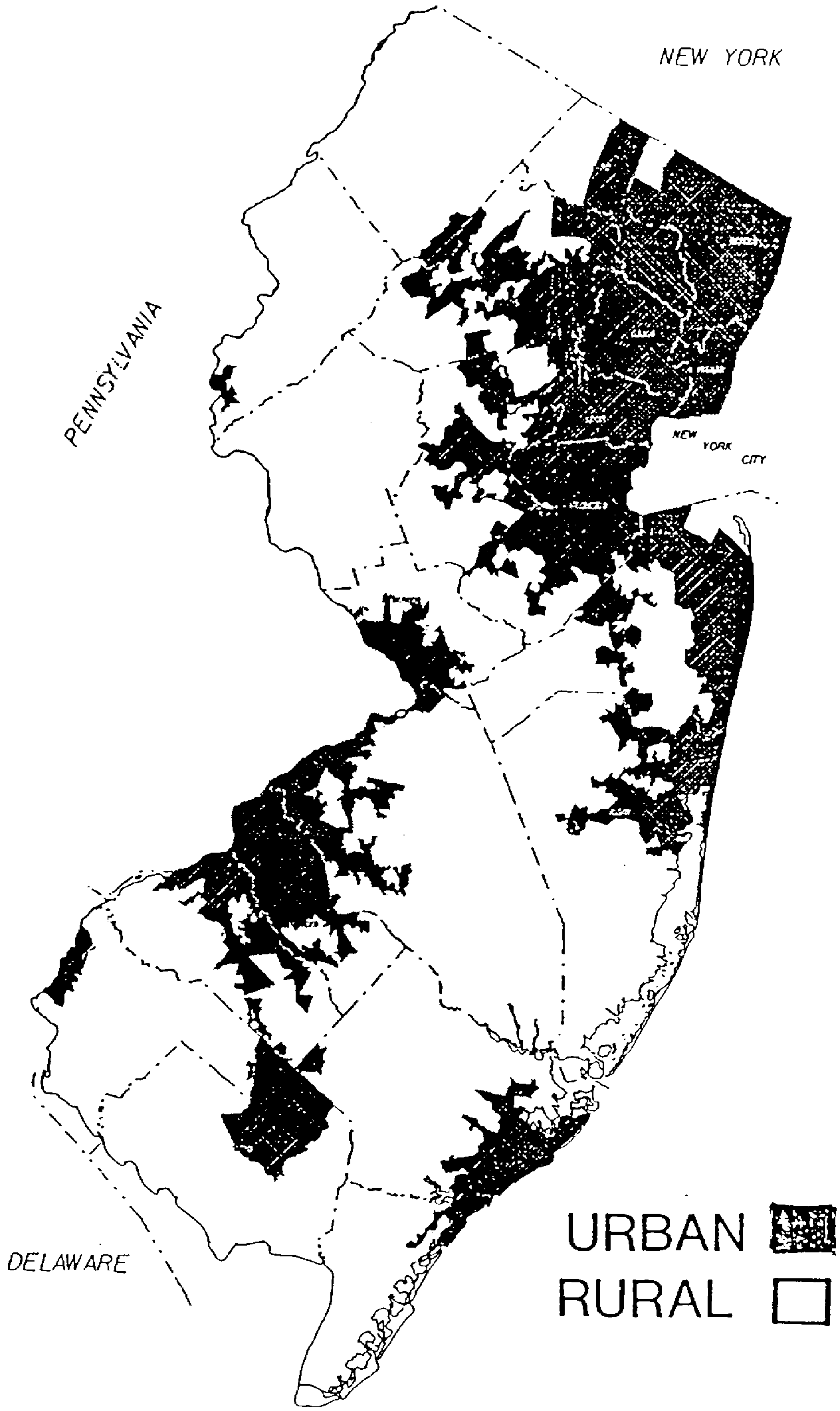


EXHIBIT 6

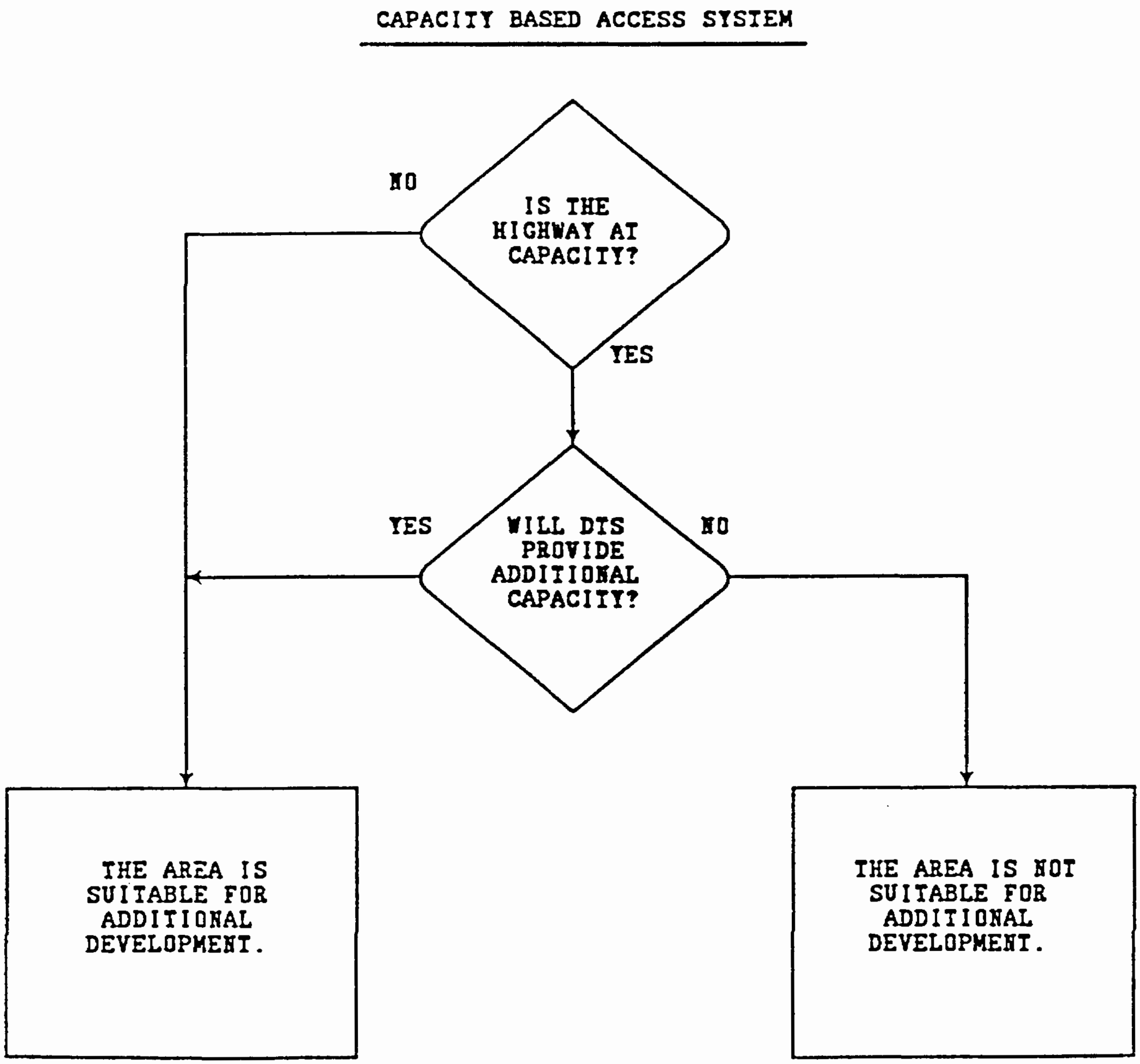

CAPACITY BASED ACCESS SYSTEM
IS THE HIGHWAY AT CAPACITY?
NO
YES
WILL DTS PROVIDE ADDITIONAL CAPACITY?
YES
NO
THE AREA IS SUITABLE FOR ADDITIONAL DEVELOPMENT.
THE AREA IS NOT SUITABLE FOR ADDITIONAL DEVELOPMENT.

EXHIBIT 7

ACCESS CODE
1991 MUNICIPAL-COUNTY OUTREACH

COUNTY	*COUNTY RESPONSE*	*# MUNICIPALITIES*	*RESPONSES*
Atlantic	No	20	3
Bergen	No	46	4
Burlington	Yes	31	5
Camden	No	32	2
Cape May	No	7	2
Cumberland	Yes	10	4
Essex	No	16	1
Gloucester	Yes	19	2
Hudson	No	10	0
Hunterdon	Yes	21	6
Mercer	Yes	12	9
Middlesex	No	19	2
Monmouth	Yes	43	19
Morris	Yes	31	9
Ocean	No	25	7
Passaic	Yes	10	3
Salem	Yes	13	2
Somerset	Yes	17	6
Sussex	No	18	1
Union	Yes	17	3
Warren	Yes	21	5
Special Jurisdictions	--	8	1

Session 5T

Local Government Approach to Access Management

Moderated by Frank "Bud" Koepke, Metro Transportation Group

This technical session covered topics related to access management at the local level. Three speakers discussed topics related to how access management fits into the site planning process, how access management can be used as a congestion management tool, and how land use regulations can support access management.

The first speaker was Gary Sokolow of the Florida DOT who made a presentation titled, "Access Management in the Site Planning Process." In it he describes a methodology for site development that stresses access management and differs from the way that site development is often done today. He covered access issues including driveway design treatments, turn lanes, internal circulation, and joint access and discussed the importance of designing a site from the outside in rather than the other way around.

The second speaker was Vergil Stover of the Texas Transportation Institute. In his paper, "Access Control as a Congestion Management Measure," he describes how access management will be an integral part of the congestion management systems (CMS) mandated by ISTEA. He briefly discussed different access management techniques (signal coordination and spacing, medial access, and marginal access) and their potential to reduce congestion and delay and improve safety. He also discussed the importance of implementing a long range access management plan and the necessity for cooperation between local governments, state agencies, and developers.

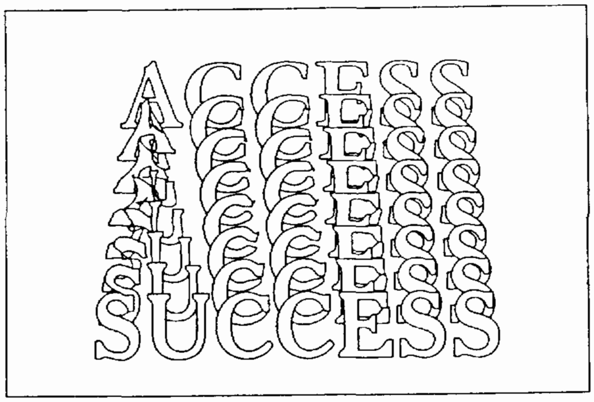
The final speaker was Kristine Williams of the Center for Urban Research, University of South Florida. She presented a paper, "Land Development and Subdivision Regulations that Support Access Management," in which she describes how strict development regulations can enhance access management. She argued that conventional strip development and lenient lot split rules cause deterioration in the performance of our arterials because they require too many access points. She discussed access management issues related to lot split requirements, single access subdivisions, driveway spacing requirements, joint access, and retrofitting non-conforming properties. Finally, she stressed the need for simplified review processes and better coordination among review agencies to ensure that land use planning and access management work hand in hand.

This session was attended by approximately 70 people. Questions and answers for the speakers are summarized in the discussion section for Sessions 3T, 4T, and 5T.

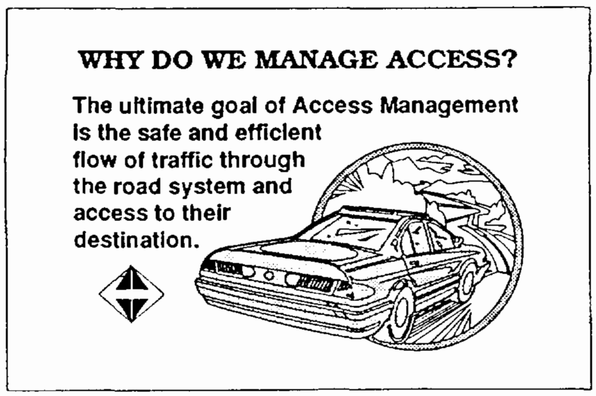
ACCESS MANAGEMENT IN THE SITE PLANNING PROCESS

Gary Sokolow
and
Kurt Eichin
Florida Department of Transportation

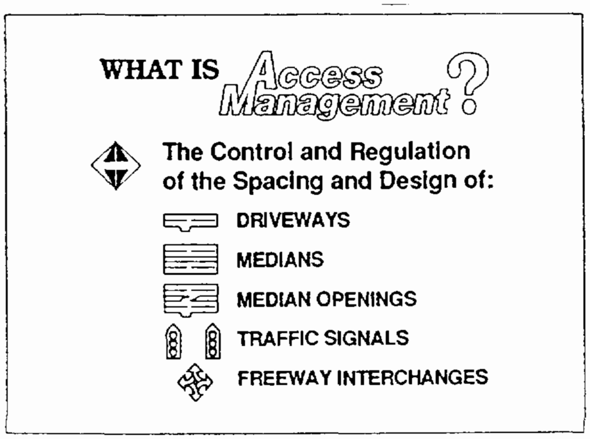
Introduction To Access Management Principles



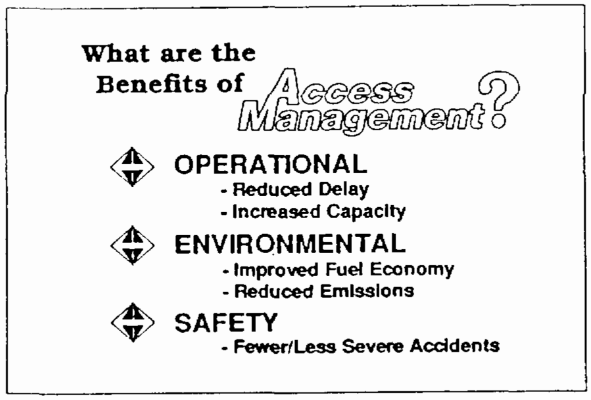
Critical to the success of any site plan is access to the highway system. Access is the way that vehicles enter and exit the highway system.



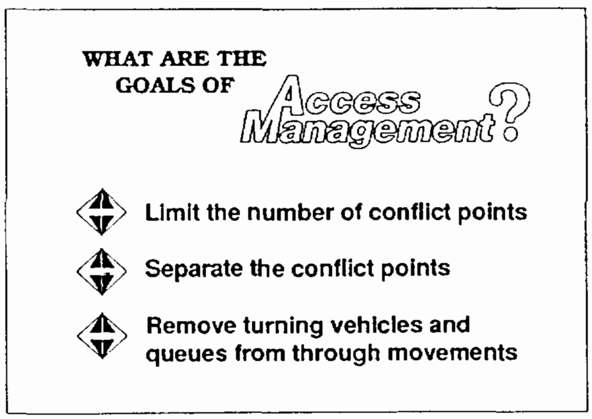
Access management is a comprehensive approach to the control and regulation of all aspects of highway access. They are, in fact only a part of the access process.



A full examination of access will include medians and median openings, traffic signals, freeway interchanges, as well as driveways.



Properly implemented, access management will result in improvements to traffic operations, minimize adverse environmental impacts, and increase highway safety. As traffic flow is improved, delay is reduced as are vehicle emissions. In addition, roadway capacity and fuel economy are increased, and most importantly, accidents are less numerous and/or less severe. **NIII 1-2**



By limiting the number of conflict points, separating the remaining conflict points, and removing turning vehicles from through lanes, access management can produce a safer and more efficient highway network. **NIII 4-1**

HOW ARE THESE GOALS ACHIEVED IN THE SITE PLANNING PROCESS ?

- Connection Location & Design
- On-Site Circulation & Parking

In the site planning process, these goals are achieved by careful adherence to standards which guide the location and design of connections, and well conceived on-site circulation and parking plans.

	Class	Medians	Connection >45mph	Connection ≤45mph	Median Opening Directional	Median Opening Full	Signal
		GENERALLY DEVELOPING OR UNDEVELOPED					
Well planned with system of service roads	2	Restrictive w/ Service Roads	1320	660	1320	2640	2640
Essentially the same except for medians	3	Restrictive	660	440	1320	2640	2640
	4	Non-Restrictive	660	440			2640
		GENERALLY DEVELOPED					
Essentially the same except for medians	5	Restrictive	440	245	660	2640/ 1320	2640/ 1320
	6	Non-Restrictive	440	245			1320
The Urban/ Suburban Strip	7	Both Median Types	125		330	660	1320

To assist in the control and regulation of access spacing, the Florida Department of Transportation has established a number of minimum spacing requirements for access points. These requirements are stated in Rule 14-97, which takes into account the highway's speed, the type of median, and the existing and potential intensity of development on the adjacent land. **Chapter 14-97 F.A.C.**

Site Design Principles

ISSUES TO INDENTIFY

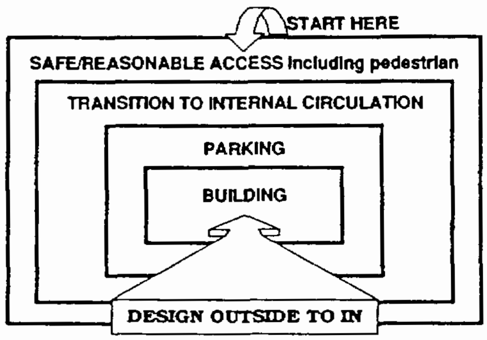
- SITE DESIGN ISSUES
  - Design vehicle dimensions
  - Vehicle turning path/speed
  - Pedestrian/Cyclist conflicts
- ROAD DESIGN ISSUES
  - Speed & Volume of surrounding roads
  - Speed differential
    - Deceleration rate
    - Acceleration rate

Site design issues include design vehicle dimensions and speed, and pedestrian/cyclist conflicts. Issues such as acceleration/deceleration rates, speed differential, and driver perception-reaction time are more readily categorized as road design issues. **NHI 7-9, NHI 6-7**

NECESSARY INFORMATION:

- Site plan
  - Basic geometry of site/ Aerial photographs
  - Detailed drawing of access, circulation & parking
  - Landscaping details
  - Location of existing/proposed utilities
  - Finished grades and contours
  - Neighboring properties
- The critical measurements (Rule 14-97)
  - distance between driveways
  - corner clearance
  - median opening spacings
- Traffic data critical to the site analysis
  - - look especially for conflicts (left turns)

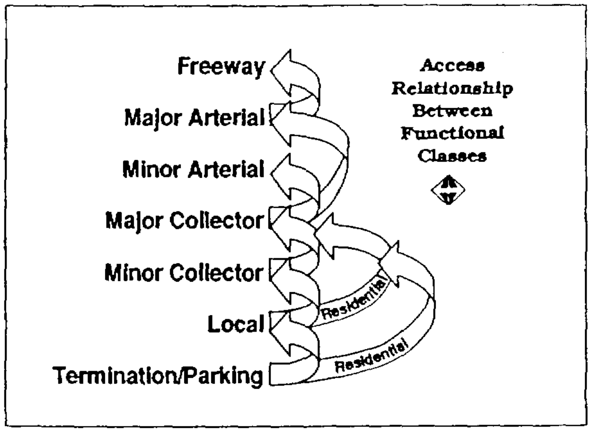
In addition to the road and site design issues mentioned, permit applicants should be required to supply additional information necessary for a comprehensive site plan review. Plan reviewers should be comfortable in their knowledge of the critical measurements found in Chapter 14-97. Reviewers should also obtain any available traffic information on adjacent roads, especially conflict identification.



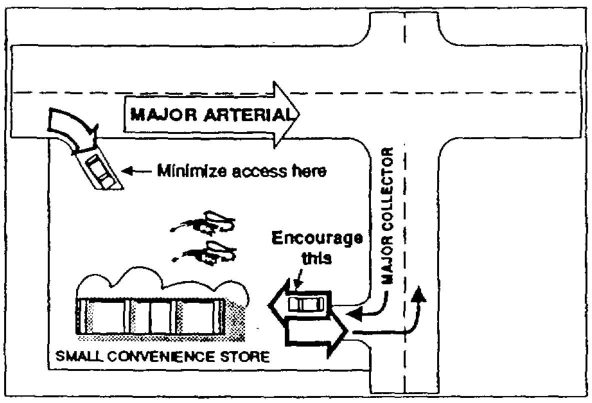
Site planning starts on the periphery of the site and works its way in. Driveways, median cuts, signals, etc., should be located first. Building footprints, internal circulation, and the like should be determined only after connections to the highway system are located. **NHI 7-3**

> Driveway terminals are in effect at-grade intersections and should be designed consistent with the intended use. The number of accidents is disproportionately higher at driveway terminals than at other intersections; thus their design and location merit special attention.
>
> 1990 AASHTO Greenbook

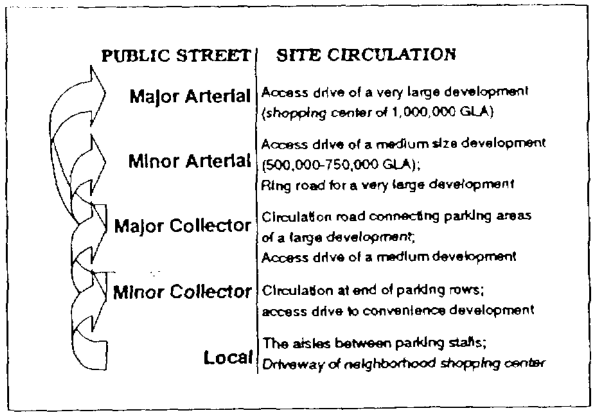
According to the American Association of Highway Transportation Officials, "Driveways are in effect at-grade intersections" with a disproportionately higher number of accidents than at other intersections, therefore due care must be given to their location and design. **NHI 2-1**



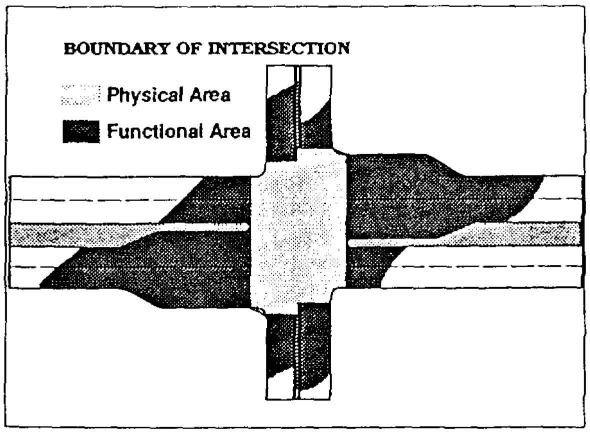
Designers and reviewers should also consider the access relationships between the functional classes in the highway and access system. An important access management principle states that roads should not connect directly into others of a much higher classification. For instance, a local road may be connected to a major collector, and a major collector may be connected to a minor arterial, but a local road should not connect directly with a major arterial if possible. **NHI 2-9**



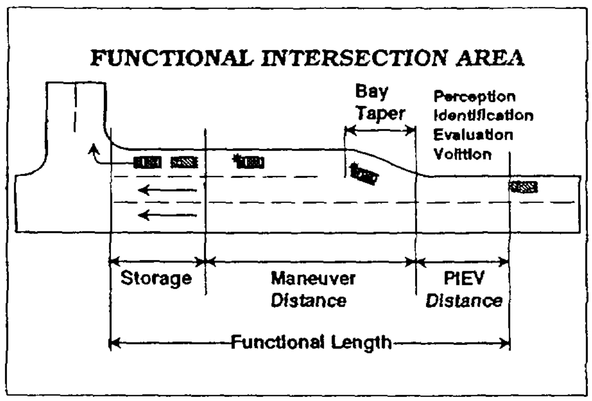
In this access management example, a small convenience market should ideally have the principal connection, which would be considered a minor collector, connect to a major collector rather than the major arterial.



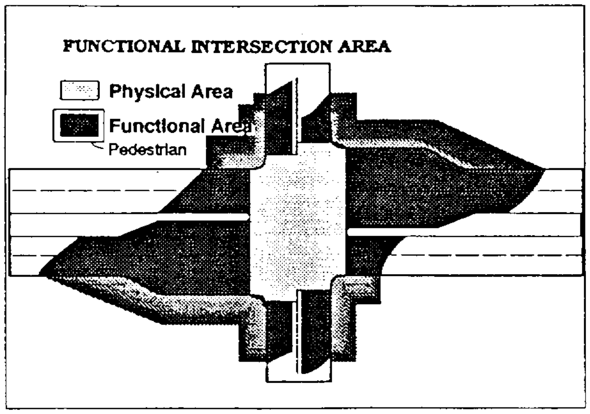
Using a rough estimate of the projected volume of the driveway, the reviewer can assign a conceptual classification to the driveway. This conceptual classification can then be used to determine an appropriate access location. **NHI 2-8**



All efforts should be made to prevent connections to the highway within the functional area of an intersection. **NHI 2-22**



Upstream functional area includes the PIEV distance, the distance required for maneuvering, and the vehicle storage space. The PIEV is the distance required for driver Perception, Identification, Evaluation, and Volition of traffic decisions. Downstream limits of the functional area re less readily identified. **NHI 2-25**



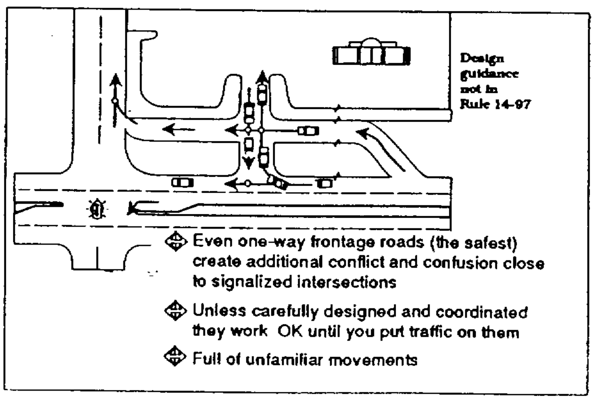
The functional area also included bicycle and pedestrian facilities.

CONNECTION SPACING & CORNER CLEARANCE

Access Class	Medians "Restrictive" physically prevent vehicle crossing "Non-Restrictive" allow turns across at any point	Connection Spacing (feet)		Median Opening Spacing		Signal Spacing
		>45mph	<45mph	Directional	Full	
2	Restrictive w/ Service Roads	1320	660	1320	2640	2640
3	Restrictive	660	440	1320	2640	2640
4	Non-Restrictive	660	440			2640
5	Restrictive	440	245	660	2640/ 1320	2640/ 1320
6	Non-Restrictive	440	245			1320
7	Both Median Types	125		330	660	1320

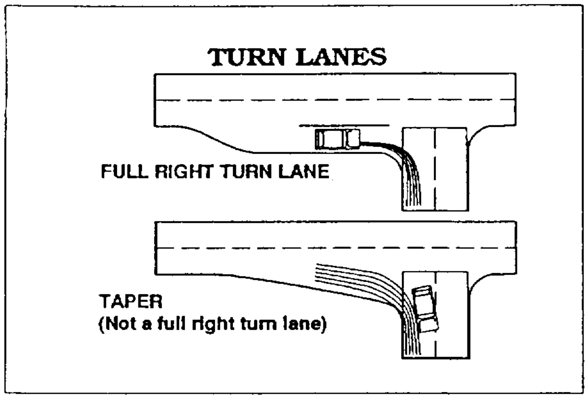
To assist in the determination of functional area, Rule 14-97 describes the minimum distances acceptable between driveways, intersections, signals, and median cuts. The primary goal of the minimum spacing standards is to prevent a driver from encountering more than one conflict at a time. These numbers can be used as estimates for the upstream limits of the functional area. Though in some cases, that functional area may be much larger.
Chapter 14-97 F.A.C.

Access Service Roads

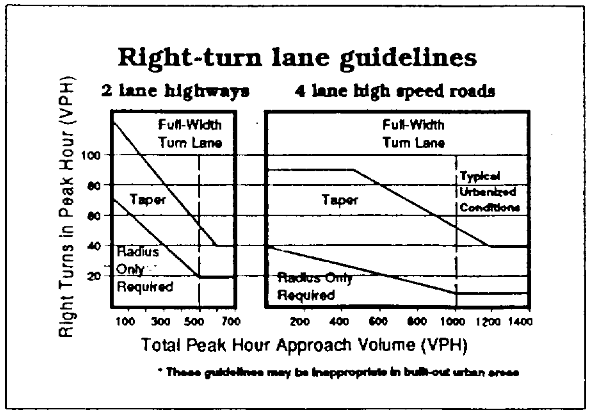


Access service roads have been used to separate access movement from through movements. Be careful when using this approach, as access roads often create or amplify more conflicts than they eliminate. Many times, service roads can actually increase the number of traffic conflicts. Without careful design and construction, even one-way access roads, usually considered safer than two-way roads, can cause problems. **NHI 6-63**

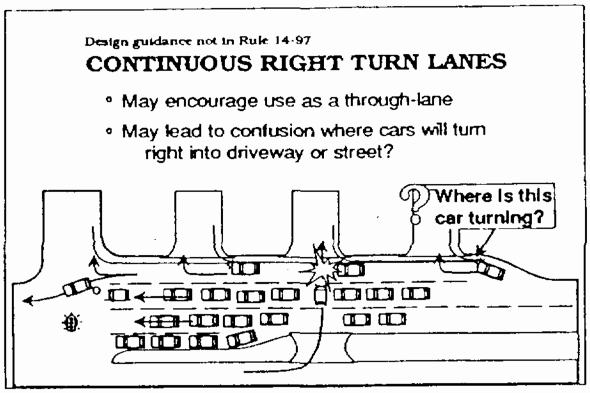
Turn Lanes



Tapers and right turn lanes can be used to provide a better transition from the road to the property. FDOT does not have any official standards for the requirement of right turn lanes.

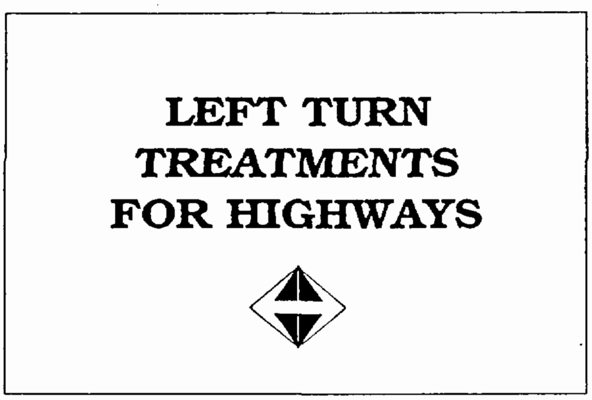


The National Cooperative Highway Research Program Report #279 says that if the Design Right Turn volume is between 20 and 40 vehicles per hour, a taper should be provided. If the design right turn volume is over 60 vehicles per hour a full right turn lane should be provided. Use of these guidelines should include a thorough inventory of surrounding land uses. Thresholds for built-out urban areas should generally be assumed to be higher.
NCHRP Report 279 pg. 64

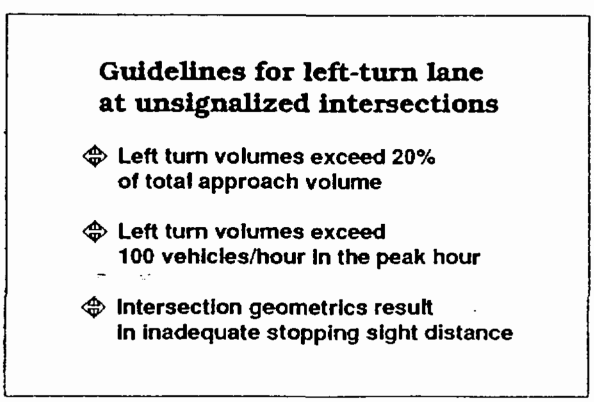


Use of continuous right turn lanes also introduces new problems. Near intersections with considerable queuing, right turn lanes often function as auxiliary through lanes creating several potential hazards. Not only are drivers attempting to enter the roadway confused, left turning vehicles from the opposing lane are often put at considerable risk, especially when "good samaritans" stopped in the queue wave left turn traffic through.

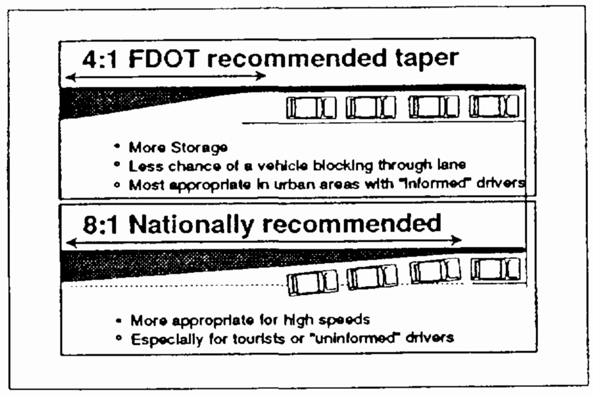
Left Turn Treatments for Highways



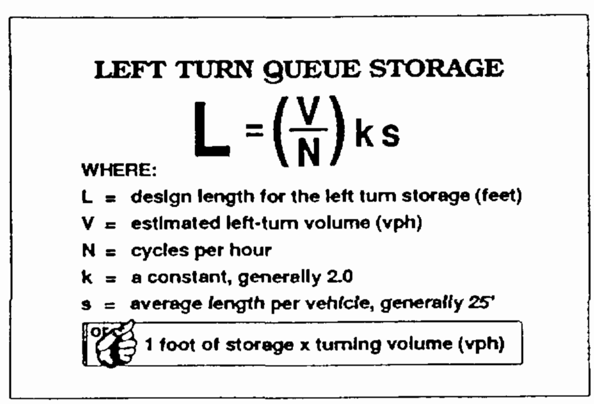
Left turns are perhaps the single most influential movement affecting traffic flow. FDOT has no established warrants for determining when a left turn lane is necessary at an unsignalized intersection. **NCHRP Report 279 pg. 49**



Report #279, however, does list several "rules of thumb" that are useful in determining the need for left turn lanes: Left turn lanes or separate treatment should be used when left turn volumes exceed 20% of total approach volume, left turn volumes exceed 100 vehicles/hour in the peak hour, or intersection geometrics result in inadequate stopping sight distance. Degradation of traffic flow is not the only cause in determining the need for left turn lanes. Safety plays a *large part in the decision-making process.* For instance, rural signalized intersections rarely present capacity problems, however, most would agree that separate lanes for left turning vehicles are necessary in high speed isolated locations.



Design standards for left turn lanes are available from several sources, most of which base their rate of taper on approach speed; the faster the speed, the longer the taper. The FDOT does offer standards for the design of left turn lanes. The FDOT Standards Index of 1992 dictates the use of a 4:1 ratio for bay tapers on all multilane divided facilities regardless of speed. This may be a considerably abrupt transition area, however, most urban areas will benefit from a longer storage area. Urban speeds are generally lower which lessens the need for gradual tapers. Some rural, high-speed facilities may warrant a more gradual taper, especially where high numbers of tourists and other drivers lacking local knowledge are present.
NHI 6-34



Adequate storage for left turning vehicles is critical to access management goals. In one calculation method storage equals the number of turning vehicles per hour divided by signal cycles per hour times a constant, usually equal to two, times the average vehicle length. NHI 6-41

A simple, though less accurate method, is simply to multiply the average number of vehicles turning per hour by 1 foot. This method should be used only in conceptual analysis.

LEFT TURN QUEUE STORAGE

$$L = \left(\frac{V}{N}\right) k s$$

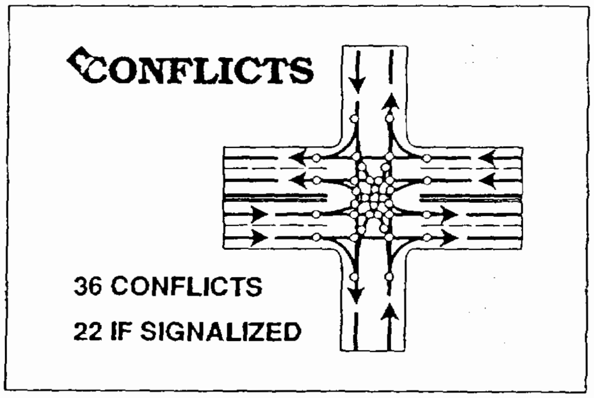
$$\left(\frac{180 \text{ vph}}{40 \text{ cycles}}\right) 2*25' = 225 \text{ feet}$$

40 cycles = 3600 seconds / 90 seconds

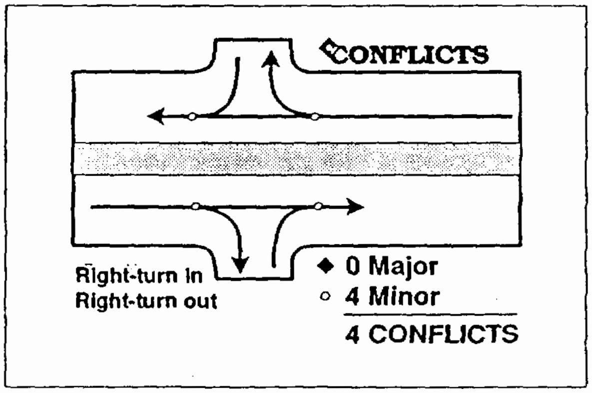
For example, if there are an estimated 180 turning vehicles per hour and 40 cycles per hour, application of the formula would yield a result of 225 feet of required storage. Using the rule of thumb, 180 feet would be required. The difference between these numbers increases greatly as cycle length increases, so caution is well advised. Regardless of the method used, the reviewer must realize that storage does not include PIEV or maneuver distance. These distances must be added to any necessary storage. Of course, all of these calculations should be reviewed by District Traffic Operations Staff.

Channelization and Conflict Reduction

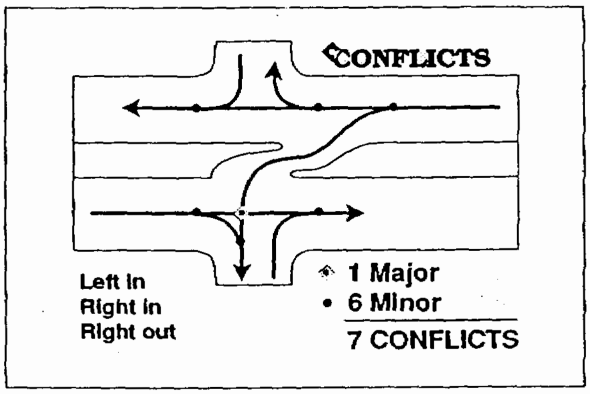
Careful treatment of left turn lanes is necessitated by the severity of conflicts they generate. Restricting or prohibiting left turns through channelization can greatly reduce the safety, operational, and environmental problems they pose.



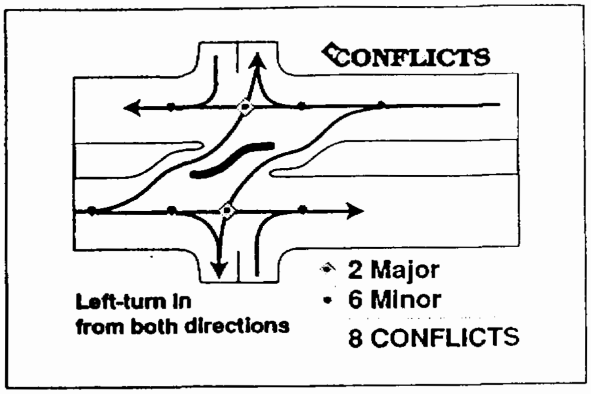
A typical four-legged intersection, such as where two driveways line up across a four lane arterial, has 36 conflict points or 22 if signalized.



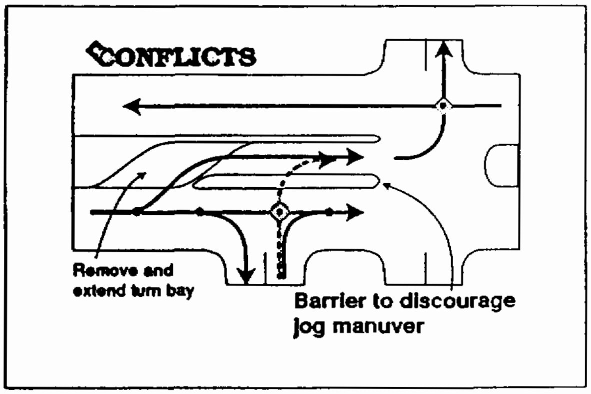
Restricting left turns and through movements can reduce the number of conflicts to four which is two per arterial direction of travel.



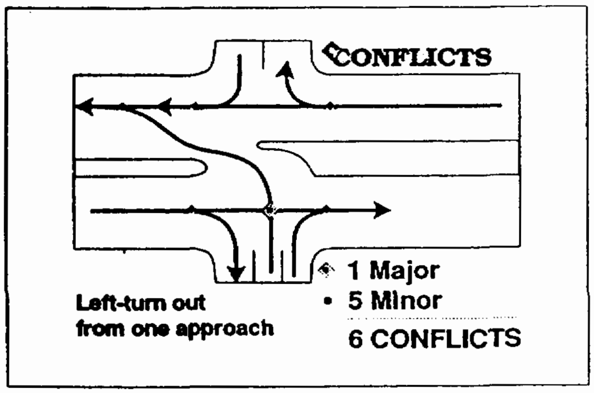
Notice the distinction between major and minor conflicts. Merge and rear-end conflicts are less severe than crossing or head-on conflicts. Sometimes it is appropriate to "trade" major conflicts for minor conflicts.



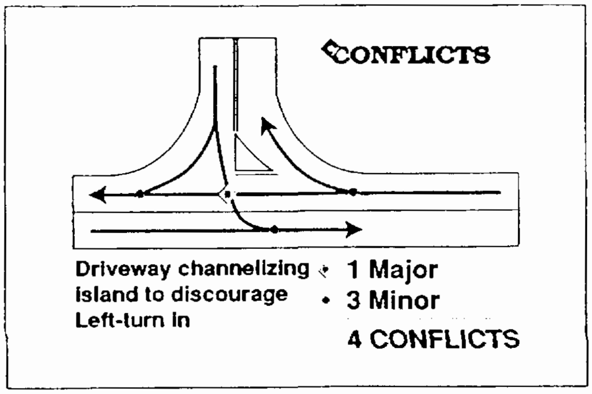
Numerous medial treatments exist to meet the needs of a specific driveway's operations. The elimination of crossing and especially left turn movements can significantly reduce conflict.



