MOVING FORWARD

ACCESS MANAGEMENT 2000

Fourth National Conference on Access Management

August 13-16, 2000
Portland, Oregon

4th National Access Management Conference

Portland, Oregon

	A	B	C	D	F
Sunday	**PAPER COPY OF PROCEEDINGS**	**SUMMARY OF PROCEEDINGS**	Intro to Access Management Biking, Pedestrians and AM – Field Trip		Welcome Reception
Monday	**1** Opening Session Click on a block to view presentation list	**2** Access Management at State Level	**5** Access Management at State Level (cont.)	**8** AM Programs at the Regional & Local Level	Evening Dinner Event at The Oregon Museum of Science and Industry (OMSI)
		3 Median Related Issues	**6** Impacts of AM Techniques (Part 1)	**9** Recent Research	
		4 Corridor Management	**7** Applying AM to Site Reviews	**10** Legal Issues in Access Management	
Tuesday	**11** Access Management Plans	**14** Access Management Permitting	**17** OR's Development of AM Rules	**20/21** Mock Administrative Hearing	**Tracks** 1: Administrative 2: Technical 3: Workshops
	12 Impacts of AM Techniques (Part 2)	**15** Roundabouts and Interchanges	**18** Access Management Spacing		
	13 What would you do with this street?	**16** Public Involvement Workshop	19/22 Median Construction Project – Field Trip to Salem		
Wed	**23** Livable Communities, Top 10 Comments	**24** Closing Session: AM "Tricks" and Access Jeopardy	TRB AM Committee Meeting	The 5th AM Conference In Texas June 23-26, 2002	Attendee List

Pre-conference Workshops

Paper

Introduction to Access Management:

A comprehensive overview of the practice

Instructors: Vergil Stover, University of South Florida
Bud Koepke, S/K Transportation Consultants, Inc.
Rindy Lasus, New Jersey Department of Law & Public Safety

Other

Mobile Workshop

Implementation of Access Management with Pedestrian/Bicycle Issues

Instructors: Xavier Falconi, Entranco, Inc.
Michael Ronkin, Oregon DOT
Gerry Juster, Oregon DOT
Del Huntington, Oregon DOT

Other

WELCOME RECEPTION

AN INTRODUCTION TO ACCESS MANAGEMENT

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1.0 OVERVIEW

1.1 What is Access Management?

Access management is the process of balancing the competing needs of traffic movement and land access.

Access management provides access to land development while simultaneously preserving the safe and efficient flow of traffic on the roadway system. It applies traffic engineering principles to the location, design and operation of access drives serving activities along the highway. It evaluates the suitability of providing access to a given road, as well as the suitability of a site for land development. It addresses the basic questions – when and where access should be located, how it should be designed, and the procedures needed to administer the program. In broad context, it is resource management, since it is a way to anticipate and prevent safety problems and congestion.

Access management includes: 1. Classifying roadways based upon functional criteria which reflect the importance of each roadway to statewide, regional and local mobility; 2. Defining allowable levels of access for each road class, including criteria for the spacing of signalized and unsignalized access points; 3. Applying appropriate geometric design criteria and traffic engineering analysis to the allowable access; and 4. Adopting appropriate regulations and administrative procedures. The highest levels of access location and design are applied to freeways and arterials. The least access control is applied to local roads – including minor collectors and local access roads.

1.2 Why Manage Access?

Streets and highways are an important resource and represent a major public investment that should be preserved.

Solomon (1) recognized the need for access management as indicated by the following:

"When conventional highways are constructed on new rights-of-way, initially there are few commercial driveways and the safety record is good. As the highways get older, the traffic volume builds up, roadside businesses develop, more and more commercial driveways are cut, and the accident rate gradually increases."

Solomon concludes:

"This demonstrates the importance of maintaining control of access when either two-lane or multi-lane highways are built on new locations. Increased numbers of either intersections or driveways will increase the accident rate. Intersections should be restricted to those essential for the highway, and the right (direct) access from abutting businesses should be severely limited."

McGuirk (2) established the fact that accidents at access drives increase as both through-lane traffic volumes and driveway volumes increase. The problem has also been recognized in the following quote from the State Highway Access Code of Colorado (3):

> "The lack of adequate access management on the highway system and 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 in the state. As new access approaches are constructed and traffic signals erected, the speeds and capacity of the highway decrease, and congestion hazards to the traveling motorist increase."

What are the Symptoms of Poor Access Management?

- High crash rates
- Poor traffic flow and congestion
- Numerous brake light activations by drivers in the through lanes
- Unsightly strip development
- Neighborhoods disrupted by through traffic
- Using a local street parallel to the overburdened "arterial" to make a one-way pair
- Pressures to widen an existing street or build a bypass
- Bypass routes as congested as the roadways they were built to relieve
- A decrease in property values

1.3 What if We Don't Manage Access?

New and improved major roadways lead to convenient movement and increased traffic volumes. The increased activity is accompanied by an increase in the number of driveways. This results in an increase in the number and severity of conflicts, an increase in traffic crashes and a decline in the quality of traffic service. This, in turn, generates the demand for additional improvements or the need for a bypass.

Safety hazards and congestion on major roadways translate into significant social and economic costs. The Colorado DOT reported that access-related crashes on Colorado state highways cost society approximately $900 million per year (4). In Oregon, access related crashes on state highways, excluding interstate highways, cost at least $816-million per year, $380-million of this is attributable to only 632 miles of state highways in urban areas (5).

Washington DOT Finds A Close Relationship Between the Number of Access Points and the Number of Crashes

State Route 99, Pacific Highway, is a 4-lane roadway with a TWLTL and shoulders. Figure 1 prepared by the Washington State DOT shows a close relationship between the number of access points (access drives plus cross-streets) and the number of crashes.

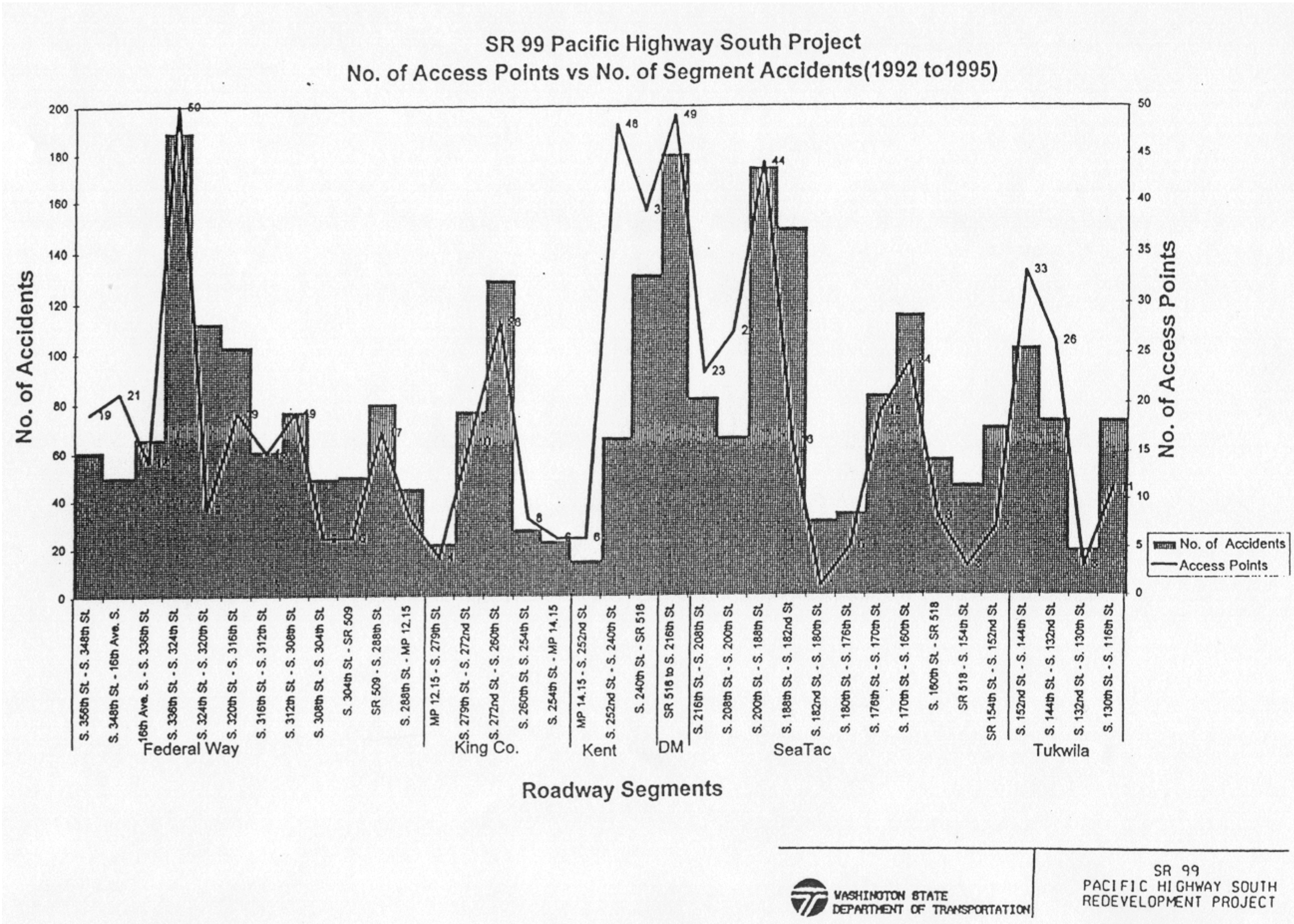

SR 99 Pacific Highway South Project
No. of Access Points vs No. of Segment Accidents(1992 to1995)
No. of Accidents
No. of Access Points
No. of Accidents
Access Points
Federal Way
King Co.
Kent
DM
SeaTac
Tukwila
Roadway Segments
WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
SR 99
PACIFIC HIGHWAY SOUTH
REDEVELOPMENT PROJECT

Figure 1

1.4 Who Benefits from Access Management?

Motorists

- Fewer crashes
- Reduce travel time
- Reduce travel delay
- Lower fuel consumption

Pedestrians and Bicyclists

- Fewer driveways mean fewer conflicts with vehicles
- Pedestrian refuge in median
- Fewer pedestrian and cyclist deaths and injuries

Bus Riders

- Reduce travel time
- Improved schedule reliability

Property Owners

- Preserves private investment
- Limits through traffic in residential areas

General Public

- Helps stabilize land use patterns
- Encourages coordination of land use and transportation decisions
- Preserves the public investment in major thoroughfares
- Fewer deaths and injuries resulting from vehicular crashes and vehicular – pedestrian/cyclist crashes
- Reduced loss in property damage
- Reduce vehicular emissions
- Supports and helps maintain livable communities

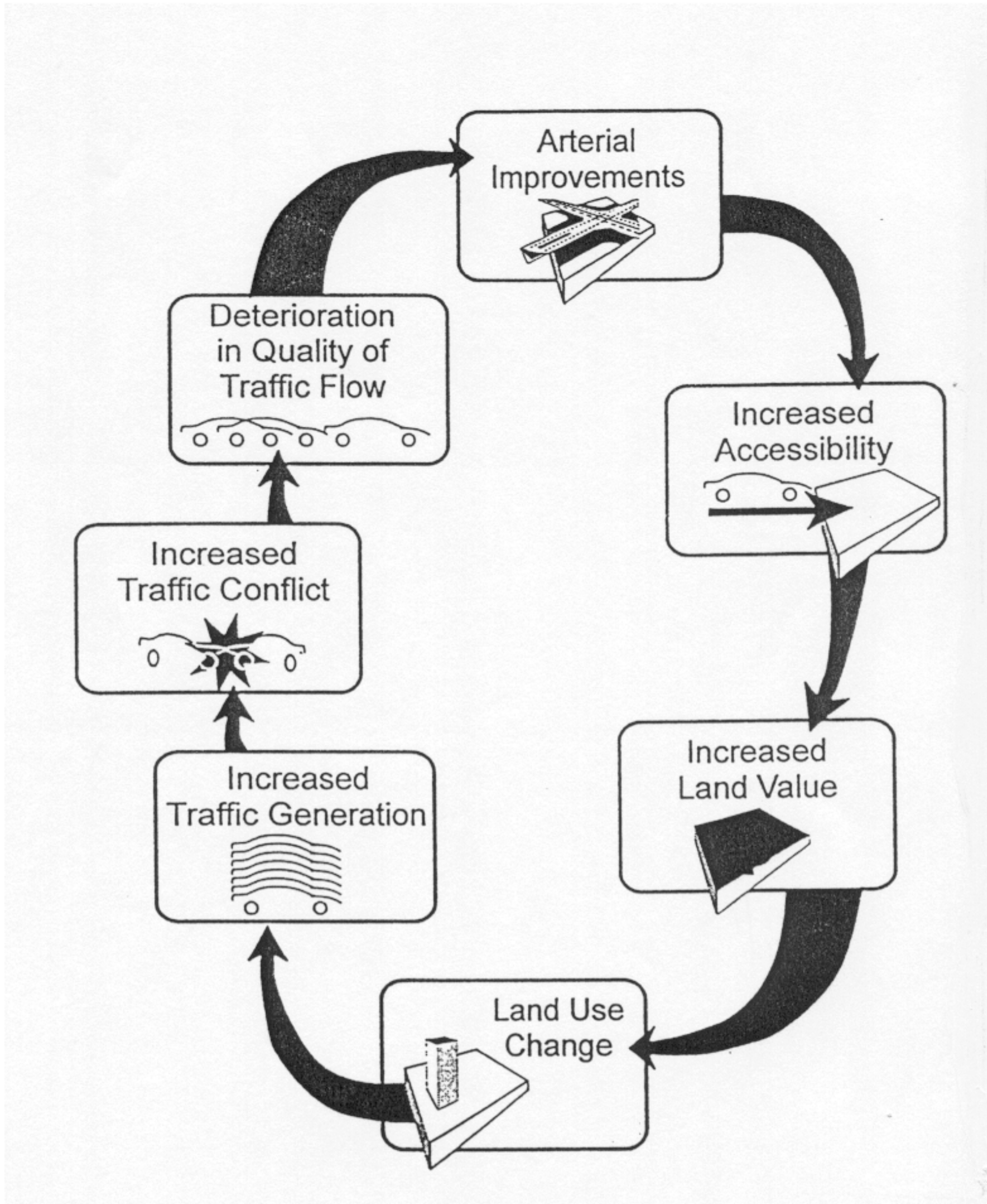
1.5 The Transportation-Land Use Cycle

The Failure To Manage Transportation And Land Use Results in a Continuing Cycle of Obsolescence

Major improvements in the roadway system change the relative advantages of various locations. This in turn, results in a change in the pattern of land values and land uses. In the absence of good land use planning and access management, traffic safety and the quality of traffic movement deteriorates. The need to decrease vehicular crashes and restore capacity requires improvements to the roadway system.

Reconstruction to increase the level of service of an existing arterial is generally very costly and disruptive to both the public and the abutting businesses. Furthermore, improvement in the level of service is often temporary because the improved service stimulates increased business activity. Furthermore, the shallow property depth, multiplicity of ownership, and right-of-way limitations generally preclude good redesign of access and site circulation, even when substantial expenditures are made for reconstruction of existing streets. In order to better accommodate traffic demand, roadway improvements are required and a cyclical sequence of events occurs which requires continuing capital investments for arterial improvements or relocation. In the more severe cases, the arterial must be relocated due to functional obsolescence and the process starts all over again on a new location. The cycle is illustrated in Figure 2.

Poorly coordinated on-site circulation systems and the failure to develop a supporting roadway system force more trips onto the arterial roadways. This results in multiple traffic conflicts, increased congestion and a decline in traffic and pedestrian safety. This generates a demand for roadway improvements and the cycle begins again. Failure to address the congestion and safety problems ultimately leads to a deterioration in the abutting properties. These are not the inevitable of development and urban growth. Rather, they are symptoms of inadequate attention to access management to preserve the integrity of the roadway system as development occurs. However, local governments have extensive powers which can be applied to manage land uses as well as roadway improvements. State highway agencies are limited to dealing with managing the highway system per se. In any event, close coordination between the state DOT and local government is essential to effective management of the transportation-land use cycle.



The Transportation-Land Use Cycle

Source: Reference (6)

Figure 2

1.6 References

1. David Solomon, "Accidents on Main Rural Highways Related to Speed, Driver, and Vehicles," Public Roads, July 1964.

2. William K. McGuirk, "Evaluation of Factors Influencing Driveway Accidents," Report of the Joint Highway Research Project, Purdue University, May 1973.

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

4. Philip Demosthenes, "Access Management Coordination," Colorado DOT.

5. Vergil G. Stover, Presentations to the Association of Oregon Counties and the League of Oregon Cities, November 1996.

6. Vergil G. Stover and Frank J. Koepke, Transportation and Land Development, Institute of Transportation Engineers, Prentice-Hall, Inc. 1988.

Opening Session

Moderators: *Del Huntington, Oregon DOT*
Craig Greenleaf, Oregon DOT

Other 1A. Keynote Speaker:

Henry Hewitt, Chair of the Oregon Transportation Commission

Other 1B. Access Management in the New Millenium

Ron Giguere, FHWA, Chair of the Transportation Research Board Committee on Access Management

The Essence of Oregon – Slide Show

Access Management Programs at State Level

Paper 2A. South Dakota Program
David Rose, Dye Management Group

Paper
Slides
Other
2B. Missouri's Start-up of Their 99-2000 Access Management Program
David Plazak, Iowa State University

Paper
Slides
Other
2C. Lessons Learned from Access Management Programs in Selected States
Bill Frawley, Texas Transportation Institute

Monday-August 14, 2000 – 10:00 AM – 11:30 AM
Track 1 - Administrative

South Dakota
Department of Transportation
Office of Research

DYE MANAGEMENT GROUP, INC.

U.S. Department of Transportation
Federal Highway Administration

Access Management in South Dakota

Paper prepared for the
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DISCLAIMER

The contents of this paper reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the South Dakota Department of Transportation, the South Dakota Transportation Commission, or the Federal Highway Administration. This paper does not constitute a standard, specification, or regulation.

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Dennis Landguth .... *Rapid City Region*
Jody Larson ...... *Local Government Assistance*
Mark Leiferman .... *Roadway Design*
Roger Mack .... *SD 1st Planning District*
Craig McIntyre .... *Planning & Programs*
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Access Management in South Dakota

■

This paper presents an overview of the results and recommendations from a review of the South Dakota Department of Transportation's (SDDOT) highway access control process. The project was initiated in March 1999, with the final draft report completed in February 2000. The results of the review are summarized, along with the next steps to be taken and project success factors.

A. Overview

The principal purpose of the review of SDDOT's highway access control process was to develop improved access policies, design guidelines, and procedures for applying them. The policies, guidelines and procedures are intended to:

- **Improve highway safety by minimizing the number, severity, and cost of accidents arising from access onto and off of South Dakota's highway system.** Nationwide, various studies have documented that good access management can significantly reduce the number of traffic accidents, including fatal injury and property damage crashes.
- **Preserve investments in South Dakota's highways and roads by maintaining the functional integrity of the system.** Access management prolongs the useful life of existing roads and maintains or increases their capacity to carry traffic. It frees scarce resources for maintenance and operation of existing roadways that would otherwise be spent on major widening or new roadway projects.
- **Provide consistency and predictability regarding access.** The project provides clearer policy direction and guidelines that will enable a consistent approach to access management.
- **Improve coordination and consistency between state and local governments regarding access policies.** Local governments' policies regarding access to city streets and county roads, subdivision review, and other development review impact access policy goals. For the state system, successful access management requires effective coordination and consistency with local government.
- **Update South Dakota's 1970's access management policies and design guidelines to provide an improved and consistent basis for managing highway access.** Dating from the 1970s, the old policies and guidelines do not adequately address South Dakota's needs for the twenty-first century.

Achievement of these goals was facilitated through the development of materials that communicate the benefits of improved access control and through consensus building for change to procedures among the state, regional, and local interests. Broad based stakeholder understanding and constituency building regarding the safety and system benefits from improved access management was an important success factor for the project.

B. Approach

The steps taken for the Review of SDDOT's Highway Access Control Process are summarized below.

- **Review of Access Regulations and Policies in South Dakota.** This step evaluated how effectively contemporary access management can be implemented under existing laws, administrative rules and procedures in South Dakota.

- **Analysis of South Dakota Access Management Issues.** This involved undertaking a series of issue identification interviews with key participants and stakeholders, including key SDDOT managers in the headquarters and the regions, representatives of local jurisdictions, and other stakeholders.

- **Evaluation of National Experience Applicable to South Dakota.** This step involved assisting South Dakota in learning from the experiences of other states. This evaluation drew on the project team's similar evaluation as part of access management work for other states. This was supplemented by conducting a scan of neighboring states and access management activities.

- **Developed Factual Information to Support Policy.** This involved developing factual information to demonstrate the safety corridor preservation and other benefits of updated access management. The approach had three elements:

  - Conclusions were drawn and evidence cited from national research into accidents, costs, capacity impacts, effects on business, and other variables.

  - South Dakota's safety data was used to generate specific estimates of the safety benefits.

  - Illustrative case studies specific to South Dakota were conducted. The case studies illustrate benefits from access management such as preserving public investment, community preservation, and benefits to property owners.

- **Conducted Regional Workshops with Key Stakeholders to Obtain Input and Build Support for Implementation.** This provided the opportunity for involving key stakeholders: elected officials, business leaders, developers, motor carriers, and others to validate and provide input on the draft access policy, design guidelines, model ordinances, and other project work products.

- **Developed Access Policy.** Input from the workshops, technical panel and the results of the previous steps provided the basis for developing recommendations for an access management policy applicable to South Dakota.

- **Developed Access Guidelines and Criteria.** This included identification of where access should be allowed or denied for various classes of roads, what should be the allowable spacing for signalized and unsignalized access connections, and where should alternative access be required.

- **Developed Tools for Local Government Including Model Ordinances.** The study recommended a process for incorporating the recommendations into the land use and development review process. This involved conducting interviews, reviewing documented procedures, and requirements to determine the effectiveness of current practices. Weaknesses with current procedures were documented and recommendations developed to strengthen them. Ordinances in South Dakota were reviewed and existing inventories of relevant ordinances used in other states were drawn upon. These were then used to prepare model ordinances applicable to South Dakota.

- **Developed Permitting Process Recommendations.** The recommendations are based on input received during group interviews involving process participants in each of SDDOT's regions and review of current documented policies, procedures, and business practices.

- **Prepared Implementation Plan.** This prepares a work breakdown and plan for implementing the recommended new access management policy and procedures. Performance measures to monitor the success of the implementation were also developed.

C. Project Outcomes

The following summarizes the major outcomes from the project.

1. Documented the Benefits of Access Management to South Dakota

It was important for the project to clearly establish and document the benefits to South Dakota of improved access management policies and guidelines. Documenting the following benefits made the business case for improved access management in South Dakota:

- **Minimizes access-related accidents.** Improved access management reduces the number, severity and cost of access-related accidents. Analysis of South Dakota's statewide accident data found that between 1995 and 1997 there were more than 5,300 accidents identified as driveway accidents. This included 13 fatalities. Driveway-access accidents cost South Dakota about $36.5 million per year.

- **Preserves investment in highways and major roads.** Improved access management prolongs the useful life of existing roads and maintains or increases their capacity to carry traffic. This frees scarce resources that would otherwise be spent on major widening or new roadway projects for maintenance and operation of existing roadways.
- **Improves access to property adjacent to highways and roads.** Improved access management provides safe and easy access to businesses adjacent to the roadway, making them more attractive and inviting to potential customers.
- **Preserves private investment.** Improved access management provides predictability for the development process and maintains accessibility to businesses.

2. Developed Updated Policy

The project recommended that SDDOT adopt the following policies for providing safe, efficient access to the highway system.

- Protect the public's investment in the highway system by preserving its functional integrity.
- Use police powers and existing statutory authority, and promote the modernization of South Dakota Codified Law to ensure the safe and efficient management of access.
- Establish and maintain an access classification system that defines the planned level of access for different highways in the state.
- Provide a consistent statewide approach to the management of access to the state highway system.
- Maintain and apply access criteria, based on best engineering practices to guide driveway location and design, to implement the access classification system.
- Coordinate with local jurisdictions to ensure that South Dakota's access policy and criteria are addressed early in decisions affecting land use.
- Provide advocacy, educational, and technical assistance to promote access management practices among local jurisdictions.
- Undertake proactive corridor preservation through coordination with local units of government on corridor management, the purchase of access rights, and other investments.
- Require traffic impact analysis for developments that impact the safety and capacity of the highway system.

3. Developed Access Classification System

The project recommended that SDDOT develop and maintain an access classification system to preserve the functional integrity of the highway system. The purpose of the classification system is to specify the planned level of access for different roadways in the state. The recommended classification system, detailed in Exhibit 1, distinguishes between urban, non-urban, and low volume routes by their level of importance or functional role.

Exhibit 1: Recommended Access Classification System

Level of Importance/Functional Role	Undivided or Divided	Area
Expressway	Undivided	Non Urban Urban
	Divided	Non Urban
		Urban
Principal Arterials	Undivided	Non Urban – low volume[1]
		Non Urban
		Urban
	Divided	Non Urban
		Urban
Minor Arterials	Undivided	Non Urban – low volume[1]
		Non Urban
		Urban
Collectors	Undivided	Non Urban – low volume[1]
		Non Urban
		Urban – Primarily through traffic
		Urban – Primarily local traffic

- [1] Low volume is defined as 550 or less Annual Daily Traffic.

4. Developed Access Criteria

Access location criteria were developed to preserve the functional integrity of South Dakota's highways, provide for smooth and safe traffic flow, and afford abutting property an appropriate degree of access. The recommended access criteria for signalized and unsignalized driveways and at-grade intersections are based on the following general considerations:

- Allowable access should vary by roadway classification, facility type, access type, roadway speed, and development density.
- Access spacing criteria do not have to be consistent with existing access practices.
- Allowable tolerances for deviations from the desired criteria generally should vary with the access type or functional class of the roadway involved. These tolerances are greater for collectors and minor arterials than for principal arterials.
- Traffic signal spacing criteria for both driveways and at-grade public intersections should be related to roadway speed and should govern both intersecting public streets and access driveways. They should take precedence over the unsignalized spacing criteria in situations where there is potential for future signalization.
- Ideally, locations for signalized at-grade intersections should be identified first. Unsignalized right-turn and left-turn access points should then be selected based on existing and desirable future signal locations. Right-turn in and out should be located with consideration for corner clearance and driveway spacing.
- Reasonable alternative access must be considered. However, care should be exercised to avoid merely transferring problems.
- Access for land parcels that do not conform to the spacing criteria may be necessary when no alternative reasonable access is available. The basis for these exceptions or variances should be identified.

The recommended criteria are summarized in Exhibit 2 on the following page.

Exhibit 2: South Dakota Access Location Criteria

Level of Importance/ Functional Role	Undivided or Divided	Area	Signal Spacing Bandwidth*	Signal Spacing Distance (mile)	Median Opening Spacing (mile)[1]	Minimum[2] Unsignalized Access Spacing (feet)	Denial of Direct Access When Other Available
Expressway	Undivided	Non Urban	N/A	N/A	N/A	½ mile	Y
		Urban	40-45%[4]	1/2[4]	N/A	½ mile	Y
	Divided	Non Urban	N/A	N/A	1/2 F 1/2 D	½ mile	Y
		Urban	40-45%[4]	1/2[4]	1/2 F 1/2 D	½ mile	Y
Principal Arterials	Undivided	Low volume	N/A	N/A	N/A	N/A[3]	No[3]
		Non Urban	45%	½	N/A	660	Y
		Urban	40-45%[4]	1/4 –1/2[4]	N/A	250 – 660[4]	Y
	Divided	Non Urban	45%	½	1/2 F 1/4 D	660	Y
		Urban	40-45%[4]	1/4 –1/2[4]	1/4 - 1/2 F[4] 1/8 - 1/4 D[4]	250 – 500[4]	Y
Minor Arterials	Undivided	Low volume	N/A	N/A	N/A	N/A[3]	No[3]
		Non Urban	45%	½	N/A	660	Y
		Urban	35-40%[4]	1/4 –1/2[4]	N/A	200 – 450[4]	Y
Collectors	Undivided	Low volume	N/A	N/A	N/A	N/A[3]	No[3]
		Non Urban	N/A	N/A	N/A	N/A[3]	No[3]
		Urban - Primarily through traffic	35-40%[4]	1/4 –1/2[4]	N/A	150 - 350[4]	Y[5]
		Urban - Primarily local traffic	N/A	N/A	N/A	N/A[4]	No[3]

[1] N/A = Not Applicable; F = Full Movement; D = Directional Only.
[2] Stricter Standards could apply if set by other jurisdictions.
[3] Considerations other than unsignalized access spacing should govern, e.g., sight distance.
[4] Where a range of spacing is shown, the greater distance or bandwidth would apply to posted speeds of 45 mph or higher.
[5] If so, conference among the governing authorities.

* Bandwidth measures how large a platoon of vehicles can pass through a series of signals without stopping for a red traffic light. It represents a "window of green" in which motorists travelling along a roadway will encounter a series of green lights as they proceed. For example, a bandwidth of 45 percent indicates that, if a traffic signal has a 100-second cycle length, there is a 45-second band in which a platoon of vehicles will encounter green lights as they travel along a roadway.

5. Developed Retrofit Techniques

The access location and design criteria developed for the project describe the desired outcome for access locations. A major implementation issue addressed is that in many urban areas where the abutting land is fully developed it is not possible to achieve the desired conditions. To address this problem it was recommended that retrofit techniques need to be used to the maximum extent feasible to accomplish the access policy goals; however, care was taken to recognize the context within which the access location decision takes place.

Mechanisms and tools for institutionalizing the use of retrofit techniques to reduce the number of access connections (conflict points) and reduce their adverse effects became major elements of the project. This emphasis is an important practical consideration because it results in improvements to the current undesirable situation. The following techniques for driveway consolidation/relocation, corner clearance, and left-turn entrances and exits were recommended as part of retrofit during reconstruction projects:

- Consolidate and/or relocate driveways.
- Require adjacent properties to share access.
- Coordinate driveway locations on both sides of the roadway.
- Maximize corner clearance by locating access as far from the intersection as possible (i.e. near the property line).
- Provide separate left-turn entrances and exits at major traffic generators.
- Install barrier to prevent uncontrolled access along property frontage.
- Install driveway channelizing island to discourage left-turn maneuvers.

6. Improvements to Permit Process

Review of SDDOT's permitting practices showed that procedures were not consistently applied and that there was considerable variation between SDDOT regions. Recommendations were made to improve access permitting procedures by strengthening the process for making an application, processing an application, making the permit decision, and by increasing coordination during development and subdivision review. Standardizing forms were developed to apply for and review access permits. It was also recommended that Area Engineers be given signature authority for permit approval.

7. Recommendations to Strengthen Access Management Authority

The evaluation of South Dakota's statutory authority found that:

- South Dakota statute provides a weak basis for implementing a modern access management program.
- Existing statute does enable SDDOT to designate controlled access routes.

The study recommended that South Dakota's statutes be modernized to provide SDDOT with the authority to establish standards and procedures that ensure safe and efficient access to the highway system on the entire system, not just the controlled-access facilities. In addition, the study recommended SDDOT use existing authority to designate controlled-access facilities. Existing authority can be used to implement the access classification on controlled-access facilities. Highways can be designated as controlled-access facilities with access managed based on the adoption of the access guidelines recommended by the project.

8. Created Tools to Assist Local Government

Successful access management policies and criteria will be implemented through coordination between SDDOT and local units of government. This includes joint planning for protecting critical corridors, adoption of development review practices that consider access criteria, and support for enacting ordinances and other actions favorable to SDDOT's access policies and guidelines. Strengthening the partnership among SDDOT, counties and cities is key to implementing access policies in South Dakota.

As part of the project, city and county level model ordinances were drafted that support access management in the following areas:

- **Access Permitting.** Proper access location and design is paramount for preserving the functional integrity of city or county streets, providing for smooth and safe flow, and affording abutting properties an appropriate degree of access. The draft model ordinances produced by the project include ordinances for unsignalized access (driveways and intersections), signal spacing, corner clearance, sight distance, and nonconforming access features.
- **Land Development.** The interdependence of land development and access controls is another important dimension of regulating access. Subdivision regulations, lot-split requirements, and development review provide an opportunity to assure proper access and street layout in relation to existing or planned roadways.
- **Major Traffic Generators.** The recommended policy developed for the project is that developments that generate 100 or more peak hours in plus out trips are considered to be major traffic generators. Major traffic generator ordinances may have limited applicability for some cities and counties in South Dakota. However, a model ordinance code was developed for those situations where it does apply.

- **Access management plans.** Access management plans are intended to facilitate coordination of access between public roads and surrounding developments. These plans delineate current and future access points on the highway, as well as lay out a means for achieving the plan, including the elimination of nonconforming access.

D. Implementation

South Dakota has an implementation plan for institutionalizing its new access management policies, guidelines, and procedures. Work is underway and progress is being made.

1. Implementation Plan

Careful implementation planning provided good results. A plan was prepared that defined implementation projects with sufficient work task detail to estimate, at a high-level, resource needs and implementation timelines. The major components of the implementation plan are:

- **Adopt Recommended Access Policy and Establish Implementation Responsibilities.** This work element involved SDDOT management adopting the access policy project recommendations. These would be adopted by SDDOT as draft policy recommendations that are then subject to public review and comment as part of implementation.

- **Adopt Policy, Statewide Access Classification, and Administrative Rules.** This work element involves undertaking a public planning process through which the draft access policy, the proposed access classification system, and administrative rules for their implementation are subject to public and stakeholder input. This requires applying the recommended classification criteria to establish a proposed classification for the state highway system.

- **Incorporate Access Design Criteria into Roadway Design Manual.** This work element involves incorporating the access design recommendations into the roadway design manual. This will ensure that project design decisions are based on the standards required of permit applications.

- **Strengthen Statutory Authority.** Statutory change is required to strengthen the authority for access management. New legislation was recommended to modernize the current statutes to provide authority for SDDOT, counties and cities to manage the provision of safe, reasonable access to the highway system. This implementation task was successfully accomplished.

- **Prepare Access Permit Procedures Manual.** The prior work elements change the policies, criteria, and authority governing the review and administration of access permits. This work element will use the recommended procedures and changes to the access permit application process to develop a manual and guidance for SDDOT employees and permit applicants. This will take, as its starting point, the recommendations from the access policy project.

- **Provide Education, Training, and Tools to Local Government.** This implementation element involves using the communications information produced through the project to make the case for access management. This includes developing and implementing a program for technical assistance to local officials, and city and county employees regarding the implementation elements described above.

- **Prepare Access Plans for Selected High Priority Segments and Identify Access Management-Related Improvements Eligible for Project Funding.** This work element will focus effort on the problem areas and will secure real benefits. The program will focus on corridors that the state, counties, and cities view as the highest priority and where the jurisdictions can work jointly on corridor preservation/management. This implementation element will enable SDDOT regions to develop "access management projects" eligible for project funding and that will compete with construction projects for funding.

2. Implementation Management and Communications.

Central to implementation is the recognition that there will be considerable change in the work performed across SDDOT's functions and regions. Successful implementation will require a large number of employees being educated about SDDOT's access management objectives, the new access management procedures, and their application. Therefore, change management and cross-functional oversight and communication is built into the implementation approach.

3. Performance Measurement

In recognition that "what gets measured gets done", performance measures were developed for implementation. The purpose of the performance measures is to provide data indicating the extent to which SDDOT's access management objectives are being met. Performance measures were evaluated for short-term application in South Dakota based on considerations that focus on what is measurable, reportable, and reasonable (e.g. effort and cost required). The recommended measures are included in Exhibit 3.

Exhibit 3: Recommended Performance Measures

Performance Measures	**Objectives**						
	Safe transportation system	**Efficient traffic operations**	**Preservation of investment in the highway infrastructure**	**Increased understanding of access objectives and local government capacity**	**Customer-service oriented process**	**Consistent and predictable process**	**Efficient and effective business procedures**
Number and type of exceptions to the adopted access criteria.	✓	✓	✓				
Number of driveways consolidated as part of retrofit activity.	✓	✓	✓				
Local jurisdictions with ordinances that support access policy objectives.	✓	✓	✓				
Dollars spent annually on retrofit projects.	✓	✓	✓				
Road user benefits (dollar value) through reduced delay.		✓					
Average number/percent of permit requests processed within established turnaround time.					✓		
Customer service rating for permit process.					✓	✓	
Number of individuals participating in training and other on-going activities.				✓			
Miles of state highway system with access plans.						✓	✓

4. Implementation Status

The following outlines progress made on SDDOT's access management project since the final review report was presented in February 2000.

- SDDOT has taken a proposal to the state legislature to grant rule-making authority to SDDOT for access location criteria.
- The state legislature granted SDDOT rule-making authority for access management in the spring of 2000.
- SDDOT is in the process of developing the new rules for access management, based on the recommendations of this project. There will be extensive public consultation involved with developing the rules.
- SDDOT is filling a new position to manage the access management implementation.

E. Success Factors

1. Organizational Readiness and Executive Support

SDDOT executives and line managers across the affected functional areas had been involved in the initial scoping and issue identification that led to the project. They provided support throughout the process and the leadership necessary to act in a timely manner on the project recommendations.

2. Partnering and Organizational Support

SDDOT, local jurisdictions, and the consultants for the Review of SDDOT's Highway Access Control Plan partnered well to build support for implementation. This went a long way toward the successful project outcome, combined with the fact that SDDOT was organizationally aligned and supportive of developing new access management policies, guidelines, and procedures.

3. Stakeholder Buy-in

In order to incorporate input from the public and SDDOT region staff, four workshops were held around the state in November 1999. Separate meetings were held for SDDOT staff and the public, although many staff members also attended the public meetings.

The public meetings included city and county superintendents, planners, commissioners and engineers, as well as public works staff, property owners and local politicians. The meetings were well attended and productive. In general, most stakeholders were in favor of modernizing the state's access management policies, guidelines, and procedures. Participants were pleased with the opportunity to provide input and this helped to ensure stakeholder buy-in.

4. Use of Case Studies to Demonstrate Benefits of Access Management

The use of South Dakota case studies to illustrate the benefits of access management ensured that the benefits were tangible to stakeholders. People had personal knowledge of the case studies and could relate to the benefits. At the workshops, many more problem areas and/or examples of good practice were discussed.

5. Development of Tools for Local Governments

Tools were developed to assist local jurisdictions and SDDOT to improve the coordination between the development review process and land use planning and access management in the following areas:

- Access permitting.
- Land development.
- Major traffic generators.
- Access management plans.

These tools were presented at the workshops. Local jurisdictions were appreciative of these tools and other educational materials developed for the project. Many people agreed that having these tools and educational materials is important for an effective implementation of access management.

6. Implementation Based on Education and Communication

Education and communication form an integral part of the project implementation plan, explaining the concepts, procedures, and actions required to address access management. This is particularly important given that many jurisdictions do not have staff with a background in or knowledge of access management. Tools and resources that counties and cities can use, including the model ordinances developed through the project, will be disseminated as part of the communication plan.

“Missouri: A Comprehensive Process for Developing A Statewide Access Management Program”

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ABSTRACT
The Missouri Department of Transportation (MODOT) is responsible for one of the largest state-jurisdiction road systems in the United States. MODOT controls over 20,000 miles of rural major and minor collector routes that are usually managed by counties in mid-western states. This gives MODOT an opportunity to develop and implement more comprehensive highway transportation programs than many states, particularly in areas outside of municipalities.

Missouri has recently decided to embark on an access management program and has focused on utilizing access management mainly to meet safety, traffic operations, and economic development goals. Access management involves carefully designing and controlling the level of access that land development has to arterial and collector roadways via private driveways. When access is poorly managed, the result is higher crash rates, reduced traffic capacity, reduced travel speeds, increased delays, loss of roadway capacity, and a host of other ills. Poorly access-managed roads are a sub-optimal use of taxpayers’ investment in roadways.

The Missouri Access Management program development process involves a number of key steps. These include:

- Stakeholder identification and participation. These key groups include both internal MODOT staff and management plus external groups that have not traditionally been involved in access management planning, such as developers.
- Participant education on access management principles and impacts.
- Development of specific statewide goals for access management. These goals are being tied closely into MODOT’s enterprise strategic plan, especially the sections on safety and economic development.
- Development of an easy to understand (and communicate) access management roadway classification system based on MODOT’s existing functional classification system.
- Development of a detailed set of access management standards and guidelines in the form of a guidebook. (Some of these guidelines are being developed to suggest best practices to local transportation and land use planning organizations.)
- Development of administrative processes (such as the driveway permitting process).
- Identification of current and likely future access management problem corridors.
- Identification of promising “pilot” project corridors where access management principles could be applied. These corridors could be used as examples for the rest of the state and evaluated in terms of their effectiveness and impacts.
- Access management awareness and training for stakeholder groups identified through a marketing plan.

This paper will provide an overview of the start-up and development of the Missouri access management program, including such issues as system classification, standards, and the participation of economic and land developers as well as local government officials in the design of the program. It will also briefly cover a process for the identification of problem corridors using management information system data and geographic information systems (GIS) technology. This paper will be useful to other states and state DOTs wanting to address access management in a comprehensive fashion.

INTRODUCTION

(NOTE: The Missouri Comprehensive Access Management Planning Process is an ongoing project. All materials presented in this paper are subject to change.)

In all states, the roadway system plays a dual role. It provides service to through traffic, while also providing access to adjacent properties, residences and businesses. When these two roles are not properly balanced and managed, safety problems and operational issues result. These negatively impact both the traveling public and the adjacent landowners. Access management involves striking the proper balance between the dual roles roadways must play. This is done through the application of access management standards, which involve such features as spacing between driveways, driveway geometric design, internal circulation design for land developments, and installation of medians.

An extensive amount of access management research and programmatic activity is currently taking place in the Midwestern states. For example, Kansas is pursuing an aggressive corridor management program, while Minnesota and South Dakota are developing comprehensive access management programs. Iowa has commissioned several research projects designed to explore the relationships between access management and safety, traffic operations, and business vitality. Missouri is the latest state in the region to begin working on an access management strategy.

The Missouri Department of Transportation (MODOT) is responsible for managing a far more extensive system of roads than its neighbors—over 30,000 miles in all. Unlike most other states in the Midwest, MODOT manages rural roads that are functionally classified as collectors and some routes that would be classified as local service routes in other states. Missouri's "peer states" were identified based on the nature and extent of their road systems. These peer states are identified in Table 1 and were contacted to obtain their access management standards, classification systems, and administrative policies. States that are considered to be leaders in access management based on their presentations at the three past National Access Management Conferences were contacted for similar information.

Table 1: Missouri's Peer States in Terms of State Highway System Extent

"PEER STATES" FOR MISSOURI ACCESS MANAGEMENT I

	RURAL HIGHWAYS, STATE ADMINISTRATION						
STATE	MILES	LANE-MILES	DVMT 2/	AADT/ LANE 3/	PERCENT OF STATEWIDE TOTAL RURAL 4/		
					MILES	LANE-MILES	DVMT 2/
North Carolina	68,715	142,253	87,982	618	91.2	91.8	79.0
Texas	68,298	153,219	159,616	1,042	31.9	34.5	89.7
Virginia	48,662	103,798	73,580	709	95.5	96.4	86.2
South Carolina	34,609	72,454	62,004	856	63.9	64.8	87.8
Pennsylvania	32,388	68,703	85,804	1,249	37.9	39.1	72.2
West Virginia	30,850	63,083	30,849	489	96.1	96.1	84.3
Missouri	30,649	64,321	66,267	1,030	28.8	29.8	85.6
Kentucky	25,031	53,242	52,453	985	40.4	41.9	76.2
Ohio	15,275	33,312	73,245	2,199	18.7	19.8	66.7
Arkansas	14,999	33,722	43,816	1,299	17.8	19.8	86.2
Georgia 1/	14,843	32,457	73,407	2,262	17.4	18.6	68.4
Louisiana	14,643	32,599	47,635	1,461	31.3	33.6	81.2

Source: Federal Highway Administration (FHWA), Highway Statistics.
Notes for Table 1:

1/ Travel is estimated by FHWA; other data are for 1996.

2/ DVMT means Daily Vehicle-Miles of Travel.

3/ AADT means Annual Average Daily Traffic. AADT/Lane is a system-wide average.

4/ Statewide totals for mileage, lane-miles, and travel are found in tables HM-20, HM-60 and VM-2.

Missouri's State Constitution gives the Highways and Transportation Commission the authority to manage highway access:

> "The highways and transportation commission shall have authority over all state transportation programs and facilities as provided by law, including but not limited to, bridges, highways, aviation, railroads, mass transportation, ports, and waterborne commerce, and shall have authority to limit access to, from and across state highways where the public interest and safety may require."(1)

Missouri has historically had a tax on motor fuel that is well below the average for the states. This has led to a situation where Missouri's roadways are replaced on a longer cycle that those in other states. This is important for access management for a number or reasons, not the least of which is that Missouri's highways often have more curvature and greater profile change than other, nearby states. Combined with the rough topography of the state, this means that sight distance is often a major concern in locating driveways in both rural and urban areas. Missouri has not practiced access management in a comprehensive manner until now. Instead, it has largely approved or disapproved individual driveway permits along its routes on the basis of desirable or minimum sight distance standards. Several types of variances to the sight distance standards have been issued at the District level in situations where only a minimum stopping sight distance standard could be met.