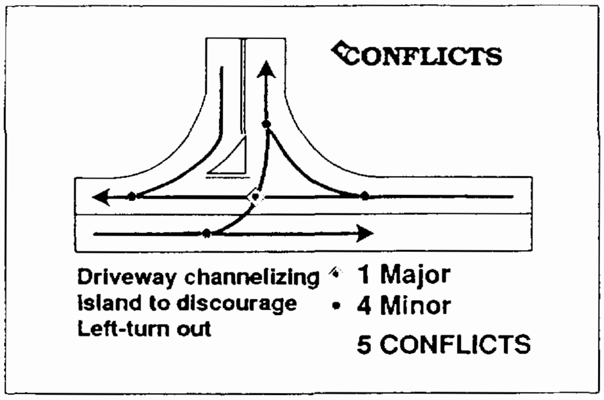
Channelization can be used to prevent unsafe "jogs" occurring when drivers attempt to make a left hand turn from a driveway that is very close to an intersection. As with all channelization, the design should not introduce new hazards such as a dangerously wide barrier. NHI 4-25



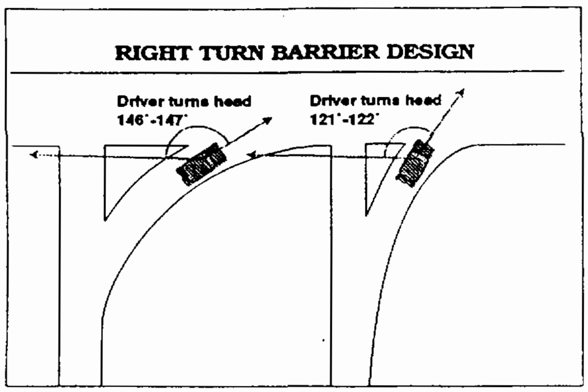
Florida law states that the FDOT is not limited in its ability to restrict operational characteristics. This gives the Department considerable authority to control the design and spacing of median openings and signals. **Chapter 335. F.S. 184(3)5(d)**



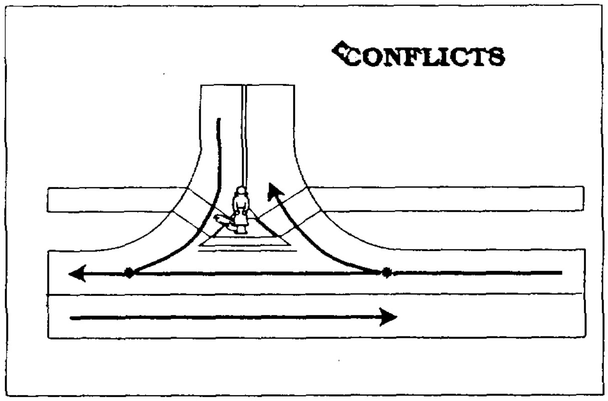
Florida allows the Department to restrict the directional movements of driveways. For example, while the Department may be required to grant access to a particular property, safety and/or operational concerns may require restricting driveway movements to the right in only movements. **Chapter 335. F.S. 184(3)5(d)**



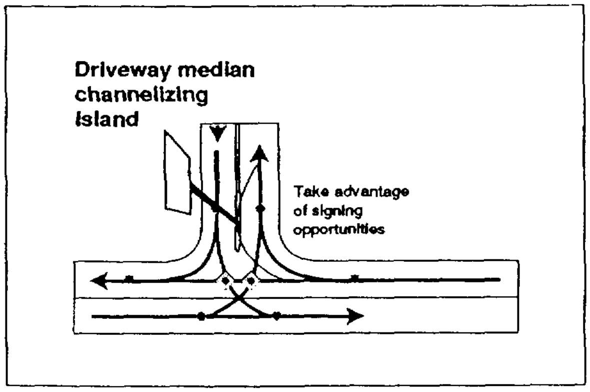
Restrictions may be fine tuned to specific traffic conditions by designing channels to control traffic movements.



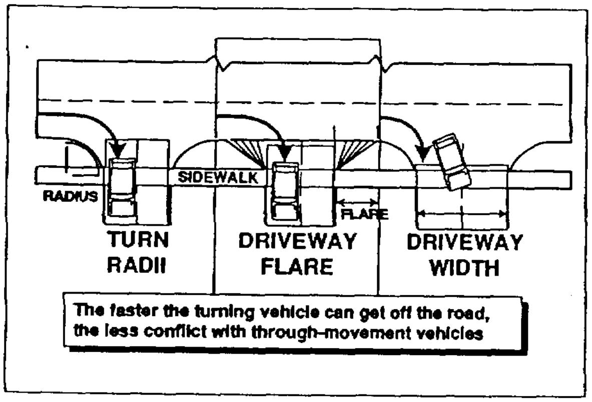
For example, designing the barrier so the vehicle approaches at a 55 degree angle allows a driver to look over his shoulder easier without significantly affecting acceleration.



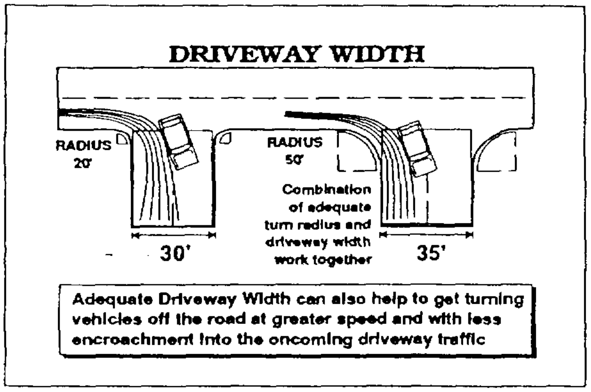
Channelization not only benefits vehicular movement but also serves as a pedestrian refuge.



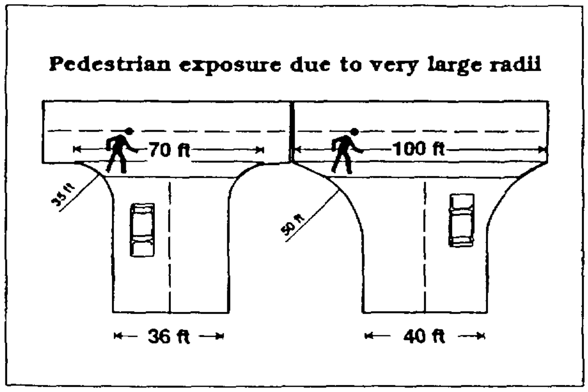
Driveway medians help to provide positive guidance for motorists and allow excellent signing opportunities.



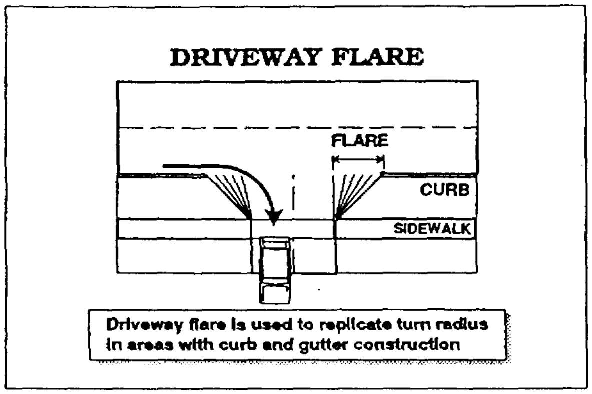
Driveways should be designed to allow vehicles to quickly exit the through lane. Radii, flares, and adequate driveway width all contribute to better through lane progression. A large driveway radius permits vehicles to maintain a higher rate of speed as they exit the highway. NHI 4-70



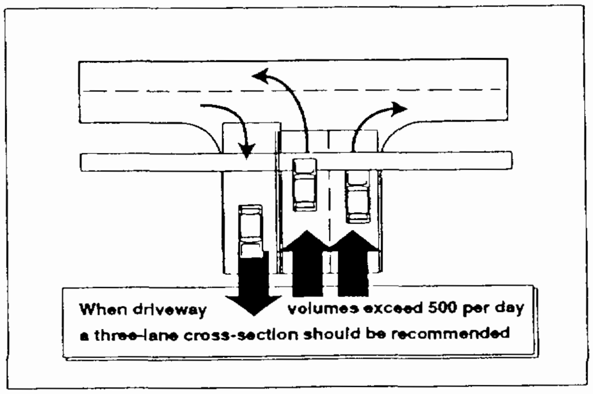
Wide driveways allow exiting vehicles to take wider turns, emulating the effects of a large radius.



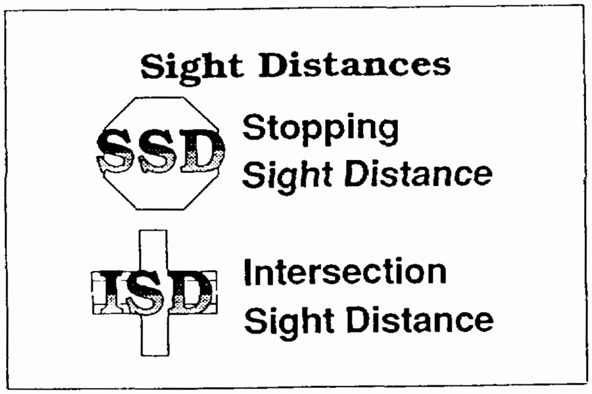
However, if driveway width and turn radii are over emphasized, you may end up with an enormous driveway area which is both unsafe to drivers, who may have a hard time deciding where to position themselves, and also unsafe to the pedestrian who now has a large gulf of asphalt to walk across.



A flare or taper does not significantly influence an exiting vehicle's speed but it does reduce its exposure. Sidewalks, generally, should cross driveways at their narrowest point. **NHI 2-31**



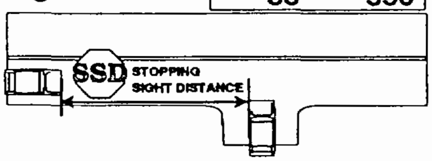
Obviously, the number of driveway lanes affects the performance of the driveway. Driveways carrying sufficient numbers of vehicles should have separate lanes for left and right turns. If multiple lanes are used, proper signing and marking is important. **Vergil G. Stover**



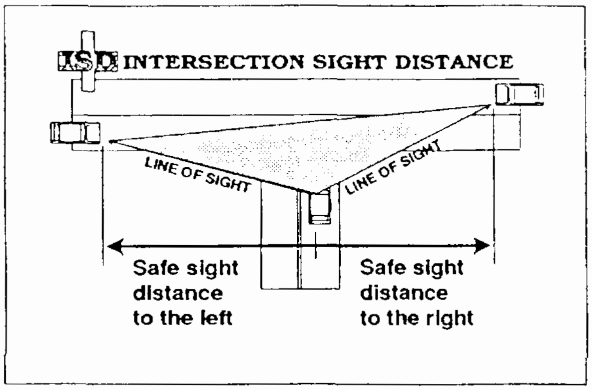
Site planning for access management is concerned with two types of sight distance; stopping sight distance and intersection sight distance.

Minimum Stopping Sight Distance

Operating Speed (mph)	(feet)
35	250
45	400
55	550



Stopping Sight Distance (SSD) includes the distance travelled during perception-reaction time beginning at the time an obstruction is first perceived and that distance travelled during the vehicle's braking maneuver. **NHI 2-33**



Intersection Sight Distance (ISD) is the unobstructed line of sight necessary for most drivers approaching an intersection to avoid collision. When the lines of sight for both left and right directions are combined, a sight triangle is formed. There should be no visual obstructions in this triangle. These might include mailboxes, shrubs, traffic control equipment. The ISD depends on the highway operating speed and desired maneuver of exiting vehicle. NHI 2-33

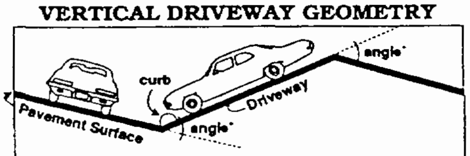
Sight Distance for Crossing Movement (Passenger Car)

Operating Speed (mph)	(feet) 2-lane	4-lane
25	250	310
30	300	375
35	350	435
40	400	500
45	450	560
50	500	625
55	550	690

Reference: based on AASHTO crossing sight distance

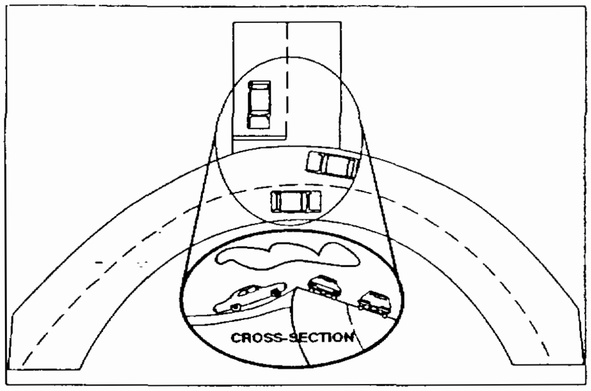
The length of unobstructed sight distances are determined by the design speed of the main roadway and its number of lanes. As speed and laneage increase, minimum sight distance also increases. The appropriate sight distances for the crossing movements are shown here. **NHI 6-60**

VERTICAL DRIVEWAY GEOMETRY

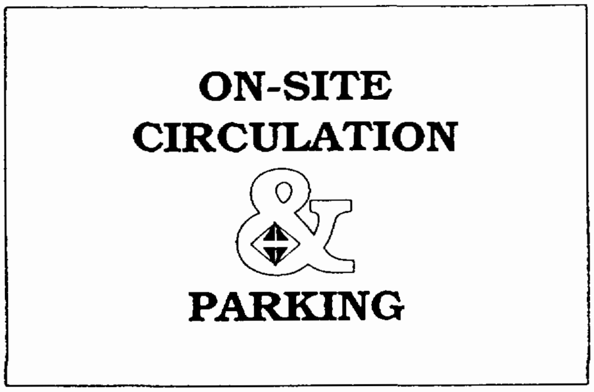


Functional Class	Maximum angle*
Arterial	3 - 4°
Collector	5 - 6°
Local	< 8°

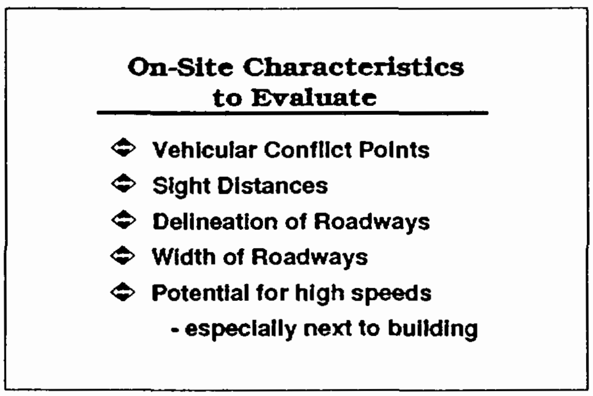
A driveway's vertical profile should allow a smooth transition from or to the roadway. Severe grade changes can cause vehicles to significantly reduce speeds thus impeding through traffic. **NHI 6-55**



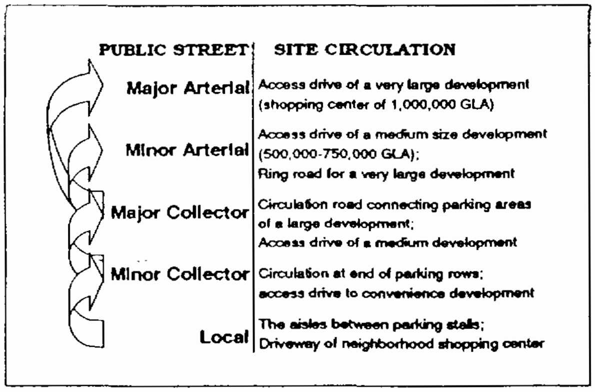
Do not overlook the effects of roadway superelevation on driveways. Connections at the outside of banked curves are especially critical. A sudden transition can cause vehicles to lose control and even roll over. Sight distance may also be impaired.



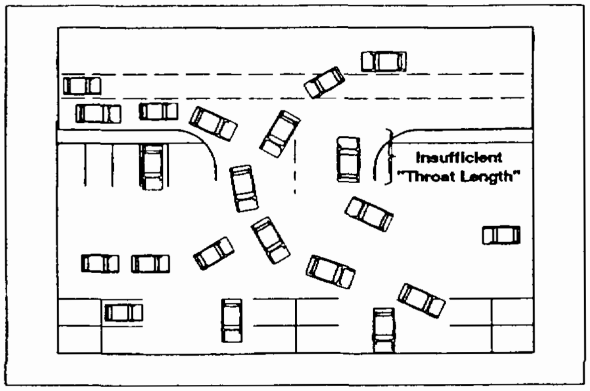
Although we have less control across the Right-of-Way line, on-site circulation and parking are important considerations when planning for access management.



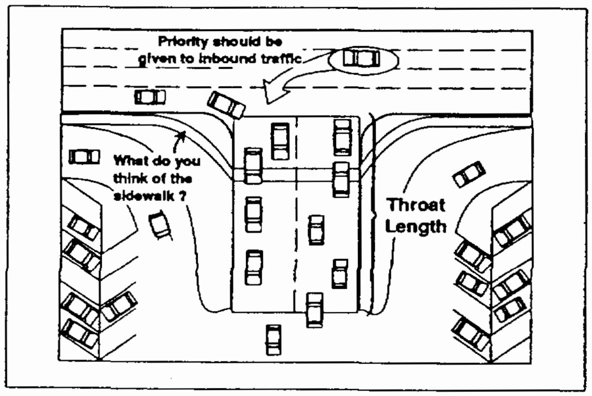
Sight designers should consider on-site vehicular operations with the same attention to detail and safety as if it were a public street. Attention to vehicular conflict points, sight distances, and roadway widths should not diminish. Delineation of the roadways and speed control differ in technique from the public highway, but their necessity remain. NHI 7-9



The relationship of internal circulation facilities to public street classifications is important to remember when evaluating sight plans. NHI 7-4



Insufficient driveway throat length confuses drivers and can impede the movements of both exiting and entering vehicles. TLD 162

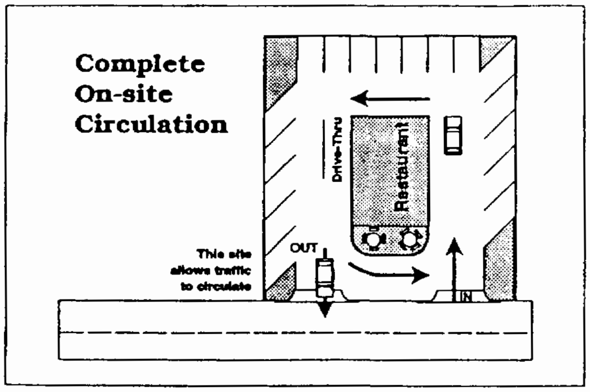


With adequate throat length, the chance of exiting vehicles blocking through movements is greatly diminished. Priority should always be given to inbound traffic. Note that this sidewalk crosses the driveway at its minimum exposure, however, most pedestrians would probably not walk the extra distance.

Generally Adequate Driveway Throat Lengths

Shopping Centers > 200,00 GLA	200'
Shopping Centers > 200,000 GLA if dual lefts are needed	250'
Smaller Developements	80'-90'
Unsignalized driveways	2-3 vehicles

Adequate throat lengths are determined based on the volume of vehicles expected to be generated by the served parcel. **Vergil Stover**

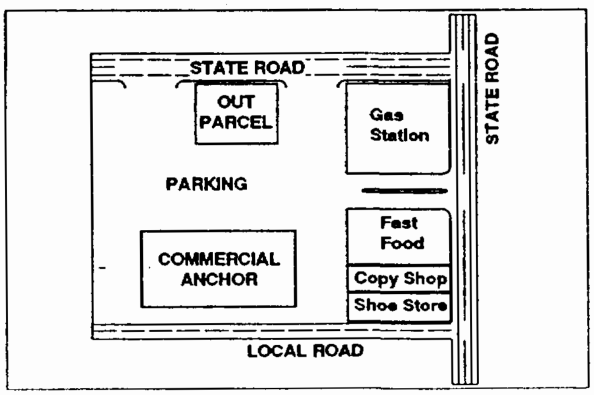


On site circuity should also be provided to allow traffic to circulate without re-entering the highway system.

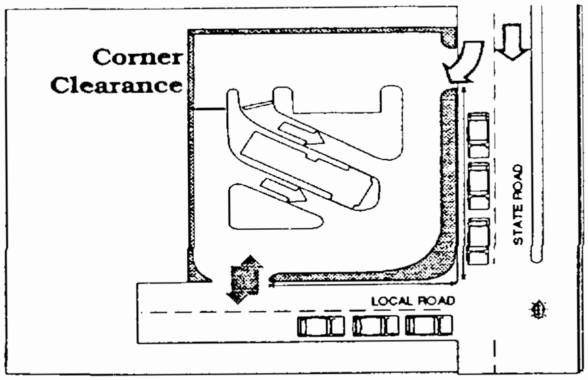
On-Site Characteristics to Evaluate

- Pedestrian Concerns
- Special Concerns
  - Fire Lanes
  - Large Vehicle Concerns
    - Loading Docks
    - Solid Waste
  - Treatment of Outparcels

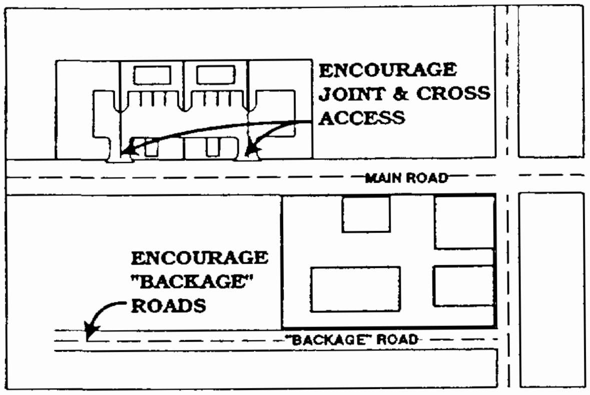
Other characteristics to identify include pedestrian concerns, the placement of fire lanes, loading docks, waste removal, and access treatments for outparcels.



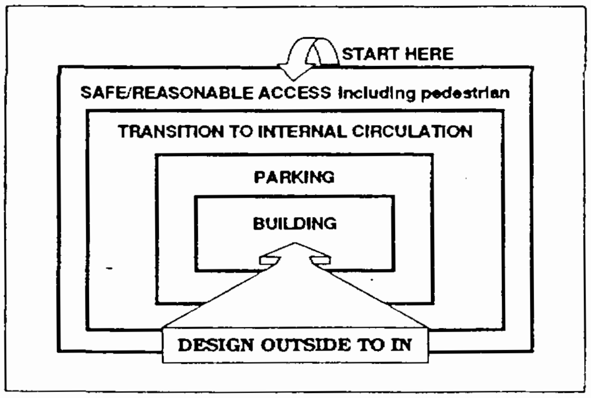
A quality site plan will locate the parcels serving large volumes of vehicular traffic nearest to major driveways.



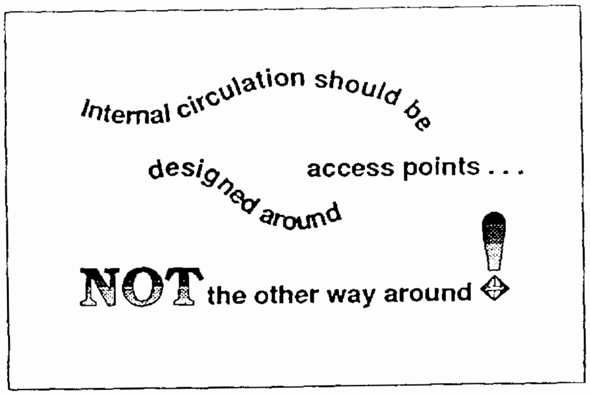
Good corner clearance prevents queues from blocking the driveways.



For large developments, joint and cross access, as well as "Backage" roads, connecting different commercial uses, should be encouraged.



The goals for Access Management are just as important for site planning as for highways. Through the proper use of turn lanes, channelization, driveway design and sight distance, site planning can increase operations, minimize adverse environmental impacts, and increase safety for everyone.



Above all else, remember: internal circulation should be designed around access points... not the other way around.

REFERENCES

1. NHI Course No. 15255, "Access Management, Location and Design: Participant Handbook," Publication No. FHWA-HI-92-033, U.S. Department of Transportation, Federal Highway Administration, National Highway Institute, October 1991.

2. Transportation and Land Development, Vergil G. Stover and Frank J. Koepke, Prentice Hall, Englewood Cliffs, New Jersey, Institute of Transportation Engineers, 1988.

3. "Intersection Channelization Design Guide," Timothy R. Neuman, National Cooperative Highway Research Program Report 279, Transportation Research Board, National Research Council, Washington, D.C., November 1985.

Access Management as a Congestion Management Strategy

Vergil G. Stover
Patrick E. Hawley
Donald L. Woods
Robert A. Hamm
Texas Transportation Institute

ABSTRACT
It is now recognized that the construction of additional lanes on existing arterials and new roadways cannot fully alleviate current or future congestion. In response to the need to conserve investment in transportation infrastructure, the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) mandated the development and implementation of six management systems (traffic congestion, safety, public transportation, intermodal, pavement, and bridges).

Access control is an effective method for managing congestion and is a necessary part of a congestion management system (CMS). Access management techniques include signal coordination, signal spacing, the use of non-traversable medians, the spacing of median openings, the design of unsignalized medial access to prohibit crossings and limit left-turns, the location and design of driveway and intersection spacing, the provision of deceleration lanes for turning traffic, and interparcel circulation. All of these methods are effective in improving traffic flow and reducing congestion on arterial streets.

For example, increasing the signalized intersection spacing to uniform intervals of one-half mile and the use of a non-traversable median to restrict left-turns will increase the capacity of a four-lane urban arterial by about 50% as compared to quarter-mile signal spacing and unrestricted left-turns. This is the same increase in capacity that can be obtained by widening a four-lane divided arterial to six lanes. Also, safety will be increased and congestion reduced to a greater extent than by the roadway widening.

Fewer but better designed driveways reduce the conflict between turning and through traffic which translates to reduced congestion. It also increases the capacity for traffic to enter the arterial street from adjacent properties. And, interparcel circulation reduces congestion by removing trips from the public street system.

INTRODUCTION
Congestion can be defined as the condition where traffic on streets or highways ceases to operate at an acceptable level of service -- speeds diminish and drivers experience delays. Congestion increases vehicle-hours of delay, wastes fuel, and increases vehicular emissions. Roadways operating at or above acceptable capacity are the primary cause of congestion. Capacities can be increased to accommodate the traffic demand by the construction of additional lanes and/or by imposing congestion management measures which enhance the flow of traffic along the arterial.

As part of the Intermodal Surface Transportation Efficiency Act (ISTEA) all states are required to develop and implement Congestion Management Systems (CMSs) to identify, measure and monitor congestion as well as to address the sources of congestion. Effective administration of a CMS can be used to: 1) manage or reduce the existing congestion; and 2) avoid future congestion problems from occurring.

In the past, the primary measures used to reduce congestion have been the construction of new roadways or the reconstruction of existing streets. However, on highly congested roadway sections, reconstruction alone cannot fully alleviate congestion. In response to the growth in congestion and mounting environmental regulations -- most notably the Clean Air Act of 1990 -- transportation agencies are looking at alternatives that utilize existing arterial streets. Access management techniques are often used in conjunction with roadway reconstruction projects to manage and minimize congestion.

For over thirty years the interstate system has been a testament to the benefits of access control. No other system of roadways uses the high level of access control found on the interstates; and consequently, no other system operates as efficiently. Improved capacity can also be achieved on major arterial streets with the implementation of access controls. In the construction or reconstruction of arterial roadways, some degree of access control needs to be designed for -- particularly new facilities where the potential for commercial or office development exists.

The 1984 and 1990 editions of *A Policy on the Design of Geometric Highways and Streets* promote functional design rather than the previously followed volume-based design. "The failure to recognize and accommodate by suitable design each of the different trip stages of the movement hierarchy is a prominent cause of highway obsolescence." [1 p.2; 2 p.2] The functional design of streets utilizes the principle that individual elements of a street system do not serve travel independently, and that each element of a functional hierarchy serves as a collecting/distributing facility for the next higher element of the system. This hierarchal street system provides for the graduation in function from access to movement. Effective street design also recognizes that there is a hierarchy of intersections which provide the transition (connection) between roadways in a hierarchal system. [34] Congestion and conflicts occur along major arterials when the transitions are either misplaced or functionally inadequate. Control of access to an arterial will reduce interference between turning and through traffic, promote movement, and consequently minimize congestion.

Access management relies on a variety of access control techniques to promote efficient vehicular movements. [4,24] These include the following:

- Limit Number of Conflict Points.
- Separate Conflict Points.
- Limit Deceleration.
- Remove Turning Vehicles from Through Lanes.
- Space major intersections to facilitate progressive travel speeds along arterials.
- Provide adequate on-site storage to accommodate both ingress and egress traffic.

Several access management techniques implement all of the above categories in one measure. Of these techniques, signal coordination and spacing, medial access treatment, and marginal access treatment (driveway spacing) will be discussed due to their significance and proven proficiency in congestion management.

An added benefit of effective access management along major arterials is the improvement in fuel efficiency. The fuel consumption rate per mile is reduced by improving the quality of vehicular traffic flow.[28] Decreasing the number of stops, starts, and their respective accelerations and decelerations improves a vehicle's fuel efficiency. Studies conducted by the Texas Transportation Institute [29] documented the fuel savings as a result of access control measures. The study compared an arterial with half-mile signal spacings and right turns only to an arterial with quarter-mile signal spacings and allowing left and right turns. The arterials considered had the following conditions and results:

Conditions:

- Ten-mile section of urban arterial
- 700 vehicles per hour per lane in peak direction
- 55-45 directional split
- Two-hour morning and two-hour evening peak periods
- Speed of 13 mph (20 km/h) without access control, 22 mph (35 km/h) with access control

Fuel Savings:

Improvements in speed	240,000 gal/yr
Reduction in delay	335,000 gal/yr
	575,000 gal/yr

Access management maximizes steady, uncongested, and safe traffic flows while still allowing access to abutting property. Implementing access management on existing and new major roadways, as a part of a congestion management system, improves traffic operations as a whole along arterials. Effective access management also improves traffic safety. The number of conflict points, and therefore accidents, are reduced by careful management of the access points granted along an arterial. Therefore, the ranking of all potential access points according to their functional hierarchy is imperative. In this paper, access management as a congestion management tool is organized in the following categories.

1) Signalized intersection spacing and coordination
2) Medial access treatment
3) Marginal access treatment

Signalized intersection spacing has a major impact on the efficient movement of traffic on an arterial. Moreover, an early definition of intersection locations, which will be signalized, has a major influence on land use patterns and on the development of a supporting street system which accommodates short trips. Also, it is disruptive to activity patterns and politically difficult to change signal locations after development has occurred. Thus, signal spacing is perhaps the first factor to consider in the design of a street system on which congestion management is to be exercised.

Medial access is also critical to effective congestion management as well as safety management since a non-traversable median is the only positive means of limiting left-turn ingress and egress movements. The friction between traffic using direct access drives and through traffic further contributes to congestion.

SIGNAL COORDINATION AND SIGNALIZED INTERSECTION SPACING

Introduction

During the planning, design, and operation stages of a signalized arterial street system four variables need to be considered [3]:

1) Speed of the Progression Platoon
2) Signal Cycle Length
3) Signal Spacing
4) Efficiency of Progression

Maximum flow rates occur at a uniform speed of approximately 35 mph (55 km/h) to 40 mph (65 km/h). To accommodate peak hour traffic volumes, the arterial needs to operate within this range of speeds. In addition to capacity considerations, vehicle emissions and fuel consumption are also minimized when speeds range between 35 (55 km/h) and 40 mph (65 km/h). However, during off peak operation, a higher range of progression speeds is desired. On major arterials, this desired range of speeds is 45 mph (70 km/h) to 55 mph (90 km/h). Therefore, to accommodate both peak and off-peak traffic demands, it is necessary that the signal timing plan maximize efficient traffic flow for a range of speeds.[4]

Major arterial streets must be able to operate efficiently under a range of combinations of speeds vs. cycle lengths in order to accommodate traffic volumes as they change over time.[3] During off peak hours, a short cycle length is desirable so as to minimize delay; a cycle of about 60 seconds is frequently appropriate. The large volumes present during the peak hours require long cycle lengths to minimize lost time per phase and therefore reduce the overall delay of the intersection. This lost time results from perception-reaction time at the beginning of the green indication, as well as lost times due to excessive headways between queued cars prior to achieving the minimum headway. 120 seconds is generally accepted as the maximum desirable cycle.

The final variable involved in the planning, design, and operation of signalized arterial street systems is the efficiency of traffic progression (progression band width divided by cycle length). As a consequence of increasing the efficiency, capacities increase and delays decrease. A reduction in stopped and delayed vehicles has a direct impact on lowering speed variance, reducing vehicle emissions, and lowering fuel consumption.[3] The effects of these reductions are obviously beneficial to both the environment and congestion management.

Signal Coordination

One of the easiest methods to improve flow and relieve congestion on major arterial streets is to coordinate traffic signals. Traffic signal synchronization projects consist of retiming existing signals, installing advanced computer control, and/or optimizing traffic signal timing plans. The estimated daily impact of implementing a traffic signal synchronization plan is a 10% decrease in vehicle-hours of travel. [28] Reducing vehicle hours of travel by 10% yields a 3.5% savings in fuel consumption, which amounts to almost 12-million gallons annually for a city with a population of one million. [28]

From 1983 to 1985, the Fuel Efficient Traffic Signal Management Program (FETSIM), a statewide program in California, involved the retiming on 3,172 traffic signals. Significant benefits included first-year reductions of 15% in delays, 8.6% in fuel use, 16% in stops, and 7.2% in travel time. [36,37]

A similar traffic signal synchronization program in Texas resulted in a 24.6% reduction in delay, a 9.1% reduction in fuel consumption, and a 14.2% reduction in stops. [38] The project required the retiming of 2,243 signals in 44 cities throughout the state. Another synchronization project in Florida yielded similar results with a 13% to 22% reduction in travel time. [39]

Benefit/cost ratios were estimated for many projects and included fuel savings, travel time savings, and vehicle stops eliminated. The National Signal Timing Optimization Project initiated by FHWA in 1981 involved signal timing projects in eleven cities across the United States. The benefit/cost ratios for these projects ranged from 20 to 1 to 30 to 1. [40] A benefit/cost ratio for a signal optimization project in North Carolina and for the Texas Traffic Light Synchronization (TLS) project were determined to be 108 to 1 and 62 to 1, respectively. [41,38] These ratios differ substantially due to different estimates on the dollar value of stops, delays, travel time, and fuel. Regardless of the dollar estimate, all of these signal timing projects resulted in a substantial benefit/cost ratio for vehicle stops, travel time, and fuel savings. Since traffic signal synchronization projects are so cost effective and result in substantial benefits, they have proven to be a productive method for reducing delays and congestion on major arterial streets.

Signal Spacing

While traffic signal synchronization methods work well on established arterial street systems, the ideal method of traffic signal access control is to control signal spacing. An arterial street must be able to function efficiently in both peak and off-peak periods. The high volumes experienced during the morning and evening peaks require maximization of the lost time due to changes in signal phases and achievement of high flow rates. Maximum flow rates are obtainable at about 35 mph (55 km/h) or slightly higher speeds. Flow rate decreases markedly at speeds less than 30 mph (48 km/h). A cycle of 120 seconds is commonly considered to the longest cycle length desirable for general use. However, the signal system must also be flexible so as to provide efficient traffic progression during the off-peak hours when higher speeds and shorter cycle lengths are encountered.

Figure 1 [3] shows the relationship between signal spacing, speed, and cycle length. Similar information is given in tabular form in Table 1. 1/2 mile (0.804 km) signal spacing produces maximum progression efficiency with a cycle length of 120 seconds and a speed of 30 mph (48 km/h). This spacing also provides for efficient progression with cycle lengths commonly used in off-peak hours (60 to 80 seconds). Inspection of Figure 1 also shows that progression speed and efficiency will deteriorate with a cycle length larger than 120 seconds. The figure also shows that with 1/4 mile (0.402 km) spacings and peak period cycle lengths (90 seconds or longer), progression speed is much lower than that at which maximum throughput and fuel efficiency occurs. Moreover, a 1/4 mile (0.402 km) signal spacing does not provide flexibility for efficient traffic progression during off-peak periods.

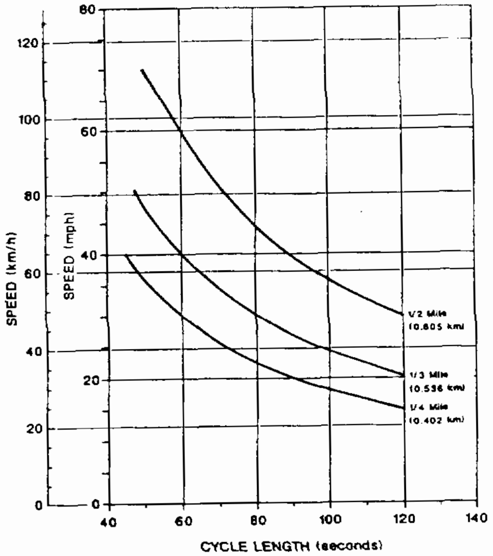


Figure 1. Optimal Signal Spacing as a Function of Speed and Cycle Length [3]

The 1/2 mile (0.804 km) spacing also can be used during the off peak hours by utilizing shorter cycle lengths. Cycle lengths of 65 and 80 seconds result in off-peak progression speeds of 55 mph (90 km/h) and 45 mph (70 km/h) respectively when signals are located at 1/2 mile (0.804 km) increments. Cycle lengths less than 65 seconds result in speeds which are too fast for urban arterials and cycle lengths longer than 80 seconds result in speeds which are too slow.[4]

Stover, Demosthenes and Weesner used PASSER II-87 to generate progression efficiencies for various speeds at 60, 90 and 120 second cycle lengths. [3] Progression efficiencies were found to decrease rapidly as the spacing departed from the optimum signalized intersection interval.

Table 2 shows the decrease in efficiencies with slight variations from the optimal signal spacing (200 feet and 400 feet) for cycle lengths of 60 and 120 seconds respectively.

Table 2 also shows that as the cycle length increases, the progression efficiency increases. The maximum efficiency obtained using a 60 second cycle was just over 0.30, while for a 120 second cycle, the maximum efficiency rose to approximately 0.36. This increase in efficiency can be attributed to the reduction in lost time due to fewer phase changes per hour.

Table 1. Optimal[1] Cycle Lengths for Various Speeds and Signal Spacings [3].

Speed mph(km/h)	Signal Spacings 1/4-mile (0.402 km)	1/3-mile (0.536 km)	1/2-mile (0.804 km)
15(24)	120 sec		
20(32)	90 sec	120 sec	
25(40)	72 sec	96 sec	
30(48)	60 sec	80 sec	120 sec
35(56)	51 sec	69 sec	103 sec
40(64)	45 sec	60 sec	89 sec
45(72)		53 sec	80 sec
50(80)		48 sec	72 sec
55(88)			65 sec
60(97)			60 sec

[1] Maximum progression efficiency

Table 2. Progression Efficiency [3].

Cycle Length Seconds	Signal Spacing Feet (metres)	Approximate Progression Efficiency
60	1540 (470) 1340 (410)	0.31 0.05
120	3040 (930) 2640 (800)	0.34 0.08

The Colorado Access Control Demonstration Project compared a 4-lane divided access controlled arterial having 1/2 mile (0.804 km) signal spacing and right turns only at the 1/4 mile (0.402 km) locations) with an uncontrolled access roadway having 1/4 mile (0.402 km) signal spacing and full movement access every 1/8 mile (0.201 km). As shown in Table 3, the controlled access condition shows substantially better traffic flow than the uncontrolled situation. The Florida Department of Transportation has concluded that an access controlled 4-lane arterial has the same capacity as a 6-lane roadway without access control.[21]

A NCHRP study completed in 1970 revealed similar results. [14] This study evaluated the effect of signal spacing on the operating costs of the through traffic using the arterial. Varying cycle lengths, speeds, signal operation, and volumes were compared. "At high volumes, spacings should be at least 1600 ft; and there would be economic advantages from providing spacings up to 2400 ft. Additional cost to cross-street traffic would be extremely nominal." [14] Implementing 1/2 mile (0.804 km) signal spacings with the proper cycle lengths to suit the respective time periods, is the single most effective design tool used to manage congestion on major arterials.

Table 3. Effectiveness of Access Management On Traffic Congestion Parameters [5]

	Travel Speed mph (km/h)	Total Travel veh-hours/hour	Total Delay veh-hours/hour
Controlled Access	22 (35)	542	275
Uncontrolled Access	13 (21)	942	675
Percent Change	+69%	-42%	-59%

Safety and Congestion Issues

The safety benefits of long uniform signal spacings has yet to be researched in-depth. Many of the newer reconstructed arterials with 1/2 mile (0.804 km) signal spacing are also fitted with other access control measures. This makes it difficult to determine what percentage of the benefits (accident reduction) can be attributed to each measure.

Research by Squires and Parsonson [6] found a strong correlation between the number of signals per mile and the number of accidents per million vehicle-miles on four and six lane arterial roadways with either raised medians or C2WLTLs. The study showed that for each design alternative (raised median or C2WLTL and 4 or 6 lane cross section), the number of accidents increased linearly with the number of signals per mile.[6]

MEDIAL ACCESS

Introduction

Medians are the roadway element that separates traffic travelling in opposite directions. Since the median is defined as part of the "travelled way," restrictions in medial access are easier to mandate with the exercise of police power than restrictions on marginal access.[4] The design of medians as an access control measure involves the following elements: median type, median width, the geometrics of median openings, and spacings of median openings.

Median Types

Median designs fall into the following three classifications; non-traversable, traversable, and continuous 2-way left turn lane. The non-traversable design actively discourages medial crossings through the use of either a raised or depressed design. The traversable design is a flush or slightly raised median which vehicles may easily cross. The continuous 2-way left turn lane is a flush traversable center lane which provides storage for, and allow for deceleration of, left turning vehicles.[4]

Non-traversable
Although non-traversable medians have numerous design options, the most common urban median is 12 to 20 feet (3.7 to 6.1 metres) wide, with curbs.[7] To provide for dual left turn bays, the width of urban medians needs to be 28 to 30 feet (8.5 to 9.1 metres). A 28 foot (8.5 metres) median provides two 12 foot (3.7 metres) lanes and a 4 foot (1.2 metres) median. A median width of 28 to 30 feet (8.5 to 9.1 metres) also aids in restricting medial movements by providing adequate width to accommodate medial channelization.[23]

Non-traversable medians are the only positive access control measure to control or restrict left-turns. With the implementation of non-traversable medians, cross traffic and left turning movements on and off the major arterial can be eliminated or restricted to certain locations, and full movement access points are limited to major intersections. This results in three consequences; 1) increasing the throughput capacity of an arterial, 2) discouraging new strip development, and 3) greatly improving traffic safety.[6]

When adding non-traversable medians to an existing arterial, additional delay time occurs for left turning vehicles at the intersections due to the rerouting of mid-block traffic. However, through speeds increase approximately 5 mph (~10 km/h) with the implementation of a raised or depressed median. [9]

Major arterials with high through volumes are generally the recipients of non-traversable medians. For raised medians, unsafe conditions occur if speeds exceed 45 mph (70 km/h). Rather than guiding the vehicle back onto the roadway, the raised median may cause the vehicle to overturn or go out of control at speeds above 45 mph (70 km/h).[6]

Traversable
As the name implies, traversable medians permit cross traffic and left turns along their entire length using a slightly raised or flush median design. Compared to raised medians, mountable or flush medians pose less of a safety hazard at higher speeds, but are less effective as an access control measure.[7] In areas with traversable medians, drivers often make maneuvers such as crossing or executing left turns despite pavement markings and signing which prohibit these movements. [4] Therefore, since access control is desirable along all segments of major arterials, traversable medians should not be used.

Continuous 2-Way Left Turn Lane (C2WLTL)
Continuous 2-way left turn lane treatments are flush traversable medians that allow maximum left turn access without impeding the arterial's through volume. In doing this, C2WLTLs reduce the delay of left turning vehicles at intersections.[6] Although C2WLTLs improve operational flexibility, they defeat the concept of principal arterials by permitting access along the entire left side of the roadway. C2WLTLs make no attempt to reduce points of conflict along the arterial.[9] This medial design becomes a real problem when the v/c ratio exceeds 0.8; there are too few gaps to allow unsignalized left turns and the turns are not focused at one point.

Safety and Congestion Issues
Many traffic accidents are a result of poor traffic flow and congestion. Therefore, studies which show a reduction in accidents may also indicate that the treatment also had a positive effect in reducing congestion.

Table 4 summarizes the accident data analyzed in a research project by Georgia Tech.[8] The study identified 32 raised median sections and 50 C2WLTL sections. The researchers concluded that raised medians resulted in safer operation than C2WLTL's when the ADT exceeded 24,000 to 28,000 vehicles per day (vpd). As the ADT surpasses 24,000 vpd, gaps in the opposing traffic stream become shorter and more infrequent. This makes it increasingly difficult for vehicles to execute left-turns at midblock along a C2WLTL. A raised median forces all turns to the next intersection where left-turn phasing can eliminate the conflicts from the opposing traffic.

A before and after study of replacing a C2WLTL with a raised median on Memorial Drive, a high-volume, six-lane arterial in Atlanta, Georgia showed a 37 percent reduction in the total accidents and reduction of 48 percent in the injury accidents.[25]

With the construction of raised medians along an arterial, left-turn maneuvers are shifted to the median openings. In order to limit the speed differential found between left-turning vehicles and through traffic, and hence reduce congestion, a turn bay should be provided at all median openings. [7] Figure 4 shows the length of turn bay required to limit the speed differential to less than 10 mph (16 km/h). Left-turn bays attempt to eliminate the "shock wave" effect of decelerating vehicles. The shock wave effect occurs where no turn bay is provided -- left-turning vehicles are forced to decelerate in the through lanes, and this causes through traffic to decelerate also. The queue of left-turning vehicles in a turn-bay of insufficient length may extend beyond the turn bay and block the through lanes. Turn bays with insufficient length not only produce shock waves in the through lanes, but they also pose problems for

Table 4. Summary of Accident Data [6].