PROJECT OBJECTIVES

Missouri is taking a comprehensive approach to access management. Access management is being integrated into MODOT's overall enterprise strategic plan. In particular, access management will be one of the most important strategies in the agency strategic plan for achieving improved highway safety. The main objectives of the Missouri access management comprehensive plan are to:

- Develop a comprehensive approach to access management in Missouri.
- Develop all necessary classifications, standards, guidelines and administrative processes.
- Identify current and likely future corridors with access management problems.
- Provide access management training for the MODOT staff and other stakeholders.

STAKEHOLDER ANALYSIS

Key stakeholders for access management in Missouri were identified prior to the initial meeting for the project. Important groups to involve in the develop in access management planning and outreach for Missouri were: Missouri DOT District staff, Missouri DOT Central Office/Support Center staff from a variety of disciplines (including traffic engineering, right of way, planning, and highway design), land developers, economic developers, and city government officials. A key feature of the planning process involves the identification and involvement of local land use planning officials and private developers. These groups can either help or hinder the application of access management standards through their decisions.

PLANNING PROCESS

Separate Oversight and Technical Committees were formed to guide the planning process. The oversight committee was established to:

- Provide high-level guidance for the study (e.g. setting goals)
- Direct the Technical Committee to address issues
- Discuss policy issues
- Consider different viewpoints, including business vitality, economic development, and land development, in developing the access management plan.

The Oversight Committee includes managers from various Missouri DOT divisions and district offices, plus experienced land developers and economic developers, as well as city elected officials.

By contrast, the Technical Committee was to:

- Develop technical standards and guidelines for access management
- Report these back to the Oversight Committee.

The Technical Committee is made up of Missouri DOT staff from several divisions and district offices plus local transportation planning and engineering professionals who are involved in access management.

ACCESS MANAGEMENT GOALS

The following access management goals were set during an initial meeting of the Oversight Committee. They are shown in order of importance from highest to lowest and are:

- Increased Safety. Fewer crashes and lower crash rates are the main measures of success for this goal.
- Improved Traffic Operations. The expectation here is that access management can help reduce congestion, shorten travel times, improve mobility, and help protect the environment through salutary effects on energy use, air pollution, and land use.
- Protection of the Taxpayers' Investment. Access management is hoped to be able to preserve past and present investments in expensive roadway assets and to defer the need for future investments.
- Better operating conditions for non-auto modes. Pedestrians, bicyclists and public transportation users as well as motorists are expected to be beneficiaries of access management.

The MODOT access management project has already been closely integrated with the Department's overall strategic plan. One of the main goals for the enterprise strategic transportation plan is safety. A strategy under safety in the enterprise plan is now to:

> "Integrate access management at the local, regional, and statewide levels."

The Division Engineers and the Traffic Division of MODOT have joint responsibility for this strategic element of the MODOT enterprise strategic plan.

CLASSIFICATION SYSTEM

Classification systems are a key part of the access management process. They allow access management standards to properly fit the present and future functional roles of highways. Classification systems are also useful for helping to explain access management concepts to the public and land and business owners.

Several other states' access management classification systems were reviewed for applicability to Missouri's highway system, current functional classification system, and jurisdictional arrangements. The Technical Committee adopted a system partially modeled on Colorado's access management classification system. The main reason for adopting this system is that it is relatively simple to understand and explain; yet it reflects the continuum of roles that roadways must play. The proposed classification system is shown in Table 2 below.

Table 2: Proposed Missouri Access Management Classification System

Proposed Missouri State Highway Access Management Classification System

(Ten Classification Levels—Largely Based on Current MoDOT Functional Classification System)

	Urban	Rural
Interstate/Freeway	U1	R1
Principal Arterial (A)	U2	R2
Principal Arterial (B)	U3	R3
Minor Arterial	U4	R4
Collector	U5	R5

A Principal Arterial (A) is a key, non-freeway or non-Interstate intercity or inter-regional route that is intended to support long-distance travel. An example is US 63, which runs north to south across Missouri between Iowa and Arkansas.

U indicates Urban: the highway is within Census current urbanized or urban area or is forecast to be in an urban area within 20 years. Future urban highways will be planned as such in terms of access management.

R indicates Rural: the highway is <u>not</u> currently urban and is <u>not</u> in a 20 year forecast urban area.

DETERMINATION OF FEATURES TO BE MANAGED

A determination of features to be included in the access management standards for Missouri was made jointly by the Oversight Committee and the Technical Committee. The features for which standards are being developed are:

- Distance between interchanges on Interstates and other freeways.
- Clearance of functional areas of interchanges.
- Distance between at-grade interchanges.
- Transition areas on the same route between freeway and expressway standards.
- Distance between traffic signals.
- Driveway spacing and density.
- Corner clearance and clearance of functional areas of intersections.
- Sight distance for driveways.
- Driveway geometrics and surfacing.
- Median openings.
- Guidelines for using two-way left-turn lanes, three-lane cross-sections, and raised medians.
- Dedicated right and left turn lanes.
- Frontage and backage road spacing from mainline routes.
- Parking on facilities.
- Accommodations of non-auto modes in conjunction with managing access.
- Connection depth (throat length) standards for major traffic generators.

These standards are currently being developed by the technical Committee for presentation to the Oversight Committee. In addition, the Technical Committee is developing a set of recommendations for local governments that have to do with matters that they control that impact access management. This set of guidelines includes such things as minimum lot frontages, encouraging joint and cross access, and avoidance of development practices such as “flag lots”.

PROBLEM AND PILOT PROJECT IDENTIFICATION USING GIS

An additional task of the planning process has involved the identification of problem highway corridors using geographic information system (GIS) technology and existing Missouri DOT safety management data. Right-turn and left-turn crash density and crash rates have been mapped statewide in Missouri using ArcView 3.1. Several of the maps produced are shown below in Figures 1 and 2. These maps are being used to identify places where access management retrofit projects would be most beneficial and also to identify places where past projects have had a positive impact.

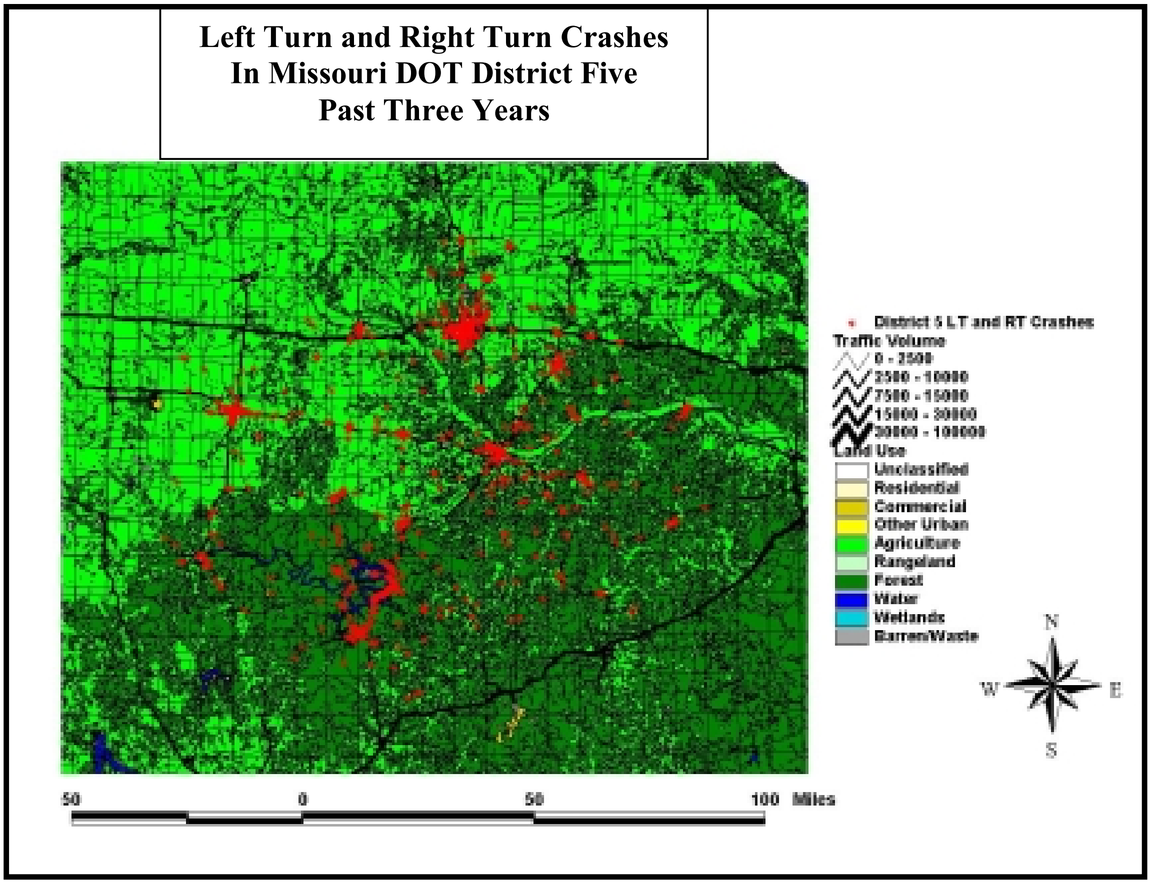

Figure 1: Left and Right-Turn GIS Crash Map for MoDOT District 5

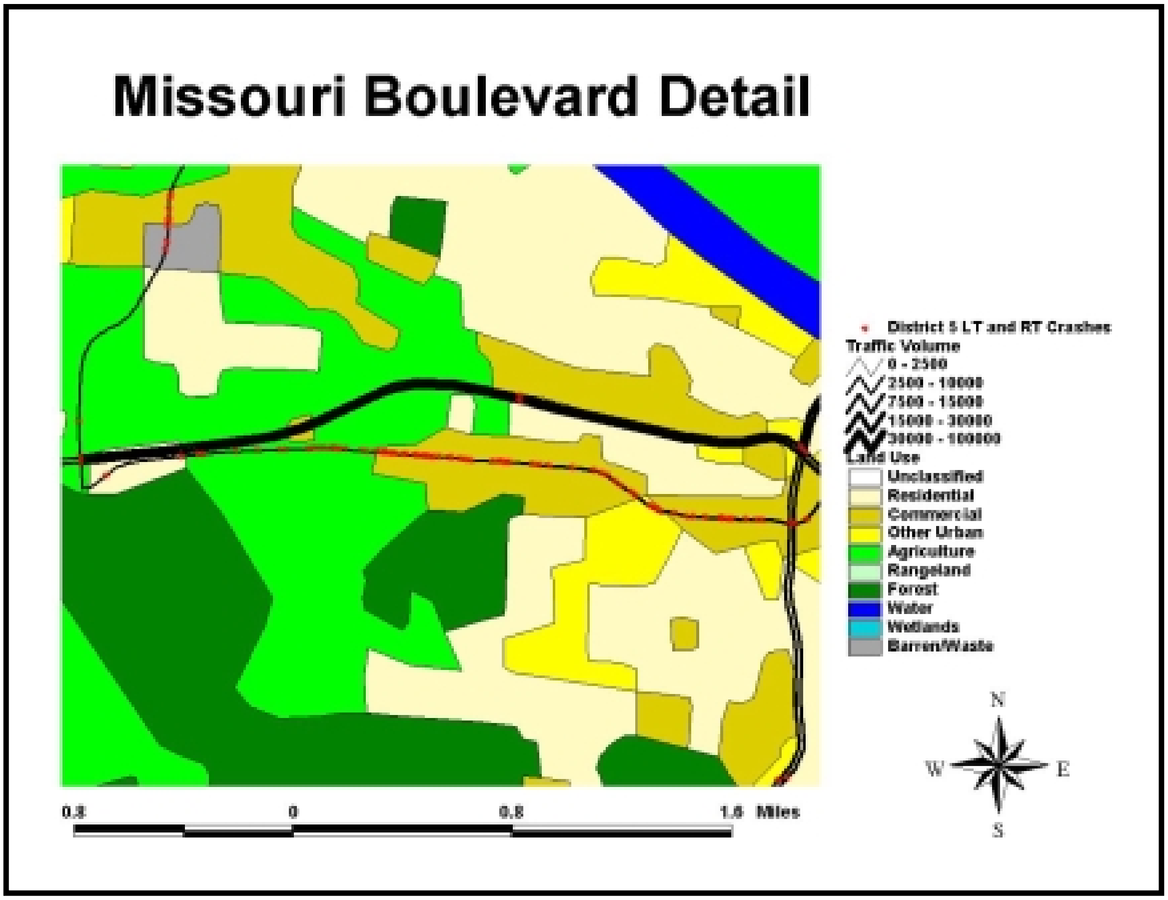

Figure 2: Detailed GIS Crash Map for Part of Jefferson City, Missouri.

ADMINISTRATIVE PROCESS

Once standards are in place, a next step will involve laying out an administrative process for applying them. A preliminary set of goals has been discussed with the Oversight Committee. These include:

- Making safe and operationally beneficial access decisions.
- Protecting the public investment in roadways.
- Providing a timely and predictable decision making process for landowners and developers.
- Encouraging uniformity of application of standards statewide, especially on Interstates, Other Freeways, and Strategic Principal Arterial routes.
- Making decisions based on clear and logical access standards.
- Allowing flexibility and engineering judgement where warranted.
- Keeping the number of variances at a reasonable level
- Providing for an efficient appeals process.
- Setting good precedents for future access decisions.

Administrative process guidelines such as driveway permit fees, centralized versus decentralized decision-making, and time-lines for making permit and variance decisions will be established as a part of this phase of the project.

The concept of a hierarchy of features to be managed through the variance process has been adapted from a paper on variances presented at the second National Access Management Conference in 1996. (2) Some features, such as sight distance requirements, should be given the most scrutiny in reviewing potential variances since they are critical to maintaining a safe road system.

EDUCATION, OUTREACH AND MARKETING

The Missouri access management project began and will end with education. The first completed task involved educating the Oversight Committee about the benefits and impacts of access management. National and regional information on access management and its benefits was presented; in particular information from neighboring Iowa about the safety and business vitality impacts of access management was highlighted.

One of the last phases of the project will involve the development and use of educational materials designed to teach access management concepts and raise awareness. The educational materials will be targeted both internally within MODOT and externally to key stakeholder groups such as city officials, local land use planners, local transportation professionals, and developers.

RESULTS AND CONCLUSION

The Missouri DOT’s comprehensive access management planning process is ongoing. Considerable work remains to be completed. The success of Missouri’s access management plan will depend on three main factors. These include the ability to coordinate implementation within MODOT, the ability of MODOT to coordinate and cooperate with local governments on access management, and the ability of MODOT to persuade the development community of the value and importance of access management.

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LESSONS LEARNED:
ACCESS MANAGEMENT PROGRAMS IN SELECTED STATES

by

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ABSTRACT

The authors of this paper are currently investigating the development of access management programs in various states. This investigation is part of a research project to determine the legislative and regulatory requirements for the Texas Department of Transportation (TxDOT) to develop and adopt a comprehensive access management program. Researchers have interviewed officials from state DOTs in Colorado, Montana, Oregon, New Jersey, Michigan and Wisconsin regarding their access management programs and other related practices, with particular interest in their development and implementation.

This paper provides an overview of current access management programs in various states, explaining "lessons learned" during the development and implementation of the programs. Examples of the lessons learned include hiring a large enough staff dedicated to the program, creating a separate bureau/department/division for access management, and including a process to handle waivers. Specific recommendations from state DOT officials are also presented. This paper and presentation will be useful to states, provinces and cities that are interested in developing or amending an access management program.

INTRODUCTION

Background

As traffic volumes and congestion have increased in recent years, transportation officials have sought ways to protect the public's investments in arterial streets and freeways. The primary purpose of these facilities is the movement of vehicles. This purpose is in contrast to that of local streets, which are built to provide direct access to businesses and residences. In order for arterial streets and freeways to operate most efficiently, access to and from those roads must be limited to specific points. This strategy reduces the potential conflict points involving vehicles crossing lanes of traffic and those make turns into and out of driveways. The solutions to these problems are found in comprehensive access management programs. A comprehensive access management program includes tools such as driveway spacing, median treatments, auxiliary turning lanes, and grade-separated interchanges, as well as the policies for implementing them.

Several state departments of transportation (DOTs) around the country have established comprehensive access management programs. Certain states, such as Colorado, Florida, New Jersey and Oregon, are well known for the success of their access management programs. Those states have already completed the processes of creating, adopting and implementing access management programs. Other states have begun to develop access management programs and are either proceeding with this work or have interrupted it. In all of these cases, there are valuable lessons to be learned by transportation agencies that are considering developing comprehensive access management plans. The "lessons learned" presented in this paper represent a variety of experiences and perspectives of transportation planners and engineers from around the country.

RESEARCH METHODOLOGY

There have been few attempts in the past to collectively document various states' access management and related programs. In addition to conducting literature searches, research team members interviewed professional contacts who do this work to gain additional knowledge of access management programs. These contacts provided at least basic background information about programs and the people involved with them.

Using information from the literature review and the original contacts, researchers began to investigate programs, including those planned and under development, around the country. The research team considered each of the programs and identified several to develop into case studies. Case studies were developed by three means - personal interviews with state DOT staffs, telephone interviews, and literature review. Five states' programs were targeted for in-depth investigations, involving personal interviews with state DOT staffs at their offices.

RECOMMENDATIONS FROM OTHER STATES

Program Development / Administrative Support

Document Production

A common suggestion by DOT officials from several states is to create a work plan in the beginning. A work plan will help keep all parties involved in developing the access management program focused on the desired end results. It is quite common for DOTs to hire consultants to write laws, administrative codes and implementation policies as elements of their access management programs. One strong recommendation related to this practice is to also hire a good editor, with quality technical expertise. The editor will insure consistency in wording throughout individual documents, as well as consistency among the various documents. Another related comment was to be careful about word choice. For instance, assigning words an access management meaning if they already have another connotation can lead to confusion by all parties involved. "Access" has been a difficult word for some agencies to technically define.

Implementation Timing

New Jersey DOT staff shared that the transportation agency, including staff and administration, should not underestimate the amount of time that will be required to implement legislation. All parties need to understand this issue and allow time between the adoption of the legislation and the required implementation date. This interim time allows staff to properly develop the enacting regulations and procedures, as well as all of the detailed aspects, such as application forms and review checklists. The agency must also allow adequate time for staff hiring and training.

Administrative Support

If a transportation agency, such as a state DOT, is going to successfully develop and implement an access management program, there must be administrative support. The agency administration must be patient and understanding of the time and resources required to establish an access management program. The bottom line is that the administration should at least allow, if not encourage, the program development.

If the agency administration is not in support of an access management program from the outset, there are at least two methods staff can utilize to promote the idea. Most importantly, the access management program should follow a consistent theme, while addressing all relevant perspective, such as safety, design, right-of-way, etc. A consistent theme will provide a solid foundation for making decisions about the program.

Another important method is to build a case for access management based on success stories in other locations and local information. The Oregon experience showed success in gaining agency support for their program through background provided by their scientific documentation which provided supporting evidence that access management is necessary and beneficial. In order to prepare such documentation, the authors obtained numbers on accident rates and attributable costs (including property damage, injuries and fatalities) relevant to access management. Additional support can be obtained by analyzing accidents related to intersections (including driveways) and by breaking out statistics between urban and rural roads. Such data should be tracked for several years. If possible, it is helpful to compare accident histories of two similar roads built several decades ago - one with some type of median barrier and one without.

Another related method that can be used to promote access management is to address is the cost of additional relief routes. Staff may develop comparisons between the costs of building relief routes (also referred to as bypasses in some states) to the costs of retrofitting existing streets with access management techniques. The staff may also compare the expenses of new roads to be built with and without access management techniques, as well as the costs of relief routes if access management techniques are not included. This information is important when discussing the value of implementing access management techniques, in order to preserve the viability of existing or new roads.

MARKETING ACCESS MANAGEMENT

In addition to possibly needing to sell DOT administration on the idea of access management, it is necessary to market the benefits to other stakeholders as well. Marketing access management was a consistent theme among all of the DOTs interviewed in the research project. A long-time coordinator of one access management program, Philip Demosthenes of Colorado DOT, stated that after many years he is still selling, still problem solving, and still acting like it's a new program that is always under pressure. This interviewee added that, in the early years, the best marketing tool was a set of a few hundred aerial photos, and a few ground photos showing the "good, bad and ugly." Emphasizing the "bad" - this is the problem and access management is the solution - can be very influential when presenting access management to stakeholders. At the same time, it is important to keep in mind and show what good access management looks like - as if to say, "see, that doesn't look bad, it's not scary." The person marketing access management should explain that it involves better decision making and better unitization of current and proven engineering and design. Collecting and presenting accident-related statistics will also aid in marketing access management.

There are many opportunities to market access management to groups through the use of speakers. However, there are also individuals and groups that may be more effectively targeted with printed materials. It is also constructive to develop a user-friendly document that most people can understand. Such a document needs to clearly explain the intent and contents of the access management program. Producing and distributing the document(s) will make the program development go much more smoothly than it would proceed otherwise. It will help give the stakeholders the best opportunity to know exactly what is being proposed.

PROGRAM OPERATION/MAINTENANCE

An access management program must have a full time specialist committed to it from the very beginning. This specialist does necessarily need to have a great amount of access management experience, but should at least have good technical and people skills and be willing to learn about access management. This type of controversial, political, legal and complex program will not run on its own. It will be one of the few regulatory programs within a DOT. One interviewee stated this idea very plainly by saying, “the program must have a specialist - unless you simply want a mediocre program with mediocre results.” The program needs a coordinator who can serve as the focal point for questions and concerns from everyone involved, as well as to ensure that the program develops and grows in a positive direction.

A lesson learned from the New Jersey experience is that once the access management program is up and running, it is vital to make sure there is cross-communication between project-oriented staff and permit-oriented staff, if they are separate. The coordinator of one well-established program reported that such cross-communication had been lost in their agency. This cross-communication insures consistent application of the same set of regulations. It also allows the permit staff to inform applicants about proposed projects that may affect their property.

POTENTIAL BARRIERS AND OBSTACLES

While there are a myriad of barriers and obstacles that can and do present themselves when developing and implementing an access management program, several specific ones were mentioned by interviewees in the research project. Most, if not all, of these barriers and obstacles stem from two issues - money and people.

Money

Many officials' experiences have shown that there will likely never be enough money to do everything in the best possible way and there will always be competition for available funds. Persons involved in developing an access management program should realize the need for funding from the outset. Keeping this need in mind will help stress the importance of proving the value that access management provides to the infrastructure and the motoring public. It is also important to keep in mind that political priorities internal to each agency will have great impacts on how funds are spent.

People

Staff

While the issue of money is relatively simple - the consensus says that you need as much as you can get - there are several barriers and obstacles related to people. One "people" issue is similar to the general "money" issue - you need as many people as you can get. In addition to the dedicated access management program coordinator, there needs to be enough people to handle all of the work involved. People are needed for a variety of tasks, including processing permits and requests, reviewing sites and plans, performing legal work and research, and working with the public. All persons interviewed emphasized the need to have an adequate number of people on staff.

Politics/Bureaucracy

Developing and implementing an access management program can be a politically sensitive issue, since it potentially affects many stakeholders. Several DOT officials interviewed stated the need to be aware of this fact, so attempts can be made to not upset stakeholders, whether they are internal or external to the transportation agency. Colorado DOT staff explained that this goal can be accomplished by using appropriate, quality educational materials that explain all aspects of access management, including the benefits and costs. Program developers need to be aware of the specific concerns and lack of knowledge that stakeholders will likely have and be ready to address as many issues as possible. Specially targeted efforts may be required in order to thoroughly explain information to some people that may be more easily understood by others.

In order to obtain and/or maintain internal administrative support, proper agency protocol must be respected. In some cases, it may be necessary to go through chains of command to talk to necessary people and make progress. This may occur in the implementation as well as the development of the program. Some examples of where protocol issues may be involved include obtaining authority for the access management coordinator to make decisions and request staff time from other divisions, departments or agencies. More than one interviewee stressed that it is more work than one person can accomplish.

LEGAL ISSUES

There are numerous potential legal issues that may arise when developing and implementing an access management program. Decisions have to be made regarding legislation that authorizes and enacts the program. Other issues correspond to property rights, takings and access rights. This section highlights a few of the concerns that were discussed in the interviews with state DOT officials.

Regulations

New Jersey DOT staff shared that writing clear, accurate and complete regulations in proper regulatory language and voice was suggested as a method to enjoy success related to legal issues. Testing all the ways the rules will be used, and running all the various scenarios to test the text and the standards are ways to ensure that this goal is met. One interviewee stated that the weaker the rule is, the faster it will be ignored.

Case Law

Case law is based on decisions in previous legal cases. While those decisions may not be overturned, it is important to keep in mind that case law interprets legislative law. The legislature can change case law by enacting new legislation. Therefore, each state needs to understand its case law in order to write new law and regulations. A new access code/regulation will help change future decisions in case law. Knowing other states' case law helps understand the complexity.

It is important to have one attorney from the Attorney General's office responsible for access management work. That way he or she will be able to learn a great amount about the engineering and planning issues that affect legal cases. Discussions with the Attorney General's office, in order to determine who has authority if the State is going to give cities the right to review access management plans and related requests, are a vital part of the overall program. Clear rules related to these processes must be established and followed.

WAIVERS

Every access management program must be flexible enough to allow for situations that cannot be predicted and/or are out of the ordinary. It is not possible to create a specific rule or regulation for every potential scenario that may materialize. Therefore, the program must allow for waivers "on both sides of the counter," for the public and for the transportation agency.

One concern that needs to be addressed is consistency among various waiver requests and responses. A suggestion to help provide some consistency it to establish a database in which all waiver requests and answers are entered. This will provide various application reviewers a means of referencing similar previous requests.

While it is necessary to provide flexibility through waivers, one interviewee emphasized the importance of keeping waivers to a minimum by stating that the Code is a tree and every waiver is a whack at the tree with an axe.

Another suggestion regarding the waiver process is to not include drawings, since they are difficult to amend. It was further stated that with such figures you not only bind the property owner, but you also bind the DOT.

"IF I COULD DO IT AGAIN"

One of the questions asked during the interviews was, "if you had it all to do over again, what would you do differently?" Some of these responses repeat points made previously, but are important enough to include in this section as well, since they were reiterated by the interviewees. Since these points were made more than once, they may be some of the most important issues related to developing an access management program.

- Have more staff, a better developed program and more money to support projects to improve access locations with proven accident records.
- Spend more time on education up-front.
- Start by trying to define what the law means (considering that we started with a law); a lot of issues have come up related to intent of the law.
- Broaden our stakeholders list.

- We started with urban, suburban and rural standards, but, you have to be able to establish where such areas begin and end; it is difficult to paint a suburban line on the ground.
- I would develop the law and the program at the same time; that way you involve all of the constituency groups and develop laws and regulations more smoothly. It would be beneficial to at least go a good way down the path with the two together.
- If the law will say regulations have to be adopted within a certain amount of time, make

sure it is a reasonable amount of time.

- You won't get it right the first time - "perfection is the enemy of the good" - you will spend too much time trying to perfect it and won't ever finish.
- Do not ignore highway projects - make sure there is wording on how to implement the program other than through permits.
- We would have actual legislation, instead of relying on the [State Transportation] Commission for everything.
- To avoid as much political pressure as possible, there needs to be an actual access management bureau or section within the state DOT. Such a group would bring together staff with experience and expertise.

CONCLUSION

This paper has presented the majority of suggestions made by state DOT officials in states where access management programs are being successfully operated and in states where programs are being developed. The authors hope that these "lessons learned" will be useful to officials in cities, counties, states and provinces where access management programs are being developed or refined. It is important to note that not every suggestion presented is applicable for every agency, but this collection of "lessons learned" provides a menu from which to choose.

FOR FURTHER INFORMATION

Additional and more specific information on these and other issues may be found in documents produced by various research institutions and state DOTs. Some examples are:

- New Jersey DOT Design Manual - Metric (provides examples of jughandle designs)
- New Jersey State Highway Access Management Code
- Montana DOT Access Management Plan
- Colorado State Highway Access Code
- Access Management CD Library (see also www.accessmanagement.gov)
- Center for Urban Transportation Research (University of South Florida) web site (www.cutr.eng.usf.edu)

In addition to these resources, the authors of this paper will be publishing a research report with much more detailed information. It is likely to be available from the Texas Transportation Institute in the Spring of 2001.

Median Related Issues

Monday-August 14, 2000 – 10:00 AM – 11:30 AM
Track 2 - Technical

INDIRECT LEFT TURNS -

THE MICHIGAN EXPERIENCE

By

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ABSTRACT

INDIRECT LEFT TURNS – THE MICHIGAN EXPERIENCE

BY

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Left turns at intersections have been a recurring problem, especially at suburban intersections. To simplify conflicts, indirect left/U-turns in advance or beyond intersections have been increasingly utilized. The Michigan Department of Transportation has provided U-turn channels on highways with wide-medians and prohibited all left-turns at signalized intersections for many decades. More recently Oakland County, Michigan has installed “U” turns on some of its arterials.

This paper provides an overview and analysis of the Michigan “U”. It describes the origin, features and application of the concept, with a focus on the Detroit metropolitan area – including the more recent applications in Oakland County. It presents the reported safety and operational benefits, and community response. It compares capacities and service levels with those for more conventional facilities.

The paper also gives a case study of Telegraph Road (US-24) in six-to-eight lane roadway carrying up to 100,000 vehicles per day. It describes the signal coordination, traffic flow, and travel times/speeds as well as safety. It also describes the Livernois Road Experience in Oakland County.

Finally, the paper describes the access management implications, and the opportunities for application elsewhere.

INDIRECT LEFT TURNS - THE MICHIGAN EXPERIENCE

Left turns pose problems at driveways and street intersections. They increase conflicts, delays, and crashes, and they complicate traffic signal timing. Therefore, left turns have been given increased attention both in access management plans and roadway design concepts.

The Michigan Department of Transportation (MDOT) has long believed that the best way to improve safety and capacity along wide median divided highways is to prohibit left turns at signalized intersections and to install directional "U Turn" crossovers downstream from the nearby signalized intersections. The crossovers then accommodate the left turns that would otherwise occur at signalized intersections. MDOT has installed these crossovers for more than forty years.

The discussion that follows provides an overview and analysis of these directional median crossovers. It describes the origin, application, and design features, presents the reported safety and operational benefits, and gives some case studies.

BACKGROUND

Several highways in Michigan, particularly in the Detroit area, were constructed with wide medians on wide rights-of-way. Many of these medians are 60 to 100 feet in width and were built in semi-rural areas decades ago to separate opposing directions of traffic and to provide an adequate median width for landscaping and beautification. The wide rights-of-way were originally established for “super highways” as they were called, in the 1920’s. By the early 1960’s many of these highways were experiencing capacity problems, generally because of interlocking left turns within the bi-directional crossovers at the major street intersections. To correct this capacity problem, directional (one-way) crossovers were constructed through the median on the far sides of the intersection of the major crossroads, and the left-turning traffic was required to use the crossovers. The prohibition of left turns at signalized intersections permits two-phase traffic signal control, increases in capacity and improves safety.

Today, there are more than 425 miles of “boulevards” with directional crossovers on the state highway system.(1) Most of these crossovers are found along divided highways in the Detroit Metropolitan Area. The ‘U’ turns have been provided wherever the central median is at least 50-to-60 feet.

Figure 1 shows the extent of the 116 miles of MDOT “boulevards” in Wayne and Oakland Counties in the Detroit Metropolitan Area. Directional ‘U’ turns are found on major arterial roads such as Telegraph Road (US24), Woodward Ave (M-1), Fort Road (M-85), Eight Mile Road (M-102), Grand River Ave (M-5), Michigan Road (US12), Northwestern Highway (M-10), Hall Road (M-59), and M-15. Interchanges have been provided at a few locations where these major highways cross (i.e. 8-Mile Road at Telegraph and Woodward).

Table 1 summarizes 1998 traffic volumes and crash rates for these trunk line highways. Traffic volumes range from about 9,000 vehicles per day (Fort Road) up to 147,000 vehicles per day (Northwestern Highway). The crashes (accidents) when normalized by distance and traffic volumes range from about 1 to 6 accidents per million VMT.

The extent of these indirect left turn lane designs, and the estimated time periods when these lanes were probably installed are as follows.

Table 1

1998 Traffic and Crash Data
State Highways With Indirect Left Turns in the Detroit Area

Wayne County Route:	Terminus	Terminus	Distance	Low ADT	High ADT	Crashes	Crash/Mi.	Est. Crash Rate/ Million VMT(1)
M-102/8Mile Road	Grand River	I-94	20.4 Mi.	28,700	82,500	1035	101.4/Mi.	5
M-5/Grand River Ave	Middlebelt Road	Telegraph Rd.	2.9 Mi.	20,500	31,000	165	56.9/Mi.	6
M-85/Fort Road	I-75/Monroe Co.	I-75	14.6 Mi.	8,700	39,900	502	34.4/Mi.	3.8
US-12/Michigan Rd.	Wayne Co. Line	Greenfield Rd.	15.0 Mi.	12,800	49,600	951	63.4/Mi.	5.6
M-1/Woodward Ave	McNichols Road	South Boulevard	16.0 Mi.	19,800	79,900	967	60.4/Mi.	3.4
US-24/Telegraph Rd.	Eureka Road	8 Mile Road	17.5 Mi.	18,300	75,800	1616	92.3/Mi.	5.4
Oakland County								
US-24/Telegraph Rd	8 Mile Road	Orchard Lake Road	13.7 Mi.	56,600	96,000	1411	103.0/Mi.	3.7
M-10/Northwestern	I-696	14 Mile Road	4.0 Mi.	74,800	146,800	905	226.3/Mi.	5.6
M-59	Oakland Co. Line	Porter Road	7.5 Mi.	24,500	31,000	92	12.3/Mi.	1.2

Notes: (1) Based on Average of Low and High ADT

Source: Michigan Department of Transportation

Wayne County 3.

M102 8-Mile Road. This boulevard section is about 20.4 miles and serves as the dividing line between Wayne County and Oakland and Macomb Counties. It extends from Grand River Avenue on the west to I-94 on the east. In 1968, a major improvement was made and lanes were added to increase capacity. This may have been when indirect left turns were introduced and median crossovers were signalized. 1998 daily traffic volumes ranged from 39,000 at the west terminal to 82,500 near the Lodge Freeway (M-101) and decreased to 23,700 on the east terminal near I-94. The approximate crash rate was 5.0 crashes per million VMT.

M-5 Grand River Avenue. This boulevard section extends 2.9 miles from the northwest of Middlebelt Road to the southeast of Telegraph Road. A major improvement was made in 1960. 1988 daily traffic volumes ranged from 20,500 to 31,000; and the estimated crash rate was 6.0 crashes per million VMT.

M-85 Fort Road. The boulevard section extends from I-75, one mile south of the Wayne/Monroe County line northeasterly 14.6 miles to I-75 in the City of Detroit. A major improvement was made to this section in 1956. The improvement probably included added capacity, and it is likely that the indirect left turns were introduced at that time. 1988 daily traffic volumes ranged from 8,700 VPD at the southern terminus to 39,900 near the northern terminus in Detroit. The estimated crash rate approximated 3.8 crashes per million VMT.

US-12 Michigan Avenue. This boulevard section is 15 miles in length. It extends from the west Wayne County line to Greenfield Road in Dearborn. A major improvement was made in 1972 to this roadway, which may have involved converting it to a boulevard section with indirect left turn provisions. 1988 daily traffic volumes ranged from 12,800 vehicles per day at the western terminus to 49,600 at the eastern terminus (Data Drive). The estimated crash rate was 5.6 crashes per million VMT.

M-1 Woodward Avenue. The long boulevard extends from McNichols Road in the City of Detroit in Wayne County to South Boulevard in the City of Pontiac in Oakland County. It is approximately 16 miles in length. The last major improvement was made in 1969. There is some question as to whether indirect left turns were introduced at this time or earlier. 1998 average daily traffic volumes ranged from 19,800 to 79,900. The estimated crash rate was 3.4 crashes per million VMT.

US-24 Telegraph Road. This boulevard extends from Eureka Road in Taylor, Michigan (Wayne County) to Orchard Lake Road near Pontiac (Oakland County) - a distance of approximately 33 miles. A major improvement in 1959 probably included widening and providing indirect left turns. Telegraph Road has several freeway and arterial interchanges, but it also has many at-grade intersections with provisions for indirect left turns. 1988 average daily traffic volumes in Wayne County ranged from 18,300 VPD at its southern terminus (Eureka Road) to 75,800 at I-96. Average daily traffic volumes in Oakland County ranged from 56,600 at the Northern Orchard Lake terminus to 96,000 at about 12-Mile Road on the south. The estimated crash rates were 5.4 crashes per million VMT in Wayne County and 3.7 in Oakland County.

Oakland County

M-10 Northwestern Highway. This boulevard section extends about 4.0 miles from I-696 northwesterly to 14 Mile Road. A major improvement was made in 1963 probably included capacity improvements and indirect left turns. 1998 average daily traffic volumes ranged from about 74,900 to 148,600. The estimated crash rate was 5.6 crashes per million VMT.

M-59. This road has several sections of boulevard within Oakland County. In total there are approximately 7.5 miles of boulevard with indirect left turns beginning at the western county line and extending easterly to Porter Road. However, there is no indication when they may have been introduced. The last major road improvements were made in the early 1980's. 1998 average daily traffic volumes ranged from 24,500 to 31,500 VPD. The estimated crash rate was 1.2 crashes per million VMT.

M-5. A two-mile "boulevard" section of M-5 between 12 and 14 Mile Roads was open in 1999. It has a wide median with provisions for indirect left turns.

Several county roads in Oakland County also contain indirect left turn lanes. Wide-median boulevards include the following.

1. Long Lake Road from Coolidge Highway to Rochester Road. This 3-mile section has an ADT of 22,000 vehicles per day.
2. Crooks Road from Long Lake Road to Square Lake Road. This section is slightly over 1-mile in length and has an ADT of 30,000 VPD.
3. Big Beaver Road from Coolidge Highway to Dequindre Road. This section is 5 miles long and carries between 53,000 and 66,000 VPD.

Livernois Road - a narrow median boulevard has an ADT of 32,000 VPD. This section is about 1.25 miles long.

DESIGN FEATURES

The design concept for the Indirect Left Turn Strategy (sometimes called the "Michigan U") is shown in Figure 2. The key features include:

1. Two-phase signal operation at the major intersection where all left turns are prohibited.
2. Directional U-turn crossovers for left turns located about 660 feet on each side of the signalized intersection. These may be coordinated with side streets and are sometimes signalized. (The signalized left turn eliminates cross weaves into the opposing traffic).
3. Right turn lanes on the artery and cross street.
4. Left turn lanes in the median of the artery for the U-turn crossovers.
5. Coordination of signals in each direction of travel along the artery to ensure progression.
6. Minor cross street intersections that are unsignalized become two “T” intersections. Thus, there are no direct unsignalized crossings of the median.

The current design template for the indirect left turn was officially established with design guidelines adopted by MDOT’s Traffic and Safety Division in December 1987. The actual construction of this design had occurred many years before then, but the guidelines were established to provide guidance to MDOT’s Design Division for various right-of-way and/or cross street options. They contain the dimensions, spacings and operations that should be considered.

The required median width was based on field tests of various design vehicles. These led to the minimum designs for ‘U’ turns set forth in Figure 3. The directional crossovers require a 60-foot median to accommodate WB-50 trucks on a six-lane highway, or a 50-foot median on an 8-lane highway. If encroachment into an auxiliary right turn lane is allowed, the required median width could be reduced 10 feet.

The desired location of crossovers is 660’ ±100’ from the signalized intersection. Additional crossovers may be provided at 660-foot intervals in urban areas and 1320-foot intervals in rural areas.

In urban areas where major developments occur frequently, midblock back-to-back directional crossovers are sometimes constructed to service these developments and to minimize travel time. The spacing between these midblock crossovers is set at 150 feet (100-foot minimum).

A typical signing plan for left turn movements is shown in Figure 4. A series of directional signs are complemented by appropriately placed regulatory signs.

BENEFITS AND IMPACTS

The safety and traffic operational benefits of directional median crossovers have been well documented. The indirect left turn strategy results in lower accident rates, increased capacity, and less travel times.

Safety.

The overall safety effects of directional crossovers, and bi-directional crossovers as reported in a Michigan State University Study(2) are summarized in Table 2. Directional crossovers have one-third the accident rate of two-way left turn lanes and about two-thirds the rate of that for bi-directional crossovers.

Table 3 compares the accident rates by type of accident for “boulevard” designs (both directional and bi-directional crossovers) with those for two-way left turn lanes. The boulevard designs have lower crash rates for all types of crashes. The major accident reductions with boulevard designs involve driveway and head-on left turn crashes.

The accident reductions resulting from replacing four bi-directional (full) median openings on 0.43 miles of Grand River Avenue in Detroit, Michigan, with directional openings are shown in Figure 5. The average number of accidents per year from 1990 to 1995 were reduced from 32 to 13 -- about a 61-percent decline. Angle crashes were reduced by 96 percent, sideswipes by 61 percent, and rear-end accidents by 17 percent. Injury accidents decreased by 75 percent[1].

The safety benefits of directional versus bi-directional crossovers as a function of traffic signal density were analyzed for 123 segments of boulevard containing 226 miles of highway[2]. The results, shown below, indicate that directional crossovers have increasingly lower crash rates (accidents per 100 million vehicle miles) as traffic signal density increases. For typical suburban conditions, with signal densities of one or more signals per mile, the crash rate for directional crossovers was about half of that for bi-directional crossovers.

Signals Per Mile	Completely Bi-directional	Completely Directional	Percent Difference
0	420	480	+14
>0 - 1<	533	339	-36
1 - 3	1,685	856	-49
>3	2,658	1,288	-52

Traffic Operations.

Operational benefits include increased capacity, reduced travel times and improved signal coordination. Even though all left-turning traffic must pass through the traffic signals twice, by prohibiting left turns at the intersection of two roads only two phases are required, and more green time can be given to the through traffic on both roads. Several studies have documented the capacity gains and delay reductions.

Capacity.

A study by Koepke and Levinson[3] found that the directional crossover design provides about 14 to 18 percent more capacity than the conventional dual left-turn lane designs. Table 4 summarizes the detailed analysis results. Results of a critical lane volume analyses, taking into account overlapping traffic movements, show reductions of about 7 to 17 percent in critical lane volumes, depending upon the number of arterial lanes (6 or 8) and the traffic mix; see Table 5.

A Michigan study[1] cited capacity gains of 20 to 50 percent as a result of prohibiting left turns at intersections and providing two-phase traffic signal operations. Reported level of service comparisons for four- and eight-lane boulevards, suggested a 20-percent capacity gain (Figure 6). This increase is consistent with that estimated by Koepke and Levinson[3].

A study by Stover[4] computed critical lane volumes for the intersection of two six-lane arterial roads. Using these volumes, analyses conducted for NCHRP 420 computed the effects of redirecting left turns. The various comparisons are summarized in Table 6. The provision of dual left-turn lanes on all approaches reduces critical lane volumes by 12 percent over just providing single left turn lanes, but still requires multi-phase traffic signal controls. The rerouting of left turns via directional crossovers and their prohibition at the main intersection reduces critical lane volumes by 17 percent.

Travel Times.

Simulation analyses performed by Michigan State University[2] addressed whether or not the delay savings for through and right turning traffic are offset by the extra travel times imposed on left-turning traffic. The TRAF NETSIM model was applied to a six-intersection network, with spacing of 1/2 mile for three basic conditions: (1) Direct left turns from a 5-lane section; (2) direct left turns from a “boulevard”; and (3) indirect left turns from the "boulevard". The simulations found that indirect left turns experience less delay than direct left turns and that overall travel time in the network is less whenever the major entry links have a 50% or more saturation. At 70% saturation, the average travel time in the network was reported at 4.5 minutes per vehicle for directional crossovers versus 6.0 minutes per vehicle for two-way left-turn lanes (33 versus 25 mph).

Thus, the greater distances traveled by left turn vehicles via indirect left turn crossovers are offset by the reduced intersection delay.

Traffic Signal Progression. Two-way signal progression is possible at all times of the day on sections of divided roadways with directional crossovers. This is because signals for both directions are needed only at major crossroads that are locted at the mile or half-mile points. Other signals can be added at directional crossovers on side of the roadway to provide gaps. Since they effect only one direction of travel these signals can easily fit into the direction’s progression.

SUCCESSFUL MEDIAN MODIFICATIONS PROJECT -- *CASE STUDY*

By

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ABSTRACT

It is necessary to plan and create sufficient access and travel patterns as development occurs along the highway system. Operational or collision problems can occur when large developments have access only along the highway. Congestion and collision problems arise due to the conflicts between traffic entering and exiting the facility competing for gaps in highway traffic.