	Total Accidents			Midblock Accidents		
	C2WLTL	Raised Medians	Percent Change	C2WLTL	Raised Medians	Percent Change
Accidents/MVM						
4 Lane Sections	8.99	7.67	-14.7	3.50	1.34	-61.7
6 Lane Sections	10.82	8.15	-24.7	4.19	1.92	-54.2
Accidents/Mi/Yr						
4 Lane Sections	99.45	70.91	-28.7	38.78	12.39	-68.1
6 Lane Sections	130.26	94.07	-27.8	50.46	22.13	-56.1

leading left-turn signal phasings. Short turn bays often prevent left turning vehicles from entering the turn bay in time to utilize the leading green. This situation results in excessive delays as the left turning vehicles are compelled to wait through the entire cycle. Congestion at intersections will be lessened by ensuring that left-turn bays are designed with sufficient length. Existing intersections with insufficient turn bays can be lengthened to improve the quality of flow through the intersection.

At intersections with high volumes of left-turns, the installation of dual left-turn bays (or in limited situations, triple left-turn bays) can accommodate high storage requirements without unreasonable turn bay lengths. Dual turn bays are also able to service greater volumes in less time than single bays -- dual bays can service nearly double the number of vehicles as single bays. The servicing of left-turns in a shorter time period allows a greater percentage of the cycle length to be allotted to the through movements. This has the effect of enlarging the green band, improving progression, and thereby reducing congestion along the arterial corridor. As Table 5 shows, the desired median width to provide dual left-turn bays is 30 feet (9.1 metres).

If signalized, single left-turn bays are either permissive only, protective-permissive, or protected only. Historically, dual left-turn bays have been used with protective only phasing. However, there are conditions (low opposing volumes) in which protective-permissive phasing can be incorporated. The low opposing volumes apply to both through and left-turning volumes. The through volume must be low enough to provide ample gaps of adequate width; and for sight distance reasons, the opposing left-turn volume must also be low.

Median width

There are three primary reasons for requiring minimum median widths along non-traversable medians: 1) separate opposing traffic streams; 2) provide auxiliary lane(s) to decelerate vehicles and store left turning vehicles and U-turners; and 3) protect cross traffic at medial breaks.[7] Table 5 shows the recommended minimum and desired median widths for arterials. Each of the given reasons aim to reduce congestion with an increase in the capacity of the arterial by limiting the through traffic's exposure to cross traffic and turning vehicles. Limiting the exposure improves congestion by allowing the through traffic to maintain a constant speed along the arterial.

Channelization of the median, to permit or restrict selected movements, is an important aspect of access management. As an access control measure, medial channelization is used for one or more of the following purposes: to separate conflicts; to protect and store turning and crossing vehicles; to block prohibited movements; and to segregate traffic movements having different speeds, directions, or right-of-way control.[20] As shown in Table 5, 30 feet (9.1 metres) is desired to facilitate medial channelization. Thirty feet (9.1 metres) is ample width to design for specific maneuvers such as left-turn ingress or egress only at a development.

Along arterials with non-traversable medians, intersection designs must accommodate U-turns at all median breaks -- both signalized and unsignalized. The provision of designated U-turn locations compensates for the loss of direct left-turn access due to the non-traversable median. Left-turn bays service U-turns if designed with an adequate width. On a 4-lane facility, Table 5 shows that 45 feet (13.7 metres) is desired to permit U-turns.

Table 5. Recommended Minimum and Desired Non-Traversable Median Widths For Urban Arterials [4].

Median Function	Minimum Width ft(m)	Desired Width ft(m)
Separation of Opposing Traffic Streams	4(1.2)	10(3.0)
Storage of Left Turning Vehicles		
Single Left Turn Bay	14(4.3)	18(5.5)
Dual Left Turn Bay	25(7.6)	30(9.1)
Protection for Vehicles Crossing or Turning Left	25(7.6)	30(9.1)
Design for Selected Ingress or Egress Movements Only	18(5.5)	30(9.1)
Provide for U-Turns:inside (left) lane to outside (right) lane, passenger cars, 4-lane facility	45(13.7)	45(13.7)
Provide for U-Turns:inside lane (left) to outside (right) lane, passenger cars, 6-lane facility	33(10.1)	33(10.1)

Spacing of Median Openings

The spacing and design of medial and marginal access along arterials should be designed to eliminate or substantially reduce the speed differential between traffic leaving the roadway and through traffic. Table 6 shows the relative likelihood of being involved in an accident is minimal when a vehicle is traveling at a speed less than that of other traffic. The table also shows that accident potential dramatically increases as the speed differential increases. [20] Other studies show that typical access designs without turnbays result in very high speed differentials. [20]

While not addressing congestion directly, research shows that a non-traversable median improves capacity and safety. For example: The ". . . data indicated that the raised median results in less system-wide delay, increased roadway capacity, is safer for pedestrians, has a positive impact upon development and creates a more aesthetically pleasing environment." [9] The C2WLTL does help to reduce delay for left-turning traffic by providing continuous access, but system-wide delay on the roadway is less with a raised median than a C2WLTL. And, "The installation of a raised median is the best available technique to preserve the through-traffic movement function of an arterial street . . ." [35]

Table 6. Relative Accident-Involvement Rates for Arterial Roadways [20].

	Speed Differential mph (km/h)				
	0 (0)	-10 (-16)	-20 (-32)	-30 (-48)	-35 (-56)
Accident Rate	110	220	720	5000	20,000
Ratio, 0-mph (0 km/h) differential	1	2	6.5	45	180
10-mph (16 km/h) differential		1	3.3	23	90

Interparcel circulation is often used to accommodate consolidating left-turn movements of several business at selected median breaks.[8] This interparcel circulation can be provided by the use of: joint parking lots, alleys, connections between adjacent parcels, or any combination of these. This allows circulation of localized trips between adjacent and/or nearby developments without creating conflicts with traffic on the street and thus contributing to congestion.

Intersections which are spaced too closely produce conflicts in the traffic stream, which in turn contributes to roadway traffic congestion. The distance required to eliminate conflicting intersections is the functional length. Four components shown in Figure 2 make up the length of the functional area of an intersection, these are; 1) the length required to store queued vehicles, 2) the length needed to decelerate turning vehicles, 3) the length of the entering taper, and 4) the distance traveled during PIEV time.[9]

The same elements are involved for left-turns as for right-turns. Minimum median spacings are calculated to eliminate any overlap in functional areas of intersection.

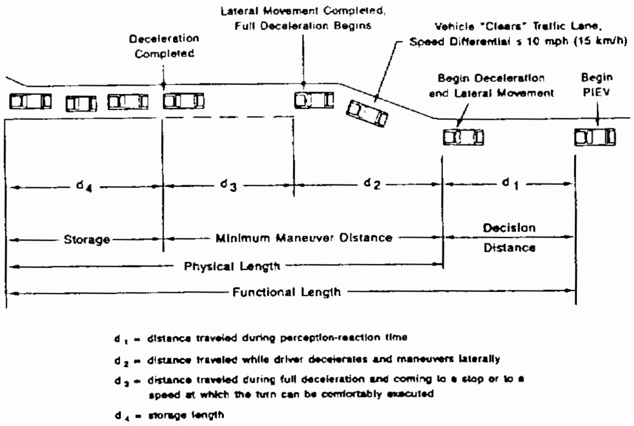


Figure 2. Determinants of the Intersection Maneuver Distance [20].

Conclusions
In terms of improved safety and capacity, as well as reduced congestion, non-traversable medians should be constructed on all major arterials. Constructing arterials 28 to 30 feet (8.5 to 9.1 metres) wide in design provides flexibility. This median width can accommodate dual left-turn lanes at major intersections and left-turn/U-turn lanes at minor signalized intersections; it also facilitates channelization at unsignalized intersections where full movements are not desired.

MARGINAL ACCESS

Introduction
Marginal access includes both public and private intersections with the major arterial. Although commercial driveways often carry traffic volumes comparable to public intersections, they have not been previously designed as such. All intersections, public as well as private, must be designed to enhance traffic flow along the arterial. As with medial access guidelines, marginal access guidelines are established to eliminate or reduce speed differentials greater than 10 mph (15 km/h) found between through traffic and right turn ingress movements.

Capacity and Delay
Uncontrolled marginal access results in reduced roadway capacity. Marginal access describes the access provided to unsignalized intersections caused by either private driveways or public roadways. One source estimates that, " . . . under average conditions, the capacity of a four-lane arterial street with a 45 mph speed limit will be reduced by one percent for every two percent of the traffic that turns between the right lane and the driveways at unsignalized intersections." [12] Consider the following example.

A four lane major arterial has an initial capacity of 1600 vph in one direction without marginal access. Currently the roadway is carrying 1500 vph, which is under capacity. If driveway access were permitted, what would be the effect on the arterial?

> Capacity will be reduced by 1% for every two percent of the turns. Assuming 20% turns per mile (10% into driveways and 10% out of driveways), roadway capacity will be reduced by 10%. The capacity with driveway access can be estimated as:

$$Reduction = 0.10 * 1500\ vph = 150\ vph$$

$$Capacity\ w/Driveways = 1600\ vph - 150\ vph = 1450\ vph$$

The capacity for the major arterial has been reduced to 1450 vph. Demand now exceeds capacity and congestion will occur along the arterial. Therefore, by allowing marginal access along the major arterial, capacity has been sufficiently reduced to create undesirable levels of congestion.

Another study indicated that multiple driveways at close spacings do not decrease vehicular delay for vehicles turning onto an arterial. [14] In addition, contrary to popular opinion, closely spaced driveways do not increase the ability of the arterial's through lanes to absorb traffic. [13] Major and Buckley reported as early as 1962 that the ability of an arterial to absorb egress traffic increases as the driveway spacing increases. [27] For high-volume traffic generators, in order to reduce delay to vehicles entering the traffic stream, driveways should be spaced at distances greater than 1.5 times the distance to accelerate from zero to the speed of traffic. [27] The resulting minimum driveway spacing for various acceleration rates are shown in Table 7.

"Under high volume conditions, even a few turning movements will cause serious problems in the through traffic stream. It is evident from observation that the problem is the number and spacing of the access points more than the number of vehicles. Frequent unsignalized access points of short spacings result in lower egress capacity from the abutting properties and increased delay to the vehicles waiting to enter the arterial." [14] Therefore, by providing adequate spacing between unsignalized access points, capacity and traffic flow will be improved and congestion reduced on both the arterial and at the access points.

Table 7. Minimum Spacing between Driveway Access Points to Maximize Egress Capacity [42].

Speed mph (km/h)	Spacing feet (metres)
30 (50)	340 (105)
35 (55)	450 (140)
40 (65)	625 (190)
45 (70)	850 (260)
50 (80)	1150 (350)
55 (90)	1500 (455)

Right Turn Bays

When marginal access is allowed along major arterials, right turn bays (or in some limited cases, continuous right turn lanes) are recommended. As with left turn bays, right turn bays/lanes allow turning vehicles to decelerate without seriously impeding through traffic. There are two primary situations in which turning traffic impedes on the through traffic: along arterials where no turn bays or turn lanes are provided, the speed differential, due to the deceleration of turning vehicles, exceeds 10 mph (15 km/h); and at signalized intersections, a turn bay with inadequate length does not allow turning vehicles to exit the through traffic stream such that the traffic behind the turning vehicle is able to close the gap formed by the turning vehicle. Closing the gap and obtaining a low headway is crucial to maximizing an intersection's capacity.

At intersections operating under congested conditions due to high volumes of right-turning vehicles, extending the length of an existing turn bay or constructing a dual right-turn bay can improve the flow of both mainline and turning traffic. Both measures increase the storage capacity for right-turning vehicles, and the dual right-turn bay has the additional benefit of being able to service nearly twice the number of vehicles as a single turn bay.

In determining the spacing required between marginal access points, the functional upstream area of the intersection must be calculated. The process is the same for public street intersections and private access drives except that the site design of private access drives should be designed so that queue storage for traffic entering the site is accommodated on the site, not on the public street. However, provide storage when designing for the intersection of two public roadways.

Safety and Congestion Issues

Driveways and unsignalized intersections introduce conflicting movements into the traffic stream which affect roadway safety and congestion. A study of Chicago suburbs indicated that over 11% of all accidents on major arterials involved turns in and out of a driveway.[12] Other studies have shown similar percentages, such as 14.4% of two-vehicle accidents on county roads in Indiana involved driveways and 6.5% of accidents in Los Angeles county involved uncontrolled driveway access.[15] Another study reported that each accessible driveway along an arterial street adds between 0.1 and 0.5 accidents per year, and driveway accident rates decrease as the number of accessible driveways is decreased.[16]

In a recent article based on a FHWA report on access management, safety research indicated that there was a direct correlation between the accident rate and the number of uncontrolled access points, as shown in Figure 3.[17] As the number of businesses and driveways increase per mile, side friction and accident rates also increase accordingly. The increase in side friction not only leads to more potential accidents, but it also indicates congested traffic conditions. Therefore, to reduce the accident rate and limit congestion on major arterial roadways, driveway access must be limited and controlled. Another study [21] reinforced the correlation between accident rates and driveway spacing; these data are shown in Table 8.

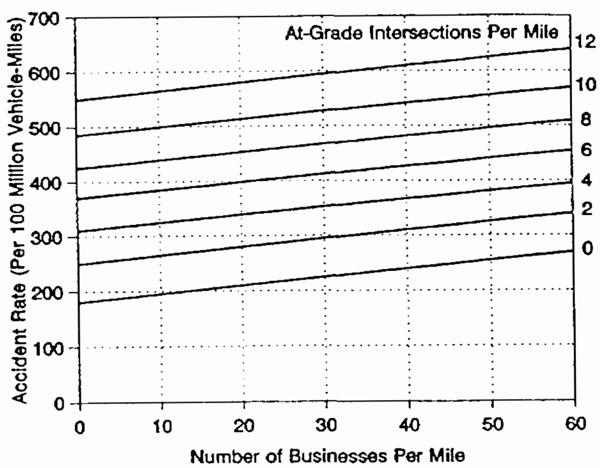


Figure 3. Accident Rate on 4-lane Divided Arterials Due to Uncontrolled Access [17].

Table 8. Effects of Driveway Spacing on Accidents [21].

	Accidents per Million Kilometres Traveled
0-12 Access Points per Kilometre	1.2
Over 12 Access Points per Kilometre	2.5

In addition to right-turn bays or lanes, consolidated driveways, proper design of driveway width and throat length, and driveway visual cues each contribute to the lessening of congestion along arterials. Visual cues denoting driveway entrances reduce abrupt decelerations and eases the transition from the arterial to the driveway. Limiting the deceleration along the arterial keeps traffic flowing smoothly. Figure 4 shows an example of driveways with poor visual cues. The consolidation of driveways limits the potential conflicts encountered along the arterial. Consolidation can occur either by closing driveways within one development or by closing driveways of adjacent developments and providing a shared driveway with cross-parcel circulation.

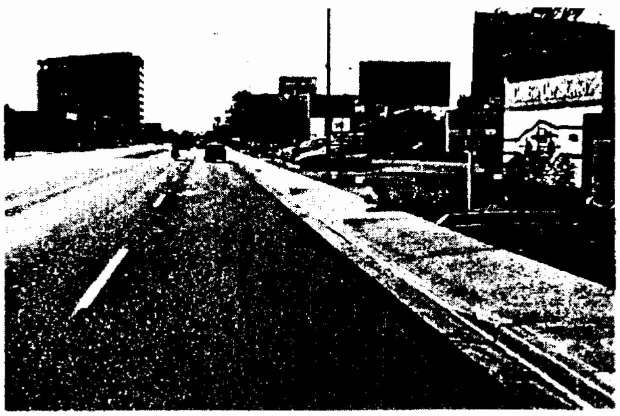


Figure 4. Absence of Contrast Provides Drivers with Poor Visual Cues as to Driveway Locations

The width of the driveway (or cross street) and the intersection's corresponding curb return radius directly impact the speed at which vehicles can turn off of the arterial. Obviously, as the driveway width and curb return radius increase, the speeds of the turning vehicles also increase.

Conclusions

Efficient marginal access management produces benefits similar to those obtained from medial access control.

Controlled driveway access along high volume arterial streets results in lower accident rates, higher roadway capacity and decreased vehicular delay for turning vehicles. Higher traffic volumes are able to operate safely by limiting the speed differential between through volumes and turning vehicles and thereby reducing congestion. The primary marginal access control measures are:

- Based on the speed of the arterial, mandate minimum spacings to be allowed between intersections.
- Provide right-turn bays/lanes at all intersections.

CONCLUSIONS

One of the greatest problems encountered along undeveloped roadways is the belief that low volume arterials will tolerate more direct land access because they provide less through movement. However, as traffic volumes increase, the direct access will prove to be a hinderance. It is easier to start without access than to try to retrofit an arterial and take accesses away from businesses and residents at a later date.[9]

Implementing a long range access management plan requires cooperation between local governments, state agencies and developers. Although some developers often want unlimited access, many experienced developers also realize the long term benefits of efficient access control including stable activity patterns and property values.

Access control measures are effective tools for mitigating roadway traffic congestion problems. The most effective, especially when used in combination, are: long uniform signal spacing; non-traversable medians which restrict left-turns at unsignalized access locations; improved design of marginal access; and the provision of turn bays at all medial and marginal access locations -- both public and private.

REFERENCES

1. *A policy on the Geometric Design of Highways and Streets*. American Association of State Highway and Transportation Officials. 1990

2. *A policy on the Geometric Design of Highways and Streets*. American Association of State Highway and Transportation Officials. 1984

3. Stover, Vergil G., Philip B. Demosthenes, and Elizabeth M. Weesner. "Signalized Intersection Spacing: An Element of Access Management." *ITE 1991 Compendium of Technical Papers*. pp. 176-181.

4. *Access Management, Location and Design: Participant Notebook*. National Highway Institute Course No. 15255. U.S. Department of Transportation. Federal Highway Administration. October 1991.

5. *Colorado Access Control Demonstration Project*. Colorado Department of Highways. U.S. Department of Transportation. Federal Highway Administration. June 1985.

6. Squires, Christopher A. and Peter S. Parsonson. "Accident Comparison of Raised Median and Two-Way Left-Turn Lane Median Treatments." *Transportation Research Record 1239: Geometric Design and Operational Effects*. 1989.

7. *Median, Frontage Road, and Traffic Signal Control Criteria for Controlling Access on Major Routes*. ITE Technical Committee 5B-8. October 1983.

8. Parsonson, Peter S.. *Development of Policies and Guidelines Governing Median Selection: Final Report*. Georgia Tech Sponsored Research Project No. E-20-841. February 27, 1990.

9. Long, Gary and Jeff Helms. *Median Design for Six-Lane Urban Arterials*. Transportation Research Center. University of Florida. October, 1991.

10. Solomon, David. "Accidents on Main Rural Highways Related to Speed, Driver, and Vehicle." *Bureau of Public Roads*. July, 1964.

11. Solomon, David. "Highway Safety Myths." Highway and Traffic Safety: A Problem of Definition. *North Carolina Symposium on Highway Safety*. Volume II. Spring, 1970.

12. Bochner, Brian S.. "Regulation of Driveway Access to Arterial Streets". *Public Works*. October 1978.

13. Stover, Vergil G.. "Guidelines for Spacing of Unsignalized Access to Urban Arterial Streets". *Texas Engineering Experiment Station Technical Bulletin No. 81-1*. Texas A&M University. January 1981.

14. Stover, Vergil G., William G. Adkins, and John C. Goodknight. *Guidelines for Medial and Marginal Access Control on Major Roadways*. NCHRP Report 93. 1970.

15. *Synthesis of Safety Research Related to Traffic Control and Roadway Elements, Vol.2*. U.S. Department of Transportation. Federal Highway Administration. December 1982.

16. McGuirk, William and Gilbert T. Satterly. "Evaluation of Factors Influencing Driveway Accidents". *Transportation Research Record 601*. 1976.

17. Ismart, Dane. "Access Management State of the Art." Excerpt from FHWA's July 1990 Final Report, *Access Management Evaluation*. Office of Program Review.

18. Stanhagan, W.H. and J.J. Mullins. *Highway Transportation Criteria in Zoning Law*, and *Police Power and Planning Controls for Arterial Streets*. Highway and Land Administration Division Bureau of Public Roads. October, 1960.

19. New Jersey Department of Transportation. *New Jersey State Highway Access Management Code*. New Jersey Department of Transportation. Division of Transportation Systems Planning. Bureau of Access and Development Impact Analysis. April 1992.

20. Stover, Vergil G., Frank J. Koepke. *Transportation and Land Development*. Institute of Transportation Engineers. 1988.

21. Sokolow, Gary. Florida Department of Transportation. *Access Management and its Role in Congestion Management*. RA/International Conference Centre Amsterdam, The Netherlands. April 12-15, 1992.

22. State of Florida Department of Transportation. *Access Management: The Use of Trip Generation In Access Permitting*.

23. Stover, Vergil G.. Lecture Notes for Civil Engineering 612. Transportation in City Planning at Texas A&M University. Unpublished. Spring 1993.

24. Koepke, Frank J., and Vergil G. Stover. *Medial Access Location and Design.* Transportation Research Board Presentation. 1993.

25. Parsonson, Peter S., Marion G. Waters III, and James S. Fincher. *Effect on Safety of Replacing an Arterial Two-Way Left-Turn Lane with a Raised Median.* Access Management Conference of the Transportation Research Board. August 3, 1993.

26. Scalpone, Janet. *Waushara County Access Control Plan.* East Central Wisconsin Regional Planning Commission. September, 1986.

27. Major, I.T., and D.J. Buckley. *Entry to a Traffic Stream.* Proceedings of the Australian Road Research Board. pp. 206-228. 1962.

28. Wagner, Frederick A. *Energy Impacts of Urban Transportation Improvements.* Institute of Transportation Engineers, Washington, D.C. August 1980.

29. *An Evaluation of Strategies for Improving Transportation Mobility and Energy Efficiency in Urban Areas.* Texas Transportation Institute. Texas A&M University. Project 60011.

30. Scalpone, Janet. *Waushara County Access Control Plan.* East Central Wisconsin Regional Planning Commission. September, 1986.

31. *Lake County Highway Access Regulation Ordinance.* Lake County Division of Transportation. April 12, 1988.

32. *Model Traffic Mitigation Ordinance.* Northwest (Illinois) Municipal Conference. September 3, 1992.

33. Falconi, Xavier R.. "Access Management: Relationship Between Developers, Local Government and State Government." *ITE 1991 Compendium of Technical Papers.* pp. 71-76.

34. Stover, Vergil G.. "Access Control Issues Related to Urban Arterial Intersection Design." An invited paper presented at the 70th annual meeting of the Transportation Research Board. January, 1991.

35. Harwood, Douglas W.. *Effective Utilization of Street Width on Urban Arterials.* NCHRP Report 330. August, 1990.

36. Deakin, E. A., A. Skabardonis, and A. D. May, "Traffic Signal Timing as a Transportation Management Measure: The California Experience," in *Transportation Research Record 1081: Urban Traffic Management*, Transportation Research Board, National Research Council, Washington, D. C. (1986) pp. 59-65.

37. Macaluso, Richard, "California's Fuel Efficient Traffic Signal Management Program 1983-1987, *ITE 1987 Compendium of Technical Papers*, pp. 37-41.

38. Fambro, Daniel B., Carlos A. Lopez, and Srinivasa R. Sunkari. *Benefits of the Texas Traffic Light Synchronization (TLS) Grant Program I: Volume I, Executive Summary and Appendices A-D.* Texas Department of Transportation, Texas Governor's Energy Office, and Texas Transportation Institute, Texas A&M University (October 1992).

39. Poteat, Victor P., "Traffic Signal Retiming: It Works!," *Strategies to Alleviate Traffic Congestion: Proceeding's of ITE's 1987 National Conference*, pp. 297-307.

40. Federal Highway Administration, "National Signal Timing Optimization Project: An Executive Summary," *ITE Journal* (October 1982), pp.12-14.

41. North Carolina Department of Transportation and the Institute for Transportation Research and Education, "North Carolina's Traffic Signal Management Program for Energy Conservation," *ITE Journal* (December 1987), pp. 35-38.

42. Stover, Vergil G., Frank J. Koepke. *Transportation and Land Development.* Institute of Transportation Engineers. Second Edition in Progress.

Land Development and Subdivision Regulations That Support Access Management

Kristine M. Williams, AICP
Center for Urban Transportation Research

Abstract
Effective local access management requires planning as well as regulatory solutions. Communities should establish a policy framework that supports access management in the local comprehensive plan, prepare corridor or access management plans for specific problem areas, and encourage good site planning techniques. Land development and subdivision regulations should be amended accordingly and communities may also consider a separate access management ordinance. Access management programs should address commercial development along thoroughfares, as well as flag lots, residential strips, and other issues related to the division and subdivision of land. Comprehensive and subarea plans provide the rationale for access management programs and can serve as the legal basis for public policy decisions.

Communities are increasingly concerned about the effects of development on service costs, community character, and overall quality of life. Yet conventional regulatory practice has played a role in perpetuating land development problems. Nowhere is this more apparent than the cycle of functional obsolescence created by strip commercial development along major arterials. The practice of strip zoning major corridors for commercial use is widespread. The primary reasons are accessibility and the expedience of rezoning highway frontage for commercial use as additional land is needed. Extension of utilities along highway rights-of-way promotes this linear land use pattern, and commercial businesses favor corridor locations because of the ready supply of customers.

Yet as development intensifies, the growing number of curb cuts and turning movements conflict with the intended function of arterials--to move people and goods safely, quickly, and efficiently. Unlike urban downtowns or activity centers, commercial strips are rarely designed for pedestrians or transit. Commercial corridors, residential areas, and office parks are frequently sealed off from each other with walls, ditches, loading docks and a host of other barriers--including the heavily traveled arterials that serve them.

Poorly coordinated access systems force more trips onto the arterial, traffic conflicts multiply, and congestion increases. As the level of service declines, additional lanes, controlled medians, and other expensive retrofitting measures are needed to maintain the capacity of the corridor for regional traffic. Businesses also suffer as accessibility deteriorates. Heavy traffic, difficult left turns, and poor sight clearance at corners deter customers. Businesses may relocate to areas where accessibility is less impaired, vacancies increase, and property values decline. Eventually the corridor is transformed into an unattractive and confusing jumble of signs, curb cuts, utility lines, and asphalt.

These are not inevitable results of development and growth. Rather, they relate to the lack of adequate land division and access controls and problems inherent in current planning and regulatory practice. This report examines the role of the comprehensive plan in developing an access management program, aspects of current regulatory practice that contribute to access problems, and regulatory techniques that support access management principles.

The Comprehensive Plan
The local comprehensive plan is the policy and decision making guide for future development and capital improvements in the municipality. It anayzes development trends; identifies key planning issues; provides the policy framework; and specifies strategies for carrying out the plan. Purposes of the plan are to:

- promote orderly and efficient development;
- protect property values;
- preserve community character, natural resources, and the environment;
- promote economic development; and
- increase awareness of the forces of change.

Local comprehensive plans should establish how the community will balance mobility with access, identify the desired access management approach, and designate corridors that will receive special treatment. This may be supplemented through functional plans, such as an access management or thoroughfare plan, or through subarea plans, such as an interchange or corridor plan. These plans evaluate long term trends; provide data on traffic accidents and related considerations; and establish the relationship between access management and other community objectives, such as congestion management and transportation level of service. By establishing the relationship between regulatory strategies and public health, safety, and welfare, these plans can serve as the legal basis for access controls.

The comprehensive planning process is an opportunity to increase community awareness of the forces of change and determine a strategic course of action. What level of growth can the community expect? What are the future land use and capital improvement needs? And what type of land development patterns do citizens prefer? Public opinion surveys, town meetings, and visioning workshops may be used to identify citizen concerns and build political support for regulatory change. Citizen dissatisfaction with commercial strips, for example, can be translated into policies for joint access, shared parking, and sign regulation.

When evaluating future land use needs, communities should account for vacancies and surplus land already available for that use (Chapin and Kaiser, 1985). Many communities set aside far more land than required to accommodate reasonable estimates of growth, thereby encouraging scattered development patterns and strip development. It is not uncommon for communities to strip zone the majority of their highway frontage for commercial use. Additional highway frontage should not be planned or rezoned for commercial use where vacant or surplus commercial space is already available. This encourages reuse of existing commercial sites, increases property values in those areas, and is a long term economic development strategy.

The City of Orlando has incorporated these planning and access management principles throughout its comprehensive plan. Orlandos planning and regulatory framework includes mixed-use corridors, rather than commercial strips, and mandatory mixed use with transit access in activity centers. The City limited the supply of commercial areas to encourage reuse, designated cross access corridors with joint access requirements, and adopted a comprehensive access classification and driveway spacing program modelled after Florida Department of Transportation standards. The City also has strong policies and standards relating to bicycle and pedestrian access, including a classification system and standards for pedestrian streets.

Subdivision Regulations

Subdivision regulations help ensure: proper street layout in relation to existing or planned roadways; adequate space for emergency access and utilities; adequate water, drainage, and sanitary sewer facilities; and appropriate site design. The subdivision ordinance establishes: the administrative review and evaluation procedure for processing conceptual, preliminary, and final plats; information that must be included on the plat; design principles and standards for lots, blocks, streets, public places, pedestrian ways, and utilities; required improvements, including streets, sidewalks, water, sewer, and curbs and gutters; and financing and maintenance responsibilities.

The subdivision review process should address a variety of issues, including:

- Is the road system designed to meet the projected traffic demand and does the road network consist of hierarchy of roads designed according to function?
- Is access properly placed in relation to sight distance, driveway spacing, and other related considerations?
- Do units front on residential access streets rather than major roadways?
- Does the project avoid areas unsuitable for development?
- Does the pedestrian path system link buildings with parking areas, entrances to the development, open space, and recreational and other community facilities?
- Have utilities been properly placed? (Listokin and Walker, 1989)

State subdivision statutes grant local governments authority to regulate subdivision of land and establish minimum requirements for subdividing and platting. New Jersey's statutory framework defines subdivision as the division of land into two or more parcels and provides exceptions only in special circumstances (i.e., a new street will not be required and the lot will be 5 acres or more, but only if the planning official determines it will be used for agricultural purposes). The New Jersey legislature recently took an unprecedented step in strengthening its subdivision requirements. The New Jersey Site Improvement Standards Act of 1993 provides for updating technical proisions of the states model subdivision and site plan ordinance (1987) and adoption of the ordinance by the state. The requirements will automatically repeal and replace all local subdivision and site plan provisions. The new regulations will also consist of standardized application forms and administrative procedures, and should be completed by 1995.

Yet many subdivision statutes exempt division of land into larger parcels or creation of a small number of lots from review and conformance with subdivision standards. Michigan has one of the more lenient statutes--exempting creation of parcels larger than 10 acres from local review and allowing successive redivision into four more parcels of 10 acres or less after a ten year period. Florida's Plat Act, Chapter 177, F.S. defines subdivision as the division or platting of real property into three or more lots or parcels and includes resubdivision or establishment of streets or alleys. Under these requirements, division of land into two lots or parcels is exempt from review.

The practice of allowing unregulated division of land produces results that are contrary to access management and other important public goals. Lots may be created that are unbuildable because they lack sufficient width or depth to meet lot dimension or setback requirements, are in a wetland or floodplain, or have inadequate access to public roads. Buyers may be unaware that the lot has been divided in a manner that is inconsistent with state or local regulations until they are denied a building or driveway permit. At that point the community is often compelled to issue a variance due to the risk of a regulatory takings suit. A streamlined review process for smaller subdivisions helps assure that new lots are buildable under the regulatory framework and access is appropriate, without placing an unnecessary review burden on the property owner.

Lot Split Requirements

Lot split regulations provide for local review of divisions of land that are exempted from subdivision review. Types of lots that pose special access concerns are flag lots, through lots, and corner lots. A review process for lot splits is intended to prevent creation of unbuildable lots, excessive flag lots, or other land division patterns that can lead to access problems. It further prevents creation of lots with inadequate or inappropriate access to a public road.

Floridas Model Code establishes a process for reviewing lot splits, called Minor Replats. Minor Replat is defined as:

"The subdivision of a single lot or parcel of land into two (2) lots or parcels, or the subdivision of a parcel into two or more lots solely for the purpose of increasing the area of two or more adjacent lots or parcels of land, where there are no roadways, drainage, or other required improvements, and where the resultant lots comply with the standards of this Code."

The Model Code provides for review by the local Planning Department (and any other local departments); requires information regarding water or sewer service; requires a scaled drawing of the intended division and any principal or accessory structures by a registered surveyor; provides for recording the replat in the official county records; and requires conformance with the following standards:

1. Each proposed lot must conform to the requirements of this Code.

2. Each lot shall abut a public or private street (except as hereinafter provided) for the required minimum lot width for the zoning district/category where the lots are located.

3. If any lot abuts a street right-of-way that does not conform to the design specification provided in this Code, the owner may be required to dedicate one-half the right-of-way width necessary to meet the minimum design requirements.

Once a Minor Replat has been approved, the Code restricts further division unless a development plan (or plat) is prepared and submitted for review. Local regulations should also require proof of lot split approval by the planning commission or zoning administrator before a building permit may be issued.

Residences scattered along state and county roads can be more damaging to the regional transportation network than commercial strips because they may occupy hundreds of miles of highway frontage. Over time such development patterns landlock interior land, school buses must make longer trips, emergency services must cover a wider area, and the cost of extending utilities becomes prohibitive. As the number of driveways increase, the highway is gradually transformed into a high speed version of a local road. The safety implications are obvious, as vehicles travelling 55 mph are mixed with residents entering and exiting their driveway.

Yet this development pattern is virtually prescribed by the combination of conventional zoning and unregulated land division. Despite authority to monitor creation of new lots, many communities have not adopted a lot split ordinance. Sarasota County, Florida, for example, goes beyond the exmptions prescribed in statute to exempt lots of 5 acres or larger from review or division of land into two parcels. The division of agricultural land into 5 acre parcels effectively converts it for residential use. Over time the land is subdivided, creating residential strips along rural roadways rather than shared access subdivisions.

Lot split review provides an opportunity to discourage residential stripping of rural highways. Yet flexible zoning is even more effective in achieving access management and resource management objectives. An innovative approach is the combination of subdivision review with site planning and cluster zoning techniques, proposed by rural landscape planner Randall Arendt. Arendt recommends the following access standard for small rural subdivisions:

"Subdivisions with frontage on state-numbered highways shall be designed into shared access points to and from the highway. Normally a maximum of two accesses shall be allowed regardless of the number of lots or businesses served. (Yaro, Arendt, et al. 1990.)

In the absence of flexible zoning, a sliding scale or quarter/quarter zoning approach to land division in rural areas is preferable. The former might permit division of one two acre lot per 10 acre parcel, and the latter may permit one nonfarm residential lot per 40 acres of farmland (Misseldine and Wyckoff, 1987).

Flag Lots

Local plat maps often reveal lots shaped like flags with long narrow access poles . Flag lots are especially prevalent along lakes, rivers, cul-de-sacs, and rural highways. They are useful as a land division technique in areas where natural features or land division patterns create access problems, but flag lots proliferate in some areas where interior lots should instead be served by a private road. Landowners may stack flag lots when dividing a parcel to provide interior lots with direct access to a state or county road, thereby avoiding the expense of providing a public or private road. The narrow frontages afford inadequate spacing between driveways and increase safety hazards from vehicles turning on and off the high speed roadway.

Local land development or subdivision regulations should discourage creation of flag lots, except in unique circumstances. Exceptions could be provided where a site has unique physical constraints, such as wetlands or other natural features, that prevent access via a local street or where frontage requirements create access problems. Moskowitz and Lindbloom (1993) suggest the following flag lot standards:

- a minimum lot area (often at least twice the area allowed in that zone, not including the access right-of-way);
- minimum front, side, and rear yard requirements for primary lot;
- a minimum of 20 feet and maximum of 50 feet for the access right-of-way;
- not more than one flag lot per private right-of-way; and
- a minimum separation distance of at least the minimum frontage requirement of that zoning district. [Note: Some communities also restrict the length of the access pole.]

The City of Orlando, Florida, provides for flag lots when deemed necessary to achieve creative planning, to eliminate access to collector or thoroughfare streets, preservation of natural amenities or important historical or archaeological values...but only in residential developments approved in accordance with [site plan review requirements] and provided the following conditions are satisfied:

- no flag lot shall abut more than one other flag lot, nor shall flag lots be double stacked across a common street;
- in no instances shall flag lots constitute more than 10% of the total number of building sites in a given development, or 3 lots (whichever is more);
- the lot area occupied by the flag driveway shall not be counted as part of the reuired minimum lot area;
- flag lots shall not be permitted whenever their effect would be to increase the number of building sites taking driveway access to a Collector or arterial Street; and
- no flag driveway shall be longer than 150 feet [Section 60.128].

Access requirements in Hillsborough County, Floridas Land Development Code require all lots to have access to a public street through a portion of the lot, through an approved private street, or through commonly owned property [Section 2.5.9.10]. If through commonly owned property and serving more than one lot, the access must be at least fifty feet wide. Additional flag lot standards are provided for rural or semi-rural areas. These allow a single parcel to have a minimum twenty foot access provided it is separated from any other such access by at least the minimum lot width for the district and the access pole is not longer than 800 feet. If an easement access is required, it is subject to a minimum width of 20 feet and can serve no more than one parcel.

Private Road Ordinances

Private roads offer an alternative means of access to small subdivisions in rural areas and to lots that are not subject to subdivision review. In the absence of provisions for private roads, common practice is the creation of multiple lots served by a common lot, easement, or multiple easements as in the example of stacked flag lots. The easement then becomes a private unpaved road serving several properties. Unregulated private roads raise several problems. They may be inacccessible to emergency vehicles or large delivery trucks, placing public safety and private property at risk. Substandard roads deteriorate quickly and without a maintenance agreement, the local government may be called upon to maintain it. Buyers may not be aware of the maintenance issues associated with the road. Narrow rights-of-way may impede placement of utilities and private roads can exacerbate inefficient land development patterns.

These problems can be avoided through private road regulations that address design, construction, joint maintenance agreements, signage, and review. Private roads should be permitted for residential uses only and standards should be tied to lot split (minor replat) or subdivision regulations. Limitations should be placed upon the number of residences that may be served by a single access to a public road. Most communities require a minimum 66 foot right-of-way. Many rural areas do not require paving if the roadway conforms to gravel road specifications, whereas others require paving after the number of dwelling units served exceeds a certain number. Some ordinances provide a sliding scale approach, allowing gravel roads of about 12 feet to 18 feet wide for 2-4 parcels and requiring county road specifications for larger developments.

Single Access Subdivisions

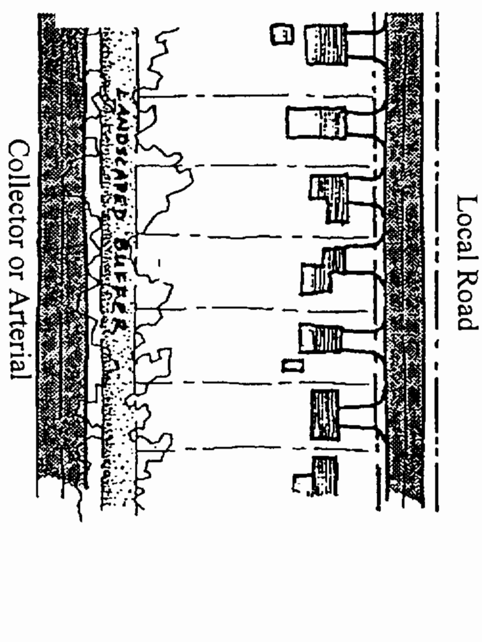
Linear subdivisions served by a single access drive ending in a cul-de-sac may inhibit emergency access and increase traffic congestion during peak hours by providing only one point of ingress and egress. Single access problems may also result in phased subdivisions where additional access is proposed for future phases. If future phases are not built, the remaining subdivision may have insufficient access. Although this is not a problem where only a few dwelling units are served, how many lots is too many?

Average daily trips for residential streets provide a baseline for access and cul-de-sac standards. Listokin and Walker (1989) recommend that when a subdivision on a single access rural road exceeds 20 lots (or 20 dwelling units), it should have at least two access points. The maximum number of dwelling units permitted for residential access streets would be about 50 per loop. A minimum turning radius that accommodates emergency vehicles should be required for cul-de-sacs.

Lot Frontage and Dimensional Requirements

Through lots, also known as double frontage lots, are lots with frontage on two streets. Through lots should be required to obtain access on the streetwith the lower functional classification. When a residential subdivision is proposed that would abut an arterial, it should be designed to provide through lots along the arterial with access from a local road. These requirements are known as reverse frontage (Figure 1). In either case, the community could require that access rights to the arterial or collector be dedicated to the local government and this restriction recorded with the deed. Sarasota County, Florida provides that when a new subdivision is created, lots abutting an arterial are prohibited from having direct access to that arterial. Instead, access to these lots must be from an interior local street or frontage street and access rights to the arterial must be dedicated to the County and run with the land (*Sarasota County Land Development Regulations*, Section B3.3(j)).

Figure 1.
Reverse Frontage



Minimum lot frontage requirements are tied to zoning requirements for a district and set the minimum lot width or frontage on a public road. Minimum lot frontage standards should be higher on arterials and collectors to allow for greater spacing between commercial or residential driveways. The frontage requirement will vary depending upon the minimum lot size in that zoning district and other dimensional requirements, such as the width-to-depth ratio. Although driveway spacing standards may be used to limit residential driveways along rural highways, land division controls and higher minimum lot frontage requirements can be more effective in controlling residential strips.

Minimum lot frontage and maximum lot width-to-depth ratios prevent the creation of long and narrow or irregularly shaped lots. Width-to-depth ratios may be included in the local land development code or subdivision regulations. Rural areas may adopt a maximum width-to-depth ratio of 1:4, meaning that parcels with 100 feet of frontage may not be longer than 400 feet. Urban or suburban areas may use maximum ratios of 1:2.5 or 1:3. Width-to-depth ratios should be set higher in coastal areas to account for erosion (Williams et al., 1990).

Driveway Spacing Requirements

Spacing standards limit the number of driveways on a roadway by mandating a minimum separation distance between driveways. These standards reduce the potential for collisions as travellers enter or exit the roadway and encourage sharing of access. Driveway spacing at intersections and corners should provide adequate sight distance and response times and permit adequate stacking space. Spacing standards should be tied to the state DOT access classification and driveway permitting standards for the state highway system. Driveway spacing standards on other roadways may be tied to the posted speed limit or functional classification of the roadway, with the minimum distance between driveways greater as speed limits increase (Table 1). Some communities provide variable spacing depending upon the land use intensity of the site served and that of adjacent sites.

Table 1.
Driveway Spacing Based on Sight Distance

Highway Design Speed (mph)	Sight Distance (Feet)
30	200
35	225
40	275
45	325
50	350

Source: Jeffrey Kern. "Managing Vehicle Access Along Commercial Strips," PAS Memo. Chicago: American Planning Association, July 1983.

Joint Access
Joint access requirements provide for a unified on-site circulation plan and adequate driveway spacing along developing commercial corridors. Orlando, Florida has a comprehensive program for minimizing curb cuts through joint access and cross access requirements. Joint use driveways and cross access easements must be established wherever feasible and the building site must incorporate a unified access and circulation system. Orlandos cross access standards require:

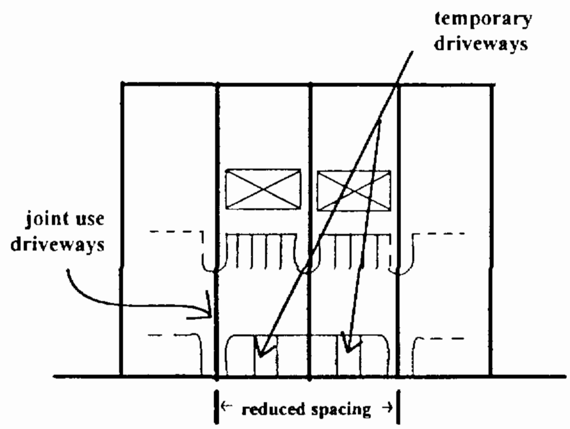
a. A continuous linear travel corridor extending the entire length of each block it serves, or at least 1,000 feet of linear frontage along the thoroughfare, and having a design speed of 10 mph.
b. *Sufficient width to accommodate two-way travel* aisles designed to accommodate automobiles, service vehicles and loading vehicles in accordance with [design] requirements;
c. Stub-outs and other design features that make it visually obvious that the abutting properties may be tied in to provide cross-access;
d. Linkage to other cross-access corridors in the area.