An operational and safety problem existed at a divided highway in an suburban area with several commercial development accesses located solely along the highway; no alternative access from the local street system existed. An improvement project was undertaken to address the safety and operational concerns. The project incorporated measures to separate major conflicting movements, increase left turn storage, and remove U-turns and left turns from the through traffic lane. In addition to highway changes, some driveway and site changes were necessary to ensure internal travel patterns conformed with access and operational changes.

A before and after study was conducted to evaluate the project's impact. The safety impact review revealed that this segment has decreased from 55 collisions for the two years before the project to only 12 collisions (78% decrease) for the two years after the project was complete. Furthermore, the congestion problems observed prior to the project were also addressed.

The median and driveway modification project addressed the specific mid-block collision problems it sought to correct without adversely affecting any other portion of the highway. This significant reduction in collisions demonstrates the safety benefit of access and operational changes. Median and access modifications measures can be used in reducing crashes and improving the operation of both the state highway and business properties along a highway.

INTRODUCTION

Maintaining a safe and efficient highway system hinges upon creating sufficient access and travel patterns for residential and commercial developments located along the highway. Operational or collision problems can occur when high traffic generators have access only along the highway with no alternate access. Traffic entering and exiting the facilities must find gaps in through highway traffic. Often, both ingress and egress conflicting moves cannot be accommodated at the same access point. Congestion and collision problems can arise due to the delay and difficulty exiting the facility because vehicles entering the driveway have the first opportunity to utilize the gaps in highway traffic.

Several operational and safety problems existed along a half-mile segment of a six-lane divided highway within the Wisconsin Department of Transportation, Southeastern Wisconsin jurisdiction. This segment of Highway 100, between the signalized intersections of Layton Avenue and Cold Spring Road, has a posted speed of 40 mph. The 30' wide median has raised curb and gutter with limited median openings (See Figure 1, Study Area Exhibit). The businesses directly along the highway are separate from the residential area. No other access existed to allow the business traffic to depart from a side road and utilize the signalized intersections for alternative access onto the highway. As a result, several collision and congestion problems occurred.

The operational and traffic problems must first be fully understood in order to determine appropriate improvement alternatives. The community and businesses requested a traffic signal to address collisions at one business driveway. This measure is not necessarily the best improvement to address the issues. First, crash data and operational issues were reviewed to determine the specific problems. Project objectives were then established for considering alternatives. This led to establishing study project objectives and selecting improvement measures. The before and after improvement crash data was evaluated to demonstrate project effectiveness. This report will also discuss techniques for improving operation and safety which were developed based on this project.

FIGURE 1   STH 100 STUDY AREA

STUDY INVESTIGATION

Data collection and analysis is imperative to understanding the problem and issues.

Improvement measures at one median opening can affect the overall operation along the segment. To review the problem in a comprehensive manner, the entire half-mile segment would require study.

Volume data was collected to conduct a signal warrant study and capacity analysis. Distance measurements, collision diagrams, speed data, driveway locations, and internal circulation patterns were all evaluated during the investigation phase. Retrieval of the crash data and field observations revealed specific collision and congestion problems along this highway segment.

A collision diagram was prepared for the two years prior to the improvement project (See Report Appendix -- Figure 2, Before Project Collision Results – 1993 & 1994). The highway segment from the median south of Layton to Cold Spring Road, had 135 total crashes for the two year study period. This highway segment, which was counted in 1993, has an annual daily traffic count (AADT) of 28,980 vehicles. This highway crash rate of 1276 collisions per 100 million entering vehicle miles is over three times higher than the statewide average crash rate of 373. The injury crash rate of 444 injury collisions per 100 million entering vehicles was also significantly higher than the statewide average injury crash rate of 122. The signal analysis evaluation indicated that an additional signal at Armour Avenue would create poor progression and have an impact on travel speed and delay. The signal analysis evaluation indicated an additional signal at Armour Avenue would have poor progression, increase delay, and lower the average travel speed for through traffic along the highway.

A large number of collisions occurred at the Wal-mart entrance located across from Armour Avenue. These crashes involved through traffic and vehicles exiting the business. Traffic attempting to make a left turn to exit this business incur delay while waiting for both the entering traffic and through highway traffic. The high number of angle collisions here could be attributed to motorists pulling out into too small of a gap because they became impatient waiting to leave.

Motorists were also experiencing long backups due to traffic entering and exiting a cinema on the opposite side of the highway. Poor parking circulation and the close proximity of parking spaces to the driveway caused difficulties for traffic to enter and exit the lot. A large number of vehicles were exiting the lot at the same time motorists were coming for the next set of shows. Particularly on Friday and Saturday nights, traffic would queue along the highway waiting to enter the lot to park. Motorists would become impatient while stopped on the highway waiting to enter the first driveway. Some motorists would weave out of the right most lane into the middle lane to travel to the next driveway. This presented a potential side-swipe problem with full speed traffic traveling in the middle lane. Other customers would avoid the lot congestion by parking on the opposing side of the highway and walking across the highway. While the median does provide some refuge across this six-lane highway, the heavy traffic and 45 mph travel speed creates a serious safety concern for pedestrians.

In addition to the congestion and safety problems at these two businesses, rear-end crashes occurred near the signalized intersections at the median opening (See Figure 2, median opening reference numbers 1 and 2). These openings, typically called “pre-U-turn” openings, allow traffic to turn around since U-turns are not legal at signalized intersections per Wisconsin law. Several problems arise, particularly for traffic using this opening after traveling through the signalized intersection. Traffic does not expect a motorists to stop in the through lane directly after receiving a green light to continue traveling along the highway. The left turn storage needs at the Layton Ave. signal precluded establishing a left turn or deceleration lane at these nearby median openings. In addition, motorists making left turns through a "courtesy gap" in traffic queued for the traffic signal result in additional right-angle collisions.

A signal analysis and warrant study was conducted for the Wal-mart main entrance and Armour Avenue (See Figure 2, median opening reference number 3). While this is a four leg intersection, the west approach has very little traffic. Most motorists use alternate roadways to access the subdivision in order to avoid the conflicts and congestion caused by the high traffic generated by the business driveway on the opposing side of the highway. The major volumes came from the Wal-Mart entrance that serves customer traffic, not a through travel need. Signalizing this entrance, which was only 900 feet from the Layton Avenue signal, would not allow good progression. Through traffic would experience more delay and lower average travel speeds. Additional stops for main highway traffic increases the likelihood of rear end collisions. Since U-turns are illegal at signalized intersections, traffic that currently utilizes this opening to make U-turns would be redirected. A major portion of cinema traffic made U-turns at this median opening to go north after leaving the lot. This site is the only median opening with a deceleration lane before the signal. The installation of a signal here would create indirection and the potential for moving safety and operational problems further down the highway. Based on these numerous issues and disadvantages, installing traffic signals was determined not to be the correct solution to addressing safety problems at this intersection. Furthermore, signals would not address the other collision and congestion issues along this highway segment.

To develop an improvement plan which will address the safety and operational problems for the study area, a set of parameters or goals must be outlined. Each alternative needs to meet the study objectives. The alternatives can then be taken to the community and businesses to discuss the plan and impacts.

PROJECT SCOPE

To address the safety and operational concerns, specific project objectives or goals were established. These objectives allowed various alternatives to be developed and evaluated. The specific elements of the project include:

- **Separate conflicting maneuvers to facilitate safe ingress/egress to businesses on the highway.** This allows the exiting traffic to utilize all available gaps in through traffic without first waiting for the traffic turning into the driveway. This measure reduces delay for traffic leaving the site. In addition, the median opening will no longer become congested with various vehicles turning onto and off of the highway.
- **Increase left turn storage lengths at signalized intersection, as needed.** Sufficient left turn storage is needed to accommodate the traffic volume turning at the signal. If the lane is too short, vehicles will spill back into the through lane, causing a safety and operational problem. The lane may also need to be lengthened to allow left turn traffic to get into the lane without being blocked by through traffic already queued at the traffic signal.
- **Prevent left turns from occurring at locations where opposing through traffic queues for the traffic signal (requiring turning through "courtesy" gaps).** This main crash problem is avoided by allowing only left turn maneuvers at an opening past the opposing through traffic queue.
- **Remove U-turns and left turns from the through traffic lane.** Installing a left turn deceleration and storage area provides refuge for turning movements, thus reducing rear-end crashes. Interruption in through traffic flow is also reduced since the lane eliminates the

need for through traffic to suddenly stop or move to the middle lane to avoid a stopped vehicle in the through lane.

Various median configurations and traffic flow pattern alternatives were investigated. Each alternative met the project objectives, but created different ingress/egress traffic flow patterns for the area businesses. Discussing the alternatives with the businesses and community was key in understanding travel patterns and determining which configuration would best meet their need. By reviewing the overall operation and discussing concerns with the community, alternatives were refined and a final median modification plan was chosen. These partnerships were critical to creating a plan that would address both the highway and business operation needs.

PROJECT IMPROVEMENT – MEDIAN MODIFICATION PLAN

The project's main objective was to incorporate measures to separate major conflicting movements. By separating conflicting movements, motorists are able to better utilize gaps to enter or exit the highway. In addition, improvements involved increasing left turn storage at signalized intersections as needed. The project closed median openings in order to prevent left turns from occurring at locations where opposing through traffic queues for the traffic signal (requiring turning through "courtesy" gaps). Refuge areas were incorporated to remove U-turns and left turns from occurring in the through traffic lane.

The project consisted of median modifications and internal lot changes (See Report Appendix -- Figure 3, STH 100 Median Modification Plan). The changes are broken into six separate modifications which address specific safety and operational problems.

1) **Pre-U-turn opening south of Layton Avenue …** Signs restricting left turns and U-turns were installed for southbound traffic to address left turn collisions involving a vehicle turning through a gap in traffic being struck by a through vehicle in the right lane.

2) **Pre-U-turn opening north of Layton Avenue …** Close the median to address the rear end and angle collision issues. Additional storage for southbound left turns was required for southbound left turns at the signal. A new directional southbound left turn opening was created to allow access to businesses on the east side of the highway. This new directional opening has a deceleration lane to remove turns from the through lane.

3) **Existing opening at Armour Avenue and Wal-mart's south driveway …** To address the angle collision problem and delay issues, traffic was restricted from existing. This change was accomplished through internal signing changes in the Wal-mart parking lot.
4) **Wal-mart's existing north driveway …** Create a new median opening to allow traffic to exit the Wal-mart and Cinema lots. The Budget Cinema driveway was relocated to allow traffic to turn left directly from the south lot. Signs were installed on STH 100 to prohibit the conflicting mainline left turns from occurring.
5) **Existing median opening at the northerly Cinema drive and Goodyear business …** The Cinema lot was modified to restrict exiting traffic from using this driveway. A deceleration area was created to remove southbound traffic from turning from the through lane.
6) **Pre-U-turn south of Cold Spring Road …** This opening was relocated to separate the traffic turning at Cold Spring Road from left turn and U-turn traffic traveling to or from businesses along the highway. The new median opening includes a deceleration area so

turning traffic is separate from through traffic.

In addition to highway changes, some driveway and parking lot changes were necessary so that the site configurations of the businesses work with access and operational changes. These changes included:

- Several businesses have relocated/shared driveways to allow access to new median opening locations. Specifically, the McDonald's and corner business share a relocated driveway aligned with a new directional opening which allows patrons to enter these businesses from the north. The businesses near Cold Spring also share a new driveway adjacent to the relocated median opening with deceleration area. A cross access driveway for the strip mall north of the Wal-mart was added to the allow these businesses to access the median opening at the Wal-mart's north driveway.
- The Budget Cinema created a new roadway behind the building to facilitate travel to the entrance and exit only driveways. Signing and lot changes were also performed by the business to accommodate relocating the southerly driveway.
- The Wal-mart added signs and pavement marking to create a traffic pattern through their lot to facilitate the new entrance and exit only driveways.

The chosen alternative resulted in operational changes to the median and businesses to address the actual problems along the highway segment. To determine the success of the project, the collisions for the two years after the project were prepared to compare with the collision data prior to improvement project. A traveling speed study was also conducted to allow for comparison of before and after project data.

PROJECT IMPROVEMENT EVALUATION

Collision comparison

The number of collisions which occurred within the study area before (1993-1994) and after the project (1996-1997) were compared. The 1996-1997 collisions diagram demonstrates the specific location and type of crashes which occurred after the improvement project (See Report Appendix -- Figure 4, Median Modification Project; After Project Collision Results). Collision data was collected for the entire segment including the two signalized intersections of Layton Avenue and Cold Spring Road. Traffic volume data is collected on a three-year cycle. These intersections were included to ensure the mid-block median project did not merely shift the collision problem. This project segment had an Annual Average Daily Traffic (AADT) of 28,980 in 1993 and an AADT of 24,900 in 1996. The traffic volume data was used to compute collision rates (number of crashes per 100 million entering vehicles) which compares the number of crashes with respect to the traffic volume for the highway.

Table I. Before and After Collision Data for STH 100 from Layton Avenue to Cold Spring Road

	Before Project				After Project				Reduction in Total Crashes (before vs. after)
	1993		1994		1996		1997		
Location Description	Total	Injury	Total	Injury	Total	Injury	Total	Injury	
Cold Spring Road	8	2	8	3	11	7	6	2	
Between Cold Spring & Armour	4	0	13	4	1	1	4	0	
Armour Drive	16	9	13	2	2	1	2	0	
Between Armour & Layton	6	4	3	2	0	0	3	0	
Layton Ave.	30	14	20	3	14	9	8	3	
S. of Layton	6	1	8	3	4	1	6	1	
Total: Entire Segment	70	30	65	17	32	19	29	6	54.81%
Total: Improvement Project Limits	26	13	29	8	3	2	9	0	78.18%

"Total" refers to the total number of collisions. "Injury" reports the number of injury collisions.

As Table I. demonstrates, the overall number of collisions from Layton to Cold Spring Road decreased by 55% after the project was complete. The crashes for this highway segment, excluding the intersections, decreased from 55 crashes for the two years before the project to only 12 crashes for the two years after the project was complete. This is a 78 % decrease in crashes.

Table II. Before and After Collision Rate Data for the Project Area and Statewide Average for Urban Highways

	Before Project				After Project				Reduction in Rate
	1993		1994		1996		1997		
Location Description	Collision Rate	Injury Rate	Collision Rate	Injury Rate	Collision Rate	Injury Rate	Collision Rate	Injury Rate	(before vs. after)
Total Collision Rate: Entire Segment	1324	567	1229	321	704	418	638	132	28.31%
Total Collision Rate: Improvement Project Limits	492	246	548	151	66	44	198	0	74.62%
Statewide Average	396	127	350	117	355	125	313	111	10.46%

Collision and Injury Rate is reported as the number of crashes per 100 million entering vehicle miles
Collision Rate for the project is based on an AADT of 28,980 for 1993/1994 and an AADT of 24,900 for 1996/1997

The crash rate for this segment prior to the improvement project, was well above the statewide average for similar highway segments (Refer to Table II., above). The after data indicates the crash rate for the entire segment was still above the statewide average. However, the specific improvement area, excluding the signalized intersections on each end of the project, had a total rate and injury rate well below the statewide average. Overall, the collision rate for the project limits was 74.62% lower than the collision rate prior to the project. The after data also shows the total number of injury crashes and injury crash rate both dropped significantly.

Travel Speed Comparison

A traveling speed study was conducted in 1993. Data was collected for the AM peak (7-8 AM), Mid day (10-11 AM) and PM peak (5-6 PM) time periods. The study showed motorists traveled at the posted speed or above. The study involved a test vehicle traveling along the highway with the platoon of vehicles. The study area included a two-mile segment of STH 100 to allow for the test vehicle to observe the travel speed at mid-block points and stopping/starting patterns at traffic signals for the corridor. The speeds were recorded outside of the project limits and at Armour Avenue. The results of the travel speed for the mid-block point within the study limits is shown in Table III below.

Table III. Before and After Travel Speed Data for STH 100 from Layton to Cold Spring Road

	Before Project		After Project		Difference
Time Frame	Northbound	Southbound	Northbound	Southbound	NB/SB
AM Peak	40.8	44.7	42	45.5	+1.2/ + 0.8
Mid Day	42.2	43	44.3	42.75	+2.1/ -.25
PM Peak	39.9	41	42.4	44.4	+2.5/ + 3.4

Traffic Data collected in traveling speed studies conducted September, 1993 and April, 2000.
Travel Speed was recorded at Armour Avenue.

Travel speeds actually increased within the project limits and the mid-block locations beyond the study area for most time periods. Since the travel speeds increased throughout the two-mile study segment and not just within the half mile project segment, the project improvement is not likely to be the reason for the speed change. It can be concluded that the median change did not adversely affect the travel speed for this area.

CONCLUSIONS

The median modification project addressed the specific mid-block collision problems it sought to correct without adversely affecting any other portion of this highway segment. This significant reduction in collisions demonstrates the safety benefit of this project. Additionally, the travel speed was not reduced nor did the Department received complaints of operational problems with traffic entering/exiting businesses along STH 100. One minor modification was made after the project which clarified the operation of the directional left turn lane at the McDonald's restaurant (Refer to Figure 3, median site number 2). In summary, closing median openings to prohibit turns through traffic queues, separating conflicting turn movements, and providing deceleration areas for turning motorists outside the through lane are effective measures in reducing crashes and improving operation of the state highway and business properties along the corridor.

While the project was successful, retrofitting modifications to address existing problems is not ideal. Ultimately, planning access to minimize conflicts must be considered when working with development requests. To prevent problems when planning new developments, alternate access to the main intersections is necessary to direct high volume turn movements to the existing traffic signals. This minimizes conflicts at non-signalized mid-block openings on the main highway. When new signals are necessary to accommodate large developments, the signal needs to be installed at locations which connect to an internal street system so motorists can enter and exit the highway without creating excessive delay for the through highway. To ensure safe turn maneuvers into businesses, a capacity analysis and field review are needed to determine length of queues at signals. Creating deceleration refuge areas for left turns will minimize delay and the possibility of rear-end crashes. Checking existing and projected gaps will determine if the conflicting entering and existing traffic can be accommodated at the same non-signalized median opening. These steps ensure that developments are set up with good ingress/egress patterns and access points which will not incur excessive delay leading to safety concerns. Creating well planned access and internal operation will allow new businesses to operate along the highway while maintaining a safe and efficient highway system to serve new developments, existing businesses, and highway travel needs.

APPENDIX

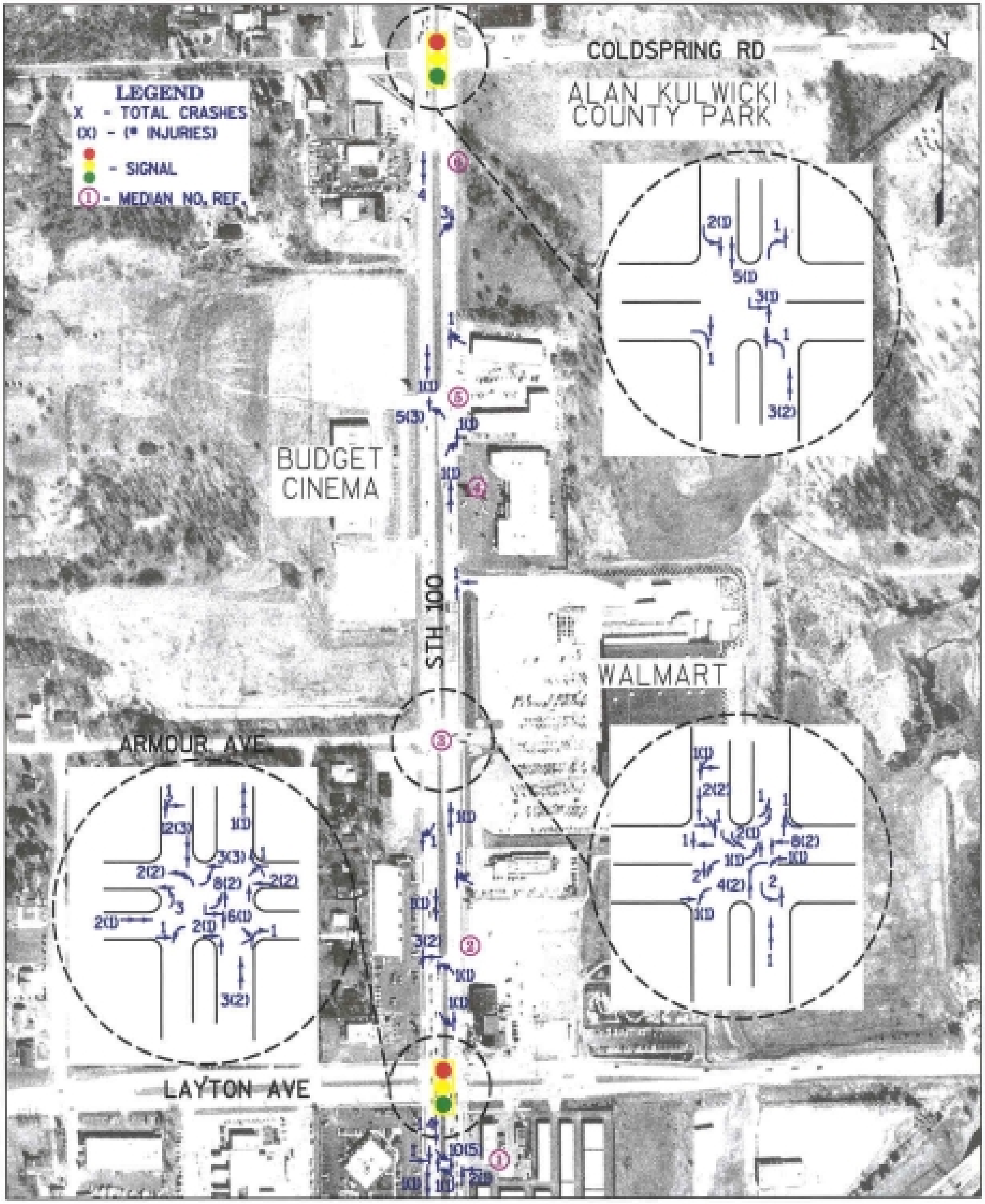

FIGURE 2 Median Modification Project; Before Project Collision Results - 1993 & 1994

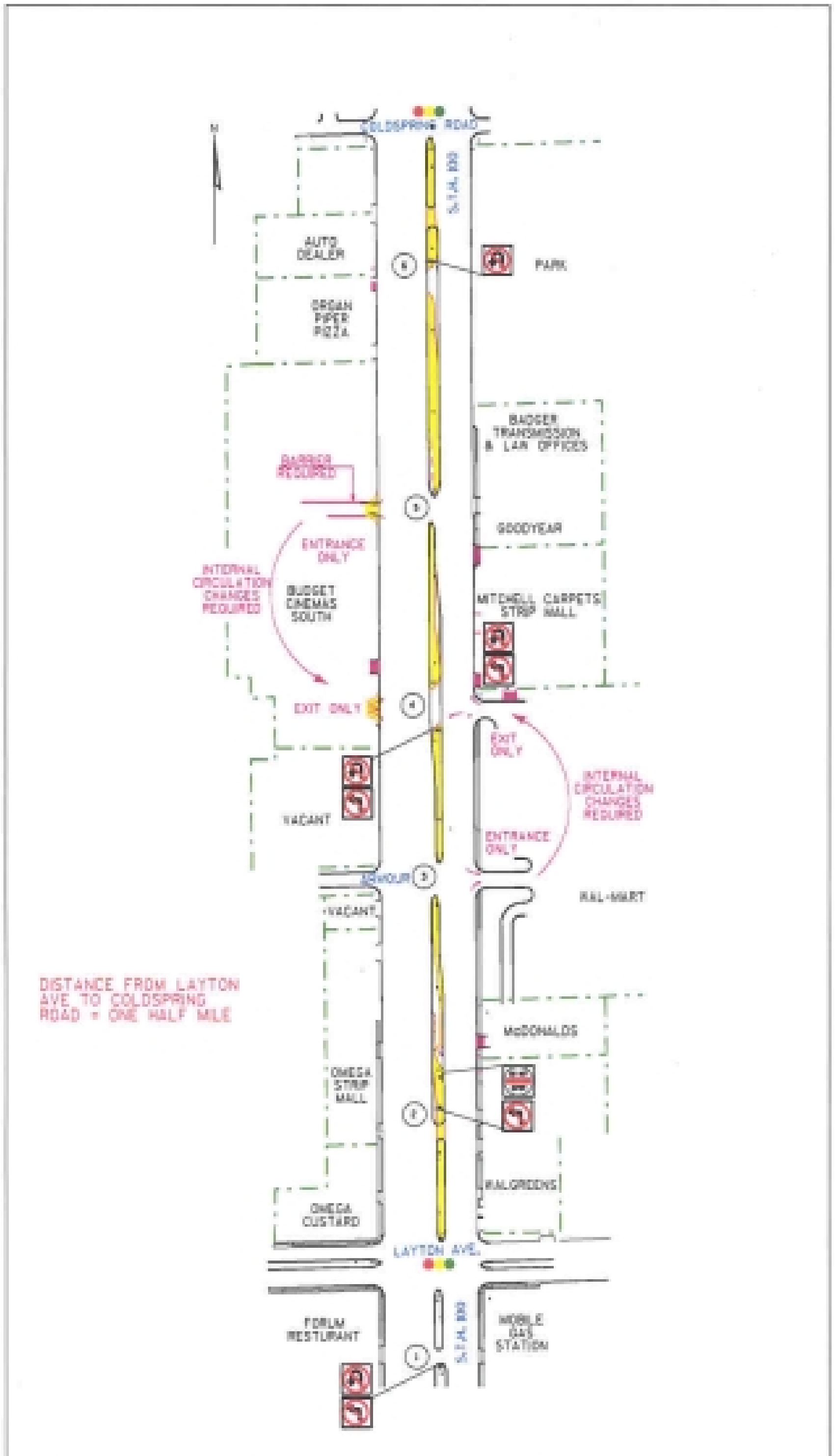

FIGURE 3 STH 100 Median Modification Plan

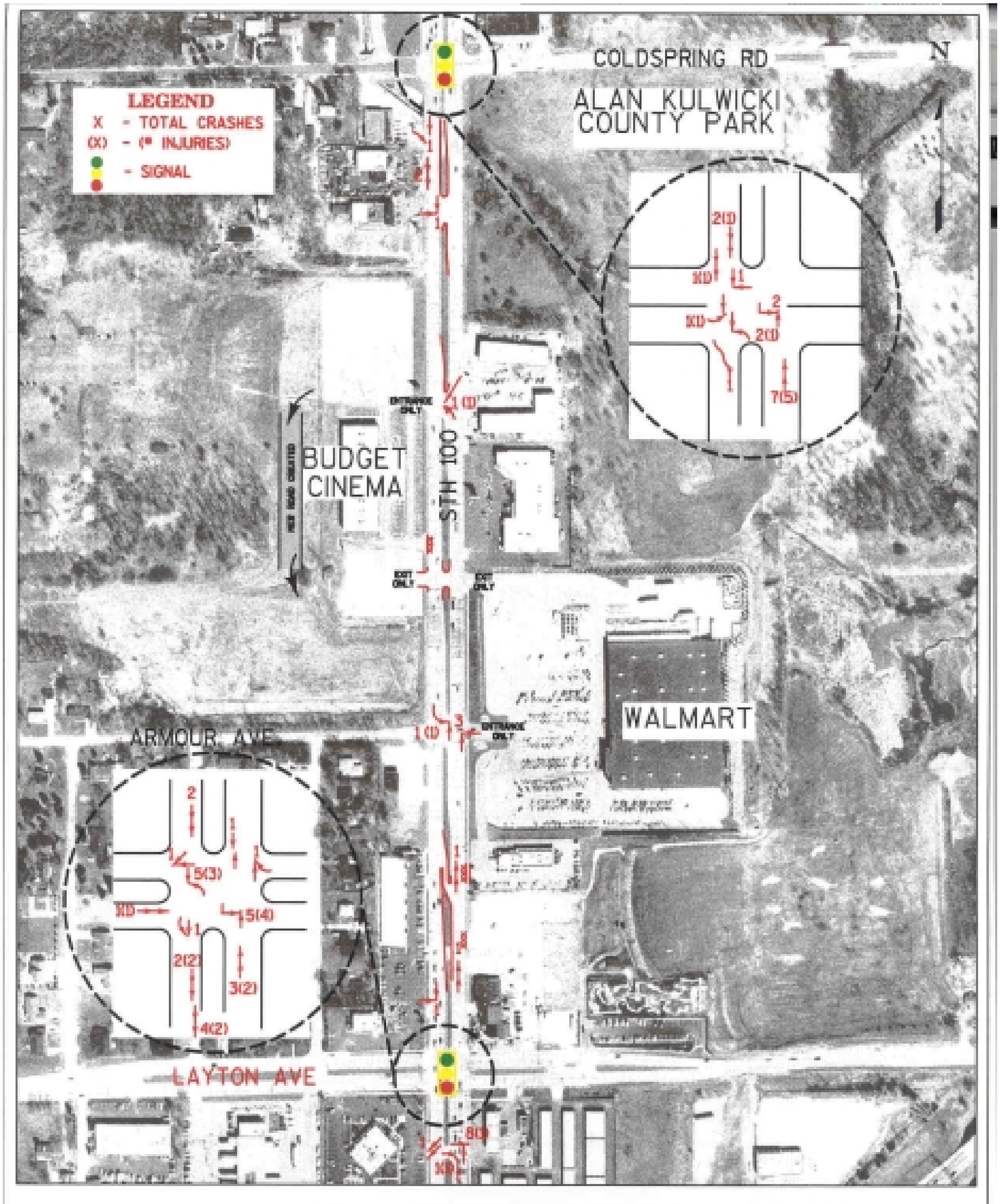

FIGURE 4 Median Modification Project; After Project Collision Results - 1996 & 1997


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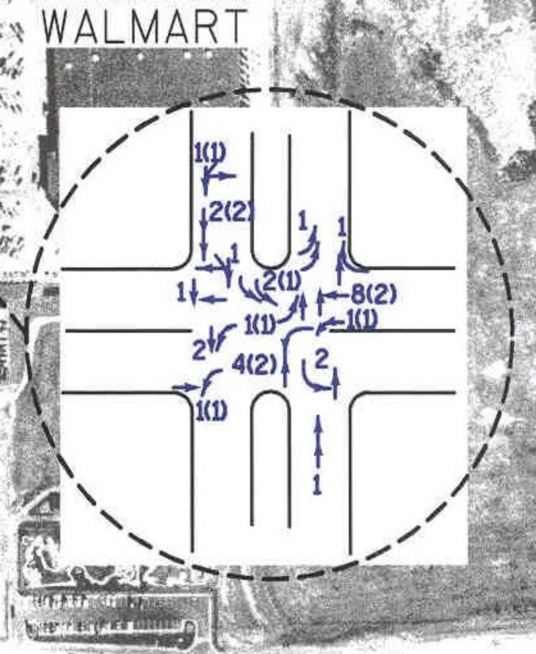

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GEORGIA STUDY CONFIRMS THE CONTINUING SAFETY ADVANTAGE OF RAISED MEDIANS OVER TWO-WAY LEFT-TURN LANES

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GEORGIA STUDY CONFIRMS THE CONTINUING SAFETY ADVANTAGE OF RAISED MEDIANS OVER TWO-WAY LEFT-TURN LANES

ABSTRACT

The Georgia DOT recently completed a large study of the crash statistics for all of the divided highways on the State Highway System for the period 1995 through 1998. The highway sections had either four or six through lanes and were classified by type of median into either a) TWLTL or b) a non-traversable center strip consisting of either a raised median with concrete curbing or else a depressed grass median and referred to simply as "raised median" or RM. It was found that the RM design is much safer than TWLTL. A striking result was that overall (intersections plus mid-block locations), RM had 78 percent fewer pedestrian fatalities per 100 miles of road, no doubt due to the relatively safe refuge area provided pedestrians by RM. A similar study performed six years earlier by the GDOT indicates that the safety gap between RM and TWLTL is widening with time. It may be that drivers increasingly distracted and inattentive to the driving task are increasingly in need of a more-structured and disciplined highway environment such as that provided by non-traversable medians.

INTRODUCTION

Since the mid-1980s the Georgia DOT has sponsored contract research (1) and performed in-house studies to determine the relative safety of two-way left-turn lanes and non-traversable medians. Gwinnett County, in metro Atlanta, took note of this and other research and by 1990 decided that, for safety, all new and reconstructed principal and major thoroughfares should be designed with raised medians; and existing arterials with two-way left-turn lanes 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 (2).

In 1990 the GDOT replaced a TWLTL with a raised-median separation along 4.34 miles of Memorial Drive in DeKalb County in metro Atlanta. In the year after completion, the project prevented about 300 crashes and 150 injuries (3). There was a 37 percent drop in total crash rate and a 48 percent drop in the injury rate. As would be expected, left-turn crashes between intersections were virtually eliminated.

The raised median caused reductions in crashes on Memorial Drive for the following reasons:

- Conflict points were reduced in number.
- Conflict areas were reduced in size.
- Pedestrians found refuge while crossing.
- Mid-block crashes dropped because of the elimination of left turns in and left turns out.
- Left turns were eliminated into and out of seven public roads and many driveways, as they were not given median crossovers (breaks in the raised median).

- All 14 median crossovers (at 10 major public-road intersections and four significant private driveways) were signalized. These are full openings, not channelized to allow only left turns or U turns.
- Intersection crashes dropped because of excellent design of geometrics, with double left-turn lanes and U-turn capabilities, and because seven intersections became right into and right out from the cross streets.

The GDOT has monitored the crash statistics on Memorial Drive since the 1990 retrofit. As of this writing in 2000, there has still not occurred the first fatality, either motorist or pedestrian, since the installation of the raised median. While the crash rate has increased during the decade, the increases have simply tracked the increases in number of crashes experienced by DeKalb County as a whole (4). That is, while the crash rate has increased during the 1990s, the benefit relative to the TWLTL design appears to have remained intact.

RECENT GEORGIA RESEARCH

The GDOT recently completed a study of the crash statistics for all of the divided highways on the State Highway System, urban and rural, for the period 1995 through 1998. The highway sections had either four or six through lanes and were classified by type of median into either TWLTL or Divided. The former indicates a flush-paved median consisting of a two-way left-turn lane, and the latter indicates a non-traversable median consisting of either a raised median with concrete curbing or else a depressed grass median. Both types of non-traversable median are hereinafter called “raised medians,” for compatibility with the literature on the topic.

The 986 sections of TWLTL studied totaled 839 miles, for an average section length of 0.85 miles. The sections varied widely in length from to 0.04 to 6.49 miles, except for one section that was over 83 miles long. The ADTs for 1997 were taken as representative and varied over a wide range from 1,200 to 68,100 vehicles per day, averaging 18,500 vpd. The daily vehicle-miles of travel (VMT) were calculated for each section by multiplying the ADT by the length; they averaged 15,725 vehicle-miles per day.

There were 1,125 sections of raised median studied, totaling 1,295 miles in length, for an average section length of 1.15 miles. The sections varied in length from 0.01 to 9.68 miles, except for one section that was 14.77 miles long. The ADTs in 1997 varied from 810 to 72,300 vehicles per day, averaging 13,900 vpd. The daily vehicle-miles of travel averaged 15,985, close to the value for the TWLTL sections.

The analysis obtained statistics for total crashes (meaning those at midblock as well as at intersections), and separately just for mid-block collisions. There was no separation of four-lane sections from six-lane sections, nor separation of urban from rural. Crash rates were calculated per 100 million vehicle-miles of travel, except that the exposure to pedestrian collisions was considered to be related more to the length of road than to the volume of vehicular traffic. Therefore, pedestrian fatalities were calculated per 100 miles of road.

RESULTS

Table 1 gives the statistics for total crashes. The table shows that raised medians had a crash rate 45 percent lower than that for the TWLTL sections, and had a 43 percent lower injury rate. The overall fatality rates for motorists and non-motorized travelers were comparable, but the rate of pedestrian fatalities was 78 percent lower for the raised-median sections.

TABLE 1. Total Crashes, Injuries and Fatalities on Georgia's Divided Highways, 1995-98

Median Type	Miles Studied	Avg. Veh. Per Day	Crash Rate†	Injury Rate†	Fatality Rate†	Pedestrian Fatalities Per 100 Miles
TWLTL	839	18,500	561	269	1.66	3.13
RM	1,295	13,900	310	153	1.59	0.69
Percent Difference, RM < TWLTL			-45	-43	-4	-78

Note: Total means including crashes at mid-block and at intersections
TWLTL means Two-Way Left-Turn Lane
RM is raised median, and includes depressed grass medians as operationally similar
† Rates are crashes per 100 million vehicle-miles of travel

Table 2 is similar to Table 1 but includes only mid-block crashes. The table shows that raised medians had a crash rate 45 percent lower than that for the TWLTL sections, and had a 48 percent lower injury rate. The overall fatality rates were 26 percent lower for the raised-median sections, and the rate of pedestrian fatalities was 78 percent lower for the raised-median sections.

TABLE 2. Mid-block Crashes, Injuries, Fatalities on Georgia's Divided Highways, 1995-98

Median Type	Miles Studied	Avg. Veh. Per Day	Crash Rate†	Injury Rate†	Fatality Rate†	Pedestrian Fatalities Per 100 Miles
TWLTL	839	18,500	173	82	0.90	1.82
RM	1,295	13,900	95	43	0.67	0.52
Percent Difference, RM < TWLTL			-45	-48	-26	-71

A comparison of the fatality rates in the tables indicates that raised medians effectively reduce total fatalities (motorists, pedestrians and bicyclists) at mid-block locations (Table 2). However, this advantage is essentially offset by the additional fatalities at intersections, resulting in little net advantage in the total fatality statistics shown in Table 1. This is understandable and points to the need for raised-median designs to include high-type intersection features such as double left-turn lanes and adequate radii for U-turns.

Perhaps the most striking statistics in the two tables are the reductions of over 70 percent in pedestrian fatalities afforded by raised medians. Two-way left-turn lanes have pedestrian fatality rates of 1.82 at mid-block and 3.13 at mid-block and intersections combined. Therefore, the rate at intersections must be 3.13 - 1.82 = 1.31, a value less than the mid-block rate. While pedestrians are supposed to cross at intersections, many are reluctant to bother to take the extra steps to reach an intersection. Moreover, many pedestrians sense the complexity of intersection crossings, and cross mid-block instead, increasing their risk (3). Raised medians provide a relatively safe refuge for pedestrians at both mid-block and intersection-crosswalk locations and are particularly vital to the safety of six-through-lane arterials where pedestrians are present.

COMPARISONS WITH A SIMILAR STUDY SIX YEARS EARLIER

The GDOT performed similar research for the four-year period 1989 through 1992 and obtained results comparable to those reported herein for the period 1995 through 1998. They are shown in Tables 3 and 4.

TABLE 3. Total Crashes, Injuries and Fatalities on Georgia's Divided Highways, 1989-92

Median Type	Miles Studied	Avg. Veh. Per Day	Crash Rate†	Injury Rate†	Fatality Rate†	Pedestrian Fatalities Per 100 Miles
TWLTL	584	17,923	623	256	2.16	3.64
RM	946	11,500	367	164	1.89	1.45
Percent Difference, RM < TWLTL			-36	-36	-13	-60

TABLE 4. Mid-block Crashes, Injuries, Fatalities on Georgia's Divided Highways, 1989-92

Median Type	Miles Studied	Avg. Veh. Per Day	Crash Rate†	Injury Rate†	Fatality Rate†	Pedestrian Fatalities Per 100 Miles
TWLTL	584	17,923	180	76	1.17	2.65
RM	946	11,500	105	47	0.84	0.82
Percent Difference, RM < TWLTL			-42	-38	-28	-69

A comparison of Tables 1 and 2 with their counterpart Tables 3 and 4 shows the following:

- Every measure of safety has improved over the six-year period, except that the injury rate for TWLTL has gone up a little.

- For the most part, safety is improving at a faster rate for raised-median sections, so the percent difference, RM<TWLTL, is increasing. That is, safety-wise there is a gap between RM and TWLTL that appears to be widening with time. The one exception is fatality rate, where TWLTL is improving at a faster rate than is RM, such that today they are almost tied.

CONCLUSIONS

Two large studies of the relative safety of two types of median treatments have been performed by the Georgia DOT since 1989. Each included four years of data and comprised very large road mileages, such that the derived data are sure to be very stable and significant statistically. Both studies showed that raised medians (and depressed grass medians) are much safer than two-way left-turn lanes, and there is evidence that the safety gap is widening with time.

While human factors are not discussed in this paper, there is no doubt that driver distraction and inattention are an increasingly important factor in crash causation, as pointed out in Reference 4. It could well be that driver preoccupation with cell phones and many other concerns unrelated to the driving task will necessitate a more structured and disciplined highway environment, including not only non-traversable medians but also more-conservative operational measures such as protected-only left-turn phasing and consistent use of red clearance intervals at signalized intersections. These changes to the highway environment may be recommended and accepted for the purpose of meeting the needs of older drivers, but in reality are as much needed by the distracted younger driver.

The data presented herein are striking for their results regarding pedestrian fatalities. The data from 1989 through 1992 show that pedestrian fatalities per 100 miles were 69 percent less for raised medians at mid-block locations and 60 percent less overall. By 1995-1998 the respective figures were 71 and 78 percent. All four rates describing pedestrian fatalities dropped sharply in the six-year gap between studies, meaning that both TWLTL and raised medians are currently experiencing lower rates both mid-block and overall than they did earlier. However, raised medians overall are experiencing 78 percent fewer pedestrian fatalities per 100 miles than TWLTL, a result that argues strongly for the provision of this relatively safe refuge in the middle of our arterials.

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Operational Effects of a Right Turn Plus U-turn Treatment as an Alternative to a Direct Left Turn Movement from a Driveway

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ABSTRACT

The Florida Department of Transportation (FDOT) restricts direct left-turn exits onto major arterials through median treatments, and provides for mid-block U-turns in advance of intersections in some areas to accommodate these movements. This research, sponsored by FDOT, evaluates the safety and operational effects of replacing direct left turns from a driveway with a right turn plus U-turn movement at varying distances from a driveway. Field experiments were performed to collect data at some typical sites. The average travel time, average waiting delay, speed reduction and conflict rate were used to measure the operational effects of replacing a direct left turn with right turn plus U-turn. Preliminary field data showed that the average waiting delay of the right turn plus U-turn movement is less than the average waiting delay of direct left turn movements. However, the total travel time of direct left turns was less than the right turn plus U-turn movement when the direct left turn volume was less than 50 vph or average queuing length was less than 3 vehicles per cycle of the upstream signal. Based on field data, it was found that there was a 1-2 mph speed difference between upstream and downstream of a full median opening. The conflict rate of the right turn plus U-turn was much less than that of the direct left turn. This paper reviews the preliminary results obtained from two test sites.

Key Words: Access Management, Traffic Operations, Traffic Conflicts, Travel Time, Speed Reduction, Delay, U-Turn Movement, and Direct Left Turn Movement.

INTRODUCTION

Florida prohibits direct left-turn exits onto major arterials in many locations through the use of nontraverseable medians, and provides mid-block median openings in advance of intersections in some areas to accommodate U-turn movements. When a full median opening was replaced by a directional median opening that only allows left-turn ingress to abutting developments, the left-turn egress movements would be made by turning right onto the arterial road and then making a U-turn downstream. Figure 1 illustrates the conflicting movements that occur with a direct left turn at full median openings and how the number of conflict points can be substantially reduced by replacing a direct left with a right turn plus U-turn. As shown in Figure 1, a right turn plus U-turn movement as an alternative to a direct left turn movement has the potential to significantly reduce traffic conflict points and improve safety. But few field data are available to substantiate this assumption. In addition, people often oppose being forced to make a right turn and U-turn due to the perception that it results in a longer travel time than a direct left turn. Hence, it is necessary to further evaluate the operational effects of these two movements, especially to compare the travel time and conflict rates.

Little documentation is available on the operational effects of providing U-turns as an alternative to direct left turns from a driveway. However, a few studies have analyzed the travel time effects associated with providing U-turns as an alternative to direct left turns. A study by Stover analyzed the operational issues associated with these two movements and established a procedure to calculate the delay in relation to upstream and downstream signal impacts using queuing analysis *(1)*. In NCHRP Report 420: *Impacts of Access Management Techniques*, an analytical model was developed and calibrated to estimate the travel time saving (or loss) in the suburban and rural environment where there are no nearby traffic lights *(2)*. The primary findings indicate that two stage left-turning vehicles will suffer longer delays than right-turning plus U-turning vehicles when the volumes on the major street are relatively high (i.e., more than 2,000 vph), and the left turns exceed 50 vph. As stated in NCHRP Report 420, this finding holds true even in cases where the right turn plus U-turn movement involves one-half mile of travel to the U-turn median opening *(2)*. A case study by Long and Helms showed that limiting access at unsignalized intersections can reduce turning volumes, increase arterial operating speeds, and improve safety *(3)*. A study by Al-Masaeid developed an empirical model to estimate the capacity and average total delay of U-turns at median openings *(4)*. There are some studies about travel time savings of the unconventional left-turn alternatives systemwide by computer simulation *(5,6)*.