All plats, site plans, and other development must meet these standards on designated thoroughfares and property owners must record an easement with the deed allowing cross access to and from other properties in that affected area. The property owner must also enter an agreement to dedicate remaining acess rights along the thoroughfare to the City and enter an agreement to be recorded with the deed that pre-existing driveways will be closed and eliminated after construction of the joint-use driveway. Cross-access corridors are indicated on the zoning map by dashed or dotted lines and distinguish those portions of the corridor where easements have been recorded.

Standards are included for coordinated or joint parking design and joint maintenance agreements must also be recorded with the deed. These standards are applied to phased development in the same ownership and leasing situations. Where abutting properties are in different ownership, cooperation is encouraged but not required. Only the building site under consideration is subject to the requirements, which are recorded as a Binding Lot Agreement prior to issuing a building permit. As abutting properties are developed or initiate retrofitting requirements then they must abide by the standards (see Retrofitting).

If properties are unable to meet driveway spacing requirements of the Access Management Classification System, the Public Works Director may waive the requirements and provide for less restrictive spacing (see Figure 2). The waiver is based on the condition that joint use driveways, cross access easements, and a unified parking a circulation plan must be established wherever feasible. Where unified access and circulation is not practical, the City may provide a variance.

Figure 2.
Joint Access



Retrofitting Nonconforming Properties
Land development regulations are not retroactive. Existing properties that do not meet land development requirements must be designated as nonconforming--a process commonly known as grandfathering. Nonconformities may relate to land use or dimensional requirements, as in a nonconforming lot of record. Nonconforming properties may continue in the same manner as they existed before land development regulations were adopted. These requirements protect the substantial investment of property owners and recognize the expense of bringing those properties into conformance.

Yet the negative impacts of nonconforming properties may be substantial. Nonconforming properties may pose *significant safety hazards, increase traffic congestion, reduce* property values, degrade the environment, or undermine community character. To address the public interest in these matters, land development regulations include conditions or circumstances where nonconforming access features may be brought into conformance. Such conditions may include:

- when new driveway permits are requested;
- an increase in land use intensity;
- substantial enlargements or improvements;
- significant change in trip generation; and
- as changes to roadway design allow.

Opportunities to bring nonconforming features into compliance typically occur after a change of ownership when the costs of required improvements may be amortized in the business loan or mortgage.

Limiting New Driveways Along Major Roads
An effective method of managing curb cuts in newly emerging commercial corridors is to restrict the permitted number of future driveways to one driveway per existing lot or parcel. This may be accomplished as follows:

1. Identify and map the emerging commercial corridor.
2. Verify the boundaries of all existing lots.
3. Assign one driveway to each mapped parcel.

The assigned driveway would be permitted by right effective upon adoption of the ordinance and map. Parcels with larger frontages could be permitted more than one driveway and additional driveways could be permitted by special use permit. Under this approach, future division and subdivision of parcels could occur, but each newly created lot would obtain access via the connection permitted by the ordinance. Because of this constraint, property owners would be obliged to share driveways, use service drives, cross access, and even rear access drives in some instances to maintain appropriate access. Limitations on new driveways may be established using a corridor overlay approach.

Outparcel Requirements
Outparcels are lots on the perimeter of a larger parcel that abut a roadway. Outparcel regulations are adopted for commercial corridors to foster coordinated on-site circulation systems that serve outparcels as well as interior development, thereby reducing the need for driveways on an arterial. Outparcel regulations may include standards governing: the number of outparcels; minimum lot frontage; access; unified parking and circulation; landscaping and pedestrian amenities; building height, coverage, and setback requirements; and signage.

The City of Pembroke Pines, Florida limits the number of outparcels to one per ten acres of site area, with a minimum frontage requirement of 500 lineal feet per outparcel. Standards also call for a minimum of 300 lineal feet of open space between outparcels. Roadways separating adjacent parcels may be included with open space in meeting this requirement. The ordinance prohibits more than one building per outparcel. Each parcel must provide all required parking on site and conform to all landscaping and setback requirements of that zoning district. Access requirements are as follows:

Access to the outparcel shall be as direct as possible avoiding excessive movement across parking aisles and queuing across surrounding parking and driving aisles. All access to the outparcel must be internalized utilizing the main access drive of the principal retail center... Drive-in facilities shall be provided on the outparcel site exclusively. In no instance shall the circulation and access of the principal commercial facilty and its parking and service be impaired.

In addition, covenants imposed by the Planning and Zoning Board and Architectural Review Board must be added to the deed if title to the outparcel is transferred after the site plan is approved. The seller must notify the buyer, who is bound by the restrictions.

Corridor Overlay Zones
Overlay zones are a growing method for managing access along commercial corridors. The technique is used to overlay a special set of requirements onto an existing zoning district, while retaining the underlying zoning and its associated requirements. Text that specifies standards for the access management overlay district is included in the land development (or zoning) code and then corridors are designated on the zoning map. Overlay requirements may address any issues of concern, such as joint access, parking lot cross access, reverse frontage, driveway spacing, and limitations on new driveways.

Sample regulations for the Grand Traverse Bay Region in Michigan apply to the area 300 feet on either side of the designated corridor, establish minimum lot frontage of 400 feet, and permit only one access per 400 foot lot (Wyckoff, M., Sept. 1992). Service drive provisions freeze the number of driveways on a designated corridor to one per existing parcel having a single tax code number at the date of the amendment. When subsequently divided, all parcels must provide access via subdivision roads, other private or public roads, or by service drives in conformance with specified design requirements.

Commercial driveway location and spacing standards are provided for regional arterials and other types of roads. Parcels with less than 100 feet of frontage may be permitted a driveway, but in certain cases a shared driveway or alternative means of access may be required. Requirements for minimum intersection or corner sight distance are tied to AASHTO guidelines and somewhat lower standards tied to the posted speed limit are provided for special circumstances, such as inadequate frontage.

Official Maps and Mapped Streets Ordinances
An official map designates future rights-of-way and shows new, extended or widened streets or other public ways. The purpose of a local mapped streets ordinance is to implement the circulation element of the local thoroughfare or street plan. Official map ordinances typically:

- prohibit construction or enlargement of any structure or other improvement within the official map lines or setbacks;
- require setbacks to be measured from the future right-of-way line;

- require all future lots of record to abut the mapped street right-of-way;
- parcels partially in the future right-of-way line must still meet dimensional requirements of that zoning district;
- new subdivisions must conform with the official map;
- restrictions on issuing a building permit or development order for structures or subdivisions in conflict with the ordinance;
- standards for issuing variances or relief to severely restricted property.

Official maps and associated standards have existed since the early 1950s as a means for state and local governments to preserve future transportation corridors identified through the planning process. Governments are unable to purchase all of the right-of-way needed for future roads in advance. If substantial building occurs within the right-of-way, then future costs of acquiring and condemning that land also become prohibitive. Thus, mapped streets requirements help preserve the corridor to the maximum extent feasible and avoid encroachment that could have been avoided. In turn, communities should recognize the important contribution of developers that dedicate right-of-way in conformance with the local thoroughfare plan and mapped streets requirements through impact fee credits or other development bonuses.

Table 2.
Regulatory Techniques that Support Access Management

- Regulate driveway spacing, sight distance, and corner clearance.
- Limit number of driveways per existing parcel on developing corridors.
- Increase minimim lot frontage along thoroughfares.
- Encourage joint access and parking lot cross access.
- Review lot splits to prevent access problems.
- Regulate flag lots and lot width-to-depth.
- Minimize commercial strip zoning and promote mixed use and flexible zoning.
- Regulate private roads and require maintenance agreements.
- Establish reverse frontage requirements for subdivisions and residential lots.
- Require measurement of building setbacks from future right-of-way line.
- Promote unified circulation and parking plan.

Disadvantages of maps of reservation include speculation on the corridor and the potential for a regulatory taking where a building permit is denied. To minimize takings claims, law professor Daniel Mandelker suggests the following:

1. Include provisions that compensate landowners for existing improvements within a mapped street;
2. Provide for short time periods for reservation of the right-of-way based on a public commitment to acquire the right-of-way (generally the shorter the better);
3. Provide remedial measures, including variances and an option for public acquisition of the property when a building permitis requested. (Mandelker and Kolis, 1989).

Another option is for the community to reserve right of first refusal on an option to the property when it is put up for sale. In turn, if the community is offered an option to condemn the property when a building permit is requested and decides not to do so, then it should remove that property from the official map.

Providing for variances and other remedial measures is crucial to avoiding a takings claim by providing due process to the property owner and avoiding unreasonable hardship posed by the regulatory framework. Federal ripeness rules have established that property owners should first exhaust available administrative remedies, including appeals to the local board of adjustment, before the case may be heard in a court of law. If such appeal procedures exist and the property owner sues before first pursuing a variance or other remedial action, the case may be invalidated on this basis.

Improving Coordination

An effective method of coordinating review and approval is through a tiered review process that begins with an informal meeting and concept review. The informal review allows officials to advise the developer regarding information needed to process the application. This may include state and local permit requirements and special considerations of the development site. The concept review provides the developer with early feedback on a proposal, before the preliminary plat or site plan has been drafted. The preliminary plan is then checked to determine if additional conditions are required for approval and the final plan should require only administrative review. A parallel review process should be established in the state DOT district office where an application involves access to the state highway system, as is currently done in Oregon (Falconi 1991).

To insure conformance with land division and access requirements, the building permit should be established as the lead permit during development review. Property owners may then be required to submit the necessary permits or certificates of approval from regulatory agencies involved in subdivision or site plan review before issuing a building permit. This should include the state Department of Transportation where the state highway system is involved to assure conformance with state access management and driveway permitting requirements.

Upon adoption of new access management requirements, planners should also initiate a training program to educate planning commissioners, the zoning administrator, and the zoning board of adjustment on the purpose and administration of the new standards. It is essential that the regulations be applied consistently--especially when opportunities arise for retrofitting nonconforming features. Variance requests should be judiciously evaluated according to specified review procedures and discretionary standards to avoid inconsistency.

Conclusion

Access management addresses a broad array of quality of life issues fundamental to promoting livable, prospering communities. Land division and access controls:

- foster well designed circulation systems that improve the safety and character of commercial corridors;
- discourage subdivision practices that destroy the rural character of the landscape or essential natural resources;
- advance economic development goals by promoting more efficient use of land and transportation systems; and
- help control public service costs and the substantial public investment in infrastructure and services.

Effective local access management requires both planning and regulatory solutions. Communities should establish a policy framework that supports access management in the local comprehensive plan, prepare corridor or access management plans for specific problem areas, and encourage good site planning techniques. Zoning and subdivision regulations should be amended accordingly and communities could consider a separate access management ordinance. Comprehensive and subarea plans provide the rationale for access management programs and can serve as the legal basis for public policy decisions.

Because land division and access controls are politically charged, planning officials are advised to develop strategies for diffusing opposition before advancing recommendations. Be aware of the practical concerns of those most affected by proposed amendments and devise strategies for ameliorating hardship. Town meetings, attitude surveys, and other techniques should be used to educate stakeholders and generate political support.

References

Brough, Michael B. A Unified Development Ordinance. Washington, D.C.: Planners Press American Planning Association, 1985.

Chapin, F., Kaiser E. Urban Land Use Planning. Chicago: University of Illinois Press, 1985.

Falconi, Xavier R. "Access Management: Relationship Between Developers, Local Government and State Government." ITE 1991 Compendium of Technical Papers, 1991.

Koepke, F.J., Levinson H.S. Access Management Guidelines for Activity Centers. NCHRP Report 348, Washington, D.C.: National Academy Press, 1992.

Listokin, D. and Walker, C. The Subdivision and Site Plan Handbook. New Jersey: The State University of New Jersey, 1989.

Mandelker, D, Kolis, B. "Interim Development Controls in Highway Programs: The Taking Issue." Journal of Land Use and Environmental Law. Winter 1989: 167-213.

McPherson, J.K., Coffey D., Easley, G. Land Development Regulations, Technical Assistance Manual for Flrida Cities and Counties. Prepared for the Department of Community Affairs. August 28, 1989.

McPherson, J.K., Coffey D., Easley, G. Model Land Development Code for Florida Cities and Counties. Prepared for the Department of Community Affairs. December 1989.

Misseldine, C., Wyckoff M. Planning and Zoning for Farmland Protection: A Community Based Approach. American Farmland Trust, 1987.

Moskowitz, H., Lindbloom C. The New Illustrated Book of Development Definitions. New Brunswick, New Jersey: Center for Urban Policy Research, 1993.

Williams, Kristine M. "Reserving Right-of-Way with Official Maps". Planning and Zoning News. July 1991: 14-18.

Williams, K.M., McCauley, T.J., Wyckoff, M.A. Land Division and Access Controls. Lansing: Planning and Zoning Center Inc., April 1990.

Wyckoff M, Williams K., Armstrong M, et al. Community Planning Handbook: Tools and Techniques for Guiding Community Change. Planning & Zoning Center, Inc. , March 1992.

Wyckoff M., Grand Traverse Bay Region Development Guidebook. Planning & Zoning Center, Inc., September, 1992.

Wyckoff M., Grand Traverse Bay Region Development Sample Regulations., Planning & Zoning Center, Inc., September 1992.

Yaro, R., Arendt, R. Dodson, H., Brabec, E. Dealing with Change in the Connecticut River Valley: A Design Manual for Conservation and Development. Amherst: Lincoln Institute of Land Policy and the Environmental Law Foundation, 1988.

SAMPLE

CROSS-ACCESS AND/OR THROUGH-ACCESS AGREEMENT

THIS CROSS ACCESS AND/OR THROUGH-ACCESS AGREEMENT (hereinafter "AGREEMENT") is made and entered into this ___ day of _______, 19__, by and between ____________________________ ____________ (hereinafter "Grantor"), and individual, and the CITY OF ORLANDO (hereinafter "CITY"), a municipal corporation existing under the laws of the State of Florida, 400 South Orange Avenue, Orlando, Florida 32801, for the purposes hereinafter set forth.

W I T N E S S T H:

WHEREAS, GRANTOR is the fee simple owner of property more fully described as follows, to wit: (Legal Description)

WHEREAS, the GRANTOR pursuant to Section 61.309 of the Code of the City of Orlando elects to utilize alternative minimum number of parking spaces in lieu of the requirements shown on the Non-Residential Parking Chart (Figure 12) in Chapter 61 of the Orlando City Code.

WHEREAS, whenever these alternative minimum requirements are used, the property owner must pursuant to the City of Orlando's Code grant cross-access and through-access easements to all abutting properties in O, MXD, MU or AC zoning districts.

NOW, THEREFORE, in consideration of the mutual covenants contained herein, and other good and valuable consideration each to the other paid, the receipt and sufficiency of which is hereby acknowledged, the parties agree as follows:

1. The recitals are acknowledged as true and correct and are incorporated herein as covenants and agreements and are made a part hereof.

2. This AGREEMENT shall be binding upon the successors, heirs, executors, administrators, personal representatives, or assigns of the parties and upon all persons acquiring an interest thereunder, and shall be a covenant running with the title to the GRANTOR's land hereinafter described until terminated as provided herein.

3. GRANTOR hereby covenants with the CITY that it is lawfully seized of said property in fee simple, that it has good right and lawful authority to convey said easement(s).

4. In the event it shall be necessary for either party to bring suit to enforce this AGREEMENT or for damages on account of any breach of this AGREEMENT, or of any warranty, covenant, condition, requirement or obligation contained herein, the prevailing party shall be entitled to recover from the other, in addition to its damages, all legal costs and reasonable attorney's fees as fixed by the Court, both at the trial and the appellate level.

5. GRANTOR hereby agrees to grant cross-access and/or a through-access easement(s), as depicted on the site plan described as Exhibit "A", attached hereto and incorporated herein, to all abutting properties in O, MXD, MU or AC zoning districts pursuant to the requirements of Section 61.309 of the Code of the City of Orlando upon written request by the City or the abutting property owner(s).

6. In consideration of the terms described above, the GRANTOR may use the applicable alternative minimum parking requirement as specified in Section 61.309 of the Code of the City of Orlando.

7. The CITY shall not be liable for or responsible for any maintenance or repairs to the GRANTOR's property.

8. This agreement and the provisions contained herein shall be construed, controlled, and interpreted according to the laws of the State of Florida, and all duly adopted ordinances, regulations, and policies of the CITY now in effect and those hereinafter adopted.

9. The location for settlement of any and all claims, controversies, or disputes, arising out of or relating to any part of this Agreement, or any breach hereof, shall be Orange County, Florida.

10. The GRANTOR and the CITY agree to comply with the laws, rules, regulations and requirements of all governing authorities having jurisdiction over the property described above.

11. The GRANTOR will record this AGREEMENT, at its expense, in the Public Records of Orange County, Florida, where its shall encumber the property.

12. GRANTOR hereby covenants and agrees that this AGREEMENT is specifically enforceable because monetary damages would be insufficient to redress the denial of such easement(s).

13. The parties hereby acknowledge that they have freely and voluntarily entered into this AGREEMENT and that each has had the benefit of or been given the opportunity to receive the advice of independent legal counsel for all negotiations in connection with this AGREEMENT.

14. The term of this AGREEMENT shall be or thirty (30) years, unless sooner terminated by the CITY.

15. This AGREEMENT may be terminated by the CITY, at its convenience, upon the giving of thirty (30) days advance written notice. Termination shall be effective upon receipt of notice as provided herein.

16. Any notice required or allowed to be delivered by this AGREEMENT shall be in writing and be deemed to be delivered when (i) hand delivered to the person hereinafter designated, or (ii) upon receipt of such notice when deposited in the United States Mail, postage prepaid, certified mail, return receipt requested, addressed to a party at the address(es) set forth opposite the party's name below, or at such other address(es) as the applicable party shall have specified, from time to time, by written notice to the other party delivered in accordance herewith:

GRANTOR:

CITY: City Clerk
City of Orlando
400 South Orange Avenue

IN WITNESS WHEREOF, the parties have caused these presents to be duly executed as said instrument the day and year first above written.

GRANTOR:
By:________________________
Printed:______________________
Title:_______________________

WITNESSES

____
Printed Name:_______________

____
Printed Name:_______________

STATE OF FLORIDA
COUNTY OF ORANGE

The foregoing instrument was acknowledged before me this __ day of ________, 1992, by ________ ________, and GRACE A. CHEWNING, City Clerk, who is personally known to me or who has produced a valid Florida Driver's License as identification and who did/did not take an oath.

____
Name:
Notary Public
Serial Number:
Commission Expires:

* * * *

CITY OF ORLANDO

____
Printed:______________
Mayor/Pro Tem

ATTEST:

____
Grace A. Chewning, City Clerk

APPROVED AS TO FORM AND LEGALITY for the use and reliance of the City of Orlando, Florida, only.
_______________, 1992.

____
CITY ATTORNEY
ORLANDO, FLORIDA

STATE OF FLORIDA
COUNTY OF ORANGE

The foregoing instrument was acknowledged before me this __ day of ________, 1992, by ________ ________, and GRACE A. CHEWNING, City Clerk, who is personally known to me or who has produced a valid Florida Driver's License as identification and who did/did not take an oath.

____
Name:
Notary Public
Serial Number:
Commission Expires:

THIS INSTRUMENT PREPARED BY:

A. Darren Jafroodi
Assistant City Attorney
Fla. Bar #0882259
City of Orlando
400 South Orange Avenue
Orlando, Florida 32801
(407) 246-2295

RETURN RECORDED COPY TO:

Office of Legal Affairs
City of Orlando - 3rd Floor
400 South Orange Avenue
Orlando, Florida, 32801

DISCUSSION PERIOD - SESSIONS 3A, 4A, AND 5A

Moderated by Arthur Eisdorfer, New Jersey DOT

The following is a summary of discussions held at the question and answer period for the speakers from Sessions 3A, 4A, and 5A. The speakers present were Herb Levinson, John Nitzel, Gary Sokolow, Del Huntington, Freddie Vargas, Richard Forester, William Frawley, Phil Demosthenes, and Suzanne Catanese. Except where noted, comments are not verbatim. Where possible, the speaker to whom the question was directed is identified.

Q: **[to Catanese] Why should a developer have to pay for roadway improvements if the master plan already has that roadway slated for improvement in the future?**

A: In New Jersey, access applications are based on present conditions. If a new access is going to substantially increase traffic and the master plan allows for roadway expansion, then the developer must pay for the improvements. If the projected traffic demand exceeds the maximum build-out assumed in the master plan, the application is rejected.

Q: **[to Demosthenes] You indicated that Colorado's current roadway classification system may be a little too complex. Does Colorado have any plans to change its classification system?**

A: No. If Colorado changed its classification system at this point, we would essentially have to start over from scratch. Colorado does not have a master plan like New Jersey does. That is something we may need to do in the future.

Q: **[to Demosthenes] Has TRB/FHWA thought about developing national access management standards to assist those states that do not have access management programs?**

A: There is nothing in the pipeline right now and no funding for any projects to develop standards. States may want to consider NCHRP Report 348 to be a standard of sorts. It is possible that the Feds may not want to set guidelines any firmer than NCHRP 348. Right now we are waiting for the report on access management and the ISTEA guidelines that Dane Ismart spoke of.

Q: **Do any states recover some of the value of access grants to improved sites?**

A: New Mexico does. If a new access point is approved, New Mexico re-assesses the value of the land use and charges the developer accordingly. Oregon has the authority to do the same, but it is something they try to stay away from right now.

Q: **[to Huntington] If safety is a significant problem, can Oregon revoke access without providing compensation to the landowner?**

A: Yes. The state has the authority to protect the public, and if an access point is considered a significant threat to public safety, the state can revoke it without compensation.

Q: **[to Eisdorfer] If a landowner in New Jersey has 3 adjacent parcels and desires access permits for each, can the state require the owner to have shared access instead?**

A: The state will try to convince the owner to do this, but can not require him to do it. The state may accept a single application for all three sites, but even with shared access would have to issue three separate permits.

Q: **[to Eisdorfer] If someone proposes access to more than one property and roadway improvements are required, who pays?**

A: In New Jersey, the owner of the lot on which the access lies is responsible for the access costs. If roadway improvements are required, they are figured proportionately for each property based on the amount of traffic generated by each.

DISCUSSION PERIOD - SESSIONS 3T, 4T, AND 5T

Moderated by Frank "Bud" Koepke, Metro Transportation Group

The following is a summary of discussions held at the question and answer period for the speakers from Sessions 3T, 4T, and 5T. The speakers present were Dane Ismart, Vergil Stover, Gail Yazersky-Ritzer, Mark Vandehey, Jack Foster, Sal Bellomo, Joel Leisch, Benedict Barkin, Gary Sokolow, and Kristine Williams. Except where noted, comments are not verbatim. Where possible, the speaker to whom the question was directed is identified.

Q: **[to Williams] When trying to encourage shared access between existing property and a new development, what do you do when the owner of the existing property refuses to accept shared access.**

A: The City of Orlando tries to encourage cooperation between property owners. If one of the property owners refuses shared access, that's fine. The developer is granted a temporary access; however, he must still dedicate an easement for a shared access and make a commitment to install shared access when it becomes possible. In the future, if the adjacent property requires a modification (such as a change in use or a new access) it must also be brought into conformance with the access codes. The temporary access will then be closed and a new shared access constructed, with the cost shared by both owners.

Q: **The warrants for providing left turn lanes are somewhat vague. There are warrants based on accident rates, delay, and opposing traffic volumes, but there are really no set standards. Have any states developed a set of left turn lane warrants which could serve as guidelines for other areas?**

A: Good guidelines are hard to find. Most states' warrants vary as to when a left turn lane is necessary. We would like to see a study on turn lane warrants so that we can establish some consistency. Peter Parsonson recently published a study which recommends a raised median with left turn bays for roadways with volumes over 24,000 vehicles per day.

Q: **We have been discussing left turn lane warrants based on existing traffic volumes. One problem that states frequently run into is whether to require a developer to build a single (or double) left turn bay based on projected future year volumes. Many developers complain that they are forced to construct left turn lanes that are necessitated not by their development but by the projected growth in background traffic. Any comments?**

A: [Sokolow] It is an inexact process, but the best thing to do is to sit down with the developer and try to work out an agreement so that both sides feel they have gained something. [Koepke] Some states are preserving the ability to expand from one to two left turn lanes in the future by using 30 foot medians.

Q: **[to Vandehey] Our state is looking at warrants to remove unnecessary traffic signals. Ultimately, the cost of removing the signals may be what determines whether they stay or not. Do any of these procedures for determining signal warrants take into account cost?**

A: The new procedure discussed in the presentation should provide much improved information on whether a signal is necessary from an operational and delay standpoint. It does not take into account cost. [Ismart] One must also remember that there are political and social considerations for removing traffic signals. One must often educate the community and local leaders on the reasons for removing a signal before actually doing so, since unnecessary signals are often installed at the request of citizens and neighborhoods for safety reasons.

Q: **Does anyone have any opinions on left turn acceleration lanes?**

A: [Koepke] Left turn acceleration lanes should only be used for left turn egress access; they simply will not work with a left turn ingress/egress access. At even moderate left turn ingress volumes, the egress capacity is seriously reduced. The major considerations for left turn acceleration lanes are the distance required for acceleration and the time required for the driver to select an appropriate gap. The distances can quickly become very large and you really need at least 1/2 mile signal spacing for acceleration lanes to work. You will not find many places that use them.

[Stover] If the left turn ingress is placed before the left turn egress, an acceleration lane might work. A more practical solution would be to provide a wide enough median to store vehicles. This way vehicles can cross the first set of travel lanes and then wait for an appropriate gap in the other traffic. You will sometimes even find two-way continuous left turn lanes used as acceleration lanes under high volume conditions.

Q: **Much of the conference has focused on using access management to preserve capacity. Could someone discuss ways of recapturing lost capacity on heavily developed arterials with access to every lot?**

A: [Vargas] Florida has undertaken several projects to do just that. In one retrofit, we closed median openings, added raised medians where there were none, and closed about half of the existing access points. We achieved gains in speeds and capacities and reductions in accidents. We generally did not touch traffic signals as these are very hard to remove for plitical reasons. It should be noted that this retrofit was very difficult to sell to the community and we spent about 2-1/2 years before construction even began just educating the community about the project.

Q: **Have any states used rumble strips in continuous two-way left turn lanes to discourage drivers from using them as an extra travel lane?**

A: Illinois has tried using them, but the noise levels were very high and drew complaints from neighboring homes and businesses. It should be remembered that if the left turn volumes are high enough, continuous left turn lanes become self enforcing because turning vehicles block the lane. States need to be careful about where they install continuous turn lanes. Problems usually occur when a turn lane is installed when it is not warranted.

Q: **[to Florida] If a developer requests a signalized access, what signal analyses do you require?**

A: [Vargas] It depends on the type of generator and its location. If it does not meet minimum signal spacing requirements, then the request will often be rejected outright. If it does conform to the minimum spacing requirements, then we require PASSER or TRANSYT-7F runs to ensure that progression is maintained. Colorado has also tried this, but has had problems with unscrupulous consultants who will manipulate the data to obtain the desired results. Florida requires that all computer files be submitted with the analysis to ensure that this does not occur.

Q: **Have any studies been done to correlate reductions in delay with reductions in air pollution emissions?**

A: Most of the current air pollution models are pretty poor at estimating pollution reductions. TTI performed one study that compared actual pollution reductions with those projected by the models and the results were not very good. The problem is that many people take the results of these models at face value and do not realize the inaccuracies involved. [Ismart] One must also remember that the bulk of air emissions result from cold starts. You could therefore reduce average trip times from 20 minutes to 15 minutes and still not significantly reduce pollution emissions. Another study has found that while ramp metering was projected by pollution models to reduce air emissions, it may in fact increase pollution emissions due to the starting and stopping on the ramps.

Q: **[to Williams] How does the Florida access management program fit in with what neo-traditionalist planners are trying to achieve?**

A: Neo-traditional planning has given us a new way of looking at functional relationships between land use planning and transportation. I think we should look at it with an open mind.

Session 6A

Access Management Case Studies

Moderated by Salvatore Bellomo, Bellomo-McGee, Inc.

This administrative session focused case studies of access management techniques that have been implemented as part of highway projects across the country. Four speakers discussed access management projects in Maryland, Illinois, California, and New Jersey.

The first speaker was Daniel Scheib of the Maryland State Highway Administration. In his paper, "Access Management Program - The Maryland Experience," which was co-authored with John Contestabile of MdSHA, he discusses access management improvements to segments of Maryland's primary highway system. He provides an overview of the criteria used to select highway segments and a brief description of the process for retrofitting access management techniques to four highway corridors: MD 2/4, US 301, MD 5, and US 50.

The second speaker was Lisa Weesner of the Metro Transportation Group. In her paper, "A State's Approach - A Strategic Arterial System," she provides a detailed analysis of the US 45 highway corridor in Northern Illinois which was selected for access management improvements. She discusses various access management techniques including limiting the number of conflict points, separating conflict areas, and proper signal spacing. This is an interesting case study because this portion of US 45 is currently undeveloped and largely unsignalized, so this project represents an attempt to preserve highway capacity before development occurs.

The third speaker was Joann Lombardo who presented a paper entitled, "Arterial Access Management Issues and Opportunities - Three Southern California Case Studies." The paper discusses the administrative and regulatory mechanisms that are utilized by three southern California cities to manage arterial access: the cities of Upland, Irvine, and Anaheim. The paper discusses the approaches to access management that have been taken in mature commercial areas like Upland and Anaheim versus the approaches used in new communities such as Irvine.

The final speaker was Salvatore Bellomo of Bellomo-McGee, Inc. In his paper, "Access Management Through Public-Private Cooperation: The Bridgewater Commons (NJ) Case Study," Dr. Bellomo highlights a case study of public-private cooperation in improving road and transit access in the environs of a major mixed use development in central Somerset County, NJ - The Bridgewater Commons Project. The paper presents background information on the project, the concept including access treatments, and a summary of the benefits of implementing access management techniques to traffic flow, safety, and quality of life.

This session was attended by approximately 60 people. There was no discussion period for this session.

Access Management Program - The Maryland Experience

Daniel Schieb, Jr.
and
John M. Contestabile
Maryland State Highway Administration

This report entails the State of Maryland's effort to preserve and enhance the capacity of the Maryland State Primary Highway system through access management. In 1985, Maryland's Access Management Program was established, it is managed by a team of professionals with different areas of responsibilities across the State Highway Administration. The Team reviews and makes recommendations on local site plans and building permits that affect specific routes on the State Primary Highway System. These recommendations are coordinated with local governments and developers. The team may also recommend purchase of development rights through access control and a purchase of an entire property. The Team also encourages local governments to participate in Access Management through sound land use planning.

The Maryland State Highway Administration developed this report so it could be shared with the participants of the first Access Management Conference in Vail, Colorado, August 1st through 4th, 1993.

In 1985 the Maryland State Highway Administration inventoried its primary highway system and evaluated 143 (21 corridors) non-freeway segments with the intent to determine which uncontrolled or partially controlled segment/corridor should be given priority for access management improvements. The segments were evaluated and ranked according to a simple 0 - 100 rating system based on three general categories: service, safety and land use. Based on this evaluation, a report was developed with recommendations that would be desirable in affecting access management measures on the State Primary System. This report was used to assess needs and set priorities for preserving and enhancing the capacity of the existing network ... through Access Management. While the basic goal would be full control of access on all principal arterial highways and partial control of access on all intermediate highways, it was soon realized that these goals were economically infeasible.

In 1985 an access management program was established and continues to this day. The objective of the program is to obtain access control on selected portions of the state primary highway system.

The Access Management Program is overseen by an "Access Management Team". The Team consists of representatives from the Office of Planning and Preliminary Engineering, Office of Real Estate, Division of Engineering Access Permits, and Office of Counsel. They meet regularly to review specific opportunities for improving access. Examples of typical actions that initiate reviews are:

- Subdivision site plans
- Building permit applications
- Property sale listings
- Access permit applications

The Team cannot deny all access to property owners abutting along the state primary highway without providing compensation. Further, their recommendations cannot impinge upon the local government's zoning powers and ordinances. Therefore, their reviews and recommendations are coordinated through individual county planning and zoning offices. The Team also develops recommendations for the State Highway Administrator in cases where acquisition of properties or controls of access are involved.

Site plans will typically be reviewed on a case by case basis to determine:

A) Does the property have alternate access to the Primary highway?

B) If not, can alternate access be provided?

If the property can have access via a public road other than the Primary highway, the team will recommend to the county that the owner use the alternate means of access to the Primary highway.

If access can only be obtained via a future service road, a "temporary" access permit may be issued. Once the improvement is realized, access to the Primary highway would be via the service road.

If a property were to be "land locked" by a State Highway Administration proposed improvement, the team may recommend the purchase of this property.

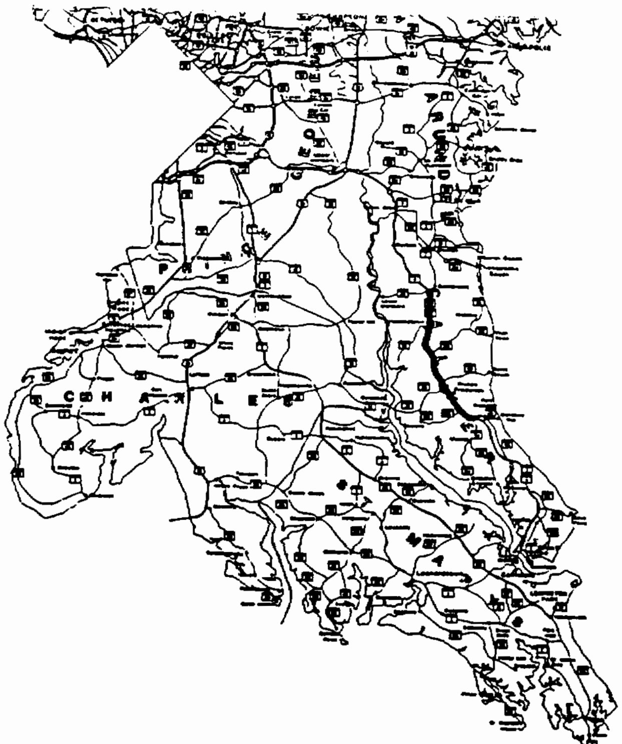
Existing permitted entrances may remain as long as no change in use, on site expansion or traffic operation/safety problems occur.

In all cases, the Team's objective is to eliminate/reduce/ consolidate entrances onto the state roadway. In most instances, the local jurisdiction will incorporate the AMT's recommendation as part of the county approval process.

Currently, the Team's major focus is managing access to:

MD 2/4 - in Calvert County,
US 301 - south of US 50 to the Nice Bridge,
MD 5/235 - in St. Mary's County, and
US 50 - on the Eastern Shore.

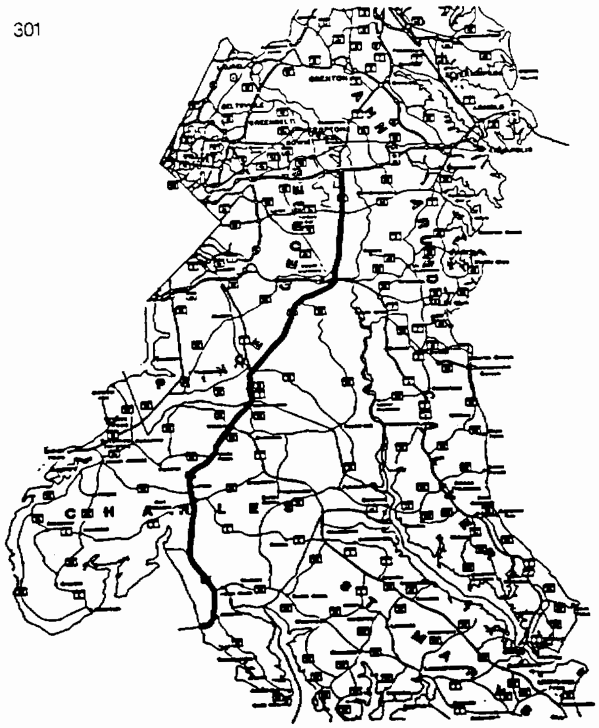
The following is a brief description and map of each of the roadways in the access management program (see enclosed map for overall view):



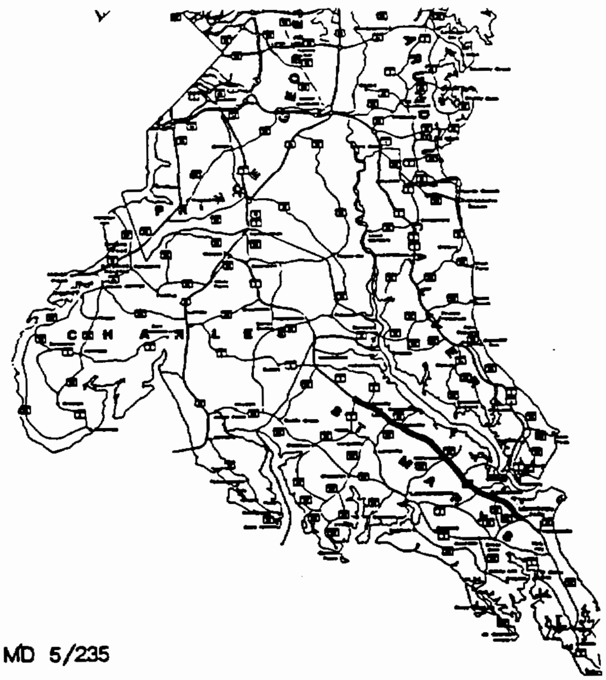
MD 2/4

- MD 2/4 in Calvert County links southern Maryland with Washington, D.C., and is an important commuter route. The length of the corridor under consideration by the AMT is approximately 23 linear miles, with actual frontage of more than 46 miles. The Team has reviewed and made recommendations on over 80 properties in this corridor.

US 301

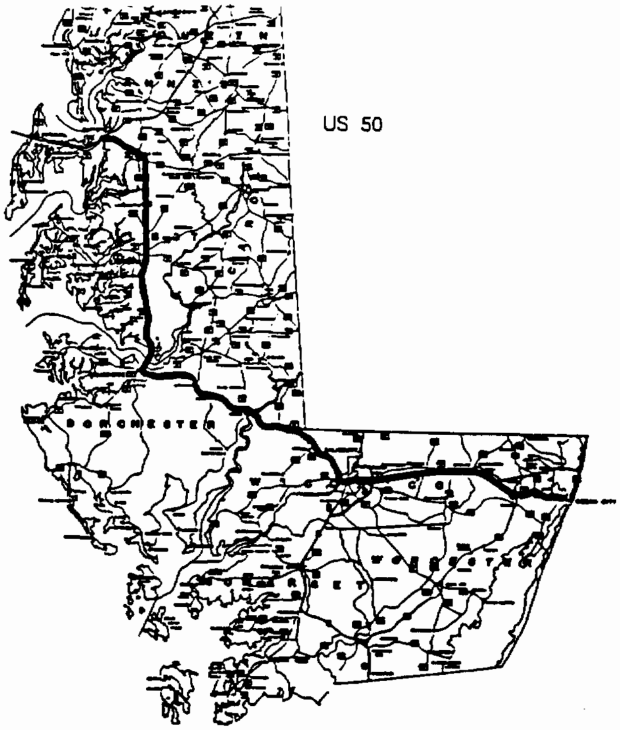


- US 301 in Prince George's and Charles' Counties provides an alternative to Interstate 95 between Virginia, Maryland and Washington, D.C.; it is also a major commuter route. The length of the corridor under AMT consideration is more than 37 linear miles, with actual frontage of more than 75 miles. The AMT reviewed and made recommendations on over 100 properties in this corridor.



MD 5/235

- MD 5/235 in St. Mary's County also links southern Maryland with Washington, D.C. and is primarily a commuter route. The length of the corridor under AMT consideration is 22 linear miles, with actual frontage of more than 45 miles. The AMT has reviewed and made recommendations on over 21 properties in this corridor. The SHA Office of Planning and Preliminary Engineering has developed service road concepts for a portion of MD 235 that have been adopted by the county. As development is submitted for approval, it is required to incorporate those concepts.



- US 50 services the Maryland/Delaware peninsula and ocean resorts. The length of the corridor under AMT consideration is 52 linear miles, with actual frontage of over 105 miles. The Team has reviewed and made recommendations on over 142 properties within this corridor. The SHA has also taken an active approach to access management within this corridor spending more than $1.5 million to purchase properties and access controls to obtain 16 miles of controlled frontage within the corridor.

The State Highway Administration also encourages local governments to participate in highway access management through sound land use planning. Specific actions local governments are considering include:

- Developing a Master Plan of Highways, with emphasis on protecting State Primary Highway corridors.
- Developing local zoning ordinances that require dedications/reservation of land, when future right-of-way needs are known.
- Developing local roadways to enhance land access and provide auxiliary support for the Primary highway corridors. (This could include, for example, developers constructing a service road as a condition for site plan approval.)
- Requiring adequate setback of structures through local building ordinances to minimize right-of-way cost.
- Purchasing strategically located properties.
- Coordinating local planning and development approval processes with the State Highway Administration.

The SHA is planning Access Management for the future by developing service road concepts for identified corridors. These concepts will address the function of the roadway and spacing issues (such as full movement intersections or right turn in/right turn out and median crossover spacing). Signalization will also be addressed, along with overpass options and interchange options. Access management in the State of Maryland has evolved from identifying a major highway concern, to implementing review and coordination procedures, to developing and proposing Access Management improvements that will reduce access points over time.

It has been recognized by the State of Maryland that Access Management enhances the development opportunities of properties along the Primary system. It is a tool, when used properly, that will promote orderly land use and benefit *all* of the Primary highway users and customers.

A STATE'S APPROACH
- A STRATEGIC ARTERIAL SYSTEM -

Elizabeth H. Weesner
and
Frank J. Koepke
Metro Transportation Group

ABSTRACT
The Chicago Area Transportation Study and the Northeastern Illinois Planning Commission recognized that not all long-distance travel could be handled by the Interstate freeway system. With this realization a 2010 Transportation System Development Plan for Northeastern Illinois was developed which designated a system of Strategic Regional Arterials to supplement the freeway/expressway system. These designated arterials, functioning as part of a regional arterial system, are intended to carry high volumes of long-distance traffic.

One method of promoting the movement of through traffic on the arterials is through the development of an access management plan for each corridor. This study details the analysis of one of the six corridors in the system. A detailed analysis of the existing and future route conditions and adjacent land uses as well as public involvement led to recommendations for basic and ultimate improvements through the use of access management techniques along the U.S. 45 corridor. Techniques which included limiting the number of conflict points, separating conflict areas, removing vehicles from the through travel lanes, and proper signal spacing, were proposed to be employed to achieve the efficient movement of through traffic flow.

The 2010 Transportation System Development Plan for Northeastern Illinois, adopted by the Chicago Area Transportation Study (CATS) and the Northeastern Illinois Planning Commission (NIPC), recognized that not all long-distance highway travel could be handled by the Interstate freeway system. Realizing that the arterial road system would have to carry some long-distance trips, the 2010 Plan designated a system of Strategic Regional Arterials (SRA's) to supplement the freeway/expressway system.

The SRA system is a 1,340 mile network of existing roads in the Northeastern Illinois region. It creates a network of sixty-six (66) routes intended to serve as a second tier to the freeway system. Identification of routes that comprise the SRA system were determined based upon the projected levels of future travel demand within different parts of the region, ranging from about three miles apart in the more densely developed areas to about eight miles apart in predominantly rural areas. Travel demand considered route classification (urban, suburban, or rural) that is based on the type and density of forecasted land use.