This paper presents some preliminary results obtained from a research project sponsored by FDOT to evaluate the operational effects of replacing a direct left turn from a driveway with a right turn plus median U-turn alternative that is located at varying distances from a driveway. Field experiments were performed at two sites to collect traffic data. Total eighty-hour traffic data were collected at the two sites for the preliminary analysis. Traffic data (including average travel time and waiting delay, traffic conflict rate, and speed reduction due to direct left turning traffic or right turn plus U-turning traffic) were used to evaluate the operational effects of replacing a direct left turn with a right turn plus U-turn. Based on field data collected from the two sites, it was found that the average waiting delay of the right turn plus U-turn movement was significantly less than the average waiting delay of the direct left turn movement. From the preliminary study results, it appeared that there were certain speed reductions caused by traffic making direct left turns at a full median opening. Also, it showed that the speed reduction caused by vehicles making right turn plus U-turn movement at the weaving area was not significant. According the field data analysis, it was confirmed that the conflict rate caused by right turn plus U-turn traffic was much less than that caused by direct left turn traffic.

In the next phase of the research, several more sites will be selected and field experiments will be carried out at these sites to obtain more detailed results. It is anticipated that quantified procedures and approaches will be obtained from an analysis of several sites so that transportation agencies could use the procedures or approaches to assess the impacts of right turn plus U-turn treatments on traffic operations. The procedures or approaches could be used to determine whether or not to restrict direct left turn movements under certain traffic conditions.

MAIN DIFFERENCES BETWEEN THE TWO OPTIONS

Direct Left Turn

The main advantages of the direct left turn option include: (1) The delay and travel time could be less as compared to the right turn plus U-turn option under the low traffic volumes; and (2) Vehicles making direct left turns would travel less distance and may consume less gas as compared to the vehicles making right turn plus U-turns.

However, there are some concerns or disadvantages associated with the direct left turn option. These include: (1) Traffic delay and travel time may greatly increase under high traffic volume conditions; (2) Direct Left turn movements involve obtaining gaps in two directions at a time when the median is too narrow to safely store one vehicle; (3) This option results in more conflict points and vehicles making direct left turns have to yield to all other movements at a full median opening; (4) Capacity of direct left-turn movements is seriously limited by the median storage; and (5) Large trucks may block the through traffic when they are making direct left turns.

To evaluate the total travel time used by vehicles to make direct left turns, the total travel time can be defined by the following equation:

$$TT_L = t_{L1} + t_{L2} + t_{L3} \tag{1}$$

where:

TT_L - average total travel time of a direct left turn movement,
t_{L1} - average waiting delay of direct left turn vehicles at the driveway,
t_{L2} - average waiting delay of direct left turn vehicles at the median opening, and
t_{L3} - average running time for vehicles to leave the driveway to complete the left turn movement (not including t_{L1} and t_{L2}).

Total travel time can be used to evaluate the impacts of replacing direct left turn movements with right turn plus U-turn movements.

Right Turn Plus U-Turn

The main advantages of the right turn plus U-turn at a median opening include: (1) Travel time and delay could be less as compared with direct left turn movements under moderate and high traffic volume conditions; (2) The capacity of a U-turn movement at the U-turn median opening is much higher than the capacity of a direct Left turn movement at the left turn median opening; (3) A right turn plus U-turn movement create fewer conflict points; (4) Drivers would often make a right-turn plus U-turn movement in preference to a direct left turn under moderate to high traffic volume conditions; and (5) A U-turn median opening can be used to accommodate traffic from several upstream driveways, especially when the driveway spacing is very close.

Similar to the direct left turn option, the right turn plus U-turn option has some disadvantages. The main disadvantages include: (1) Waiting delay could be higher as compared with the direct left turn option if major road traffic volume is low; and (2) It takes longer travel distance and may consume more fuel as compared with the direct left turn option.

To estimate total travel time for vehicles making right turn plus U-turn movements, the following equation can be used:

$$TT_R = t_{R1} + t_{R2} + t_{R3} \tag{2}$$

where:

TT_R - average total travel time of a right plus U-turn movement,
t_{R1} - average waiting delay of right turn plus U-turn vehicles at the driveway,
t_{R2} - average waiting delay of right turn plus U-turn vehicles at the U-turn median opening, and
t_{R3} - average running time for vehicles to leave the driveway to complete the left turn movement (not including t_{R2} and t_{R3}).

FIELD DATA COLLECTION

In this research, a study site was defined as an urban or suburban arterial street segment that has only two or more unsignalized access points along its length. The segment has a constant cross section and raised curb median. Geometric criteria of specific study sites are given as follows: (1) The site should have a raised-curb median with either a full median opening or directional median opening and median U-turn bay, where the medians can safely store waiting vehicles; (2) The site should have 6 or 8 through traffic lanes (3 or 4 lanes each direction). Passenger cars can normally make U-turns along divided a six-lane arterial; and (3) The site should have a speed limit of 40 mph or higher. The Florida DOT mandates that all multi-lane projects with design speeds of 40 mph or greater be designed with a restrictive median *(7).*

The results presented in this paper are based on data collected from two sites along Fowler Avenue in Tampa as listed in Table 1 and shown in Figure 1 and 2. At site one, the direct left-turn out from a driveway was replaced by a right-turn plus U-turn at a U-turn median opening with a weaving distance of 800 ft. At site two, there are three full median openings between the upstream and downstream intersections. Each can safely store two left-turning vehicles. The driveway at the second full median was selected to do the data collection because there are larger traffic volume making direct left turns and U-turns. At this site, drivers have two choices: either direct left turn or right turn followed by a U-turn at the next full median opening. To collect field data, video cameras were used to count conflicts and to monitor traffic operations between and around two median openings. Major traffic volume and speed were collected using the Automatic Traffic Counter (Peek ADR-100). A typical field setup is shown in Figure 4. Field experiments were conducted for two weeks at each site with four hours a day, including both peak and non-peak hours. About eighty hours of data were recorded by video camera at the two sites.

DATA REDUCTION

To compare the operational effects of these two movements, data from two field sites were reduced. While reducing the data, researchers tracked each vehicle, including both right-turn plus U-turn vehicles and direct left-turn vehicles. Four cameras and two traffic counters were set up at the same time so that time reference data from each of them could be matched. While reviewing the tapes, the following information was recorded: waiting delay of direct left turn vehicles and right turn plus U-turn vehicles at the driveway (defined as t_{L1} and t_{R1}, respectively), waiting delay of direct left turn vehicles at the full median opening and right turn plus U-turn vehicles at the U-turn opening (defined as t_{L2} and t_{R2}, respectively), running time of direct left turn vehicles and right turn plus U-turn vehicles (defined as t_{L3} and t_{R3}, respectively), major road traffic speed reduction caused by direct left turn vehicles and right turn plus U-turn vehicles, and traffic conflicts caused by direct left turn vehicles and right turn plus U-turn vehicles. All the average traffic data were based on a five-minute interval. Major road traffic volume and speed at different locations were recorded by the traffic counters with an average interval of five minutes.

DATA ANALYSIS

Effects on Travel Time

As defined previously, the total travel time to make a direct left turn or a right turn plus U-turn consists of average waiting delay at the driveway (t_1), average waiting delay at median openings for direct left turn movement or at the U-turn area for right turn plus U-turn movements (t_2), and average running time for both movements (t_3). From the two sites studied, traffic was recorded by four video cameras and travel time data were obtained by reviewing videotapes. Table 2 shows the comparison of the total travel time (t_1+t_2+t_3) and total waiting delay (t_1+t_2) of three types of movements: (1) two stage direct left turn, (2) right turn plus U-turn at full median opening, and (3) right turn plus U-turn at U-turn median openings. As shown in Table 2, the average total travel time for the direct left turn movement (45 sec.) was less than that for the two types of right turn plus U-turn movements (54 sec. and 52, respectively). The main reason for this was that the direct left turn volume was very low. In addition, the right turn plus U-turn traffic had to cross the weaving area. However, according to Table 2, the difference in total travel time was not significant. The average total waiting delay for the two types of right-turn plus U-turn movements (37 sec. and 31 sec., respectively) was less than that for the direct left turn movement (40 sec.). It is understood that the direct left-turn out traffic have to yield to the all other movements at the median openings in addition to through traffic. Thus, the left turn out traffic would take longer time at the driveway waiting until the median is clear to enter the median storage area as compared to the right turn traffic that would wait for only an acceptable gap of through traffic to merge the main road traffic. Therefore, the waiting time at driveway for direct left turn traffic (25 sec.) and right turn traffic (20 sec. and 18 sec., respectively) would be significantly different. It is much easier for the right turn traffic to departure from the driveway. Usually, the waiting delay has more impacts on the drivers' driving behavior. In fact, from field observations, it was noted that some drivers were waiting for gaps to make direct left turns. But, when the waiting time exceeded one minute or more or the queuing length exceeded three vehicles, these drivers changed their initial intention and looked for gaps to make right turn plus U-turns because they knew that it was easier and safer to a make right turn plus U-turn as compared direct left turns if the major road traffic and left-turn-in volume was heavy.

Speed Reduction

Right turn plus U-turn movements may have some impacts on major road traffic in the weaving area. One of the impacts could be speed reduction of the major road traffic. Major road traffic speed at upstream of the driveway may also be affected by direct left turn traffic from the driveway. To estimate the speed reduction of both right turn plus U-turn movements and direct left turn movements, the automatic traffic counters (Peek ADR-1000) were installed. One traffic counter was installed at the weaving area at both test sites to collect the speed data at 5 minute intervals. At site two, additional traffic counters were installed at 100 ft. downstream and 100 ft. upstream of the driveway to evaluate the speed reduction caused by the direct left traffic from the driveway.

Figure 4 shows that the average running speed of the major road traffic decreased slightly with the increase of right turn plus U-turn traffic volume for the peak hour and non-peak hour conditions in the daytime. An ANOVA statistical test was performed to test whether or not the right turn plus U-turn traffic volume had a significant impact on the speed. The test results indicated that the right-turn plus U-turn volume was not a significant factor at a 95 percent level of confidence.

At site two, the average speed of the upstream and downstream of the driveway was collected in pairs. Each pair of average speed at five minutes interval was taken under homogeneous conditions. To evaluate whether or not the average speed of the upstream and downstream of the driveway had a significant difference, the paired t-test was carried out. The test results indicated that at the 95 percent confident level the average speed at upstream (44.9 mph) was significantly lower than the downstream average speed (46.2 mph). The reasons for this could be the direct left turn traffic from the driveway and traffic making left turn into the driveway from the major road. The other reasons could be that the major road traffic making right turn into the driveway or making a left turn to the left turn bay might have some impacts on the speed of the major road through traffic. Figure 5 shows that the average speed of the major road through traffic at the upstream of the driveway was 1 to 2 mph slower than the average speed of the major road through traffic at the downstream of the driveway for the peak hour and non-peak hour conditions.

Traffic Conflicts

The traffic conflicts caused by right turn plus U-turn movements can be divided into the two parts: (1) conflicts between right turning vehicles and through vehicles, and (2) conflicts between U-turning vehicles and major road through traffic from another direction. The main conflict types are rear-end and sideswipe conflicts. The conflicts caused by direct left turn vehicles include the conflicts with two-direction major road through traffic and the conflicts with all other movements at the median opening for the driveway. The main conflict types include the angle and rear-end conflicts. In the research, traffic conflicts were recorded by video cameras in the fields. Conflict number was obtained by reviewing videotapes. While reviewing the videotape, three situations were used to judge if a conflict occurred: (1) brake light, (2) lane changing, or (3) perceptive deceleration. A total of 1975 right turn plus U-turn vehicles were tracked at site one. There were 56 conflicts occurred at weaving section between right turning vehicles and major road through traffic, and 43 conflicts between U-turning vehicles and major road through traffic. A total of 1764 direct left turning vehicles were tracked at site two. A total of 457 conflicts were counted from only camera one in the westbound. The conflict rates associated with the right turn plus U-turn vehicles and direct left turn vehicles from the driveway are presented in Table 3. For this study, conflict rates per vehicle observed was used to compare the difference of these two movements. The conflict data reveal that the conflict rates associated with the right turn plus U-turn vehicles (5.02 %) were much less than the conflict rates associated with the direct left turn vehicles (25.91 %). Most of the conflicts caused by the direct left turning vehicles were the conflicts with the left-turn-in vehicles. There were very few conflicts between the direct left turning vehicles from the driveway and the major road through vehicles. With the increasing of the waiting delay of the direct left turning vehicles, direct left turning drivers may tend to be more and more aggressive to move into the median opening without yielding to the left-turn-in vehicles from the major road.

CONCLUSIONS

As stated previous, the results presented in the paper are part of the results to be obtained through the research project. With these limited results, this paper intends to present the evaluation of the impacts of right-turn plus U-turn traffic from a driveway on the major road traffic. Much more test sites will be selected in the future and more details will be obtained from the data to be collected from the sites. In addition, the computer simulation software, CORSIM, will be used for more detailed simulation analysis.

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Table 1 Description of Field Sites

	SITE ONE	SITE TWO
Arterial	Fowler Ave.	Fowler Ave.
Location	N. 46th St.	19th St.
Speed limit	45 mph	50 mph
Weaving distance	800 ft	570 ft
Upstream green time(seconds)	108	100
Upstream red time(seconds)	17	70
Upstream signal cycle length(seconds)	125	170
Downstream green time(seconds)	105	90
Downstream red time(seconds)	20	80
Downstream cycle length(seconds)	125	170
Offset of upstream and downstream signal(seconds)	20	20

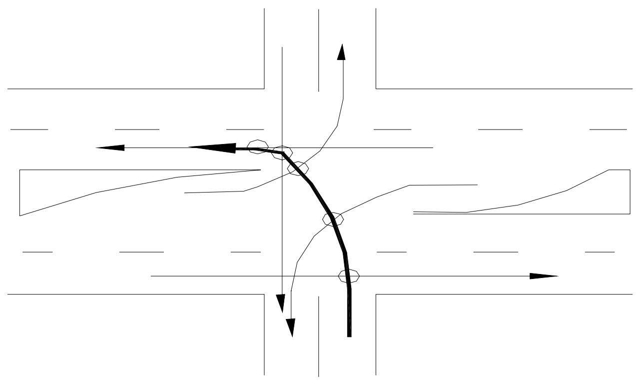

Figure 1.a Conflict Points of Direct Left Turns

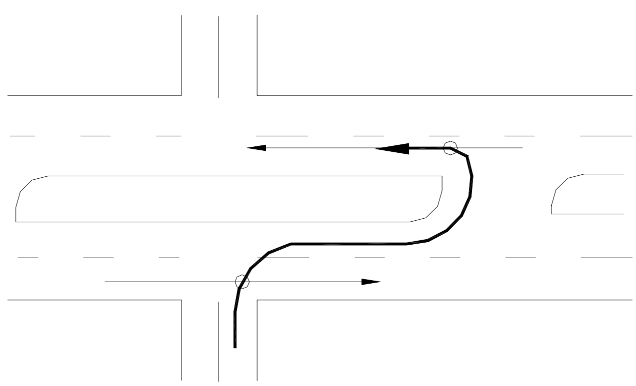

Figure 1.b Conflict Points of Right Turn Plus U-turn

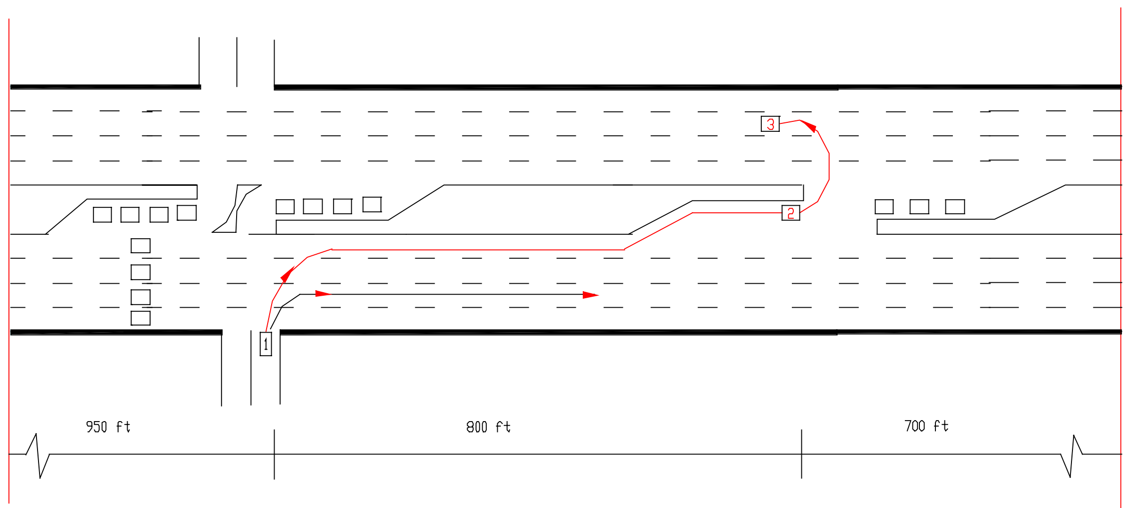

Figure 2: Vehicle Movements and Geometric Conditions of Site One

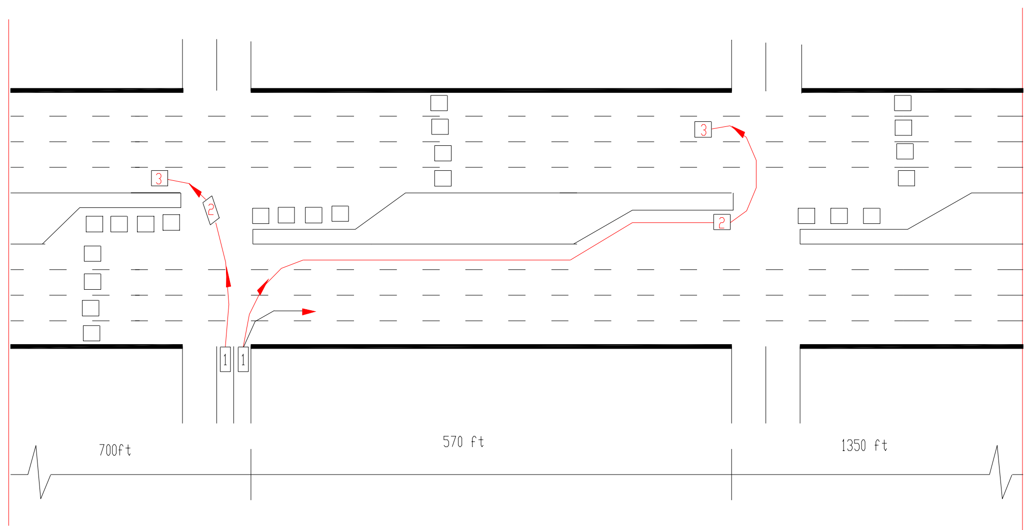

Figure 3: Vehicle Movement and Geometric Conditions of Site Two

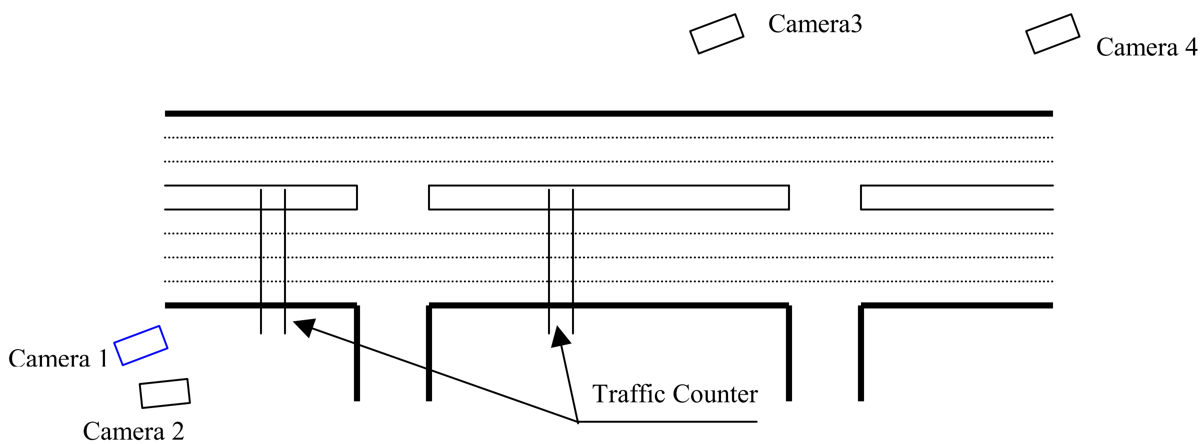

Figure 4: Typical Field Data Collection Setup

Table 2: Average Travel Time and Average Waiting Time

	DIRECT LT	RT+UT AT FULL MEDIAN OPENING	RT+UT AT U-TURN MEDIAN OPENING
Total conflicting volume (Range)	4600 (3000-6000)	4600 (3000-6000)	4400 (3000-5500)
Average LT volume (vph) (Range)	36 (0-96)	/	/
Average RT volume(vph) (Range)	/	208 (0-360)	190 (60-390)
Average U turn volume(vph) (Range)	/	84 (36-156)	47 (12-108)
Weaving distance (ft)	/	570	800
Average total travel time(seconds) ($t_1/t_2/t_3$)	45 (25/15/5)	54 (20/17/16)	52 (18/13/21)
Average waiting time(seconds)	**40**	**37**	**31**