The system, once completed, is planned to accommodate traffic volumes projected for the year 2010. CATS estimates of total travel on the Greater Chicago Area arterial system in the year 2010 will be twenty-three (23) percent more than for 1980. The regional highway system, consisting of existing and planned expressways, and strategic regional arterials is shown on **Figure 1**.

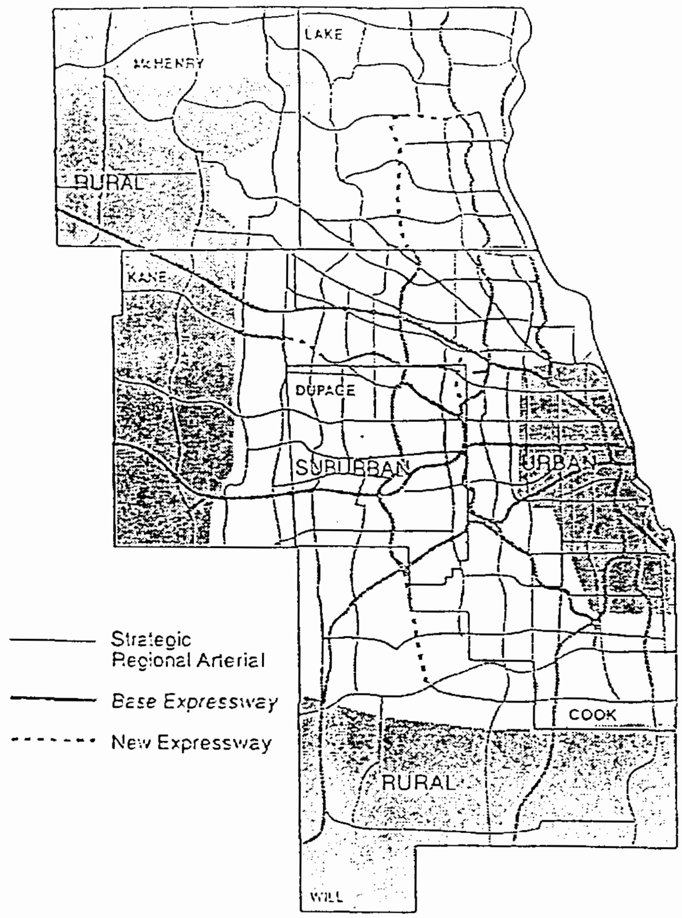


Figure: 1
REGIONAL HIGHWAY SYSTEM

THE SRA SYSTEM
The 1,340 miles of SRA routes have been divided into five consecutive studies. The routes selected for the SRA study process reflect a variety of area types - from rural/suburban settings to urban sections such as in the City of Chicago.

The first two, of the five subsets, are near completion, with the third subset currently in the initial stages of data collection.

A planning study for each SRA analyzes the existing conditions related to traffic and environmental conditions, as well as future traffic characteristics and needs. The study process includes the following work tasks:

- data collection
- identification of corridor transportation needs
- identification of environmental issues
- corridor advisory panel meetings
- corridor reports
- public hearing

The existing conditions, identification of corridor and environmental needs and issues, and the recommended plan is presented at a series of three corridor advisory panel meetings. The panel members, consisting of representatives of surrounding communities, state and local agencies as well as public interest groups, review the material and provide input in regards to the proposed and future land-use, past and future plans for the corridor and surrounding roadway system, and is a format to include public opinion. A public hearing is held at completion of the draft recommended plan in order to allow the public a chance to view the plan and state their opinion. With this information, the final plan will be completed and given to the proper agencies for use in planning future development, obtaining right-of-way and thereby planning the future roadway system.

SRA Planning Objectives
The SRA system is intended to accomplish specific objectives within the overall regional transportation system:

Supplement an expanded freeway/expressway system by:
- Improving access to freeways, expressways and major arterials
- Providing alternatives for some portions of expressway travel
- Providing a lower-cost substitute for expressways in some corridors

Enhance public transportation and personal mobility by:
- Improving access to rail transit stations
- Improving operating conditions for buses and other transit vehicles
- Identifying opportunities for future transit facilities
- Maintaining pedestrian accessibility

Accommodate commercial vehicle traffic by:
- Maximizing through-traffic movement
- Improving structural clearances

Design Concepts
To accomplish these planning objectives, design techniques and concepts were developed for use on the SRA system. These concepts, presented in the *Design Concept Report*[1], generally will be applied to the entire network of SRA routes and modified as work progresses. The concept report, endorsed by CATS Policy Committee in January, 1991, describes some of the design techniques and concepts recommended for use in implementing the objectives of the SRA system. They include:

- **Access Management** - To reduce vehicle conflicts and improve traffic operation and safety;
- **Intersection Improvements** - Consisting of provision of separate turn lanes, channelization, and restriction of certain traffic movements;
- **Adding Through Lanes** - To achieve a desirable cross-section for urban, suburban, and rural areas;
- **Traffic Operational Improvements** - Such as signals, signing and pavement markings;
- **Median Control** - To prohibit or provide for left-turning vehicles, direct turning movements to and from desired locations, and reduce centerline conflicts;
- **Bus Service Improvements** - Including bus stops and traffic signal preemption;
- **Structural Clearance Improvements** - Both vertical and horizontal clearances; and
- **Drainage Problem Correction** - Whenever required.

The design concepts also address criteria and conditions such as the removal of curb parking and implementation of high-occupancy vehicle (HOV) lanes.

ACCESS MANAGEMENT GUIDELINES
The issue of access management is especially important on the SRA routes since the SRA system emphasizes the movement of through traffic. Access management involves managing access to land development while simultaneously preserving the flow of traffic on the surrounding road system in terms of safety, capacity, and speed. Techniques include: (1) limiting the number of conflict points; (2) separating conflict areas; (3) removing turning vehicles from through travel lanes; and (4) spacing of major intersections to facilitate progressive travel speeds along arterials.

The following overview defines some access management guidelines that are being considered for use on the SRA routes. It also explores how access management techniques such as access location and signal spacing, turning lanes and turn restrictions, frontage roads, and right-of-way acquisition are being tailored to the SRA routes.

Levels of Access
In order to achieve consistent and efficient access management along the various SRA routes, the level of access to be provided should be correlated to the functional characteristics and design features of both site access and the SRA arterial. With respect to an SRA, the type or

level of access should also consider spacing criteria. Key elements include defining allowable access levels and spacing for each of the route types - urban, suburban, and rural, and the magnitude of the volume of traffic to be accessed - high or low.

Access Locations

On an SRA, in keeping with the objective of increased mobility, access would be restricted or denied from the arterial in order to increase the through traffic flow. When possible, left turn access could be permitted only at properly spaced signalized intersections. Left turn in, right turn in and right turn out maneuvers could be permitted at intermediate locations, as necessary. In all cases, turning vehicles should be removed from the through travel lanes wherever possible. This will involve the implementation of left and right turn lanes along the arterial.

Right-of-Way

Most SRA's will eventually require additional right-of-way. Access management should consider how the additional right-of-way will be acquired.

- Will the additional right-of-way be obtained from both sides of the roadway?
- Will right-of-way be obtained from only one side of the roadway?
- Will individual access be provided to most parcels?
- Will a frontage road system be provided?
- Will the right-of-way acquisition require full or partial taking of individual parcels?
- Will, or can, the existing roadway be used as a frontage road?

Frontage Roads

Frontage roads can be considered to provide access to multiple parcels, thus in keeping with the objective of increased mobility on the SRA route. The frontage road could be tied into the arterial road at properly spaced signalized locations with adequate storage space provided between the arterial and frontage road.

If frontage roads are recommended, additional right-of-way will also be necessary along the intersecting roadways to provide sufficient storage distance between the frontage road and the arterial.

Signal Spacing

Proper signal spacing should also be considered along the SRA routes. Properly spaced signals will facilitate *progressive travel speeds and thus the movement of* through traffic flow. For designated suburban SRA routes, the concept report specifies one-quarter mile signalized intersection spacing. This spacing provides adequate space between traffic signals for efficient two-way progression on lower speed arterials (30 miles per hour for a 60 second cycle length). Where higher operating speeds (over 40 mph) or longer cycle length (over 70 seconds) are desired, the signal spacing must be increased to avoid reducing the optimum through band width.

U.S. 45 PLAN

The U.S. 45 corridor is one of twelve corridors currently being studied as part of Phase II of the SRA study. This plan has incorporated many access management techniques which will, if implemented, provide a more efficient flow of through traffic.

Existing Conditions Overview

The U.S. 45 corridor is an 11-mile segment of U.S. 45 between IL 120 (Belvidere Road), on the south, and the Illinois/Wisconsin state line, on the north. U.S. 45, located entirely in Lake County, Illinois, offers areawide access to the communities of Grayslake, Third Lake, Lindenhurst, and Millburn before reaching the state line. **Figure 2** illustrates the south segment of the route, from IL 120 to IL 132, and **Figure 3** illustrates the northern segment, from IL 132 to the Illinois/Wisconsin state line.

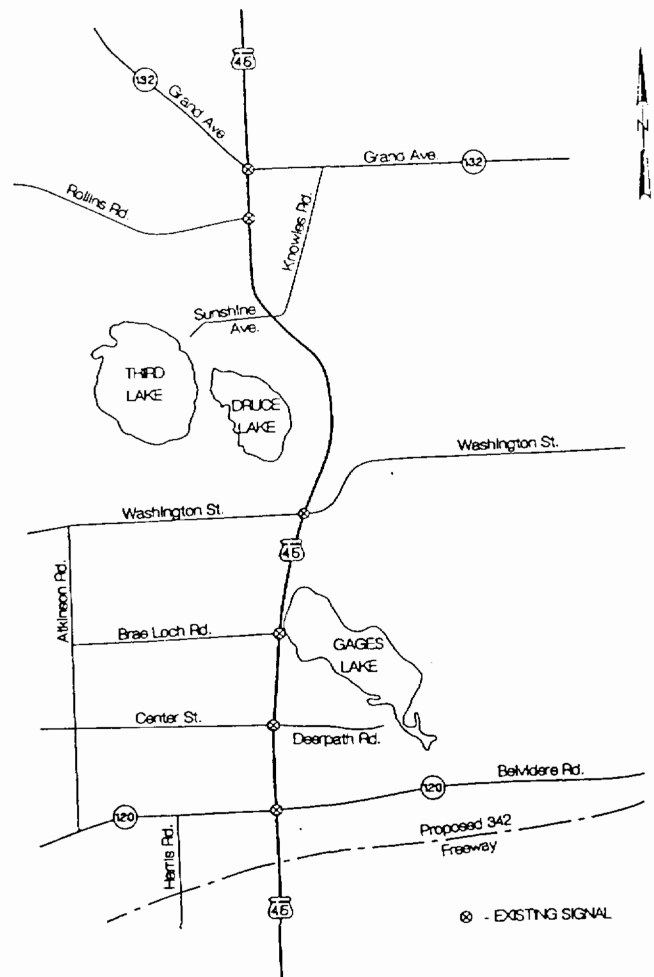


Figure: 2
U.S. 45 CORRIDOR-SOUTH

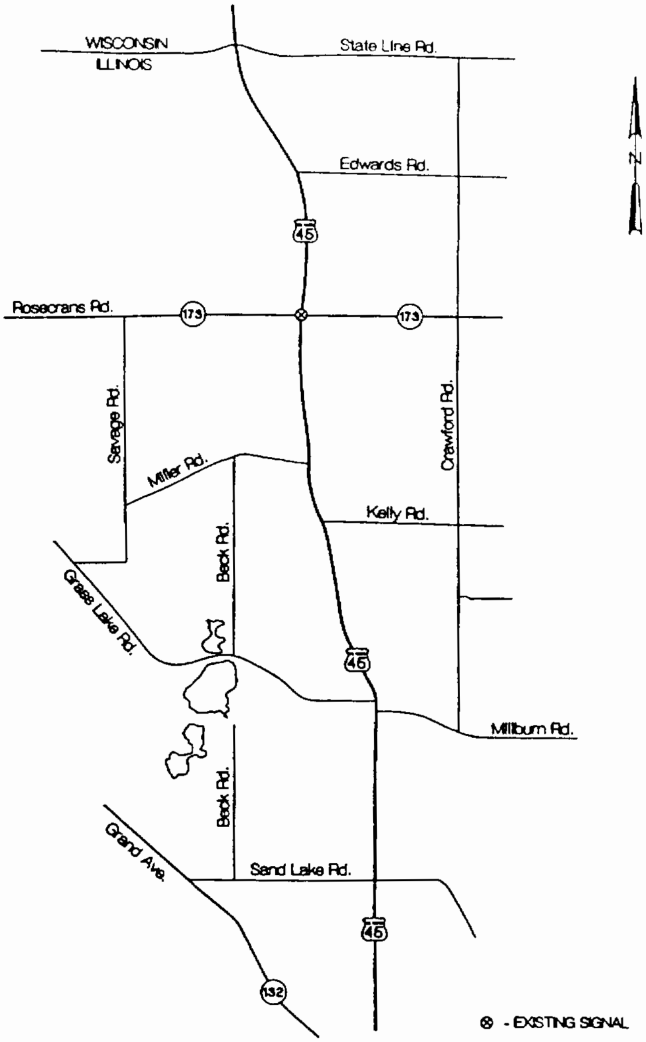


Figure: 3
U.S. 45 CORRIDOR-NORTH

The 1988 average daily traffic volume (ADT) varied from 18,400 vehicles at the south end of the corridor to less than 6,000 vehicles at the north end of the corridor. The major change in volumes occur at the IL 132 intersection. The ADT on the south leg of the intersection was 16,500 while the north leg accommodated only 8,200 vehicles. This can be attributed to the direct connection of IL 132 to I-94 west of the corridor and the substantial volume of traffic accessing U.S. 45 via IL 132. IL 132 has been designated as an SRA route.

The corridor was originally classified as a suburban SRA route from IL 120 to IL 132. At this location, suburban characteristics begin to diminish and U.S. 45 was classified as rural from IL 132 north to the Illinois/Wisconsin state line. However, major changes in land use occurred after the original classification. Recently planned development north of IL 132 are of significant magnitude to warrant classifying the entire 11 miles as a suburban facility.

The existing two lane cross section configuration of U.S. 45 is considerably different from the desirable cross section of four to six through lanes with an 18-54 foot median in a 110-180 foot right-of-way. Currently, U.S. 45 has limited right-of-way and combined with the existing physical constraints, (i.e., lakes, natural wooded preserves, and historical districts) the envisioned six lane SRA cross section may be difficult to implement. The existing right-of-way for the corridor varies from 80 to 120 feet. Furthermore, for an approximately one-half mile segment between IL 120 and Center Street, U.S. 45 has been widened to include a flush striped median. The median operates as a left turn lane for the numerous access locations in this area.

Because of the route's location in the currently undeveloped northern portion of the state, there are very few signalized intersections. There are a total of seven signal locations along the entire 11 mile corridor. Six of the existing signals are located in the southern 3.4 mile segment. Two of the signal locations, at the northern and southern ends of the segment, are at intersections with IL 120 and IL 132. The other signalized intersections are located at Center Street, Brae Loch Road, Washington Street, and Rollins Road.

Numerous unsignalized local streets currently intersect U.S. 45 in the 3.4 mile segment. Because of a combination of topographic restraints and development trends, most of the local streets are located in groups either on the east or on the west side of U.S. 45. This causes most of the unsignalized intersections to be of a "tee" configuration.

There are six unsignalized local street intersections along the east side of U.S. 45 between IL 120 and Washington Street. These include Old Plank Road, Indian Lane, Sears Street, Orchard Lane, Gages Lake Road and Wright Avenue.

Another set of unsignalized local street intersections on the west side of U.S. 45 between Washington Street and Rollins Road. These include Cottage Street, Park Place, Sheridan Drive, and Sunshine/Knowles Road. In addition to the ten local street intersections, there are sixty private driveways between IL 120 and Rollins Road, a distance of approximately three (3) miles.

As mentioned above, north of IL 132 the current characteristics of both traffic volumes and land uses are more rural in nature. Volumes vary from 8,200 north of IL 132 to 5,300 at the state line. One traffic signal exists north of IL 132 and that is at IL 173 which is also an SRA route. All other intersecting roads operate under control of stop signs.

Current land use in the northern segment is primarily agricultural with some residential development. Residential development is concentrated near the IL 173 intersection and within the unincorporated community of Millburn which surrounds the Millburn Road/Grass Lake Road intersections. Restraints in this segment include a Forest

Preserve west of Millburn and historical districts located in Millburn and just south of the Illinois/Wisconsin state line. In addition, wetland areas are found adjacent to the U.S. 45 corridor along the entire segment.

Ten unsignalized local street intersections exist along this 7.6 mile segment plus some widely spaced private drives.

Future Land Uses
The best understanding of future land use along the corridor was obtained from future land use maps furnished by the adjacent communities. The following were notable areas in terms of changing land use or land uses implying a future potential access concern.

- At the IL 120/U.S. 45 intersection, the available land will continue to be developed as commercial which may necessitate future access to U.S. 45. Also, in the vicinity of the Washington Street/U.S. 45 intersection, land uses focus on commercial/residential development with, again, multiple access locations.

- The area of Millburn is expected to remain relatively stable with respect to development. However, the Millburn Historic District requires special consideration. The SRA corridor bisects the district which limits the acquisition of right-of way in this area.

- Major residential and office developments are being planned for areas in the vicinity of IL 173. These developments are one of the reasons for changing the designation of the northern corridor segment from rural to suburban.

- The natural areas within the corridor which potentially may inhibit widening. These include Gages Lake, Brae Loch Country Club and the College of Lake County Designated Natural Area, all located in the vicinity of the Brae Loch Road/U.S. 45 intersection. The boundaries of all three areas are located directly adjacent to U.S. 45. Also, the poor alignment of IL 132 (a 45 degree angle at its intersection with U.S. 45) is an area of concern since the two intersecting SRA routes may ultimately require an interchange. North of IL 132, natural areas include the MacDonald Woods Forest Preserve west of Millburn. A portion of the forest preserve also borders the historic district, discussed previously.

- Other additional constraints included an interchange of the proposed IL 53 extension (FAP 342) and U.S. 45 south of IL 120. The proposed interchange will affect roadway geometry and signal locations along the south segment of the U.S. 45 study corridor.

Proposed U.S. 45
Utilizing the access management techniques, previously described, as well as the concept guidelines, a plan for the U.S. 45 corridor was developed. The plan including lane arrangements, cross sectional characteristics, a proposed frontage road system and intersection/interchange treatments. A schematic overview is illustrated in **Figures 4** and **5**. These figures provide an access management plan for U.S. 45.

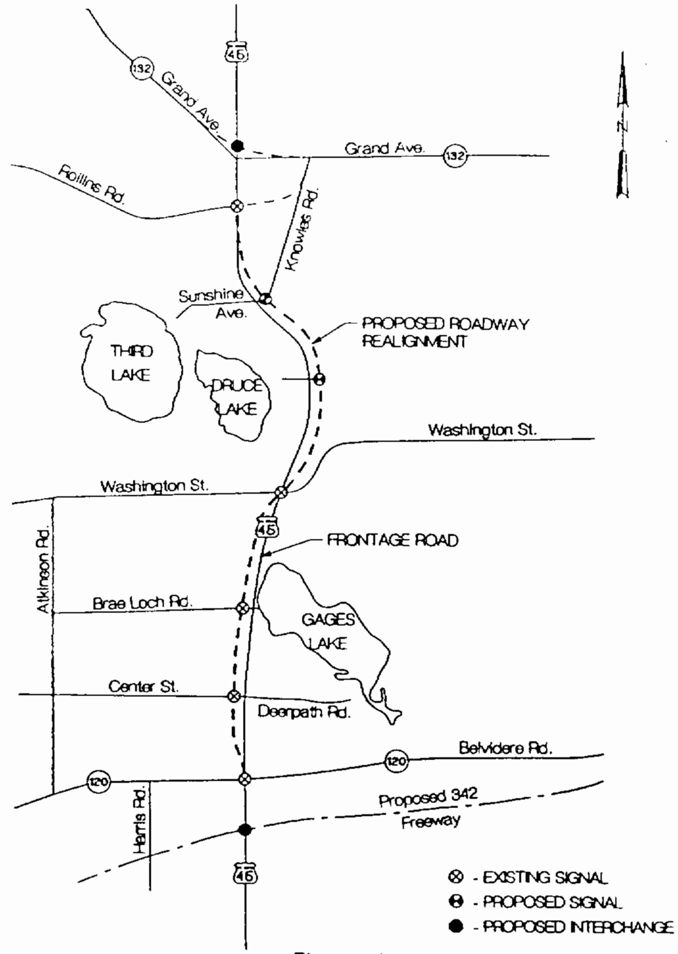


Figure: 4
U.S. 45 PROPOSED PLAN-SOUTH

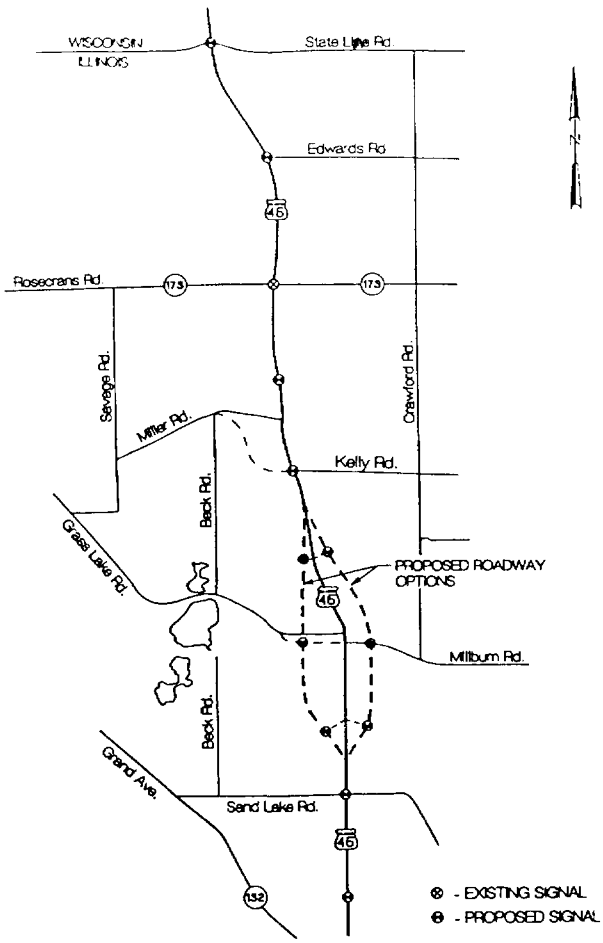


Figure: 5
U.S. 45 PROPOSED PLAN-NORTH

The long range SRA plan for U.S. 45 calls for expansion of the corridor to the full desirable cross section as designated in the *Design Concept Report*[1] and illustrated on **Figure 6.** This would include a six lane cross section with a median. To achieve this desirable cross section, U.S. 45 would have to be widened from its existing two lane cross section and additional right-of-way obtained along the length of the corridor.

To minimize initial construction cost and to provide for future expansion, the plan recommends that a four lane cross section be constructed with a 54 foot wide median (shown on **Figure 6**) from north of IL 120 to north of IL 173. This will permit construction in the median of a third through lane in each direction if and when additional capacity becomes necessary. Between the north approach to the IL 173 intersection and the Illinois/Wisconsin state line it is recommended that the typical cross section be narrowed to include four through lanes and a 30 foot wide median. At this time, the State of Wisconsin does not plan to improve U.S. 45 from the existing two-lane roadway. The plan recommends a transition from the four lane divided cross section to a two-lane, two-way roadway at the state line.

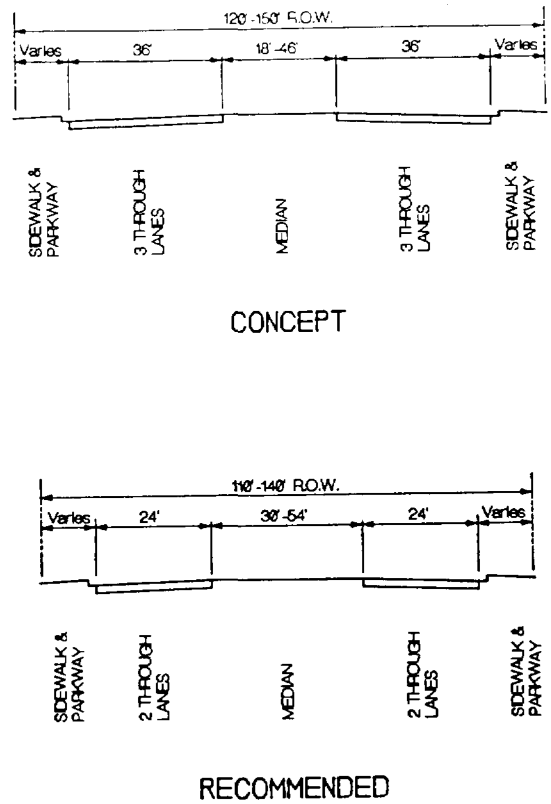


Figure: 6
SUBURBAN CROSS SECTION

Inclusion of frontage roads with the desirable cross section design, as shown on **Figure 7,** was recommended at several locations along the south segment in order to eliminate multiple access intersections with U.S. 45. These include the section from south of Center Street to Knowles Road. Within this section, existing U.S. 45 would be designated as a two-way frontage road and the improved U.S. 45 construction to one side. The frontage road would tie existing and future access locations to signalized intersections with the new SRA cross section, as shown on **Figure 8.** Other additional accesses to U.S. 45 would be limited to right-in/right-out maneuvers only.

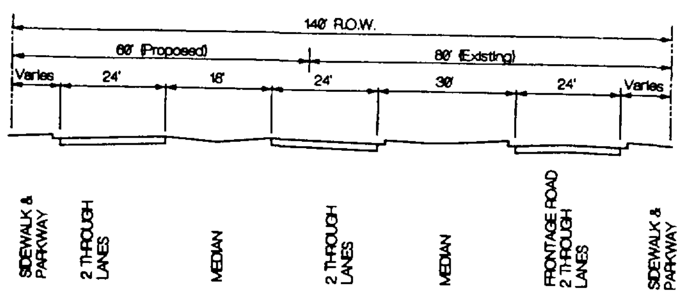


Figure: 7
FRONTAGE ROAD CROSS SECTION

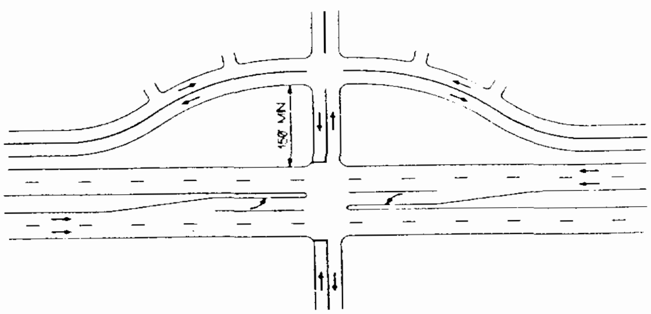


Figure: 8
FRONTAGE ROAD INTERSECTION

Due to the relatively narrow right-of-way (80 feet) along the southern segment of the corridor, and the existing physical constraints (Gages Lake on the east and existing residential and Forest Preserve property on the west) widening would have to occur on alternative sides of the roadway. This could coincide with the shift in the SRA route/frontage road cross section from the east to the west side of U.S. 45.

An alternative under consideration includes elimination of the frontage road and implementation a six lane cross section with a median. With the elimination of the frontage road, the multiple access intersection with U.S. 45 in this area could not be consolidated and would remain as unsignalized intersections. With this arrangement through traffic flow would be inhibited by turning maneuvers being made from the main arterial with U-turns being made at the signalized intersections. However, less additional right-of-way would be necessary.

Potential future signal locations were examined. Future signal locations, as shown on the exhibit, are located at one-half to one mile spacings and promote: (1) the consolidation of unsignalized intersections along U.S. 45; and (2) the coordinated progressive movement of traffic along the corridor. The existing signals would remain with future signals at the U.S. 45 intersections with Sunshine Avenue/Knowles Road, Sand Lake Road, Millburn Road (or bypass), Kelly Road/Miller Road, Edwards Road and State Line Road. Intermediate signal location were also proposed at the proper signal spacing for access to future development. These spacings will allow the acceptable through band widths to be maintained. Future signals located between the intersections listed above, will be limited to be within a 100-200 feet long "window" spaced approximately midway between designated signals. At locations with a raised median, all unsignalized access locations would be limited to right-in/right-out maneuvers only. Thus, they would fit within the time-space pattern. There would be no full access unsignalized median openings.

Potential future interchanges include FAP 342 and IL 132. With the proposed interchange, IL 132 would be realigned to improve the existing intersection angle. Because of the close proximity of the interchange with the proposed IL 53 extension (IL 342 Expressway), south of IL 120, no interchange at IL 120 is foreseen. No interchange is proposed at IL 173 due to the limited future traffic volumes in this area. Even with future development, this location is not predicted to require an interchange.

Other system roadway considerations include realignment of Miller Road and Kelly Road. This would provide a future east/west corridor and signal location while also eliminating a jog along the corridor. Grass Lake Road and Millburn Road are also proposed to be aligned to enable more direct east/west movement through the county (see **Figure 5**). In addition, Lake County Division of Transportation is also currently investigating a connection of Rollins Road to IL 132. This connection is also shown on **Figure 4**.

Due to the unique characteristics found in the Millburn Road area, including a nationally registered historic district bordered by a portion of the MacDonald Woods Forest Preserve, various bypass alternatives are being considered.

One alternative alignment would bypass Millburn to the west. U.S. 45 lends itself to this arrangement due to its alignment north and south of Millburn. However, this bypass would have to extend through and thereby segmenting the MacDonald Woods Forest Preserve. The second alternative would bypass Millburn to the east. This recognizes that the bypass would have to be extended through a portion of the historic district on the east.

The west bypass would present the shortest, more direct alignment. An east bypass is one-tenth of a mile longer, but would still have a fairly direct route. Both alignments conflict with proposed local transportation plans. The west bypass would bisect property planned for residential development while the east bypass would divide the Millburn Historic District. Environmental conditions present serious problems for both bypass alternatives.

A third alternative being considered is to continue the SRA corridor through Millburn within the existing 80 feet of right-of-way. With this alternative, the desired SRA cross-section would be reduced to four through lanes with a center left turn lane (60 feet of pavement within 80 feet of right-of-way). Improvement of this existing alignment would also present environmental problems including visual, noise, and air quality impacts on properties adjacent to the corridor. Actual selection and definition of a route is still under review.

SUMMARY

The 2010 Transportation System Development Plan provides a means of implementing a designated state system of arterial roadways which improves mobility while still providing access to surrounding development. Strategic regional arterials are an efficient and practical means of accomplishing these objectives.

Access management is one important parameter enlisted in the preparation of the plans for each SRA corridor. Through the use of access management techniques such as limiting the number of conflict points, separating conflict areas, removing vehicles from through travel lanes, and proper signal spacing, the efficient movement of through traffic flow can be achieved.

The SRA System and in the case presented, the U.S. 45 SRA corridor, provide an opportunity to apply these techniques, work with the communities, state and local governmental agencies, public interest groups and the citizens in striving to achieve a overall more efficient roadway system. The Northeastern Illinois 2010 Transportation System provides a basis for other areas to utilize in handling their future transportation needs. The U.S. 45 access management plan shows how access and signalization guidelines can be established in advance of development.

REFERENCES

1. *Strategic Regional Arterial*, Design Concept Report, Illinois Department of Transportation, Chicago Area Transportation Study, January 31, 1991.

ARTERIAL ACCESS MANAGEMENT ISSUES AND OPPORTUNITIES THREE SOUTHERN CALIFORNIA CASE STUDIES

Craig Neustaedter
City of Moreno Valley
and
Joann Lombardo
California Architecture and Regional Planning

ABSTRACT
This paper discusses the administrative and regulatory mechanisms that are utilized by three southern California cities to manage arterial access: the city of Upland, the city of Irvine, and the city of Anaheim. As illustrated by case studies for these three cities, there are a broad range of administrative and regulatory tools that can be used by municipal planners and traffic engineers to manage access. For mature commercial areas, such as Upland's Foothill Boulevard or Anaheim's Commercial Recreation Area, zoning ordinances which regulate parcel dimensions and the number and frequency of curb cuts are effective tools for controlling access to infill or substantially renovated developments. Master plans and specific plans become effective tools for new communities such as Irvine, or mature commercial areas undergoing major revitalization such as that proposed within Anaheim.

INTRODUCTION
Arterial access management issues and opportunities are unique to each jurisdiction. This paper examines three arterial access management case studies in three Southern California cities: Upland, Irvine and Anaheim. (Reference "Regional Location Map", Figure 1.) For each case study, discussion focuses on a general background to the access issues, the process followed by each city to address access issues, and the methods each city applied to implement access management solutions.

CITY OF UPLAND - FOOTHILL BOULEVARD

Background
The Foothill Boulevard Vision Plan was initiated by the city of Upland to address impacts to road configuration and access management given the anticipated widening of the Boulevard from 4- to 6- lanes. Foothill Boulevard is a four mile long segment of arterial roadway that was part of the famous U.S. Route 66. Currently, the roadway is designated as State Route 66 with the roadway and access to it controlled by the California Department of Transportation (Caltrans).

All development adjacent to Foothill Boulevard is subject to planning review by the city of Upland. With respect to planning for access to adjacent development, the city and Caltrans have somewhat divergent interests. Caltrans' primary concern is to optimize traffic flow along the roadway by limiting driveways accessing to it. In contrast, the city's primary concern is to balance access management with the need to promote commercial development and thereby enhance sales and property tax revenues. Foothill Boulevard business owners have expressed concern that access management policies, if too restrictive, will deter drive-by patronage on that their businesses depend.

Through the years the city government and Caltrans have enacted measures to address their conflicting priorities with respect to Foothill Boulevard access. These are embodied in the city of Upland Standard Drawings for Precise Plans of Foothill Boulevard Service Roads, which represent the cooperative efforts of the city and Caltrans to manage access on Foothill Boulevard. Service roads function as a buffer by limiting direct access onto Foothill Boulevard, while providing relatively unconstrained access to adjacent development. Precise plans specify the location and number of all service road openings onto Foothill Boulevard, limiting the spacing of service road openings to not less than 300 feet, or 200 to 225 feet from major cross street intersections.

As a policy of the city, service roads have been constructed concurrent with development fronting on Foothill Boulevard. Consequently, service roads are discontinuous in some locations because adjacent lots have not yet been developed, or because lots were developed prior to the city of Upland's adoption of the service road concept.

Process
The Foothill Boulevard Vision Plan develops a new circulation and land use plan for Foothill Boulevard. In part, this study was stimulated by the city's interest to explore alternative design treatments to replace or remove the service roads and instead use the right-of-way for travel lanes, and streetscape and parking improvements.

A major constraint to the removal of service roads is the number of narrow parcels that front on Foothill Boulevard. Almost half of the block segments along the Boulevard contain parcels with frontages less than 150 feet. Another major constraint to access control is that the majority of

Foothill Boulevard business owners in Upland oppose construction of raised medians at the centerline. Business owners contend that raised medians will unduly block access and thereby, hurt business.

A series of community workshops were held to allow business owners to voice their concerns and comment on alternative solutions developed by city staff and a consultant team. The following recommendations were an outcome of this process:

- Widening of Foothill Boulevard to 6-lanes by shifting the roadway a minimum of ten feet into the city service road right-of-way.

- Phasing out of the existing service roads.

- Adoption of amended access control guidelines as summarized in Table 1, "Foothill Boulevard Model Access Guidelines".

- *Left-turn channelization accomplished by using* various combinations of design treatments including raised medians, painted medians, and/or continuous left-turn medians.

- Deceleration lanes for all right-turn ingress movements at service road openings or driveways accessing directly onto Foothill Boulevard.

- A minimum lot frontage dimension of 150 feet for all new development, or a reciprocal access agreement from an adjacent parcel that limits the minimum distance between driveways to 150 feet.

Implementation

Access management recommendations of the Foothill Boulevard Vision Plan are intended as guidelines to be implemented on a segment-by-segment basis. In the Vision Plan, the four mile stretch of Foothill Boulevard is defined in terms of seven segments, distinguished by major cross streets. Each segment varies somewhat as to the size and type of existing land uses and number of and distance between driveways. To respond to these variations, implementation of the Foothill Boulevard Vision Plan will be conducted on a segment-by-segment basis, with continued input from local business owners as to the precise location of raised medians, access points and deceleration lanes. Close coordination with Caltrans will be an important component of the segment improvement plans.

Three specific mechanisms for implementation of the Foothill Boulevard Vision Plan access management guidelines will be employed: revisions of the Standard Drawings of precise plans; an access management ordinance; and an overlay zone. Together these three mechanisms will more clearly link the traffic engineering and land planning processes and in so doing, balance goals to maximize traffic flows with goals to facilitate commercial development.

CITY OF IRVINE - MASTER PLANNED COMMUNITY

Background

Since its incorporation in 1971, the city of Irvine has earned a national reputation as a premiere master planned community. A primary tenet of the master plan concept is that land use and transportation be fully integrated. In keeping with this concept, access management has been included in all stages of the city's land planning and development review process.

Process

The first stage where access management comes into play is in the general plan. Like most municipal general plans, the city of Irvine has a circulation element. A unique feature of Irvine's circulation element however is a hierarchy of arterial roadways based on access control. At *the top of the hierarchy is the arterial thruway that,* according to the general plan, is characterized by: having restricted access, supplementing the freeway system and prohibitions of on-street parking. At the bottom of the hierarchy is the local street which the general plan designates primarily for access to residential, business, and other abutting property and on which parking is permitted. In between are two additional classifications of roadway: the "parkway" and the "community" collector.

Preparation of tentative tract maps are the next stage where access management is addressed. The city of Irvine is subdivided into over twenty geographic subareas called "villages". As the first step to develop each of the villages, a master tentative tract map is prepared. As part of the preparation of the tract map, the city typically requires that an access plan be prepared that shows how access is to be provided to each parcel. Because development is planned on a relatively large scale, the city has tremendous flexibility and leverage to ensure that its general plan access policies are maintained. Under Irvine's system, entire subdivisions are designed in compliance with the general plan access management policies.

The third and final stage where access management is addressed is in the site plan review process. At this stage, the site plans for each parcel are reviewed as they are submitted for consistency with the tentative tract access plan, and refined as necessary.

As a policy of its general plan, the city of Irvine does not allow direct access for properties fronting thruways or parkways, except for retail developments or for properties that cannot take access from another road. As a general guideline, the city allows only one driveway per property, unless a circulation plan is submitted showing that more than one access in required to handle driveway traffic.

Non-retail properties fronting more than one roadway are given access from the lower classification roadway.

For non-residential development, the minimum distance between driveways is 300 feet. For single-family residential properties, the minimum distance is 150 feet.

Implementation
In the city of Irvine, the vast majority of development has occurred subsequent to the adoption of its general plan and arterial access policies. Consequently, arterial access management has been successfully implemented on a comprehensive basis throughout the city. Most of the city's thruways are operating at relatively high speeds of 45 mph or greater, with accident rates far less than the California average, and typically carrying traffic in excess of 30,000 vehicles per day.

CITY OF ANAHEIM - COMMERCIAL RECREATION AREA

Background
The Commercial Recreation (C-R) Area is a primary tourist recreation area within the city of Anaheim. Encompassing 1,033 acres, the C-R Area contains Disneyland; the Anaheim Convention Center; the former Melodyland Theater; and several hundred hotel, motel, restaurant and other tourism related uses. Two major arterials bisect the area: Harbor Boulevard and Katella Avenue, both of which are among the County's most congested arterials.

Several years ago, the city of Anaheim initiated a study to examine the congested traffic patterns and the haphazard arrangement of land use in the C-R Area. A particular concern of the study has been the number of small and narrow parcels accessing directly on to the major arterials. During the years, a variety of access management mechanisms have been explored, with the greatest progress made working through zoning and the Specific Plan process.

Process
The C-R Area, like many mature commercial areas in Southern California, developed over time and without specific standards regulating driveways accessing on to arterials. Many parcels fronting Harbor Boulevard and Katella Avenue had developed with street frontages of less than 80 feet, and each parcel had one or more driveway accessing directly on to an arterial. Larger parcels, with street frontages of 300 feet or greater, sometimes developed with three or four driveways accessing on to a single street.

Both Harbor Boulevard and Katella Avenue have raised medians that control left turn movements. However the frequent and numerous driveways restrict outer lane traffic flows, further exacerbating levels of congestion along the arterials. Pedestrian circulation is also impacted by the numerous driveways that bisect sidewalks, making pedestrian travel potentially unsafe. Safe and efficient pedestrian circulation is of particular importance in a major tourist district such as the C-R Area of Anaheim.

Local businesses were sensitive to this access issue. Many of the small businesses in the C-R Area depend on "drive-by" traffic. Consequently convenient access was considered paramount.

Options for shared access were initially examined and subsequently discarded. For most properties, shared access would require redesign of parking and vehicular and pedestrian circulation layouts. Other options considered and later discarded included lot consolidation and minimum parcel sizes, both of which were deemed potentially damaging to small businesses.

After many months of meetings with staff and local business members, a series of standards were developed that responded to the constraints of the built environment and satisfied local business concerns. These standards, which were subsequently adopted in the C-R Area ordinance (11/90), included:

- Minimum lot frontage of 175 feet for new developments.

- Maximum curb openings per street frontage of one curb cut for parcels of 300 feet or less, and two curb cuts for parcels of over 300 feet.

- Driveway separation and spacing standards requiring a minimum distance of 36 feet between driveways serving the same parcel, and a minimum distance of 40 feet between driveways serving adjacent parcels.

- Driveway dimensions of a minimum width of 25 feet and a maximum width of 35 feet.

A generous nonconforming use provision accompanied these standards, allowing exemptions for existing structures or minor renovations to existing structures.

Implementation
Shortly after these standards were adopted, Disney announced plans to overhaul its amusement and hotel properties and add a second amusement park within Anaheim's C-R Area. Disney's plans are opening up new opportunity for the city to re-examine its access management standards and perhaps take a more aggressive approach in controlling driveway access to major arterials.

Anaheim is currently working with Disney on preparation of a specific plan for the C-R Area. With Disney's potential investment of billions of dollars into the area, previously considered strategies such as shared access and lot consolidation may again be considered. The specific plan offers opportunity to reconfigure vehicular and pedestrian traffic flows; for example, mechanisms could include: directing pedestrians to one side of a street; redirecting service vehicles away from major arterials; or developing an alley system to share traffic flows. With the major changes now anticipated for the C-R Area, the specific plan provides a unique opportunity to master plan access control within an already urbanized environment.

SUMMARY AND CONCLUSIONS

Many of our urbanized communities have yet to develop or implement comprehensive access control programs. Without standardized access controls, cities face an ongoing battle between community goals for safe and efficient access and competing interests, such as the desire of many retailers to maximize access. Balancing these sets of competing priorities is the key to successful access control management. This balance can be accomplished by the implementation of a broad range of administrative and regulatory mechanisms.

American Association of State Highway and Transportation Officials (AASHTO) *(1)* and the Institute of Transportation Engineers (ITE) *(2)* publications provide many important guidelines that are helpful in developing access management policies. Typically, these will address minimum spacing for signalized intersections, unsignalized intersections, median breaks, service road openings, and driveways. These guidelines provide a helpful starting point for a city wishing to develop an access management program. But local conditions, including type and intensity of existing land uses, traffic levels and community sensitivities, must also be considered.

Once a city has developed appropriate access guidelines, it must then establish a mechanism for administering those policies. This section summarizes the mechanisms for administering access control relative to our three case studies, and the benefits and limitations of these mechanisms.

City of Upland - Foothill Boulevard

Precise plans, as utilized by the city of Upland for the Foothill Boulevard service roads, are a somewhat unique mechanism. Historically, the precise plan has functioned well in Upland as a means of balancing Caltrans requirements with local business development pressures. However in today's climate of heavy traffic and competing businesses, the precise plan will function best when accompanied by other administrative mechanisms.

An access management ordinance, as recommended in the Foothill Boulevard Vision Plan, will establish policies that will govern and standardize all future improvements to the boulevard and, in many instances, replace service roads with raised medians and driveway restrictions. An overlay zone, also recommended through the Vision Plan, will establish policies related to the use of service roads or service road rights-of-ways, and the minimum distance between driveway openings for private properties. Finally, by maintaining and modifying the precise plans in accordance with the new access guidelines, the city of Upland will be able to consider the access needs of each segment of Foothill Boulevard individually.

In an urban setting such as that along Foothill Boulevard, access control needs to respond to the built environment. This blending of three access control mechanisms (revisions to the precise plans, access management ordinance and overlay zone) will enable the city of Upland to balance community goals for safe access with local business goals for convenient access.

City of Irvine - Master Planned Community

A master planned community offers a unique opportunity to create safe and efficient access on a comprehensive basis from the outset. Development occurs in accordance with the established policies for access control, and consequently public agency/developer conflicts are less frequent.

As a master planned community, the city of Irvine's approach to access control stands as a model. Beginning with the general plan, access policies are established for each road. The master plan process then allows the city to further define those access policies into standards specific to the type and configuration of land uses planned for that area. Master planning is a mechanism most useful to new communities.

The greatest challenge for Irvine will come as once-new areas change and redevelop. Irvine must insure that the original intent of the general plan access control policies and master plan standards are maintained. Areas that are currently experiencing redevelopment, such as the 2,500 acre Irvine Business Complex, present a new challenge to the city to adapt its policies to new and intensified development.

As Irvine matures, it may need to turn to an access management ordinance mechanism that will provide flexibility to respond to the changes in access requirements as master planned developments redevelop.

City of Anaheim Commercial Recreation Area

With the creation of zoning standards, the city of Anaheim took a step toward access control within the C-R Area. The zoning standards primarily affected new infill development and existing structures undergoing major renovations. With Disney's plan for a second amusement park and the potential investment of billions of dollars into the C-R Area, there is a unique opportunity to master plan access for both new and existing developments through the specific plan process.

The specific plan is essentially a master plan regulated by state of California planning law. It contains a circulation element; a set of standards for land use, development, parking, circulation and access; and a phasing and implementation plan. It is unique in that the specific plan is both a policy and implementation mechanism. Through the specific plan, the city can expand on the access control guidelines accomplished through the recently adopted C-R ordinance. Standards for minimum parcel size, median breaks, turning movements, and bus access can be included in the specific plan.

Conclusions

Effective mechanisms for access management will vary among and within communities, depending on: percent of area developed; number, size and types of businesses; configuration of roadways; traffic flows; and concerns of local businesses. Access can be most effectively managed when addressed on a comprehensive basis and at an early stage in the planning process, such as in a municipal general plan or community master plan for a newly developing area.

The city of Irvine has taken a comprehensive approach by incorporating access control guidelines in its general plan. This has had a profound influence not only on the quality and volume of traffic flow on arterials, but also on the character of land development throughout Irvine.

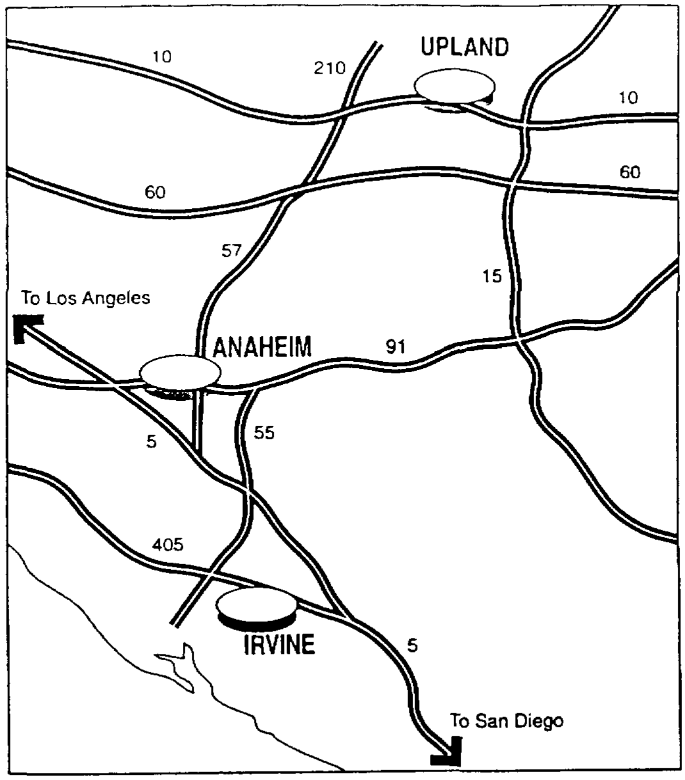
Access management also can be effectively implemented on a selective basis, such as in already urbanized areas experiencing infill development or redevelopment. The city of Upland is seeking to manage access along Foothill Boulevard by enacting an access management ordinance and zoning overlay district that will set driveway spacing guidelines for new and substantially renovated developments fronting Foothill Boulevard. When coupled with the precise plans, these guidelines will allow both control and flexibility in the siting and design of street openings.

In the C-R Area, the city of Anaheim is using zoning to govern access requirements for new developments, and may explore using the specific plan to manage access on a more comprehensive basis.

REFERENCES

1. *A Policy on Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials, 1990, pp. 538-545.

2. *Guidelines for Urban Major Street Design, A Recommended Practice*, Institute of Transportation Engineers, 1984.



Arterial Access Management Issues and Opportunities - Three Southern California Case Studies

Figure 1

REGIONAL LOCATION MAP

TABLE 1 FOOTHILL BOULEVARD MODEL ACCESS GUIDELINES

	Access Type	Minimum Spacing
1.	All-way, Signalized Service Road Opening or Driveway	1,500 ft
2.	Raised Median Breaks	300 ft
3.	Full Access Adjacent Driveways	300 ft
4.	Right-in/Right-out Adjacent Driveways	150 ft
5.	Adjacent Service Road Openings	300 ft
6.	Service Road Opening or Driveway from Signalized Intersection	200 ft

ACCESS MANAGEMENT THROUGH PUBLIC-PRIVATE COOPERATION: THE BRIDGEWATER COMMONS (NJ) CASE STUDY

Salvatore J. Bellomo, D.Engr., P.E., AICP
Bellomo-McGee, Inc.

ABSTRACT
This paper highlights a case study on public-private cooperation in improving road and transit access in the environs of a major mixed use development in central Somerset County, NJ - the Bridgewater Commons Project.

The paper presents background information on the project, the concept including access treatments, and a summary of benefits of implementation of the access techniques including reduced congestion, improved safety, reduced energy consumption, reduced VMT, reduced emissions, and better land use planning.

The case study information in this paper highlights the process and results of a cooperative state, local, and private effort in New Jersey aimed at using access techniques to improve traffic flow, safety, and quality of life for a complex access situation.

INTRODUCTION

Purpose
This paper provides a case study example of public-private sector cooperation in improving road and transit access in the environs of a major mixed-use development in Central Somerset County, New Jersey. It demonstrates how state and local governments working with the private sector can produce beneficial access improvements while providing for economic growth and development.

Background
The Bridgewater Commons Development is located in Central Somerset County, New Jersey at the confluence of U.S. 22, U.S. 202/206 and I-287. The 122 acre site is bounded by I-287 on the north, U.S. 202/206 on the west, U.S. 22 on the south and North Bridge Street (Somerville) on the east. Exhibit 1 shows the regional setting and Exhibit 2 shows the roadways in the site environs.

Route 22, which bounds the site on the south is especially significant from an access management perspective. This multi-lane divided highway was the main route between Newark, New Jersey and Allentown, Pennsylvania before the completion of I-78. Built more than a half century ago, it was one of the forerunners of express highway developments. Most cross traffic is grade-separated, and tight interchanges existed at major intersecting roads. A continuous median divider separates opposing directions of travel, and prevents left turns. However, right turn access is provided to and from the many developments that lie along the road. The road splits into two-one-way roadways, with commercial development between them in the Bridgewater Commons environs.

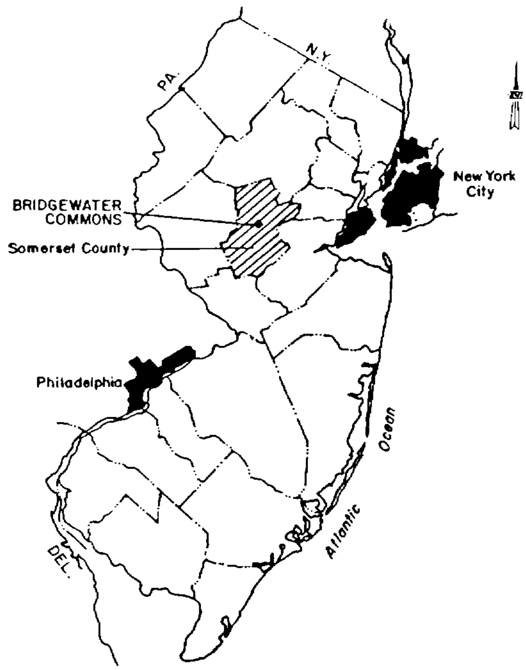


Exhibit 1. Setting of the Bridgewater Regional Center in Norther New Jersey

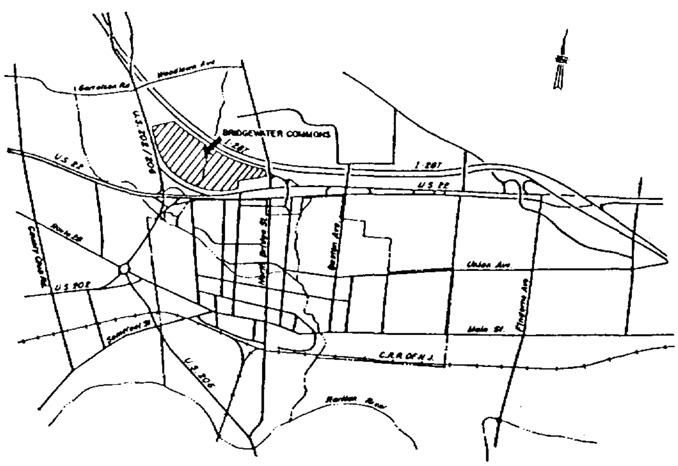
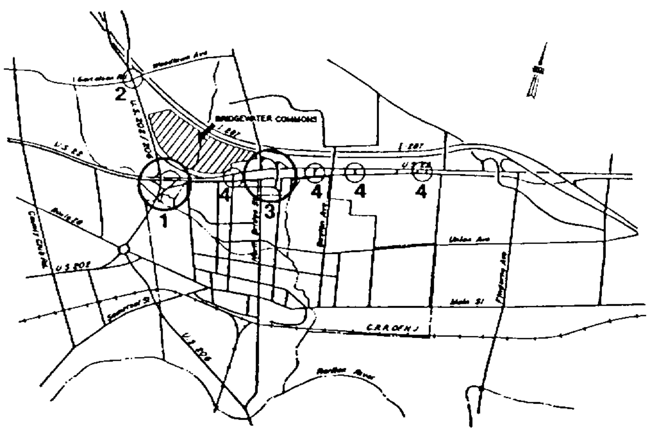


Exhibit 2. Location of Bridgewater Commons in in Central Somerset County

Average density traffic along Route 22 at Bridgewater Commons in 1992 approaches 70,000 vehicles per day. PM peak hour volumes approached 4000 vph westbound, and 3000 vph eastbound before Bridgewater Commons was build.

The roadway conditions in the environs of Bridgewater commons - before the Commons was built and the roads were improved - are shown in Exhibit 3. Most of the operating problems were concentrated along Route 22; they included substandard interchange design, frequent median crossovers, frequent driveways, and land use activities in the median strip. The high volumes, marginal frictions, and capacity limitations along U.S. 22 resulted in peak period congestion and a high accident rate.



1. Substandard Interchange at U.S. 22 & U.S. 202/206
2. Substandard Interchange at U.S. 22 & U.S. 202/206 and Garrison Road
3. Substandard Interchange at U.S. 22 and North Bridge St.
4. Median Crossovers on U.S. 22
5. Land Use Activities in Median Strip
6. Frequent Driveways Along U.S. 22 - High Side Friction
7. Congestion on U.S. 22 - Inadequate Capacity
8. Accidents on U.S. 222

Exhibit 3. Comments on Roadway Conditions Prior to Improvements

LAND USE CONCEPT

The Bridgewater Regional Center is a mixed land use development that keeps with the original Redevelopment Plan and the developer's Formal Technical and Management Proposal (FTMP) with its supplemental submittals (Dec. 1978). The land use mix and intensity was based upon a physical environmental survey, an extensive market potential study, a community attitude survey, and supplemental traffic and planning analysis. These studies were performed independently by professional advisors to the Township and by the developer's economic and planning consultants. All studies pointed to a mixed use development as the highest and best use for the land. The redevelopment site is 122.2 acres. The planned uses included:

- Regional Shopping Center (900,000 sq. ft. of GLA)
- Office Space (500,000 sq. ft.)
- Hotel/Conference Center (200 rooms)
- Open Space
- Mac's Brook Park
- Internal Roadways
- Parking (4,500 spaces)

While the shopping center, parking, roadways, and open space have been implemented, remaining uses will probably depend on market conditions.

Parking was planned as a separate use that reflects current standards for mixed use development. The objectives were to provide a close proximity to activities in the Regional Center, to preserve open space, to maximize personal safety, to provide for a feeling of security, and to use a parking design that will assist in the detention of water. To accomplish these objectives at least 30 percent of the spaces were planned to be provided in structures and the land uses were arranged to encourage the sharing of parking. Initial PM peak hour trip generation (nondirectional) was estimated at 4500 vph for the mixed use development.

TRAFFIC IMPACTS

The existing (1978) and anticipated future PM peak hour traffic on the regional highways in the site environs are shown in Exhibit 4. These traffic projections reflect four basic components. 1) existing background traffic, 2) an approximate 24% growth to 1990, 3) anticipated Bridgewater commons traffic and 4) traffic resulting from other developments in the site environs. These traffic projections provided a basis for scaling future roadway and capacity requirements.

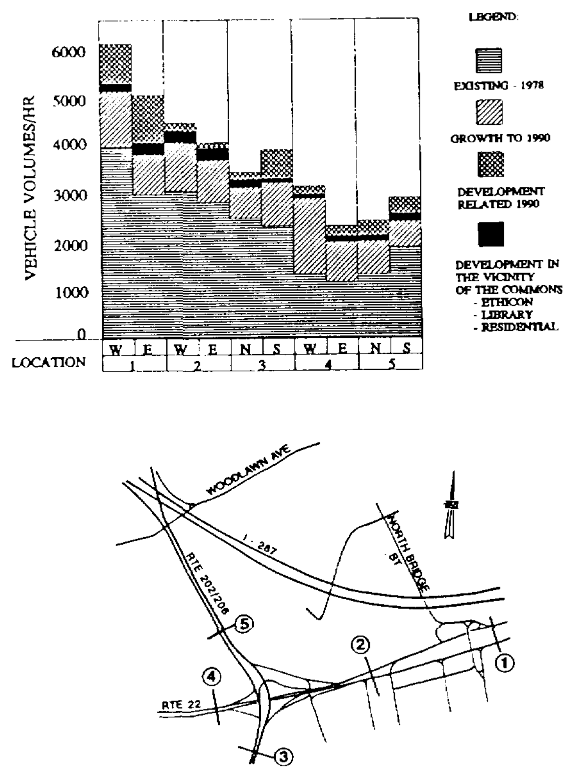
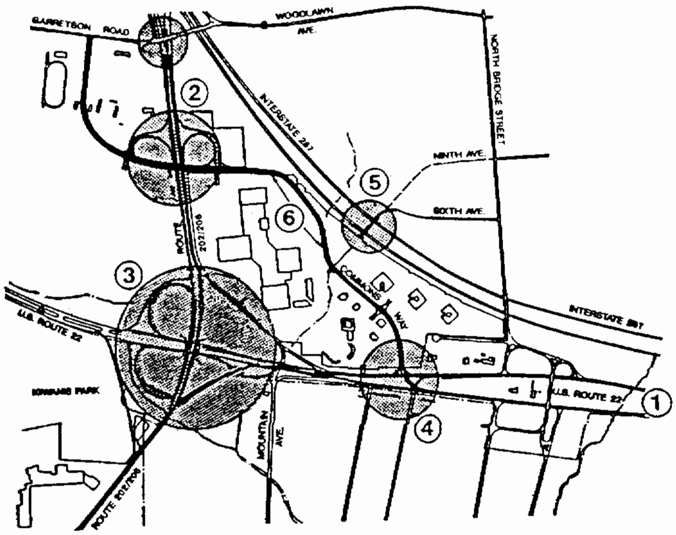


Exhibit 4. Existing and Future Peak Hour Volumes on Regional Highways

ACCESS PLAN CONCEPT

The roadway improvement and conceptual access management plan is shown in Exhibit 5. This concept emerged from an analysis of various alternatives. It was accepted by both the public and private sectors, on-site and off-site road improvements were designed, funded by the developer, and constructed before the opening of Bridgewater Commons.



1. Arterial U.S. 22 and U.S. 202/
2. Interchanges U.S. 202/206
3. U.S. 22
4. U.S. 22
5. I-287
6. Collector Commons Way

Exhibit 5. Roadway Improvement and Access Management Concept

Access management - especially along Route 22 was an integral part of the overall plan. The key elements of the plan include:

1. Closure of median breaks along Routes 22 and Routes 202/206.
2. Elimination of land uses within the U.S. 22 median, and the attendant access points.
3. Modification of access points along arterial roads to allow only right-turn entry and exits.
4. An upgrading and widening of U.S. 22 and U.S. 202/206 from four to six lanes.
5. A *new collector roadway - Commons* Way - generally parallel to existing arterials with a coordinated traffic signal system.
6. A new flyover from Commons Way into Route 22.
7. A complete rebuilding of the interchange between Route 22 and Routes 202/206, plus new interchange between Routes 202/206 and Commons Way.

The plan also provides for a possible future interchange at I-287 as conditions warrant.

The projected levels of service resulting from the various developments and road improvements are shown in Exhibit 6. Exhibit 7, in turn, gives a general comparison of the traffic and environmental impacts. The benefits resulting from the road improvements more than effect the additional traffic flows. The projections show that the levels of service on Routes 22 and 206 would improve from D to F in 1980 to C in 1995, with the improvements.

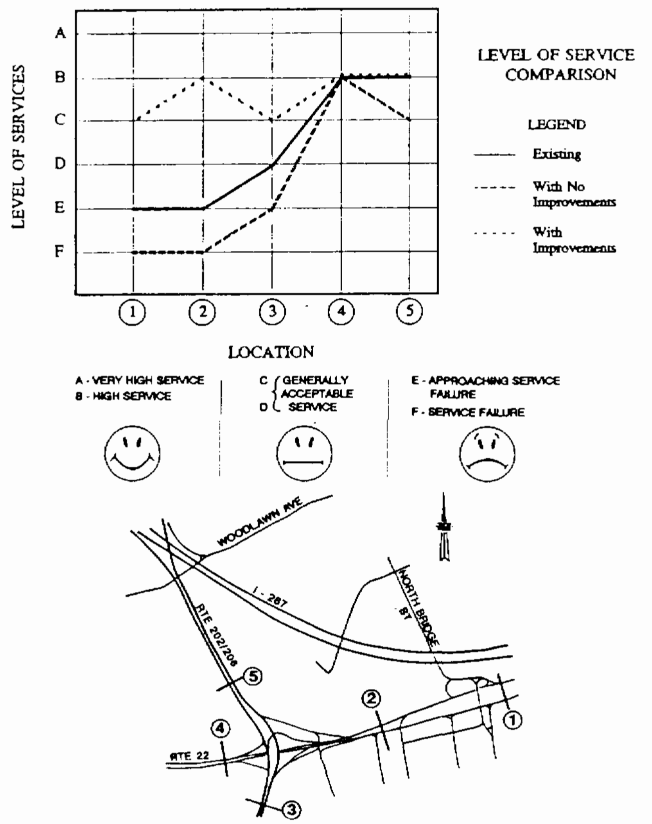


Exhibit 6. A Level of Service Comparison on Highways Surrounding the Center

General Comparison (Based on Projection in 1980)			
Criteria	Existing (1980)	Without Improvements (1995)	With Improvements (1995)
Level of Service U.S. 22 U.S. 202/206	LOS E LOS D	LOS F LOS E	LOS C LOS C
Safety Conflicts on U.S. 22	Numerous Access Points Median Crossovers	Additional Access Points Median Crossovers	Reduced/Consolidated Modified Access Points Median Closures Crossovers Eliminated
Energy * (1,000's gallons)	134,778	97,396	92,790
Trip Ends *	1,164,190	1,290,489	1,214,287
VMT (1,000's) *	2,346,291	2,685,697	2,595,720
Vehicle Hours of * Travel (1,000's)	104,532	121,801	114,125
CO Emissions *	164,873	60,389	56,847
HC Emissions *	161,097	7,070	6,634

Exhibit 7. A With and Without Comparison Table

IMPLICATIONS AND LESSONS LEARNED

To reach a consensus between the local government, surrounding area, and state, required the development and evaluation of "packaged" alternatives. Each package consisted of a transportation/access, land use, and drainage component. A broad study area (subregion) was included in the evaluation as well as the site and its immediate vicinity.

This led to a Conceptual Access Plan that was accepted and implemented. This Access Plan was extensive and included both operational and physical changes. Its principal elements included: 1) a new collector roadway parallel to an existing arterial with a coordinated signal system, 2) an upgrading of the arterial roads, 3) a new flyover, 4) a complete rebuilding of an existing interchange, 4) closure of median breaks, 6) elimination of land uses in the median, 7) elimination of access points, and 8) modification of access points to allow only right turn access. The Plan also provides flexibility for future uncertainty, by making provisions of a potential future interchange with I-287.

The offsite improvements were designed, funded (private sector), and constructed prior to the opening of the Bridgewater Commons. The roadway and access changes result in improved road performance. A key to the project's success was the development of land use patterns and densities that are generally compatible with the transportation improvements including provision for transit shuttle services.

In a broader perspective, this case study shows: a) the value of preparing an overall access plan, b) the need to integrate road changes and access changes as part of this plan, and c) the public and private sectors' willingness to reduce access and conflict points along existing arterials as part of the overall plan.

REFERENCES

1. Bellomo, S.J., et al., "Guidelines for Providing Access to Transportation Systems," Draft, Prepared for Federal Highway Administration, Bellomo-McGee, Inc., Washington, D.C., August 1992.

2. American Association of State Highway and Transportation Officials, *A Policy on Geometric /Design of Streets and Highways*, 1990.

3. American Association of State Highway and Transportation Officials, *Highway Design and Operational Practices Related to Highway Safety*, Second Edition, 1974.

4. American Association of State Highway and Transportation Officials, *Roadside Design Guide*, Task Force for Roadside Safety, 1988.

5. *Manual on Uniform Traffic Control Devices for Highways and Streets*, Federal Highway Administration, 1988 Edition.

6. Flora, J.W., Keith, K.M., *Access Management for Streets and Highways*, Report No. FHWA-IP-82-3, Federal Highway Administration, June 1982.

Session 6T

Evaluation of Roadway Access Design

Moderated by Ron Giguere, Federal Highway Administration

This session focused on different techniques for evaluating the impacts of various access management techniques. Four speakers presented papers that examined the impacts of access management techniques on safety, roadway capacity, and congestion, as well as the economic impacts on surrounding businesses.

The first speaker was Peter Parsonson of Georgia Tech who presented a paper entitled, "Effect on Safety of Replacing an Arterial Two-Way Left-Turn Lane with a Raised Median." The paper presents the results of a case study in Georgia where a two-way left-turn lane along a heavily developed commercial corridor was replaced with a raised median. The project involved significant changes to the existing traffic patterns and raised objections from some local business owners concerned about reduced access to their stores. Mr. Parsonson presented the safety impacts of the retrofit and discussed the economic impacts as well.

The second speaker was Steven Decker of Cambridge Systematics, Inc. who presented a paper entitled, "Methodology for Evaluating Economic Impacts of Restricting Left Turns." The paper provides an overview of an on-going NCHRP study (25-4) which is examining the economic impacts on businesses of restricting left turns. The paper also presents the methodology utilized to address the issues, and a qualitative description of what has been found to date. Ultimately, this research should be of interest to transportation planners and engineers who must confront this issue in daily practice.

The third speaker was Ron Giguere of the Federal Highway Administration who presented a paper entitled, "Evaluating the Operation Impacts of Access Control Strategies Using TRAF-NETSIM." The paper discusses an alternative method for evaluating the impacts of access management techniques on traffic flow, namely the use of the TRAF-NETSIM traffic simulation model. Because there are no large empirical databases of access management impacts, engineers and planners need alternative methods for predicting the benefits of access management. This paper evaluates the suitability of the TRAF-NETSIM model for estimating the impacts of access management techniques and makes recommendations for further research.

The final speaker was Brian Hoeft of the Federal Highway Administration who presented a paper by Hugh McGee and Warren Hughes of Bellomo-McGee, Inc. The paper, entitled "Safety Benefits of Access Management," presents an overview of different methods for estimating the safety impacts of access management techniques. The paper focuses on the use of conflict points, weighted conflict points, and traffic conflicts to estimate safety impacts. It describes the inherent weaknesses in each of these techniques in trying to assess safety and briefly discusses the difficulties in estimating expected number of accidents and accident reductions.

This session was attended by approximately 50 people. There was no discussion period for this session.

Effect on Safety of Replacing an Arterial Two-Way Left-Turn Lane With a Raised Median

Peter S. Parsonson
Marion G. Waters III
James S. Fincher

ABSTRACT
This paper describes the safety effectiveness of replacing a two-way left-turn lane with a raised median on a high-volume, six-lane arterial in Atlanta. In the year after completion, the Memorial Drive median project prevented about 300 accidents and 150 injuries. There was a 37 percent reduction in total accident rate and a 48 percent drop in the injury rate. Left-turn accidents between intersections were virtually eliminated. Over the 4.34-mile section, a number of less-significant public-road intersections were not given median breaks.

On similar retrofit projects, where narrow raised medians are used, all remaining median openings should be strongly considered for signalization. Also, adequately designed U-turn capability should be provided at each opening, if possible, with right-turn-on-red prohibition considered on cross-street approaches. Well designed, double left-turn lanes should be included where needed.

A mountable curb allows the median to be driven on by emergency vehicles and reduces the possibility of an errant vehicle losing control upon striking it.

A reduction in traffic volume after the project could not be attributed to the median. Several businesses on the arterial closed after the median was installed; reduction in access to abutting land seems to affect convenience-type stores primarily.

This paper documents the safety effectiveness of reconstructing a 4.34-mile section of Memorial Drive, a six-lane arterial in greater Atlanta, by replacing an existing two-way left-turn lane (TWLTL) with a raised median. Some information is also presented on the changes in traffic volume and in abutting business activity during the before-and-after study period. The introduction discusses the factors that preceded the decision to convert a section of Memorial Drive to a raised-median design.

INTRODUCTION

It is an accepted principle of traffic management that an arterial is supposed to use geometric design and traffic-control measures to expedite the movement of through traffic, while access to abutting property may be restricted (1). During the early to mid-1980s this Memorial Drive segment came to the attention of the Georgia Department of Transportation officials as a problem because of (1) a high number of accidents, particularly mid-block accidents, and a high accident rate; (2) a high number of pedestrian fatalities; and (3) an increasing traffic volume. Consequently, the Department decided to address these problems by installing a median separation. This concept was discussed with county officials; the project was programmed (funded) for construction in 1986 and a public hearing was conducted in 1987. Considerable opposition to the project was experienced from local merchants and as a result the Department modified the initial concept to accommodate as much as possible the concerns expressed. For example, one of the early concepts involved a median wall; it was revised to a raised median. Also, fewer median openings were initially proposed, but the number of these was expanded to 14, at almost all public road and significant private-driveway intersections.

Also during the mid-1980s the Department decided, based on studies and other considerations, to begin using raised medians on other projects as well. However, the Department came under pressure from local governments to incorporate TWLTLs into roads being upgraded (2). Because of this pressure, and because of a need for more-quantitative design criteria reflecting safety and volume-to-capacity considerations when evaluating TWLTL versus raised medians, the Department contracted with Georgia Tech in 1986 to develop a set of design criteria for the use of TWLTL and raised-curb medians. The safety-oriented results of the project were reported by Squires and Parsonson to the Georgia DOT in November, 1988 (3) and were published by the Transportation Research Board in 1989 (4).

Parsonson and Squires studied 50 TWLTL sections and 32 raised-median sections of four- and six-lane roadways throughout Georgia. High-volume arterials carrying almost 60,000 vehicles per day were included. The researchers developed a statistical comparison of accident rates for the two types of sections and also developed regression equations to model expected accident experience for each section. Considering total accidents (those at intersections plus those at mid-block locations), they found for six-lane roads that it could be stated with 95 percent confidence that raised medians had fewer accidents per million vehicle miles than did TWLTLs. For four-lane roads it could be stated with 78 percent confidence that raised-median designs had fewer accidents.

A major local government in greater Atlanta took note of these findings and soon adopted a policy that, for safety, all new and reconstructed principal and major thoroughfares should be designed with raised medians. Also, existing arterials with TWLTLs should be considered for installation of a raised median if the projected growth in traffic reaches or exceeds 24,000 to 28,000 vehicles daily, the local government decided. (5).

On July 28, 1989 the Georgia DOT began construction on the Memorial Drive project, described next, and construction was fully completed on September 30, 1990.

PROJECT DESCRIPTION

The project consisted of replacing a TWLTL with a median separation for 4.34 miles of Memorial Drive in greater Atlanta. The six through lanes were retained. The median was not broken at seven of the less significant intersections with public roads, thereby eliminating left turns into and out of those cross streets. Fourteen median openings were provided at major intersections with public roads and significant intersections with private driveways. All 14 were protected by traffic signals. Other key features of the project were as follows:

- The median width totaled 14 feet. The 6-inch-high raised median portion itself was 10 feet wide, resulting in a 2-foot clearance to the travel lanes on either side. At the intersections the raised median tapered to a width of 2 feet, with a 1.5-foot clearance to the travel or turn lanes, for a median width at these locations of 5 feet. The mountable curb allows emergency vehicles to drive on it and reduces the possibility that an errant vehicle might go out of control upon striking it. The speed limit is 45 mph. The curb design is Georgia DOT Type 7, identical to AASHTO's mountable curb shown in Figure IV-4(d) of its *Policy on Geometric Design of Highways and Streets*. The curb was constructed without concrete gutter; the 1.5-inch asphaltic concrete overlay came to the face of the curb and produced the desired six-inch curb height.

- To make the median more conspicuous, the curb faces were painted with yellow thermoplastic material. Yellow reflectorized raised pavement markings were installed every 20 feet on the pavement next to the curb.

- All intersections were well designed, some with dual turn lanes and all except one with U-turn capabilities.

- Because of the increased U turns on Memorial Drive, right turn on red onto Memorial Drive was not allowed from any cross street.

- The project was provided with a fully traffic-responsive, properly timed and integrated traffic signal system to promote uniform and efficient traffic flow.

Table 1 shows for Memorial Drive, before the project, the ADT, number of driveways per mile, number of signalized intersections per mile, and the number of cross-street approaches per mile. The 4.3-mile project was subdivided into three homogeneous sections for this tabulation (3).

Table 1. Characteristics of the Project Section of Memorial Drive

The project extended from George Luther Dr. at Mile 5.65 to Goldsmith Rd. at Mile 9.99.

Section	Length	ADT	Drives Per Mile	Signals Per mile	Approaches Per Mile
5.67 to 7.43	1.76	47,685	67.61	3.41	1.70
7.43 to 9.08	1.65	39,900	48.48	1.82	1.82
9.08 to 9.86	0.78	28,300	61.54	1.28	2.56

EFFECT ON SAFETY

The Georgia DOT performed a before-and-after study of the effect of the project on vehicle safety. In all of the tables that follow, rates of total accidents and midblock accidents were calculated per 100 million vehicle miles. Rates of intersection accidents were calculated per million vehicles entering the intersection on the mainline (Memorial Drive).

Table 2 shows a summary of the changes in accident rates. The accident rate for all types of accidents was reduced by 37 percent and the injury rate dropped 48 percent. As would be expected, the reduction was greater at midblock locations than at intersections; however, the total intersection rates were also reduced as well as the rates at those intersections which remained open. This demonstrates that providing excellent design and traffic signals at remaining openings can lower rates in spite of the increased activity that must necessarily be directed to these openings. In this connection, left-turn accidents at intersections are seen to have been cut in half, despite the increase in U turns caused by the raised median. Further, U-turn accidents tend to occur at lower angles of incidence and at lower speeds than right-angle-intersecting accidents and therefore they tend to be less severe and result in further injury savings.

Table 3 is a tabulation of the changes in total accidents of all types. The reductions of 55, 24 and 37 percent are repeated from Table 2. Table 3 shows that only 12 months of accident data available in the after period were compared to only 12 months of "before" data. However, the numbers of accidents were so large as to cause the changes to be very significant statistically. For example, consider item 2(b) in Table 3, the seven public-road intersections where the median was not given an opening. The reduction in accidents (corrected for traffic-volume changes) needed to be only 30 percent in order to be significant at the 95 percent confidence level (6). The drop of 68 percent in the accident rate was therefore very highly significant.

Table 2. Summary of Accident-Rate Changes, Percent

	ALL TYPE Accidents		"LEFT-TURN" Accidents Only	
	Total Accident Rate	Injury Rate	Total Accident Rate	Injury Rate
1. Midblock	-55	-59	-90	-92
2. Intersections	-24	-40	-50	-48
3. Total (1. + 2.)	-37	-48	-64	-65

Table 3. Changes in Total Accidents of All Types.

		BEFORE 12 Months (7-1-88 thru 6-30-89) #/Rate	AFTER 12 Months (10-1-90 thru 9-30-91) #/Rate	Percent Change in Rate (Before to After)
Average Annual Daily Traffic (ADT)		(50400)	(43000)	
1.	MIDBLOCK (Not at a public road nor a significant private drive intersection)	380/476	146/214	-55
2.	INTERSECTIONS			
	(a) One public road intersection where median already closed and Left-Turns and thru (Crossing) Movements not permitted prior to new median construction	12/0.65	10/0.64	-2
	(b) Seven public road intersections where median closed as a result of new median construction and Left-Turns or Thru (Crossing) Movements prohibited	76/0.59	21/0.19	-68
	(c) Ten public road and four significant private drive intersections where median remains open after new median construction and Left-Turns or Thru (Crossing) Movements continue*	479/1.86	334/1.52	-18
	TOTAL-ALL INTERSECTIONS	567/1.40	365/1.06	-24
3.	TOTAL-MIDBLOCK & ALL INTERSECTIONS	947/1186	511/750	-37

*All of these Intersections, which remain open at median, which remain open at median, are protected by a traffic signal.

Injury accidents of all types are reported in Table 4. As in the previous tables, the reductions in accident rates are very large, averaging 48 percent overall. The 20 percent increase in the rate at one intersection is not at all significant. The table does not report fatalities, but the change is known to be as follows: From January of 1979 through mid-July of 1989 there were 15 fatalities, of which 6 were pedestrian deaths. From October of 1990 to May, 1993, over 2.5 years, there have been no fatalities at all. Pedestrian traffic on Memorial Drive is significant, and pedestrians crossing Memorial Drive are probably benefitting from the median. In the absence of continuous sidewalks, it is common for pedestrians to walk on the raised median. Probably the design would have benefitted from continuous sidewalks.

Table 4. Changes in Injury Accidents of All Types.

		BEFORE 12 Months (7-1-88 thru 6-30-89) #/Rate	AFTER 12 Months (10-1-90 thru 9-30-91) #/Rate	Percent Change in Rate (Before to After)
Average Annual Daily Traffic (ADT)		(50400)	(43000)	
1.	MIDBLOCK (Not at a public road nor a significant private drive intersection)	155/194	54/79	-59
2.	INTERSECTIONS			
	(a) One public road intersection where median already closed and Left-Turns and thru (Crossing) Movements not permitted prior to new median construction	1/0.05	1/0.06	+20
	(b) Seven public road intersections where median closed as a result of new median construction and Left-Turns or Thru (Crossing) Movements prohibited	39/0.30	6/0.05	-83
	(c) Ten public road and four significant private drive intersections where median remains open after new median construction and Left-Turns or Thru (Crossing) Movements continue*	193/0.75	113/0.51	-32
	TOTAL-ALL INTERSECTIONS	233/0.58	120/0.35	-40
3.	TOTAL-MIDBLOCK & ALL INTERSECTIONS	388/486	174/255	-48

*All of these Intersections, which remain open at median, which remain open at median, are protected by a traffic signal.

Although normally little credence is attached to fatality data in such evaluations, the Department is pleased that none of the accidents occurring in this segment since the project was completed over 2.5 years ago has resulted in a fatality. On the other hand, in the 11.6 years preceding the project

(January 1, 1979 through July 27, 1989), there occurred 15 total fatalities within this project. However, fatalities should not be used as an absolute criterion when evaluating such projects, because fatalities are rare events. Furthermore, there could be other factors involved such as possibly large changes before and after in DUI involvement. Injury statistics are more important because they occur much more frequently than fatalities and because many injuries are so severe as to be almost fatal. The reduction in injuries was statistically significant on this project.

Left-turn accidents are analyzed in Table 5 and show an overall drop of 64 percent. The midblock drop of 90 percent was probably foreseeable. However, the reduction of 39 percent at the 10 intersections where the new median remained open is very encouraging, in view of the expected increase in U turns.

Table 5. Changes in Left-Turn Accidents of All Types.

		BEFORE 12 Months (7-1-88 thru 6-30-89) #/Rate	AFTER 12 Months (10-1-90 thru 9-30-91) #/Rate	Percent Change in Rate (Before to After)
Average Annual Daily Traffic (ADT)		(50400)	(43000)	
1.	MIDBLOCK (Not at a public road nor a significant private drive intersection)	96/120	8/12	-90
2.	INTERSECTIONS (a) One public road intersection where median already closed and Left-Turns and thru (Crossing) Movements not permitted prior to new median construction	1/0.05	0/0	-100
	(b) Seven public road intersections where median closed as a result of new median construction and Left-Turns or Thru (Crossing) Movements prohibited	28/0.22	69/0.31	-95
	(c) Ten public road and four significant private drive intersections where median remains open after new median construction and Left-Turns or Thru (Crossing) Movements continue*	132/0.51	113/0.51	-39
	TOTAL-ALL INTERSECTIONS	161/0.40	70/0.20	-50
3.	TOTAL-MIDBLOCK & ALL INTERSECTIONS			

Table 6 shows the changes in left-turn accidents resulting in injuries. Similar to the previous table, The overall reduction is 65 percent and the other changes are about the same.

Table 6. Changes in Left-Turn Accidents Resulting in Injuries.

		BEFORE 12 Months (7-1-88 thru 6-30-89) #/Rate	AFTER 12 Months (10-1-90 thru 9-30-91) #/Rate	Percent Change in Rate (Before to After)
Average Annual Daily Traffic (ADT)		(50400)	(43000)	
1.	MIDBLOCK (Not at a public road nor a significant private drive intersection)	57/71	4/6	-92
2.	INTERSECTIONS (a) One public road intersection where median already closed and Left-Turns and thru (Crossing) Movements not permitted prior to new median construction	0/0	0/0	
	(b) Seven public road intersections where median closed as a result of new median construction and Left-Turns or Thru (Crossing) Movements prohibited	15/0.12	1/0.01	-92
	(c) Ten public road and four significant private drive intersections where median remains open after new median construction and Left-Turns or Thru (Crossing) Movements continue*	71/0.28	38/0.17	-39
	TOTAL-ALL INTERSECTIONS	86/0.21	39/0.11	-48
3.	TOTAL-MIDBLOCK & ALL INTERSECTIONS	143/179	42/63	-65

*All of these Intersections, which remain open at median, which remain open at median, are protected by a traffic signal.

CHANGES IN ESTIMATED TRAFFIC VOLUMES AND BUSINESS ACTIVITY

Tables 3 through 6 show a reduction in estimated ADT from 50,400 to 43,000 before and after the project. An attempt was made to assess whether the drop may have been due to the installation of the raised median. Table 7 shows various volume estimates within and outside the Memorial Drive project.

The first column of Table 7 tabulates by year the averages

second column shows the averages of all the Memorial Drive estimates in a two-mile section of Memorial Drive outside the project limits but contiguous to it, where no median was constructed. Within the project the estimated volumes dropped from 49,178 before the project to 43,200 vpd after it, a reduction of 12 percent. Outside the project limits the estimated volumes changed from 31,669 to 29,921 vpd, a drop of 5.5 percent. In both sections, estimated volumes peaked in 1989-90, when the project was being constructed, and then dropped in 1991 to about their 1988 levels or a little less. Other factors that could have influenced volumes included the following: there were other major construction projects taking place during the period; there was an areawide economic recession paralleling the nationwide recession at that time; and the Memorial Drive area in general experienced some business and commercial closings or transitions during this period which could have affected traffic volumes. Therefore the indicated reduction in traffic volume may not have been attributable to any significant extent to the median. No specific evidence has been substantiated that the raised median affected traffic volume.

Table 6. Traffic Volumes Before and After the Project.

	Memorial Drive Within Project in veh per day	Memorial Drive Outside Project in veh per day
1988	45,764	29,452
Avg. of 1988 and 1989 (before)	49,178	31,669
1989	52,591	33,886
1990	52,641	32,134
1991 (after)	43,200	29,921
1992	43,456	32,472

In late 1992 the Atlanta newspapers published an article quoting merchants as saying that the Memorial Drive median had hurt business (7). The article stated that several businesses, including Blockbuster Video, Ace Hardware Workbench and Tile City closed after the barriers were installed. It also pointed to a Citgo Food Mart, on another road, that reportedly had lost 50 percent of its business after a raised median was installed. However, the reporters did not ask specific businesses their reasons for closing. The Memorial Drive project did not include any measures to improve interparcel access by providing frontage roads or driveways, rear alleyways, joint parking lots, etc.

The authors' opinion regarding impact on business is that the project probably did affect some types of stores, especially those at midblock locations and those that must do a large-volume business because of a small profit on each sale. Examples of the latter could include convenience stores, dry cleaners, video stores and the like. If a median makes it inconvenient to shop at one of these stores, the motorist knows that another one like it will soon be encountered, and on the right side of the road. An optician/optometrist establishment, on the other hand, is not so common and would not feel the effects of a median to as great an extent. There was an instance on Memorial Drive, after the median was constructed, where an OptiWorld moved into the location where a Blockbuster Video had moved out.

CONCLUSIONS

In the year after completion, the Memorial Drive median project prevented about 300 accidents and 150 injuries. There was a 37 percent reduction in total accident rate and a 48 percent drop in the injury rate. Left-turn accidents between intersections were virtually eliminated. Hopefully these results are adequate compensation for any inconvenience to merchants and motorists.

On similar retrofit projects, where narrow raised medians are used, all remaining median openings should be strongly considered for signalization. Also, adequately designed U-turn capability should be provided at each opening, if possible, with right-turn-on-red prohibition considered on cross-street approaches. Well designed double left-turn lanes should be included where needed.

REFERENCES

1. Homburger, Wolfgang S. and James H. Kell, Fundamentals of Traffic Engineering, 12th ed., Institute of Transportation Studies, University of California, Berkeley, January, 1988.

2. Archie C. Burnham, Jr., State Traffic and Safety Engineer, Georgia DOT, "Georgia DOT Position on Divided vs. Undivided Roadway Facilities," presented to the Cobb County Board of Commissioners, April 28, 1987.

3. Squires, Christopher A., "Criteria for Two-Way Left-Turn Lanes vs. Other Medians, Vol II: Accident Comparison of Raised Median and Two-Way Left-Turn Median Treatments," Final Report, GDOT Research Project No. 8602, School of Civil Engineering, Georgia Tech, November, 1988.

4. Squires, Christopher A. and Peter S. Parsonson, "Accident Comparison of Raised Median and Two-Way Left-Turn Lane Median Treatments," *Record 1239*, Transportation Research Board, Washington, D.C., 1989, pp.30-40.

5. Bretherton, W. Martin, Jr., Womble, Joseph E., Parsonson, Peter S. and Black, George W., Jr., "One Suburban County's Policy for Selecting Median Treatments for Arterials," *Compendium of Technical Papers*, Institute of Transportation Engineers 60th Annual Meeting, Orlando, Florida, August 5-8, 1990, pp. 197-201.

6. Michaels, Richard M., "Two Simple Techniques for Determining the Significance of Accident-Reducing Measures," *Traffic Engineering*, September, 1966, pp. 45-47. This material can be found in more-readily available references, such as ITE's *Manual of Traffic Engineering Studies,* 2nd ed., p.207, and ITE's *Traffic Engineering Handbook*, 4th ed., 1992, p. 114.

7. Atlanta Journal and Constitution, December 27, 1992, p.D10.

Methodology for Evaluating Economic Impacts of Restricting Left Turns

Roane M. Neuwirth
Glen E. Weisbrod
Steve Decker
Cambridge Systematics, Inc.

Abstract
The practice of restricting left turn access, particularly in heavily traveled commercial areas, has long been a cause of friction between businesses in the commercial area and traffic engineers assigned with the task of planning for traffic flow and safety in those same areas. Issues of customer access to local establishments often clash with the desire to improve through traffic speed and flow, and to reduce opportunities for accidents. Left turn restriction projects have been generating much public debate over the years, sometimes to the point of causing the projects to be abandoned due to public protest.

Much of the public protest results from the understanding by business and property owners that traffic volumes can affect the prospects for business sales, and therefore for profit. Therefore, projects which propose to restrict access are considered to threaten that profit. On the other hand, it is also clear that while pass-by access may be critical for profit of some businesses, for others it is not. The impacts on businesses of changes in traffic volumes or accessibility from any specific left turn restriction project are thus not simple to understand or predict. Differing objectives and differing expectations of impacts have made it difficult for transportation planners and businesses to be able to work together on traffic improvement projects.

To better understand the range of business impacts resulting from turn restrictions, and use that to inform the planning process in a productive way, the Transportation Research Board, through its National Cooperative Highway Research Program commissioned Cambridge Systematics to study the economic impacts of restricting left turns. This research project, under NCHRP Project 25-4, is currently ongoing, and is not yet at the stage of final results. This paper presents the methodology utilized to address the issues, and a qualitative description of what has been found in the research to date. The methodology discussed herein should be of interest to transportation planners and engineers who must confront this debate in their practice, and who could gain from further understanding the issues involved.

Introduction
Streets and highway systems have always served two functions – the movement of traffic and the service of land. At one end of the spectrum, local streets are planned to provide land use service almost to the exclusion of traffic movement. At the other end, freeways are designed to move traffic while providing virtually no service to abutting lands. In between, at various roadway types from collectors to at-grade expressways, the two functions must be jointly served, and the varying demands of each can create competition and conflict. Often faced with needs to increase capacity and safety for traffic movement, transportation agencies plan improvements that threaten to diminish the levels of land use service previously provided. When these land uses depend on access, the present problem posed by this research project arises.

Real estate acquires value because of its location, and the key to location is accessibility. For most sites, accessibility is measured by the ease with which vehicles of all kinds can arrive and depart from a site. On busy urban, suburban, and rural highways, investors and entrepreneurs have long understood that traffic volumes affect the prospects for business sales and thus for profit.

It is equally clear, however, that different types of businesses have different access needs for customer attraction. For some types of businesses, access travel time is a key factor, while for others pass-by traffic volume plays a more significant role in determining the success of the business itself (see Exhibit 1). Left turn restrictions make access to businesses more circuitous and add to travel time. For customers driving to a business from far away, the marginal increase in travel time may be trivial. Thus, the economic impacts of changes in traffic volume or accessibility resulting from any specific set of highway improvements are not simple to predict. However, for customers passing by and considering turning in, the additional circuity and hassle of access may be enough to discourage a visit to that store.

This project examines the impacts of left turns on adjacent land by looking specifically at regulating left turns from the main roadway (and, presumably, left turns back onto the main roadway). The proposed methodology uses case studies and the findings from them to develop and validate models for making assessments of economic impacts arising from left turn restrictions imposed to facilitate capacity and safety improvements.

Exhibit 1. Illustrative Examples of Business Sales Sensitivity to Pass-by Traffic

Portion of Business Sales Coming from Pass-by Traffic	SIC	Sample Business Type
Lowest	527	Mobile Home Dealers
	555	Boat Dealers
	722	Photographic Studios
	802	Dentists
Moderate	525	Hardware Stores
	572	Household Appliance Stores
	753	Automotive Repair Shops
High	541	Grocery Stores
	721	Laundry, Cleaning and Garment Services
Highest	549	Miscellaneous Food Stores
	554	Gasoline Service Stations

Source: Cambridge Systematics, Inc.

Methodology

The focus of the study is on the impacts of left turn restrictions on adjacent businesses. However, it is also important to examine the degree to which economic losses (if any) experienced by a business are offset by economic gains somewhere else. This is especially relevant to many small retail establishments selling convenience goods for which the motorist/consumer easily can find a substitute.

As a measure of economic impacts, the study focuses on turning restrictions as the potential cause of sales losses to businesses. To the degree that other factors intervene and affect business sales in the vicinity of the turning restrictions, these intervening impacts must be measured and controlled for. Examples of these impacts are the effects of overall changes in population, employment and income within the corridor region and background changes in travel patterns (trips and miles traveled).

Little data exists to support or disprove the belief that left turn restrictions impact adjacent businesses. The evidence on each side of the issue is, at best, anecdotal, with insufficient basis in fact. Unfortunately, when anecdotal evidence is perceived to be valid by the public, potentially worthwhile highway improvement projects involving left turn restrictions can be slowed, or even stopped.

To address this problem the research project focuses on three principal sets of variables which effect the economic impacts of left turn restrictions. These are traffic level and composition, roadway design, and local economic mix. The paragraphs which follow explore each of these briefly.

Characteristics of Vehicular Traffic

The traffic flows served by the roadway in question are an important determinant of economic impact. "Through" traffic (that is, traffic without an origin or destination in the local area) might be expected to react differently to left turn restrictions than "local" traffic (traffic with either origins or destinations in the local area). Different classification of vehicles behave differently as well. For instance, trucks, given their greater geometric requirements for turning, might be more sensitive to left turn restrictions than automobiles, particularly if left turns are restricted to signalized intersections where U-turn maneuvers might be difficult.

An important distinction will be made for different types of "local" traffic, specifically, the difference between destination and non-destination traffic. Destination traffic includes vehicles with clearly defined destination (attraction) choices, such as employment and specialty retail centers. Non-destination traffic includes vehicles that are attracted to destinations as they travel on the adjacent roadway system (known as pass-by tripmaking), such as service stations and fast food restaurants. These types of choices will be an important factor in gauging the economic impact of business.

Another element of concern is recreational traffic, particularly since this type of traffic will fluctuate on a seasonal basis, and on a daily/hourly basis within an individual season. We expect that recreation users might well react differently to left turn restrictions than through and local traffic using the roadway system during the average work day. Finally, it is likely that the actual volume on the roadway itself, which would have a direct relationship to the difficulty encountered in making a left turn, to have an impact.

Roadway Design

We also expect the type of access control to play a significant role in the economic impact of left turn restrictions. At one extreme, access to a roadway right-of-way could be virtually unrestricted, with numerous, driveway curb cuts serving individual businesses. There may be no control at all, with the right side of the roadway serving as a virtually continuous driveway. At the other extreme, access could be highly-controlled to the right-of-way, using a "frontage road" or "service road" system, allowing access to the main roadway only at signalized intersections.

In between these two extremes are a broad range of possibilities. Individual establishments could have their own access driveways with limits related to the number of access/egress points and lane width. State/local regulations often determine the extent for adjacent land use access controls. Alternatively, a number of businesses (such as those in a strip shopping center) may have one or two access driveways. In such a condition, some of the access points could be signalized (an unlikely condition with frequent or loosely-controlled access).

Furthermore, the type of movements permitted at individual driveways is important. Access may be restricted to right-in/right-out operation, or may involve all turning movements (left, through, and right). In the latter setting, where access is already partially limited, impacts of left turn restrictions to/from the main roadway would be expected to have a different impact than restrictions placed upon a completely uncontrolled roadway.

Finally, there are several ways in which left turns can be restricted ranging in degrees of control of the left turns. *The following methods of restriction range from lowest to* highest levels of control. The research project considers these four forms of left turn restriction.

- On an undivided roadway, the simplest method (in terms of construction) is the use of signs and pavement markings. Though this approach is not widely used, it has been employed in some regions. (This approach tends to be difficult to enforce.)

- A second method is to provide physical separation between the directions of travel. These physical barriers range from a low curb to a jersey-type barrier, with left turns being permitted at clearly-defined locations. Though these "left turn permitted" locations need not occur at signalized intersections, they frequently do.

- A third type is the restriction of left turns along the entire length of a roadway using a median barrier. In such situations, vehicles wishing to turn left must exit the roadway on the right side, and *make use of a "jug-handle" or an "at-grade* cloverleaf." Left turns are then converted to through movements from the side.

- Finally, left turns are prohibited with the elimination of at-grade intersections. This restriction is usually implemented with grade separation construction of the major roadway facility. Left turns are then accommodated through means of interchange roadways and ramps.

Differences Between Before-and-After Conditions

Finally, other geometric features of the roadway in question are expected to be important determinants of impacts as well. In particular, the type of left turn control formerly in place, the type of left turn control subsequently in place, and the differential between the two conditions, is of major importance. Logically, one would expect a more severe impact when going from a "lowest control to highest control" scenario than when going from a "medium control" scenario to a "highest control" scenario.

Another factor which is very important is the implementation of left turn restrictions in conjunction with other roadway improvements. Typically, a highway improvement project to restrict left turns involves other highway improvements as well, such as providing additional through lanes, restricting access to the right-of-way, providing continuous turning lanes for right turning vehicles, constructing frontage roads, eliminating driveways/at-grade intersections, etc. The effects of these other improvements will also be carefully assessed, in order to isolate and quantify the effects of left turn restrictions alone.

Local Economic Conditions

Several economic variables substantially influence the level and type of economic impacts which result from left turn restrictions. The first is the characteristics and mix of businesses directly affected by the turning restrictions. The second is the set of alternative choices available to customers (motorists) outside the area subject to the left turn restrictions. Both variables are discussed in detail below.

When considering the characteristics and mix of businesses at a site, it is appropriate to refer to the system of Standard Industrial Classifications developed by The Executive Office of Management and Budget (O.M.B) to categorize the entire spectrum of economic activity in the national economy. The **Standard Industrial Classification Manual**, most recently revised in 1987, provides a useful framework for classifying businesses. However, substantial variations exists in the trip generation characteristics or businesses within any given Standard Industrial Classification.

For example, the Standard Industrial Classification for *eating and drinking places is (SIC 5182).* Under this single group, there are at least 50 different types of food service establishments. Variations exist in the number of trips which may be generated by such establishments as recognized in the **ITE Trip Generation Manual** (Fifth Edition, 1991). Furthermore, while some establishments are highly dependent on pass-by traffic for the majority of their customer base, others have customers which visit their store as their primary destination. The extent to which different types of stores are sensitive to pass-by traffic to attract customers depends on a number of factors, including type of merchandise, quality and distinctiveness of the product and service offered, location of competition, and visibility.

Thus, the impacts of turning restrictions are highly situation-specific. The inability to turn left on a highway in one direction during the AM peak period may pose a critical threat to one restaurant establishment, while posing no significant threat to another. In the extreme case, a motorist's willingness to endure delay in reaching a major regional destination such as a shopping mall is well documented, *while a motorist's reluctance to endure* inconvenience to buy gasoline is equally well known. Our methodology takes these factors into consideration by looking at actual data for individual establishments in each case study area, on a situation-specific basis.

A second key variable affecting the economic impacts of turning restrictions is the degree to which business competitors and therefore shopping alternatives, exist outside the affected area, for each and all of the businesses and services which are directly affected by the turning restrictions. It is essential not only to survey and properly classify businesses within the area affected by turning restrictions, but also to identify and characterize the mix of establishments from which motorists may choose a substitute destination choice. Many factors determine customer choice for any particular establishment. These factors include brand loyalty, price, customer service, access, and convenience. Depending on the customer's own priorities and the nature of the particular product or service, many trade-offs among these factors are made by customers. For example, if all of the above factors are equal, however, a motorist's willingness to experience inconvenience to reach a gas station across a median is determined in part by how much farther he or she must drive before reaching another station. To some degree, a retailer can make up for the loss in sales caused by loss in access through other factors such as service and price, but the retailer still may lose profitability if access is essential for profitability.

The methodology for this research project, therefore, has been developed to understand the relationship of the business area affected by a turning restriction to the larger retail and service market place of which it is a part. Interviews with business owners as well as motorists will be required to understand the choices available to them and the effect of those choices on their travel behavior.

In summary, the purpose of this research project is to provide accurate techniques to quantify and, ultimately, to forecast the magnitude of economic impacts associated with any specific set of turning restrictions. The results of this research will serve to help reduce extreme claims of negative business impacts which are sometimes made and to provide a basis for an accurate discussion of potential impact mitigation measures.

Key Study Issues

The methodology being used in this project is to: (1) Identify case study sites representative of the different types of road design and economic setting; (2) collect traffic, business sales and other economic data for a period of the before and after restrictions of turns; (3) evaluate changes in business sales attributable to the turn restrictions, and (4) development of a predictive model for evaluation of future situations elsewhere.

Key elements of the methodology are discussed below:

- **Data Collection Method.** To determine the impacts of an occurrence, it is necessary to compare data from both before and after the event. There are two ways to collect this data: "before-and-after" and "post-facto."

The before-and-after technique involves collecting the relevant data prior to the event, and then collecting the same data upon completion of the event. In the case of a highway construction project, this involves collecting data before construction and then waiting until the project is constructed to collect the comparison data. The advantage to this approach is that the researcher has total control over the quality of the data and the data collection methods. If the researcher knows in advance that the impacts of a project will be assessed upon its completion, he or she insures that the full extent of appropriate data is collected before the project begins. He can also ensure that the same method is used to collect data both before and after the project is constructed. The disadvantages of this method are uncertainty over which projects will actually be implemented, when that will occur, and the length of time required to collect the "after" data. It is necessary to wait for all projects to be completed before completing the analysis. In the case of highway construction projects, this can be a very long period of time, and in fact some projects are never completed. Particularly for a large number of research sites, this approach is somewhat impractical because of the length of time required and the potential for the project not to be completed.

The post-facto approach involves reconstructing the "before" data for an event that has already happened. For projects already completed, the researcher reconstructs the "before" data through a combination of available data and surveys of those involved in or affected by the project. "After" data is collected in the same manner as in the "before-and-after" method. The advantage of this method is that it is easier to ensure good project examples, because the projects have already been completed and do not require the waiting period for their completion. A disadvantage to the post-facto technique is that it is harder to ensure good "before" data because the researcher is relying on data collected by others for purposes unrelated to the impact analysis currently under consideration. Also, any data not collected prior to the study will have to be recreated through retrospective surveying and other data sources, which may not be quite as accurate as collecting original data.

Because of the advantages and disadvantages of both of these approaches, this methodology uses a combination of them for this project to maximize the potential for quality and accurate data collection. The majority of case studies are using the post-facto approach, in which we will reconstruct the "before" data for projects which have already been completed. This is the more useful approach for a project of this nature, in which we are trying to collect data on a fairly large number of sites, within a reasonable length of time. In this way, we can insure that all of the case study sites are relevant, and that the projects are completed and appropriate to the study questions being investigated.

Once we have assimilated the data collected from the case studies done through the post-facto approach, we will use the before-and-after approach for model validation. For a small number of "validation" sites, we will collect data before and after the completion of left turn restriction projects. The use of this technique at a small number of sites minimizes the risks involved in relying on the completion of a construction project, since the majority of the research is not dependent upon completion of construction projects. It will also provide a way of checking the results obtained with post-facto data with the results from actual data.

- **Model Development.** Because of the large number of variables which the researchers believe influence motorists' choices and decisions, we believe it appropriate to use multiple regression analysis to develop a predictive model of the economic impacts of left turn restrictions. Our approach will include data collection for a large number of independent variables and the iterative use of a regression model, in order to determine which explanatory variables, and in which form, generate the best fit to the observed data on business impacts.

  The key to the successful use of a regression model is the control of the exogenous influences on the dependent variable (changes in business sales). In this case it is essential that the researchers control for background changes in economic and traffic conditions which affect changes in the levels of retail sales. It is this measure of retail sales change which the researchers propose to forecast through the regression analysis.

- **Model Validation.** The researchers plan to use a small group of before-and-after case studies to validate the model developed based upon the findings of the case studies. Then, we will take the results and test them with a few construction projects which have not yet been implemented. We will carefully select these validation case study sites to maximize the possibility of their completion in a reasonable time frame for use in this study. We will collect original data before and after the construction of the project at these selected sites and use the original data to calibrate the model. In this way, we will ensure the results determined initially by the post-facto method will be accurate.

- **Net Versus Gross Change.** Whether from the point of view of a city, county, or economic region, it is essential to distinguish changes in spending or trip making which are essentially localized from those which are of regional importance. The researchers have proposed an approach which directly addresses this issue.

  When a given set of businesses loses sales, what proportion of these sales are regained by other establishments? Where are these other establishments located? Through the use of patron and business owner interviews, the researchers will obtain answers to these questions.

  Under what conditions do turning restrictions actually enhance convenience and travel times rather than adversely effect these conditions? Clearly the introduction of turning restrictions on roads where free flowing traffic conditions exist may result in substantial inconvenience and additional travel time to motorists. On the other hand, do the introduction of turning restrictions on highly congested roads, where traffic flow is great enough to cause substantial delays for turning vehicles even in the absence of a median, actually prove beneficial to motorists? The patron surveys to be used by the researchers may yield answers to these questions.

- **Potential Mitigation Measures.** After conducting case studies of left turn restriction projects, it should be possible to identify those elements of *good engineering design and implementation* process which show the greatest potential for minimizing adverse economic impacts. In addition, the researchers will be able to identify other public policies which may contribute to impact mitigation, such as better land use planning or site plan review.

Research Approach
The project approach to the research project includes six major tasks, including the following. At this point in the project, we are conducting the field studies and beginning to analyze the data.

1. **Literature Search.** This task involved searching the existing literature to identify and summarize all available literature, published and unpublished, on this topic.

2. **Develop Work Plan.** We developed a work plan, based upon the use of post-facto studies, which will lead to conclusions concerning observed changes in business sales which have occurred at case study sites after the implementation of turning restrictions. This task also involved the selection of appropriate case study sites.

3. **Conduct Field Studies.** The third step is to conduct the field studies, where we are collecting and recording data for the case studied sites. This includes traffic data, sales data, real estate transaction data, and interviews with businesses and property owners adjacent to the project sites.

4. **Develop Causal Model.** In this task we will describe the observed changes which have occurred, at each site, and then develop a causal model to explain observed variations in business sales, across all the case study sites, using a multiple regression model. We will, in addition, summarize observed changes in a number of other transportation and economic variables, through the use of descriptive statistics.

5. **Model Validation.** To validate the model we plan to conduct three before-and-after case studies. At each site we will gather turning movement data at a sample of businesses, before and after the implementation of turning restrictions. This task also involved the selection of appropriate case study sites. In addition, we will conduct patron surveys, both before and after the turning restrictions, to gather additional data on motorist behavior and motivations. All this data will be used to determine changes in sales at the three sites, since we expect to correlate sales closely with trip ends at any give establishment. We will the compare observed changes with changes forecast by theregression model for the three sites. We will incorporate this data into the model and refine it as necessary.

6. **Final Report.** The final product will be a model to try to predict the possible economic impacts associated with left turn restrictions. The model will be a tool for use by planners and transportation officials to help in the complex process of balancing public access and safety with commercial activity and interests. In the final report, we will also provide recommendations on mitigation measures to counteract negative impacts which may result from a particular project.

Findings to Date

While the project has not yet been completed, our progress through the first few tasks has suggested some findings and issues which should be considered when trying to understand the impacts of left turn restrictions.

Literature Review

We considered several bodies of literature and knowledge which have generated key findings relative to the analysis, including: *traffic engineering; the economics of* transportation; the relationship between land use and trip making; destination choice modeling and unpublished experience.

As anticipated at the outset of the project, we found that the economic impacts of left turn restrictions is not a subject which has been studied frequently or directly by scholars or consultants. The literature offers little in the way of direct findings in terms of developing a model to measure the economic impacts of left turn restrictions. However, there were some relevant findings to assist in guiding the analysis.

Overall, findings to date on the impacts on businesses of left turn restrictions have been mixed and widely varied. In cases where businesses were surveyed, some experienced losses, some experienced gains, and some had no change. This mixed reaction to the left turn restriction is being echoed in our interviews with businesses. There is also some evidence that negative impacts, if there are any, are transitory. That is to say, after initial implementation, businesses experience some loss, but that after a few months patterns return to normal.

There is also evidence that impacts depend on the extent to which businesses rely on "pass-by" traffic versus those which are "destination-oriented." Those businesses which are convenience oriented (such as service stations and convenience marts), and dependent on pass-by traffic for a large part of their customer base, tend to be negatively affected more than other types because their products or services are more easily replaced if access is inconvenient. However, these convenience businesses also tend to relocate more easily from one location to another, which can result in higher profitability and a broader customer base.

Finally, the literature shows that in general, transportation access is only one of a number of factors that affects business location and the success of a particular business. Other factors such as the type of business, the location and nature of the competition, the overall economic climate, sensitivity to price and quality, among others, are all factors which determine why a business may lose or gain sales, and that while the left turn restriction may contribute to negative impacts (or positive ones), the restriction alone does not have a straightforward relationship to sales loss.

Case Study Identification and Data Collection

The next stage of the study involved locating appropriate case study sites and beginning our data collection efforts. To locate case study sites, we surveyed over 250 agencies and organizations at the local, state and federal level. For inclusion in the study, the sites had to meet a number of criteria. First of all, the site had to involve a project which represented a real left turn restriction or multiple restrictions, so that access to the adjacent businesses was actually affected. Secondly, traffic counts and turning movements had to be available for some or all of the intersections along the corridor, for both before and after the project's implementation. It was also necessary to select cases in relatively busy commercial/retail areas with a reasonable concentration of businesses. (Areas with only a few businesses, or those with industrial or residential activity as the primary adjacent activity, were not appropriate.)

While we received a large number of responses, we have had some difficulty in securing the number of adequate sites which we initially desired. One problem encountered is the lack of available traffic data. Many of the sites which represented good or excellent projects in terms of the nature of the restriction and the type of businesses located along the site lacked sufficient before and/or after data. Many of the agencies implementing the projects did not collect this data for both points in time. On the other hand, sites with excellent traffic data have proven to been inappropriate for other reasons.

Another problem encountered is the timing of roadway construction projects. We have discovered a number of excellent potential sites, but they are not scheduled to begin construction for two or more years. Also, several sites which initially looked promising have since been delayed or cancelled because of business or public opposition to the project. In fact, we have observed that it appears that many of the most controversial projects, to which there is strong business opposition, do not even make it past the "drawing board." This suggests that many of the left turn restriction projects which actually do make it to completion, may inherently represent a somewhat reduced impact on adjacent businesses.

Interviews

We have already conducted a number of interviews with businesses and property owners along the case study sites. The findings of these interviews appear consistent with the information available in the literature. The results appear to be very mixed. A range of impacts has been reported, from positive (an increase in sales) to very negative (causing the business to close.)

There appears to be some difference in the perception of impacts, depending on the purpose of the project. Left turns are restricted for two primary reasons: to improve through traffic flow and speed and to reduce accidents. The sites we are studying were implemented for some balance of these two reasons, but generally weighed more heavily on one than the other. There is some evidence to suggest that in those cases where safety was publicly perceived to be a serious problem, the left turn restriction actually enhanced the level of customers coming onto an area. In those cases, the safety problem was serious enough to have deterred customers from going to the businesses adjacent to the project, and therefore the restriction improved access and allowed the customers to return.

The cases where businesses seemed to be at odds with left turn restriction projects (and the planners who implement them) is when the purpose of the project is to improve the speed and flow of traffic through the corridor. The goal of a business is to attract customers and get them to stop at his or her establishment. Therefore, higher speeds and fewer opportunities to stop, mean that it will be harder to attract those customers driving through. Businesses want customers traveling at slower, not faster speeds, in front of their establishments. On the other hand, some businesses noted that increased speeds allowed customers from further away to access their establishment, increasing their market base.

On several occasions, the interviews suggested that some businesses which reported losses because of the left turn restrictions were ready to go out of business before the project was implemented or are going out of business for other reasons. This is consistent with studies done regarding economic impacts and retail turnover, and underscores the fact that it is difficult to separate cause and effect.

These interim findings will be broadened and compared with additional data on sales and other information as part of the model development project task.

Conclusions

Overall, this methodology represents the first rigorous attempt to measure the economic impacts of left turn restrictions. Clearly, the most important element of the development of a model is good data collection. Therefore, transportation planners interested in determining the impacts of a proposed left turn restriction project should consider implementing a before-and-after data collection program as part of their planning process. This would allow communities to make use of the findings from this and other studies, which should help the implementation of projects by increasing understanding of their impacts.

Evaluating the Operational Impacts of Access Control Strategies Using TRAF-NETSIM

Brian Gardner
Ron Giguere
Federal Highway Administration

INTRODUCTION

Although it is generally agreed that access management treatments should improve the operational efficiency of streets and highways by reducing the frequency and range of speed change cycles for through traffic and by eliminating conflict points, it is difficult to quantify their operational benefits. This is due, in part, to the difficulty required to capture speed change cycles between intersections. A speed change cycle occurs when vehicles are forced to slow down or stop and then accelerate back up to the running speed. Obviously, the more instances of speed change cycles that occur along a section of roadway, the more significant the operational effect. Also, when the decelerations are dramatic and unexpected, accidents can result. The number of speed change cycles classified by range, i.e. the magnitude of deceleration, can provide insights on the potential for accidents as well as information on emissions and fuel consumption. Also, the accumulation of speed change cycle data for a traffic stream can provide a very precise representation of travel time and delay.

Access points, or driveways, generate a substantial number of random speed change cycles, many of which can be quite extreme, as vehicles slow down or stop to enter a driveway. Speed changes and conflicts are also precipitated by vehicles which egress driveways and accelerate within the traffic stream. Although there is much information and many refined analytical methods for assessing the operations of through traffic at signalized intersections, there is very little information available on the mid-block effects of driveways on through traffic. The primary mid-block effects of driveways are related to the frequency, location and design of access points. To measure the effects of access management strategies on mid-block operations and safety problems, we must be able to model speed changes.

There is a limited amount of empirical data that is currently available which shows the expected operational and safety benefits of selected access management treatments. Also, some case studies have been conducted where the before and after operational and safety impacts have been assessed. Because extensive amounts of empirical data and large numbers of case studies do not presently exist, our ability to predict the impacts of implementing proposed access management strategies is limited. Typically, we can hope for no more than an order of magnitude of the benefits and there is no way to allow for the characteristics of the site. Site-specific characteristics include the actual and planned location and design of access points, the signal spacing, the roadway geometrics, driver behavior and volume characteristics. Engineering judgement is the normal mechanism by which benefits are estimated on a site specific basis. However, with the advent of sophisticated computer traffic models the ability to predict operational benefits resulting from roadway improvements has been enhanced.

MODELING TRAFFIC

There is a wide variety of models that are capable of simulating traffic operations; for most, there are two general categories: those that are deterministic and macroscopic, and those that are stochastic and microscopic. Typical macroscopic models simulate average measures of effectiveness based on traffic volumes aggregated for a specific time period (usually 15 minutes or an hour). The aggregation of volume data precludes an in-depth analysis of interactions between vehicles; therefore speed change effects are not captured directly. Macroscopic models in general are not well suited for analyzing mid-block activities, such as driveways, and indicating the effects of those activities on through traffic. Instead, these models concentrate on the impacts of signalized intersections. If mid-block disturbances are captured at all, it is usually in the form of a reduction in saturation flow or running speed based on the number of access points per mile. Therefore we cannot expect macroscopic models to be sufficiently sensitive to proposed access improvements such that their impacts are reasonably estimated.

Microscopic models allow the practitioner to predict traffic operations in much greater detail. These models track individual vehicles using either a time-based or event-based method. This allows the interaction effects of vehicles turning in and out of driveways with the through vehicles on the roadway to be captured in considerable detail. Although the vehicle interactions and speed change cycles are modeled, they are not usually reported. Average travel times and delays per vehicle for a specific time period are typical statistics. However, because of the nature of microscopic analysis, these average statistics more accurately describe the impacts of vehicles turning in to and out of access points than do macroscopic models.

Because of the large number of variables that microscopic models must track, such models are not well suited for optimization tasks, particularly signal timing. Microscopic models are usually used to evaluate design alternatives. Changes in the medial and marginal design of a roadway are reflected in the way the network is coded. For example: driveways can be closed, consolidated or spaced differently; left and right turn bays can be added for driveway ingress; median openings can be closed or relocated; one or more turning movements can be restricted and so on.

Microscopic simulation models provide a means by which we can better predict the consequences of our proposed actions. One of the most widely used simulation models for surface streets is TRAF-NETSIM. This model has proven to be quite powerful for traditional network analysis where the nodes are well-spaced, signalized and unsignalized intersections. For the purpose of evaluating access control, a non-traditional application is required. For example, driveways are often closely spaced and they are often 3-leg or T intersections which are offset from one another on opposite sides of the road. Driveways are often "yield" rather than "stop" controlled. Also, in addition to undivided and divided highway facilities, there are also significant numbers of two-way left turn lane (TWLTL) and alternating left turn lane configurations which may be considered.

The purpose of this paper is to assess the TRAF-NETSIM model as to its utility, accuracy and sensitivity for evaluating access management strategies. The utility issue will gauge the level of effort required to set up the network and to produce reliable results. The accuracy of the model speaks to the confidence that can be achieved in the results. Finally, it is essential that the magnitude of the impacts associated with implementation of strategies to manage access are adequately reflected. Therefore, the model must be sufficiently sensitive to access control treatments to capture and quantify these impacts. The emphasis of the research described in this paper is directed towards testing the utility, accuracy, and sensitivity of TRAF-NETSIM for a limited number of hypothetical access control scenarios.

EXPERIMENTAL DESIGN

Network and Traffic Characteristics

Four sample networks were created for this study; two networks simulated a four-lane, undivided arterial and the remaining two simulated a two-lane arterial. Two different driveway configurations were studied for each arterial type: one configuration with only opposing driveways (4-way unsignalized with yield control) [see Figure 1]; and one with offset driveways (3-way unsignalized with yield control) exclusively [see Figure 2].

Sixty driveways per mile were assumed for the base conditions. The access points were placed 200 feet apart on both sides of each arterial for both 4-leg and 3-leg configurations. Driveways were located close to the traffic signals to simulate corner-clearance effects.

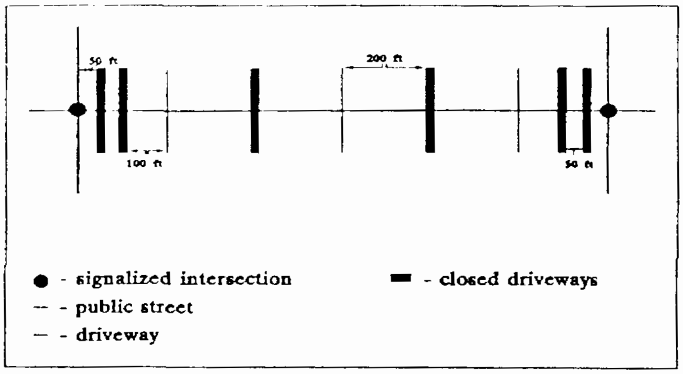


Figure 1. 4-way Driveway Configuration

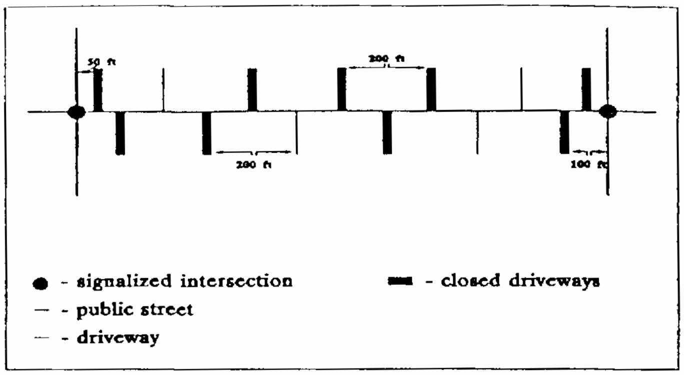


Figure 2. 3-way Driveway Configuration

To offset the problem of simultaneous arrivals at the arterial from the driveways, the lengths of the driveway links coded in the model were varied between 750 ft and 1500 ft to simulate random driveway vehicle arrivals at the arterial. Longer driveway link lengths were employed to take advantage of variations in driver and vehicle characteristics and, thus, further randomize vehicle arrivals. Driveway speeds were set at 10 mph (minimum speed for TRAF-NETSIM). Arterial and cross-street free flow speeds were set at 45 mph.

A half mile arterial section was assumed with 1/4 mile signal spacings along the arterial. Signal timings were developed using a PASSER II-90 optimization. For all signalized intersections, turning volumes were held constant at 100 vph for both left and right turning movements on all approaches. Left turn bays were provided for all signalized intersection approaches. Cross street volumes were also held constant at 1000 vph for both directions. There was an assumed 50/50 directional split for all highway and street facilities. Driveway volumes were held constant at 60 vph with a 50/50 split. Typical driveway/arterial intersections are shown in Figure 3. The vehicle composition of the traffic on the network was 100% passenger cars.

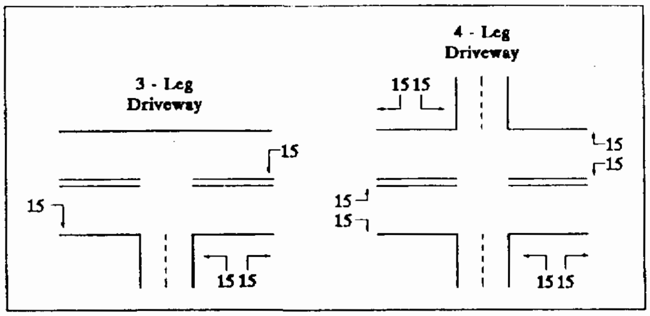


Figure 3. Typical Driveway Geometry and Traffic Volumes (vph).

<u>Study Parameters</u>

The three major sets of parameters in the experiment were (1) type of access control, (2) type of highway facility and (3) volume levels on the highway facility. The intent was to estimate the sensitivity to changes in access control as a function of traffic volume and facility type.

There were three types of access control: none, full and partial. No access control situations were represented by allowing all driveways (60 driveways/mile) on the arterial to operate freely. Full access control was represented in the simulation by closing all driveways. Partial access control was represented by consolidating driveways down to 20 driveways/mile. Where driveways were closed for partial access control, their volumes were assigned to the remaining driveways [see Figures 1 and 2].

The arterial cross-sections studied were two-lane and four-lane undivided. Volume levels simulated for the two-lane facilities were 500, 1000 and 1500 vehicles per hour (vph) in both directions. Volume levels simulated for the four lane facilities were 1000, 2000, 3500 and 4000 vph. Volumes levels were selected to represent low, medium, and high volume conditions.

Using this many parameters results in a large number of combinations. For two lane facilities, there are three volume levels, three types of access control and two intersection types (T and 4-leg) for a total of 3 x 3 x 2 = 18 combinations. For four lane facilities, there are four volume levels, three access control categories and two classifications of intersections for a total of 4 x 3 x 2 = 24 combinations. Data sets were created for a total of 18 + 24 = 42 combinations.

<u>Test Procedure</u>

The primary statistic studied was total average travel time per through vehicle on the arterial. This is easily converted into average space mean travel speed. Secondary statistics include average stopped delay per through vehicle, average total delay per vehicle, and arterial VMT. The stopped and total delays were used to determine the space mean speeds on the arterial while the arterial VMT was used as a diagnostic aid.

A 3x3 factorial design was used for the 2-lane arterial with the three treatments and three volume levels discussed earlier. A 4x3 factorial design was used for the 4-lane arterial with three treatments and 4 volume levels. For each of the 42 combinations, a quarter mile segment of the original half mile section was studied for all simulation runs. This was done primarily to reduce the effects of traffic signals on the statistics gathered for mid-block operations. In addition, it should be noted that the number of links required for 60 driveways/mile over a 1/2 mile segment exceeds the maximum number of links that the current version of TRAF-NETSIM is capable of handling(6).

The first goal was to determine the number of replications that would be needed to produce mean average travel times with 90% confidence. TRAF-NETSIM uses different random seeds to initiate each run to reflect daily variations in traffic and some preliminary investigation is required to determine an adequate sample size. To address this issue, five replications of 10 cycles lengths (900 seconds) were made for the no driveways and no controls cases for a total of 140 model runs. A warm-up period of fifteen minutes or 900 seconds was used to provide adequate time for equilibrium to be reached in the network. This allows statistics to be collected on a loaded network. Equilibrium is considered attained when the number of vehicles entering the network is approximately equal to the number of vehicles leaving. TRAF-NETSIM is capable of detecting this condition in the warm-up phase and was instructed to end the warm-up phase when equilibrium was attained and to end the run if equilibrium was not reached within the specified 900 seconds.

While the experimental design does not specifically require sampling to attain a given accuracy, it is desirable in that it allows the block means to be stated with a degree of confidence and also provides further assurance that the results will be meaningful. Assuming that a reasonable estimate of the variance was attained, the initial runs showed that for many of the combinations, 5 observations were not adequate to meet the desired confidence. It was estimated that 20 observations should be sufficient for 90% confidence for most of the 42 combinations. Twenty observations for each of the 42 combinations resulted in a total commitment to 840 observations. Given the experimental design, this was also deemed as approaching the maximum number that could be handled at the time.

The application of the batch means method (2,4) was not possible because it was found during the preliminary work that the network frequently grid-locked at the higher volumes with driveway activity present; the method of independent replications (2,4) was employed to generate the observations needed. This required one simulation run for each observation, for a total of 840 runs. The large number of simulation data files and output files could not easily be generated or analyzed manually, even with the aid of advanced word-processing and spreadsheet macros. Specialized, compiled programs were created to facilitate generating the data sets and reducing the results. The TSIS environment was bypassed in favor of executing TRAF-NETSIM directly from batch files. The summary statistics provided by the specialized programs were imported into a 3-D spreadsheet for final analysis.

In the conduct of the simulation runs, more failures were detected than had been expected. Two categories of failures were identified. One type occurred when equilibrium could not be achieved within 10 cycle lengths (900 seconds). The second type occurred when less than 10 vehicle miles of travel (VMT) occurred on the network links in 900 seconds. For the networks and volumes used in this study, less than 10 VMT indicated that the network had grid-locked within the equilibrium period or within the first five minutes. Preliminary observations showed that the statistics reported were either unrealistically high or low. Consequently, it was decided that these observations were more representative of network failure than typical network performance and were reported with the equilibrium failures in the failure rate for each combination [See Figure 4]. For example, if 5 of the total of 20 runs for a particular combination failed, then the failure rate for that combination would be 25%.

Failure Rate

2LT	Control		
VPH	Full	Partial	None
500	0%	0%	0%
1000	0%	0%	15%
1500	0%	0%	35%

2LX	Control		
VPH	Full	Partial	None
500	0%	0%	0%
1000	0%	0%	15%
1500	0%	0%	60%

4LT	Control		
VPH	Full	Partial	None
1000	0%	0%	0%
2000	0%	0%	0%
3500	0%	5%	25%
4000	0%	0%	35%

4LX	Control		
VPH	Full	Partial	None
1000	0%	0%	0%
2000	0%	0%	0%
3500	5%	0%	20%
4000	0%	5%	25%

Figure 4. Failure Rates by Block.

The decision to report failures was supported by the observed large differences between the sample standard deviation for the average total delay and the sample standard deviation for the average total travel time for combinations with network failures. Since the real difference between the average total delay and the average total travel time is the average free flow travel time, the two populations should exhibit similar standard deviations and this held true for blocks with no failures. However, this was not the case for combinations with network failures.

One problem that results from reporting the network failures separately is that it removes the observations with the highest potential delays and travel times from the sample, which most probably confounds the results. To overcome this, it was assumed that each failure provides some information that may be used to estimate the stopped delay, total delay, and average travel time for that run.

For failures to attain equilibrium, the worst case observed average vehicle stopped delay of 900 seconds was assigned. To capture the effects of network gridlock, running and travel speeds of 0 mph were assumed. This results in a average total vehicle delay of 900 seconds and average total travel time of 900 seconds for each through vehicle.

To estimate the delays and travel times for networks that failed during the first 5 minutes of simulation (VMT < 10), an averaging method was used. Stopped delay was estimated using a typical stopped delay of 100 seconds and the worst case stopped delay of 900 seconds. This resulted in an estimated average stopped delay of 500 seconds per through vehicle. Total delay was estimated using the approach delay factor of 1.3 from the 1985 HCM(5), resulting in an average total delay of 1.3 x 500 = 650 seconds. A representative average travel time of 670 seconds was found by adding the average free flow travel time of 20 seconds (the approximate time to required travel 1/4 of a mile at 45 mph) and the estimated total delay.

To complete the 3x3 and 4x3 factorial analyses, two spreadsheet templates were applied. Observations of average *travel time* per vehicle in the eastbound direction were used. Only one direction was studied in order to reduce the effects of sampling error. This was also the rationale for testing the 3-leg driveways and 4-leg driveways separately.

RESULTS

The hypotheses tested were: (1) the presence of significant differences in the mean travel times for the three access control types versus no significant differences; and (2) the interaction between control types and volumes versus no interaction. The mean travel times were calculated and compared using the Bonferroni method with an overall α of 10%.

As indicated in Figure 5, for both driveway configurations (3-leg and 4-leg) on the 2-lane arterial and for the 3-leg driveway configuration on the 4-lane arterial, significant differences were observed both between the full access control and no access control treatments and between *partial control* (driveway consolidation) and no access control cases treatments. Insufficient evidence was available to support a significant difference, with 90% confidence, between any of the treatments for any combination of arterial type, driveway configuration and volume level for the 4-leg driveway configuration on the 4-lane arterial.

Summary of Experimental Results

		3-way	4-way
2-Lane	Volume/Treatment interaction effect	YES	YES
	No Driveways		
	Driveway Consolidation		
	No Access Treatment		
4-Lane	Volume/Treatment interaction effect	Not Detected	Not Detected
	No Driveways		
	Driveway Consolidation		
	No Access Treatment		

Statistically similar results are similarly shaded.

Figure 5. Summary of Statistical Comparisons.

A significant interaction effect between volume level and treatment type was observed for both driveway configurations on the 2-lane arterial. Insufficient evidence was available to support a significant interaction effect with 90% confidence between volume level and treatment type for either of the 4-lane arterial segments.

A high variance was observed for many of the congested scenarios. This is attributable to unstable traffic flow and sampling error. The sampling error is primarily the result of the relatively short (900 seconds) simulation period used for this study. For models of this type, a boundary condition occurs at the beginning of the simulation period when link statistics are accumulated with vehicles from the initialization period and again at the end of the simulation period when link statistics might be incomplete. Wong(1) has shown that these boundary effects decrease as simulation time increases. Also, the short simulation period results in fewer vehicle observations which contributes to the variation in the sample. The large variance differences between total delay and total travel time observed for network failures are most likely due to boundary effects.

The 3-D bar graphs depicting average travel speed versus volume versus treatment type [Figures 6-9] illustrate the treatment, volume, and interaction effects. For the three cases where a significant difference among treatments was noted, the graphs show that travel speeds are directly affected by the treatment type. For the two cases where a significant volume/treatment interaction effect was observed, the relative effect of the treatment type varies by volume level. These graphs are presented to illustrate the performance differences between treatments and the volume/ treatment interaction effects. It should be noted that they may not be truly indicative of the average travel speed for the individual scenarios. For 19 of the 42 scenarios, the individual average travel speeds, particularly those for the no access treatment scenarios, do not meet the 90% accuracy criteria due to high sample variance.

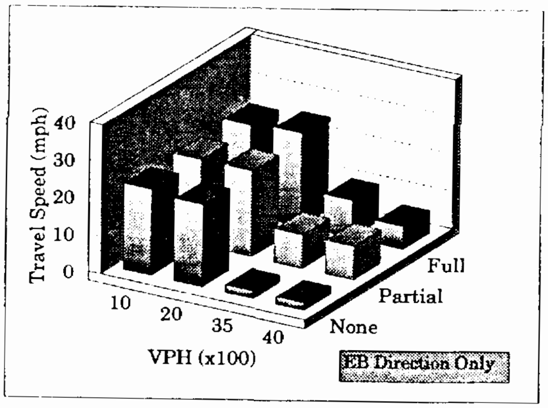


Figure 6. Average Travel Speeds 4-Lane Arterial T-way driveways.

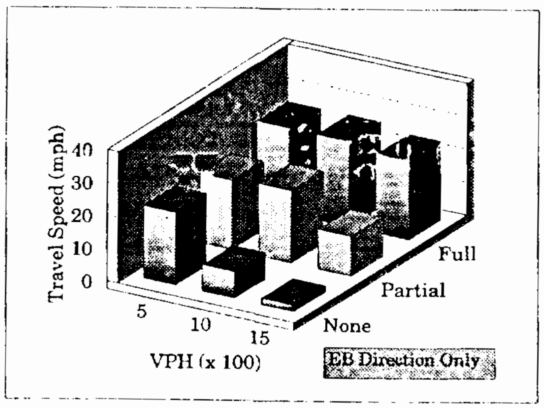


Figure 7. Average Travel Speeds 2-Lane Arterial T-way driveways.

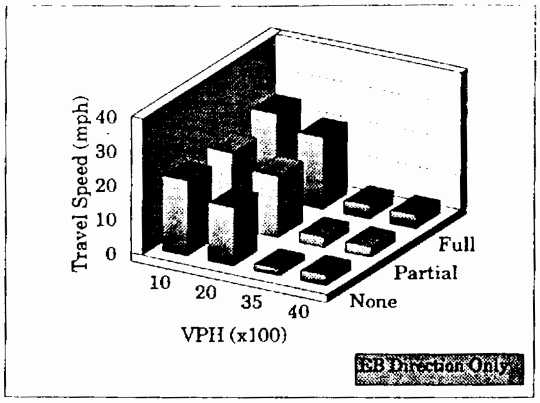


Figure 8. Average Travel Speeds
4-Lane Arterial X-driveways.

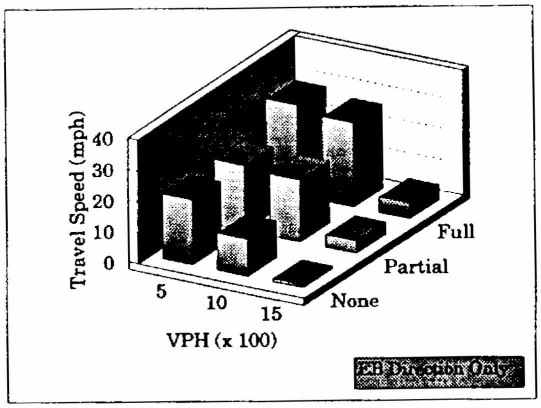


Figure 9. Average Travel Speeds
2-Lane Arterial X-driveways.

CONCLUSIONS

The results of this study show that TRAF-NETSIM is sensitive to mid-block driveway activity and has the potential to effectively evaluate and compare certain access management treatments. Further study of other access control treatments with TRAF-NETSIM particularly in conjunction with case studies would provide valuable information about the performance of the simulation model relative to actual system performance.

The behavior of TRAF-NETSIM reflects the high degree of variation that occurs as demand volumes approach capacity levels and the effects of mid-block activity on through capacity. The variation in observed travel time is markedly increased when turn movements are permitted from shared lanes on the major street. The high failure rate is also associated with intense driveway access at high volume levels. Recognizing these aspects are critical when using TRAF-NETSIM to simulate these conditions and must be addressed in the experimental design.

FURTHER RESEARCH

The experiment did not result in a definitive relationship between reduction in access points and improvements in operational efficiency, nor was it intended to. This might be developed further in a follow-up study. Also, this study presents one method for dealing with network failures in the context of an experimental design. This issue is important in determining the number of replications needed to state system performance measures with any confidence or developing an experimental design to compare alternatives.

Other methods for dealing with network failure should be explored. A sensitivity analysis for the method presented here would also be appropriate. The delay and travel times developed by the averaging method are most likely too conservative, although the experimental hypotheses were supported in three out of the four cases. If the failure issue with TRAF-NETSIM can be resolved satisfactorily, future research efforts should be twofold: (1) to determine the types of access management treatments that TRAF-NETSIM can and cannot evaluate and (2) to validate the results that NETSIM provides.

Finally, the observed difference in the performance of 3-leg or T driveways and 4-leg driveways shown in this study suggests: (1) that 3-leg driveways with adequate offsets with opposing driveways would perform better than 4-leg driveways and (2) that TRAF-NETSIM is sensitive to the additional conflict points associated with a 4-leg intersection; this should be examined in another study since it is not explicitly addressed by this one.

REFERENCES

1. Wong, S.Y., Capacity and Level of Service by Simulation - A Case Study of TRAF-NETSIM. Proceedings of the International Symposium on Highway Capacity, Karlsruhe, Germany, July 1991.

2. Chang, G.L. and Kanaan, A., Variability Assessment for TRAF-NETSIM. *Journal of Transportation Engineering* 116(5), September/October 1990.

3. Rathi, A.K. and Santiago, A.J., Identical Traffic Streams in the TRAF-NETSIM Simulation Program. *Traffic Engineering and Control*, June 1990.

4. Torres, J.F., A. Halati and A. Gafarian, *Statistical Guidelines for Simulation Experiments* (Vols. 1-3). JFK Associates, Inc., Contract DTFH-61-80-C-00124, FHWA U.S. Department of Transportation, 1983.

5. Transportation Research Board, *Special Report 209: Highway Capacity Manual*. Transportation Research Board. National Research Council, Washington D.C. 1985.

6. Federal Highway Administration, *TRAF-NETSIM User's Guide*. Office of Traffic Operations, FHWA, Washington D.C., November 1989.

SAFETY BENEFITS OF ACCESS MANAGEMENT

Hugh W. McGee
Warren E. Hughes
Bellomo-McGee, Inc.

INTRODUCTION

There have been several definitions offered for access management but they all embrace the same notion -the systematic control of the location, design, and operation of all driveways and public street connections to a roadway. It is interesting to note that in the pamphlet announcing this first national conference on access management, the first and last of several reasons cited for why one should learn more about access management focused on safety. They were:

- Access management saves lives; it reduces the frequency of fatal injury and property damage accidents.

- Access management is Safety Management.

So, it is recognized that "safety" is the first and last word when considering the benefits of access management.

This paper and presentation will focus on the safety impacts of access management. Information on what has been learned about the safety benefits of access management and how agencies should evaluate access management for the program level and specific projects will be presented.

SAFETY EFFECTS OF ACCESS MANAGEMENT

While it probably did not need proving, research has provided substantial evidence to show that controlling access to roadways has a positive safety benefit or, conversely, not controlling access has a deleterious effect on safety. A few statistics and findings related to accidents and access control can be cited.

As far back as 1953, research showed that accidents increase with an increasing number of access points within a given volume level as shown in figure 1.[1] In 1976, Glennon also confirmed the relationship of higher accidents with higher density of driveways per mile for three volume groups as shown in table 1.[2] In 1986, a regional planning commission in Wisconsin presented data, shown in figure 2, that shows that accidents per mile dramatically increased when the average spacing between access points was under 300 feet.[3]

To date, there has been little research on the safety effects of an access management program. The only reported findings are from the Colorado DOT, where their access control demonstration project showed a significant reduction in accidents on arterial facilities that were highly access managed, as shown in figure 3.[4]

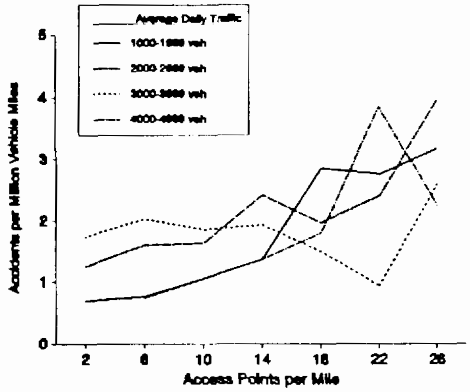
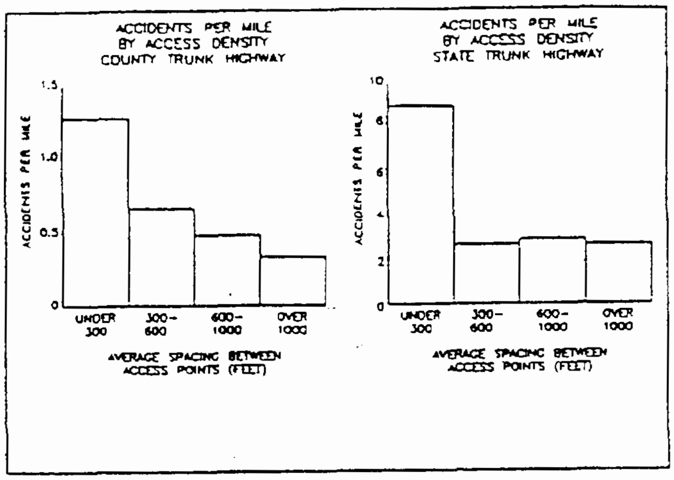


Figure 1. Accident Rates Related to Average Daily Access Points Per Mile

		Accidents Per Mile Per Year		
		HIGHWAY ADT		
		LOW	MEDIUM	HIGH
DRIVEWAYS	PER MILE	(<5,000)	(5-15,000)	(>15,000)
LOW	(<30)	12.6	25.1	37.9
MEDIUM	(30 - 60)	20.2	39.7	59.8
HIGH	(>60)	27.7	54.4	81.7

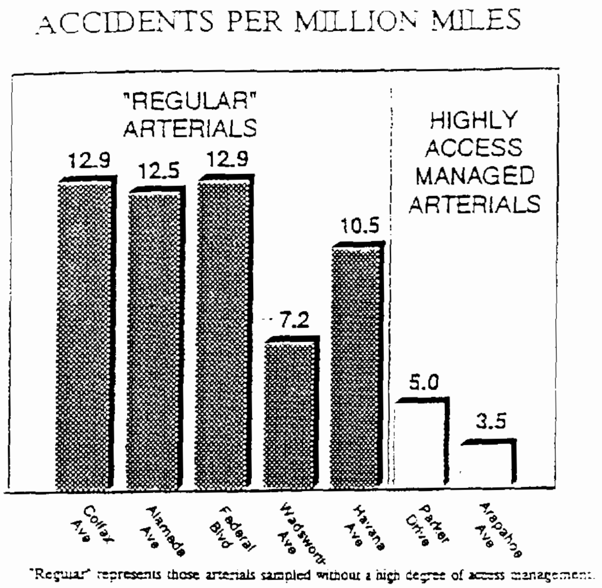
Source: Reference (2)

Table 1. Driveway Accidents Per Mile Per Year By Frequency of Access and Traffic Volumes.



Source: Reference (3)

Figure 2. Relationship Between Accidents Per Mile and Average Access Spacing.



Source: Reference (4)

Figure 3. Accident Reductions Attributable to Access Management

With regard to the safety benefits of specific access control management techniques, table 2 provides information on accident reduction potential for several techniques. These statistics came from several references and were reported in *Access Management for Streets and Highways*.[5] In that same report, 66 access management techniques were categorized into four groups: A) Limit number of conflict points, B) Separate basic conflict areas, C) Limit deceleration requirements, and D) Remove turning vehicles from through lanes. For many of these techniques, annual accident reduction factors apparently were developed from a 1975 study.[6] The accident reduction factors are grouped into three average daily volume levels (low, medium, and high), and three operational parameter levels (also low, medium and high defined by the number of commercial driveways per mile). Table 3 shows the annual accident reductions for five techniques under the B category. However, statistics such as these should be used with caution since there is no information on their reliability and, therefore, their applicability to all situations.

TECHNIQUES	ACCIDENT REDUCTION
Two-Way Left Turn Lanes	35%
Alternating Left Turn Lanes	28%
Driveway Width Controls	0.4 Acc/Driveway
Driveway Visual Cues	
Red/Yellow Flashing Beacon	53%
Advance Warning Sign w/ Flashing Yellow Beacon	24%
Left Turn Deceleration Lanes	50%

Source: Reference (5)

TABLE 2. Safety Benefits of Access Control Management Techniques.

	ANNUAL ACCIDENT REDUCTION								
	Highway Volume								
	Low (≤5,000 ADT)			Medium (5,000 - 15,000 ADT)			High (>15,000)		
	Driveway Volume			Driveway Volume			Driveway Volume		
Technique	Low	Medium	High	Low	Medium	High	Low	Medium	High
B-5	0.25	0.25	0.25	0.49	0.49	0.49	0.73	0.73	0.73
B-6	0.10	0.33	—	0.17	0.50	—	0.20	0.70	—
B-9	0.26	—	—	0.45	—	—	0.62	—	—
B-10	0.25	0.25	0.25	0.49	0.49	0.49	0.73	0.73	0.73
B-12	—	—	—	0.19	0.47	0.73	0.36	0.87	1.33

Source: Reference (6)

B-5 Regulate Maximum Number of Driveways per Property Footage
B-6 Consolidate Access for Adjacent Properties
B-9 Deny Access to Small Frontage
B-10 Consolidate Existing Access Whenever Separate Parcels are Assembled Under One Purpose
B-12 Require Access on Collector Street (when available) in Lieu of Additional Driveway on Highway

Driveway Volumes:

Low = ≤ 500 ADT
Med = 5,000 - 15,000
High = ≥ 15,000

TABLE 3. Prediction of Accident Reduction for Techniques the Separate Basic Conflict Areas

While these data provide convincing evidence that there is a safety benefit from limiting access points and implementing various management strategies, there is still a lot to learn about the safety relationships of access management and design details.

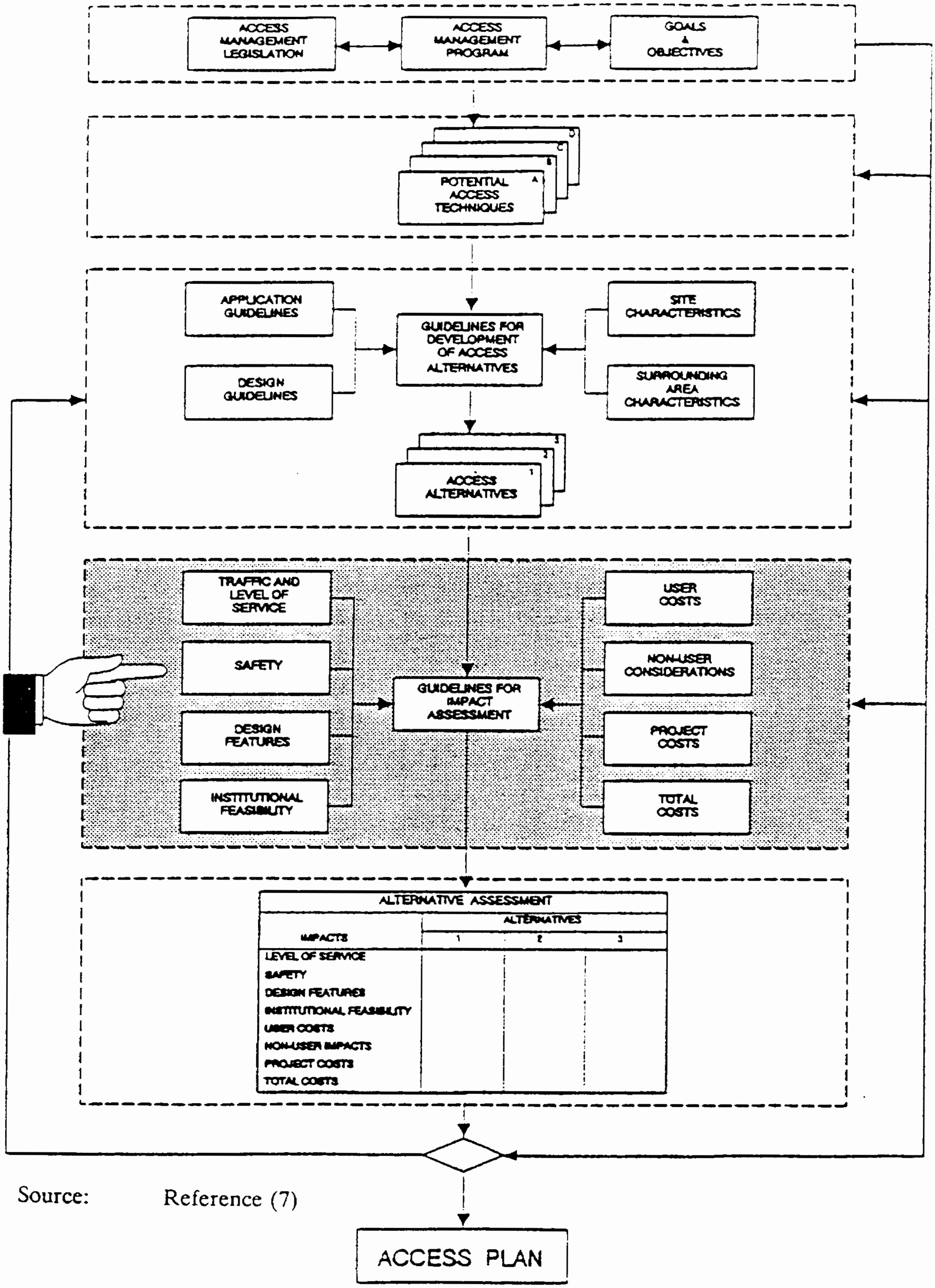
SAFETY ASSESSMENTS AND EVALUATION

When assessing the impact of various access alternatives for a corridor or specific project, there are several factors that should be considered. Figure 4 shows a process for formulation of access plans in support of State and local access management programs. This process was developed by Bellomo and Gay of BMI and will be discussed in another session of this conference. The shaded area shows the evaluation phase and it is noted that safety is one of the several criteria for impact assessment.

Bellomo and Gay's report, "Guidelines for Providing Access to Transportation Systems" (soon to be published by FHWA), provides information on how to conduct safety assessments.[7] In the report there are several procedures offered for conducting safety assessments, which range from simple conflict points analysis to a more complicated accident prediction procedure. They will be summarized here.

Conflict Points

The most simple technique is to identify and count the number of conflict points and compare them across the alternatives. The number of conflict points can be considered to be a surrogate measure of safety. Intuitively, the higher the number of conflict points, the greater the potential for accidents. As an example, consider the simple



Source: Reference (7)

Figure 4. Access Management Process

T-intersection in figure 5. The top illustration shows a total of 9 conflict points created by the crossing, merging, and diverging of traffic. Installation of a left turn lane and a right turn lane on the main street and a right turn lane on the side street reduces the conflict points to 6. Of course, if the side intersection is one of many driveways along the main street, its elimination would totally eliminate the conflict points on the arterial at this location.

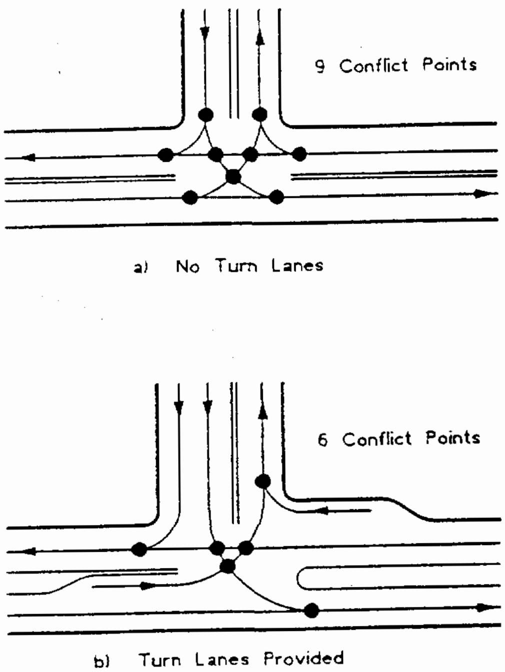


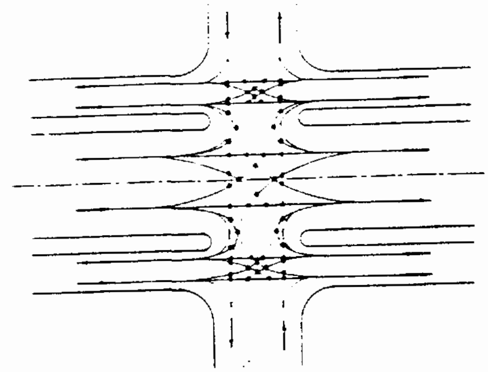
Figure 5. Conflict Points for T-Intersection.

Consider another example, that of a divided arterial with a parallel frontage road. At an intersection with a cross road, a large conflict area is created. Figure 6 illustrates the "crossing" conflict points for this situation. Excluding merging and diverging conflict points, there are 64 major "crossing" conflict points associated with this situation. Moving the intersection of the cross road and parallel frontage roads further away from the intersection of the arterial and the cross road, as illustrated in figure 7, reduces the number of crossing conflict points to 48. Experience has confirmed that the latter design is better from an operational and safety perspective.

Weighted Conflict Points

In the above example, all the conflict points are considered of equal safety impact. In reality, however, crossing conflict points put drivers at greater risk than merge conflict points or diverge conflict points. To account for this assumption, a weighted conflict point procedure is recommended whereby weighting factors are assigned to different types of conflicts. The following are suggested weighting factors:

Crossing conflict point	8
Left turn merge point	2
Right turn merge point	2
Left turn diverge point	1
Right turn diverge point	1



Source: Reference (8)

Figure 6. Conflict Points with Frontage Road.

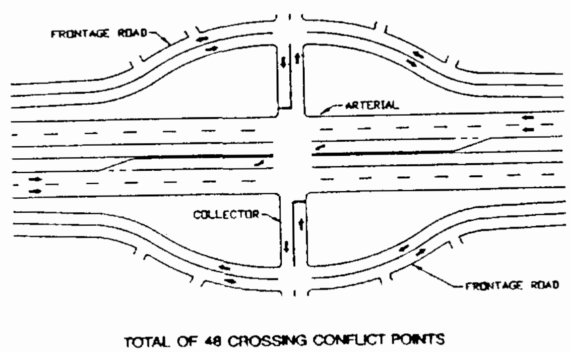


Figure 7. Preferred Parallel Frontage Road Design at Intersection.

Traffic Conflicts

Another related safety measure is the actual traffic conflicts that occur at a location. The general definition of a traffic conflict is any event involving two or more road users, in which the action of one user causes the other user to make an evasive maneuver to avoid a collision. Generally, the road users are motorists but the definition also includes pedestrians and cyclists. Conflicts are vehicle interactions that can lead to accidents. The procedure for conducting traffic conflict surveys is described in two FHWA reports entitled *Traffic Conflict Techniques for Safety and Operations -- Engineers Guide* and *Traffic Observers Manual*.[9,10]

The traffic conflicts technique would be suitable only for assessing the current condition (e.g., a facility not under an access management program) and for making a evaluation comparison after specific access management strategies have been implemented. In other words, this measure could be used for a before/after evaluation. Currently, it could not be used to assess alternative strategies at the planning stage because there are no relationships of expected traffic conflict reductions (as there are for accidents) for various access management strategies. Research is needed to develop these relationships.

Despite this significant limitation, traffic conflicts are a better measure of safety effectiveness for a before/after evaluation than is the conflict points measure because it considers traffic volume and actual conflicts.

Expected Accidents

Ideally, the best measure to assess the safety impacts of alternative access management strategies is accidents. For this procedure, the number of accidents per year would be estimated for each of the alternatives being considered. Unfortunately, this procedure is not easily accomplished. This is primarily because safety research has not yet provided reliable models to predict accidents given certain geometric and operating features. In the absence of such a model(s), the next best approach is to collect accident data for similar facilities and use those statistics as a basis for estimating accidents.

Expected Accident Reductions

A slight variation to this procedure would be to estimate the accident reduction from specific strategies. Tables 2 and 3 provided accident reduction estimates for just a few access control strategies. The fact that they are results based on dated information raises the question as to whether the estimates are still applicable. Moreover, access management plans and programs often combine a variety of techniques for which the expected accident reduction is not always additive. However, given the caveat noted before, these reduction factors could be used for those strategies. Also, there are many more techniques and strategies used for access management that are not listed in that table. Hence, there is a need to conduct accident studies of access management projects so that a data base on accident reduction can be developed for future assessments.

SUMMARY

In conclusion, research has documented that improved access management can and has produced safety benefits in terms of accident reduction. It is recommended that safety be considered and assessed when developing various access alternatives for a corridor or a specific project. This paper identifies and briefly discusses procedures that could be used to evaluate safety as part of an impact assessment. The procedures range in ease and complexity from simple (e.g., count the number of conflict points) to sophisticated (e.g., estimate accidents). Additional research is needed to develop more definitive relationships between safety and access management and to improve the applicability of these procedures.

REFERENCES

1. P. R. Staffeld, "Accidents Related to Access Points and Advertising Signs - Minnesota Highway Study," *Traffic Quarterly*," January 1953.

2. J. Glennon and J. Azzeh, "Access control on Arterial Highways," *ASCE Journal of Transportation Engineering*, Vol. 102, NTE 1, February 1976.

3. "Waushara County Access Control Plan," East Central Wisconsin Regional Planning Commission, September 1986.

4. Colorado Access Control Demonstration Project, Colorado Department of Highways, June 1985 (Cited in Reference 7).

5. J. Flora and K. Keitt, "Access Management for Streets and Highways," FHWA-IP-82-3, Federal Highway Administration, June 1982.

6. J. A. Azzeh et al., "Evaluation Techniques for Control of Direct Access to Arterial Highways," FHWA-RD-76-85, Federal Highway Administration, 1975.

7. S. J. Bellomo and C. B. Gay, "Guidelines for Providing Access to Transportation Systems," Final Report to FHWA, Bellomo-McGee, Inc., January 1993.

8. V. G. Stover and F. J. Keopke, *Transportation and Land Development*, Institute of Transportation Engineers, Prentice Hall, c. 1988.

9. M. R. Parker and C. V. Zegeer, "Traffic Conflict Techniques for Safety and Operations: Engineer Guide," FHWA-IP-88-026, Federal Highway Administration, January 1989.

10. M. R. Parker and C. V. Zegeer, "Traffic Conflict Techniques for Safety and Operations - Observer's Guide," FHWA-IP-88-027, Federal Highway Administration, June 1988.

III. CLOSING REMARKS

ACCESS
MANAGEMENT
CONFERENCE
VAIL, COLORADO 1993

CLOSING REMARKS

Phil Demosthenes
Conference Chairman

Mr. Demosthenes extended his appreciation to the conference committee, speakers, attendees and the conference crew. He expressed his hope that at the next access management conference there would be more inputs from local agencies concerning their experience. He also sees an opportunity to expose local agencies to the benefits of access management through presentations to local groups and associations of agencies.

Mr. Demosthenes noted the lack of current or ongoing research concerning safety as it relates to access management and encouraged interested state personnel to "lobby"their agencies to support such research by voting for NCHRP funding and submitting problem statements. He feels that access management is now getting recognition at the federal level and, like Ron Giguere, emphasized the need to keep the momentum going.

Mr. Demosthenes concluded his remarks with a review of the national telephone conference that he, Gary Sokolow and Art Eisdofer have been active with for the last two years. Using hardware available to the Florida DOT, bi-monthly conference "meetings" have been held that allow any interested parties to simply call in and participate through questions and discussions with Phil, Gary and Art. These usually last for an hour and will be continuing this year with a planned conference meeting in October. In order to participate, all a person need do is sign-up and provide a fax number so that they can be notified of the day, time and phone number of the next conference meeting.

Ron Giguere
Chairman, TRB Subcommittee on Access Management

In his closing session remarks, Mr. Giguere discussed "where access management should go from here" and reviewed the major players in access management. He expressed the need to keep the recent momentum going through research and development, technical information dissemination and networking by federal, state and local agencies and personnel. Mr. Giguere sees the primary role of the FHWA as one of providing technical assistance and training with a minimal amount of research and development, while the NCHRP takes the lead in access-related research. Concerning the TRB Subcommittee on Access Management, he expressed the desire that, in the short term, circular-type publications could be produced that would include papers and recent information on access management issues. A goal would be to establish a national database management system and repository that could eventually include a data retrieval system. He also noted that there could potentially be a conference session on access management at TRB in January 1994.

Mr. Giguere thanked Phil Demosthenes and the Colorado Department of Transportation, Jim Scott of the TRB, the FHWA, the presenters and participants for a successful conference. He remarked on the quality of the presentations and workshops, as well as the discussions that followed and expressed the hope that a second conference would be forthcoming.

IV. ATTENDEES

ACCESS MANAGEMENT CONFERENCE
VAIL, COLORADO 1993

Lou Dobberstein
City Traffic Engineering Assistant
Spokane, Washington
SPOKANE, WASHINGTON

Steve Droge
Region 2 Right of Way Supervisor
Colorado DOT
PUEBLO, COLORADO

Dave Edwards
Planning & Research Engineer
FHWA Missouri
JEFFERSON CITY, MISSOURI

Arthur Eisdorfer
Manager, Bureau of Major Access Permits
New Jersey DOT
TRENTON, NEW JERSEY

Lewis Entz
Representative
Colorado Legislature
COLORADO

John Falcocchio
Principal
Urbitran Associates
NEW YORK, NEW YORK

Xavier Falconi
Transportation Services Engineer
City of Lake Oswego
LAKE OSWEGO, OREGON

Michael Falini
Project Manager
Greiner, Inc Florida
TAMPA, FLORIDA

Gary Faulkner
Design Review Engineer
North Carolina DOT
RALEIGH, NORTH CAROLINA

Robert Felsburg
Principal
Felsburg, Holt & Ullevig
ENGLEWOOD, COLORADO

Bobby Finch
Design Engineer
FHWA Texas
FORT WORTH, TEXAS

J. Richard Forester
Attorney
Dispute Resolution Services
PORTLAND, OREGON

Jack Foster
Texas DOT
AUSTIN, TEXAS

Bob Fox
Director
Utah DOT
SALT LAKE CITY, UTAH

Bill Frawley
Asst Research Specialist
Texas Transportation Inst.
ARLINGTON, TEXAS

Louis Gabos
County Engineer
Routt County
STEAMBOAT SPRINGS
COLORADO

Jim Gattis
Asst Professor
University of Oklahoma
NORMAN, OKLAHOMA

David Geiger
Transportation Planner
Michigan DOT
LANSING, MICHIGAN

Ron Giguere
Senior Highway Engineer
FHWA Washington
WASHINGTON DC

Brett Gilbert
Special Project Engineer
Ohio DOT
COLUMBUS, OHIO

Dick Glaze
President
Glaze Associates, Inc.
TALLAHASSEE, FLORIDA

Jerry Gluck
Principal Associate
Urbitran
NEW YORK, NEW YORK

Hazel Gluck
President
Policy Advisors Inc
Newark, NEW JERSEY

Bob Gorman
Transportation Planner
FHWA Washington DC
WASHINGTON, DC

Sandra Goslin
Principal Planner
New Jersey DOT
TRENTON, NEW JERSEY

Ken Gudenkauf
Asst Bureau Chief/Bureau of Traffic Eng
Kansas DOT
TOPEKA, KANSAS

Charles Guenzel
Project Engineer
New Jersey DOT
YARDLEY, PENNSYLVANIA

Bill Haas
Realty Specialist
FHWA Maryland
FREDERICK, MARYLAND

Bruce Haldors
Associate
Kittelson & Associates
BELLEVUE, WASHINGTON

Paul Hamilton
Chief Planner
Tri-County Regional Plan
LANSING, MICHIGAN

M. Abu Elfara's
Engineer
Transportation Department
Medina, Saudi Arabia

Al Alonzi
Ass't Transportation Planner
FHWA Connecticut
HARTFORD, CONNECTICUT

William Andrews
Transportation Planner
City of Greeley
GREELEY, COLORADO

Kevin Ashoury
Traffic Engineer
Colorado DOT
DENVER, COLORADO

Mehdi Baziar
Highway Engineer
Colorado DOT
DENVER, COLORADO

Sal Bellomo
Principal
Bellomo-McGee, Inc., Virginia
VIENNA, VIRGINIA

Johan Bemelen
State Traffic Engineer
Colorado DOT
DENVER, COLORADO

Chuck Binford
Region 1 Access Coordinator
Colorado DOT
AURORA, COLORADO

Christine Bisio
Transportation Engineer
CH2M Hill, Denver
DENVER, COLORADO

Tim Bjorneberg
Chief Road Design Engineer
South Dakota DOT
PIERRE, SOUTH DAKOTA

Rudy Blea
Region 6, Access & Utilities
Colorado DOT
DENVER, COLORADO

Brian Borge
Region 2 Access Coordinator
Colorado DOT
PUEBLO, COLORADO

Jerry Brems
Director
Licking Co. Planning Comm, OHIO
NEWARK, OHIO

William Bunte
Principal
Crawford, Bunte, Brenmeier, St Louis
ST LOUIS, MISSOURI

Marvin Casey
Systems Supervisor
El Paso County Public Works, CO
COLORADOSPRINGS,COLORADO

Suzanne Catanese
Principal Engineer
New Jersey DOT
TRENTON, NEW JERSEY

John Cater
Realty Specialist
FHWA Missouri
KANSAS CITY, MISSOURI

Dan Centa
City Traffic Engineer
City of Pueblo, Colorado
PUEBLO, COLORADO

Ray Chamberlain
Executive Director
Colorado DOT
DENVER, COLORADO

Charles Chou
Roadway Design Engineer
Colorado DOT
DENVER, COLORADO

Gary Coburn
Statewide Planning Admin
Ohio DOT
COLUMBUS, OHIO

Bill Coxe
Asst Div Mgr, Trans & Land Dev
Mecklenburg County Engineering Dept
CHARLOTTE, NORTH CAROLINA

Robert Cuellar
Engineer of Intermodel Planning
Texas DOT
AUSTIN, TEXAS

Suzanne Danielsen
Project Engineer
Tinter Associates, Florida
FORT LAUDERDALE, FLORIDA

David Dean
Transportation Engineer
City of Kamloops, British Columbia
KAMLOOPS, BRITISH COLUMBIA

Stephen Decker
Associate
Cambridge Systematics, Calif
BERKELEY, CALIFORNIA

Gary Delaney
Realty Specialist
FHWA Colorado
LAKEWOOD, COLORADO

Philip Demosthenes
Access Program Administrator
Colorado DOT
DENVER, COLORADO

Soumya Dey
Transportation Planner
NIRPC - Indiana
HIGHLAND, INDIANA

Daryl Dinges
Quality Assurance Engineer
Colorado DOT
DENVER, COLORADO

Joe Hart
Transportation Manager
CRSS Civil Engineers, Inc
DENVER, COLORADO

John Heilman
Technical Services Manager
O-K-I Regional COG
CINCINNATI, OHIO

Larry Heintz
Access Policy Administrator
Iowa DOT
AMES, IOWA

Ronald Hensen
President
Trans Plan Assoc. Inc.
BOULDER, COLORADO

Brian Hoeft
Highway Engineer
FHWA Washington DC
WASHINGTON, WASHINGTON DC

Jack Hoffmeister
Roadway Design Engineer
Colorado DOT
DENVER, COLORADO

Del Huntington
Oregon DOT
SALEM, OREGON

Ali Imansepahi
Professional Engineer
Colorado DOT
DENVER, COLORADO

Dane Ismart
FHWA
COLUMBIA, MARYLAND

Bruce Johnson
Utilities Engineer
Colorado DOT
DENVER, COLORADO

Bob Johnson
Realty Specialist
FHWA
WASHINGTON, DC

Teresa Jones
Region 4, Development & Access Coordinator
Colorado DOT
GREELEY, COLORADO

Robert Kirkbride
Manager
Project Planning Section
LANSING, MICHIGAN

Leland Kissinger
Geometric Design Engineer
FHWA, Region 1, NY
ALBANY, NEW YORK

Frank Koepke
Senior Vice President
Metro Transportation, IL
BLOOMINGDALE, ILLINOIS

Ed Kosola
Realty Officer
FHWA Nebraska
LINCOLN, NEBRASKA

Young Kwon
Graduate Student
Texas A&M University
COLLEGE STATION, TEXAS

Dick Langoni
Region 5 Traffic Engineer
Colorado DOT
DURANGO, COLORADO

Greg Laragan
Assistant Traffic Engineer
Idaho Transportation Dept
BOISE, IDAHO

Peg Law
Staff Assistant
Colorado DOT
DENVER, COLORADO

Chuck Lee
Senior Professional Engineer
Colorado DOT
DENVER, COLORADO

Joel Leidy
Civ Eng Prog Mgr for Subdiv/Util
Delaware DOT
DOVER, DELAWARE

Joel Leisch
CH2M Hill, Illinois
EVANSTON, ILLINOIS

Pamela Leslie
Deputy General Counsel
Florida DOT
TALLAHASSEE, FLORIDA

Cathy Leslie
Civil Engineer III
City of Longmont, Colorado
LONGMONT, COLORADO

Herb Levinson
Principal
Herbert S. Levinson, Trans Cons
NEW HAVEN, CONNECTICUT

Joann Lombardo
P&D Technologies, Calif.
ORANGE, CALIFORNIA

Ron Lorenz
R/W Planning Manager
FHWA - Colorado
LAKEWOOD, COLORADO

Darrel Lowder
Region 5 Senior Right of Way Agent
Colorado DOT
DURANGO, COLORADO

Bob Manwaring
Principal Traffic Engineer
City of Lakewood, Colorado
LAKEWOOD, COLORADO

Dick Martinez
Transp.Planning Administrator
Connecticut DOT
WETHERSFIELD, CONNECTICUT

Sandra Mayer
Colorado DOT
DENVER, COLORADO

Mac McKee
Design Engineer
Colorado DOT
GREELEY, COLORADO

Bill McShane
Director, TTRC
Polytechnic Univ. NY
BROOKLYN, NEW YORK

David Merritt
Design Engineer
FHWA Colorado
LAKEWOOD, COLORADO

Jerry Moore
Trans Data Analyst Spec
Virginia DOT
COLONIAL HEIGHTS, VIRGINIA

Lewis Morris
Coordinator of Economic Development
New York DOT
ALBANY, NEW YORK

Harry Morrow
Assistant Attorney General
Colorado Attorney General's Office
DENVER, COLORADO

Jim Nall
Region 3 Traffic Engineer
Colorado DOT
GRAND JUNCTION, COLORADO

Richard Nelson
Project Manager
Muller Engineering Co
LAKEWOOD, COLORADO

Craig Neustaedter
Transp. Engineering & Planning Inc
IRVINE, CALIFORNIA

John Nitzel
New Mexico Highway & Transportation
SANTE FE, NEW MEXICO

Joe Olson
Transportation Engineer
City of Longmont, Colorado
LONGMONT, COLORADO

Pete Parsonson
Professor
Georgia Tech
ATLANTA, GEORGIA

Rick Perez
Asst City Traffic Engineer
SALEM, OREGON

Chris Picard
Project Definition Engineer
Washington DOT
SEATTLE, WASHINGTON

Chuck Pray PE PLS
Senior Professional Engineer
Colorado DOT
DENVER, COLORADO

Gary Prentiss
Region 6, Access & Utilities
Colorado DOT
DENVER, COLORADO

Eileen Rackers
Maintenance Traffic Studies Engineer
Missouri Highway & Trans. Dept
JEFFERSON CITY, MISSOURI

Sue Reed
Transportation Planner
City of Longmont, Colorado
LONGMONT, COLORADO

Michael Rewey
District One Chief Planning Engineer
Wisconsin DOT
MADISON, WISCONSIN

Yvan Rompré
Town Planner
Québec Ministry of Transportation
Québec, Québec

Jim Saag
Senior Trans Eng
CH2M Hill, Illinois
EVANSTON, ILLINOIS

Bob Sadighian
Prof. Engineer
Colorado DOT
DENVER, COLORADO

Randall Sampson
Assistant Attorney General
Colorado Attorney General's Office
DENVER, COLORADO

Daniel Scheib
Maryland State Highway Administration
BALTIMORE, MARYLAND

George Schulz
Traffic Engineer
HNTB Corp. Milwaukee
MILWAUKEE, WISCONSIN

James Scott
Senior Program Officer
Transportation Research Board
WASHINGTON, DC

Greg Severence
City Traffic Planner
City of Pueblo, Colorado
PUEBLO, COLORADO

Paul Shultes
Senior Engineer
New Jersey DOT
TRENTON, NEW JERSEY

Rob Siley
Principal Engineer
New Jersey DOT
ERWINNA, PENNSYLVANIA

Milt Silverman
Area Engineer
FHWA - Massachusetts
CAMBRIDGE, MASSACHUSETTS

Larry Simer
R/W Officer
FHWA Utah
SALT LAKE CITY, UTAH

Jerold Simpson
Ass't Staff Traffic Engineer
Colorado DOT
DENVER, COLORADO

Donald Smith
Manager, Engineering Division
El Paso County Public Works, CO
COLORADOSPRINGS,COLORADO

Gary Sokolow
Planner
FDOT
TALLAHASSEE, FLORIDA

Paul Solaegui
President
Solaegui Engineers
SPARKS, NEVADA

Tim Stevens
Director, Highway Planning
British Columbia Ministry of Trans & Hwys
VICTORIA, BRITISH COLUMBIA

Vergil Stover
Research Engineer
Texas Transportation Institute
COLLEGE STATION, TEXAS

Brad Strader
Principal Planner
McKenna Assoc. Michigan
FARMINGTON HILLS, MICHIGAN

Mark Stuecheli
Transportation Planner
City of Overland Park
OVERLAND PARK, KANSAS

Andy Sullivan
Engineer
Bellomo-McGee, Inc.
VIENNA, VIRGINIA

Miro Supitar
President
Supitar Engineering
LAKEWOOD, COLORADO

Art Taylor
Director, Right of Way
Missouri Hwy & Trans. Dept
JEFFERSON CITY, MISSOURI

Chuck Thiede
Urban Plan Development Supervisor
Wisconsin DOT
MADISON, WISCONSIN

Edward Tormohlen
Real Estate Manager
Colorado DOT
DENVER, COLORADO

Robert Torres
Region 2 Preconstruction Engineer
Colorado DOT
PUEBLO, COLORADO

Glenn Vaad
Secretary
Colorado Transportation Commission
DENVER, COLORADO

Mark Vandehey
Associate
Kittelson & Associates
PORTLAND, OREGON

Freddie Vargas
Asst Dist Traffic Oper Eng
Florida DOT
FT LAUDERDALE, FLORIDA

Charles Vidrine
Traffic Signal Engineer
City of Norfolk Virginia
NORFOLK, VIRGINIA

John Warden
Planning Director
City of Colleyville, Texas
COLLEYVILLE, TEXAS

Tom Waters
Right of Way, Environmental Prog. Mgr
FHWA New York
ALBANY, NEW YORK

Berten Weaver
Planning Director
Clear Creek County, Colorado
GEORGETOWN, COLORADO

Lisa Weesner
Senior Transportation Engineer
Metro Transportation, IL
BLOOMINGDALE, ILLINOIS

Tim White
Transportation Engineer
Virginia DOT
RICHMOND, VIRGINIA

Kristine Williams
Research Associate
USF - Center for Urban Transp. Research
TAMPA, FLORIDA

Gail Yazersky-Ritzer
Principal Planner
North Jersey TCC
NEWARK, NEW JERSEY

V. PRELIMINARY INFORMATION ON 2ND ACCESS MANAGMENT CONFERENCE

ACCESS MANAGEMENT CONFERENCE
VAIL, COLORADO 1993

1996 Access Management Conference

The second Accesss Management Conference will be held on August 11-14, 1996 in Vail, Colorado. If you would like more information or to be put on a mailing list please contact:

Philip B. Demosthenes, Conference Chairman
Colorado Department of Transportation
Staff Right of Way Branch
4201 East Arkansas Avenue, Rm. 291
Denver, Colorado 80222

Phone:	(303) 757-9844
Fax:	(303) 757-9820

*U.S. G.P.O.:1993-301-717:80417