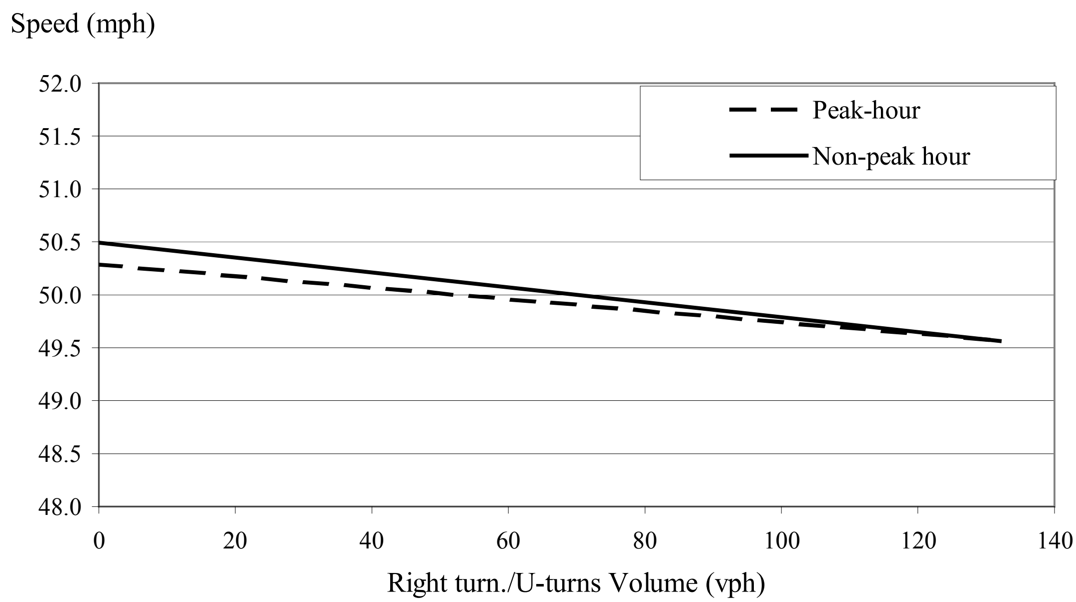

Figure 4: The Major Road Traffic Speed Reduction due to Right Turn Plus U-turn Movements at Weaving Section

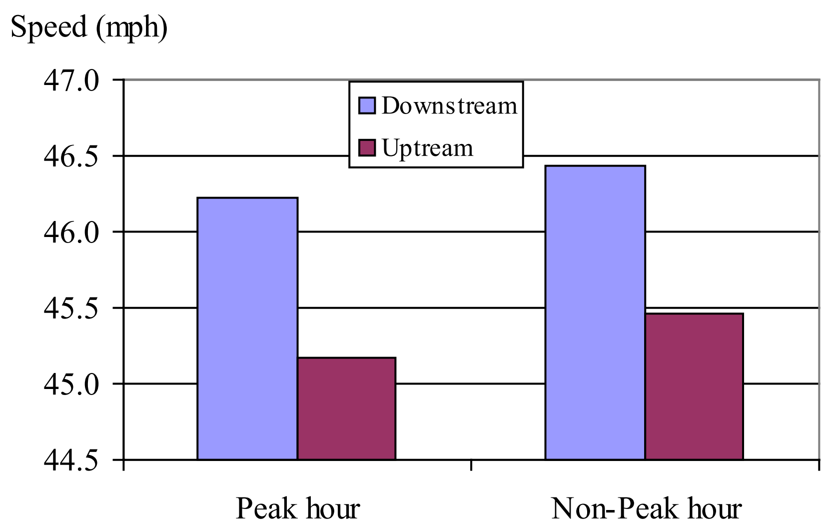

Figure 5: Average Running Speed of Major Road Traffic at Upstream and Downstream of the Driveway at Site Two

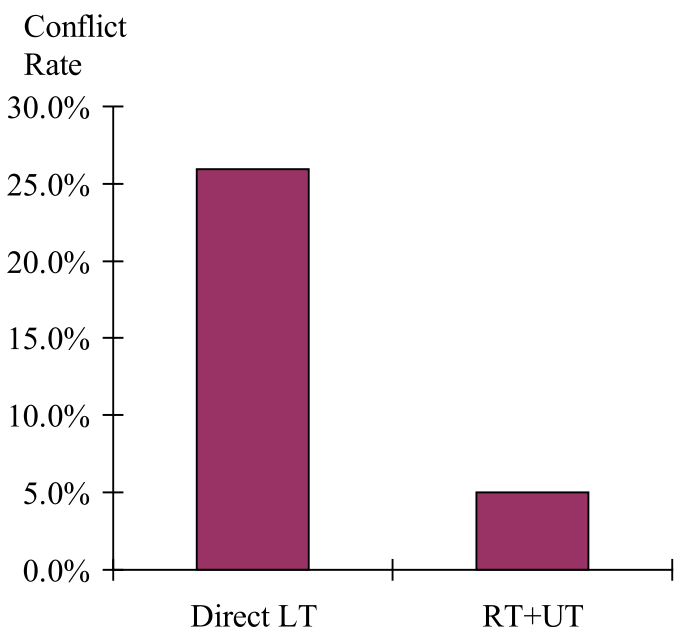

Figure 6: Comparison of Conflict Rates Caused by Direct Left Turn movements And Right Turn Plus U-turn Movements.

Table 4: Comparison of Conflict Rates

	Right turn plus U-turns		Direct left Turns
	Right turns	U-turns	
Number of Vehicles	1975	1975	1764
Number of Conflicts	56	43	457
Conflict Rates	2.84%	2.18%	**25.91%**
	5.02%		

Corridor Management

Other	4A.	Integrated Transportation Management *Chris Huffman, Kansas DOT*
Paper Slides	4B.	Okaloosa County Florida US 98 Corridor Strategy *Gary Sokolow, Florida DOT*
Paper Paper		US27 Highway Corridor US98 Highway Corridor
Slides	4C.	Corridor Planning in Oregon *Fred Eberle, Oregon DOT*

Monday-August 14, 2000 – 10:00 AM – 11:30 AM
Track 3 - Workshop

Access Management and Corridor Planning, the Okaloosa County Experience

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and Gary Sokolow (FDOT) 850-414-4912 gary.sokolow@dot.state.fl.us

In 1995 the Florida Department of Transportation and the Center for Urban Transportation Research completed a Corridor Study detailing access management and land development practices along U.S. Highway 98 in northwest Florida. This portion of U. S. 98 which runs around 100 miles from Panama City to Pensacola, contains sections of two-lane rural and four-lane and six-lane urban highways. This portion of U. S. 98 is on the Florida Intrastate Highway System. The FIHS is the designated portion of Florida State Highway System that carries the bulk of our traffic and is designated to be the most important and stringently regulated to maintain mobility.

After the Study was completed, a series of workshops were held to involve local government officials in the findings of the Study. The study of access management and land development practices along the corridor found many of the practices needing improvement. The workshops generated much interest and some of the local government engineers and planners went back to their respective cities and counties and worked towards instituting better land development regulation practices that help preserve mobility and safety on our highway systems. Okaloosa County, which is home of one of the fastest growing areas in the nation, Ft. Walton Beach-Destin Area, began working quickly to institute good land development practices that support access management. Not only were good land development regulation practices put in place, but greater coordination with Florida DOT staff on access management decisions was also instituted in the site plan approval process.

After five years the Okaloosa County experience can be seen as a great success. This success in instituting good access management can be distilled into a few major points which they saw instituted in their ordinances and site development practices. These key items are as follows:

1. Recognition of special corridors for access management techniques
2. New land subdivision and land development regulations along these special corridors.
3. Landscape requirements.
4. Driveway location and design criteria.
5. Site plan review assuring interparcel connectivity.

We will show how these features were instituted into their local land development ordinances and give specific wording of these examples from their ordinances.

NOTE: Please note that these example words are not necessarily verbatim from the Okaloosa County Ordinances but some words have been changed in order to make the presentation of this text more understandable.

Recognition of Special Corridors

One of the most important processes in creating good access management and land development system is the recognition that some corridors need more regulation. Notice that for the specially designated corridors that in this part of the ordinance there are driveway spacing requirements and many references to designing access features with the latest standards of the Florida Department of Transportation. Paragraph F limits "strip" residential development and requires residential developments to get their access from side streets and not directly onto the arterial corridor.

Example

6.03.08. Special Access Managed Roads

Special access standards shall be applicable to P. J. Adams Parkway from its intersection with Highway 85 to the Old Antioch Road, Martin Luther King Jr. Blvd. From its intersection with Green Acres Road to the Fort Walton Beach Industrial Park, U.S. Highway 98 from its intersection with the old U.S. Highway 98 eastwardly to the Walton County line and any other road hereinafter designated special access managed roadways by resolution of the Board of County Commissioners of Okaloosa County.

A. Access points shall be located no closer than six hundred sixty (660) feet apart measured from centerline to centerline of the driveway or as specified in the FDOT Access Management Classification System and Standards.

B. Median openings shall be located no closer than one thousand three hundred twenty (1,320) feet apart measured from centerline to centerline of the opening.

C. Deceleration, acceleration, auxiliary lanes, and median openings, shall be installed and constructed in accordance with the Florida Department of Transportation standards in effect at the time of application.

D. Other than currently existing driveways, no access will be allowed requiring a backing maneuver into the right-of-way.

E. Other than lots of record, no access will be allowed serving individual private residential driveways.

F. Residential developments contiguous to special access managed roads shall be by collector streets at minimum distance of six hundred sixty (660) feet apart.

G. This ordinance is not intended to deny access to any existing lot, parcel, or tract of land for which the only means of access to the same would be by the special access managed road, but is intended to limit any further divisions into parcels or lots unless compliance herewith is accomplished.

Right-of-Way Protection

Another important feature of corridor protection is right-of-way protection to allow for future improvements to the transportation system. Right-of-way protection is not only needed for adding lanes, but this allows for better bicycle and pedestrian improvements in the future also. Section H below shows the dimensions and setback requirements for the special access managed roads.

H. Right-of-Way Protection: Notwithstanding setbacks from roads rights-of-way shown in Section 2.02.00, Schedule of Dimensional Requirements in Zoning Districts, the minimum setbacks from the named rights-of-way shall be as follows:

NAME OF ROAD	*LOCATION*	*SETBACK*
P.J. Adams Road 10	*from Hwy. 85 to Interstate*	*60 Ft.*
Martin Luther King Jr. Blvd. Hill St. ext.	*from Green Acres Rd. to*	*60 Ft.*
U.S. Hwy 98 to intersection to Walton County line	*from old Hwy 98 (CR 2378)*	*60 Ft.*
State Hwy 85 EAFB to Walton County line	*from north boundary of*	*40 Ft.*

Minimum Lot Frontages

An important feature of good land development regulation practice in regards to access management is the minimum lot frontage size and the paragraph below shows how this feature is regulated along all of their state and local highways.

D. Minor Divisions of Lands: Larger parcels shall not be required to subdivide if each parcel being created is at least one (1) acre in area and no new public street or alley is being proposed. Each parcel shall also have a minimum of fifty (50) feet frontage on publicly maintained roads. Parcels created which front on roads identified as Special Access Managed Roads shall have a minimum frontage of two hundred ten (210) feet. Lot size and dimensions shall meet the requirements fro the zoning district in which the land is located. Where the size and dimensions do not meet the requirements, the owner shall obtain rezoning before dividing and conveying the title to any parcel.

A request for a minor division of land shall be submitted by application to the Planning and Inspection Department with an application fee as provided for in Chapter 12 of this Ordinance. In addition, the proposed minor division of land must meet all concurrency requirements as set forth in this Ordinance. No more than ten (10) lots may be created per parent parcel.

Landscape Requirements

Okaloosa County has used landscaping requirements to not only beautify its corridors but to make them safer and handle storm water in a better manner. The following paragraphs show how the County has used the landscaping requirements and how this works along with driveway location to prevent extremely wide driveways and prevention of numerous driveways. Okaloosa County officials say this is one of the most effective strategies to protect safety, storm water management, and aesthetics along their major corridors.

6.05.02. Landscape Area Requirements.

All land uses hereof shall devote a minimum of fifteen (15) percent of the total developed area to landscape improvement.

6.05.021. Perimeter Requirements.

A. ***Front Perimeter Landscape Areas:*** *A minimum of a ten (10) foot wide strip of land, located between the front property line and the vehicular use area shall be landscaped on all new construction, except in permitted driveways/access points. Width of sidewalk shall not be included within the ten (10) foot wide front setback perimeter landscape area.*

B. ***Material Requirements in Perimeter Area:***

1. Tree Count: The total tree count requirement within the front setback perimeter landscape area shall be determined by using ration of one (1) tree for each twenty-five (25) linear feet of lot frontage or major portion thereof with fifty (50) percent of the trees being shade trees.

2. Ground Cover: Grass or other ground cover shall be placed on all areas within the front, and other landscape areas not occupied by landscape material.

3. Use of Perimeter Landscape Areas:

(a) Overhang Areas: Vehicles shall overhang no more than two (2) feet into perimeter landscape areas.

(b) Driveways: All driveways through the perimeter landscape areas shall meet the following aisle width maximums and minimums: Not over fifteen (15) foot one-way drives, no less than ten (10) feet apart, and not over twenty-seven (27) foot two-way drives, no less than twenty (20) feet apart. If the Board of Adjustment determines

that access way separation minimum or aisle width maximum requirements will create a hardship, such minimum may be varied by the Board of Adjustment.

Driveway Location and Design

Driveway location and design criteria within the Okaloosa County Ordinance also have a beneficial impact on access management. In the landscape requirements above, Section B.3.(b), shows that Driveways are regulated to be no more than 27 feet in width.

This regulation does not pertain to major connections which may have wider driveways, but these would be handled in the site plan review process and would still be subject to the percentage landscape requirements found also in the ordinance. The regulation of the width of driveways helps to fight the all too often occurrence of completely open, with no access control corridors. Also see below the "clear visibility triangle" requirement in order to assure good visibility at driveway locations.

Clear Visibility Triangle

Sight distance at driveways is a very important safety factor. This should be regulated to assure the best placement and design.

In order to provide a clear view of intersecting streets to the motorist, there shall be a triangular area of visibility formed by two (2) intersecting streets or the intersection of a driveway and a street. The following standards shall be met.

1. *Nothing shall be erected, placed, parked, planted or allowed to grow in such a manner as to materially impede vision between a height of two (2) feet and ten (10) feet above the grade, measured at the centerline of the intersection.*

2. *The clear visibility triangle shall be formed by connecting a point on each street centerline, to be located at the distance from the intersection of the street center lines indicated below, and a third line connecting the two (2) points.*

The county must also comply with the Florida Department of Transportation sight distance requirements.

Site Plan Review

The practice of site plan review is critical in the success of a good access management program at the local level. Okaloosa County has instituted a program of interparcel connectivity along U.S. 98. The recently developed (over the last five years) properties show a good direction in terms of access management and connectivity between different developments along U.S. 98. This was established during the site plan review process where instead of individual driveways being allowed, the County insisted on public connecting roadways that served two or more properties. As the land developed even further, these connecting roadways then could actually be connected to the properties behind them leaving a system of collector and access roads served by hundreds of thousands of square feet of commercial development. Much of this was done through the site plan process and by managing subdivision of larger properties. Florida's Administrative Rule 14-97 recognizes large pieces of property under single ownership as one property even if they are subdivided into different properties. This allows the local government working along with the Florida Department of Transportation representatives to assure the best access for property without over building driveways and access.

We can not emphasis enough that this was a process that took some time that required perseverance, flexibility, and education of our elected officials. It also required relearning how local governments, the development community, and the Florida Department of Transportation work together to provide the best transportation system for the public.

Facility Management in Oregon through Corridor Planning

The 4th National Conference on Access Management
Portland, OR August 14, 2000

For more information:

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(503)731-8284 FAX(503)731-8259
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Portland-Astoria Corridor Plan

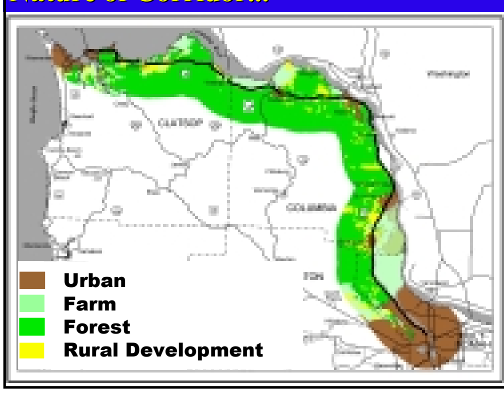
Corridor Steering Committee Members:

City of Astoria
City of Columbia City
City of St. Helens
City of Prescott
City of Rainier
City of Clatskanie
City of Scappoose
City of Portland
City of Warrenton
Clatsop County
Columbia County
Multnomah County
Port of Astoria
Port of St. Helens
Port of Portland
Metro
Tri-Met
OR. Dept. of Transportation
WA Dept. of Transportation
OR Dept. of Land Conservation and Development
Cowlitz/Wahkiakum RTPO
Cowlitz.Wahkiakum COG

April 1999
ODOT
Region 1 &

Portland-Astoria (US 30) Corridor Plan

Nature of Corridor...



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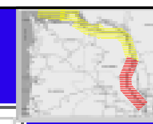
Portland-Astoria (US 30) Corridor Plan

Role and Function...

Urban Commuting



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Portland-Astoria (US 30) Corridor Plan

Role and Function....

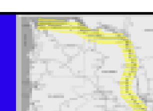
- Multi-modal Freight Connection

Portland-Astoria (US 30) Corridor Plan

Role and Function...

Freight Service

Aggregate
Processing /
Shipping Operations



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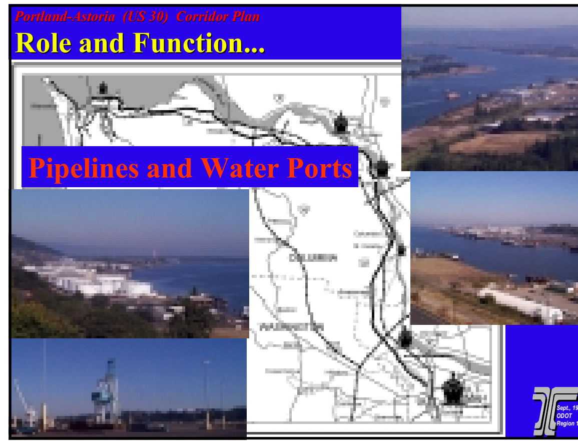
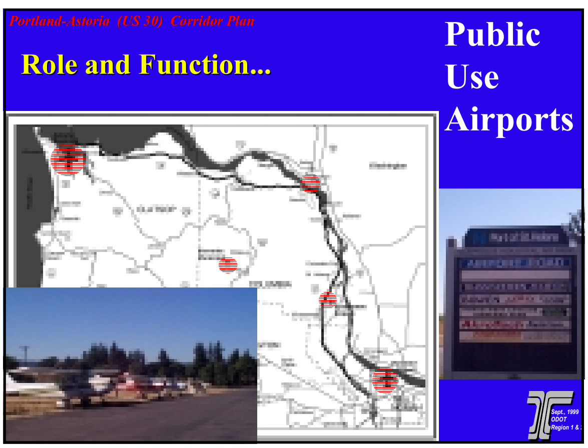
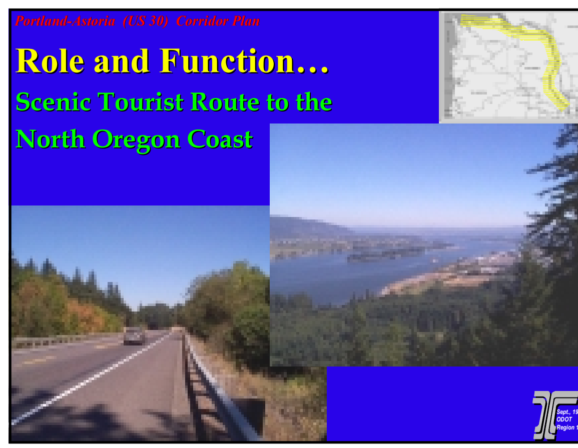
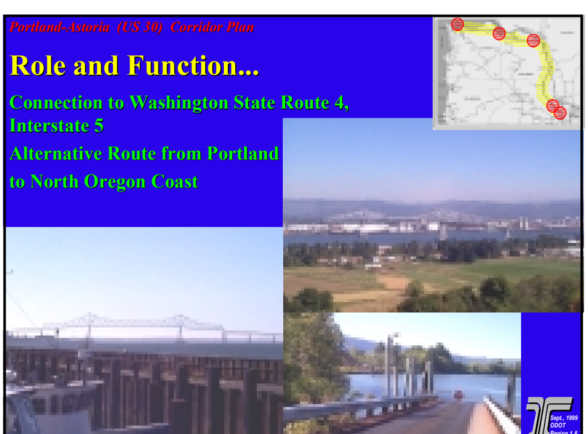
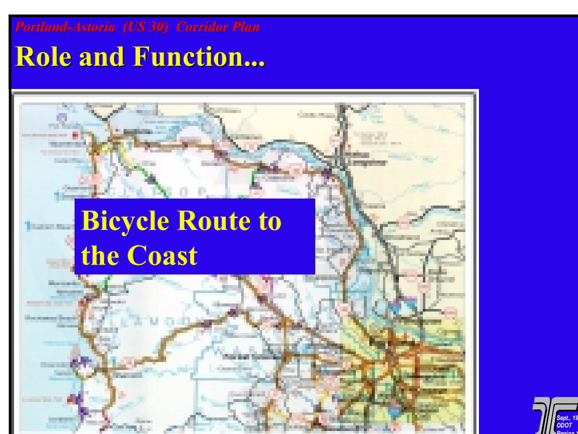
Portland-Astoria (US 30) Corridor Plan
Role and Function...
Freight Service
Forest Products
Processing /
Shipping Operations


Portland-Astoria (US 30) Corridor Plan
Role and Function...
Pipelines and Water Ports


Portland-Astoria (US 30) Corridor Plan
Role and Function...
Public Use Airports
AIRPORT ROAD


Portland-Astoria (US 30) Corridor Plan
Role and Function…
Scenic Tourist Route to the North Oregon Coast


Portland-Astoria (US 30) Corridor Plan
Role and Function...
Connection to Washington State Route 4, Interstate 5
Alternative Route from Portland to North Oregon Coast


Portland-Astoria (US 30) Corridor Plan
Role and Function...
Bicycle Route to the Coast

Portland-Astoria (US 30) Corridor Plan

Major Oregon Transportation Commission Issues / Policy

Prioritization

Maintain, Preserve existing facilities
- Maintenance Needs

Manage, Operate facilities safely
- Land Use / Growth Management
- Access Management
- Safety Improvements

Environmental Protection

Modernization
- Mobility/ Travel Time

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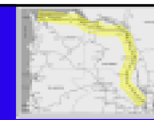
Portland-Astoria (US 30) Corridor Plan



Assumptions...

- Traffic will increase between 30% & 50% during the planning period
- Most land development growth expected inside UGBs (acknowledged Comprehensive Plans)
- Increasing recreational use of transportation system

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Corridor Plan Objectives include:

- Provide **no major expansion** in highway capacity except for (three) passing lanes
- Use **parallel routes** to decrease reliance on US 30
- Highest applicable **(most restrictive) access management** for both local arterials and US 30
- Local access management and circulation plans to **relieve localized congestion** problems
- **Preserve rural sections** as rural, through access management and land use controls
- Use access management to **limit the impacts of new development** on highway congestion

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Connections Between Places: Appropriate Travel Times

- **Acceptable travel times** for the corridor - currently 145/191 minutes (auto/truck)
- **Access management can save 22 minutes** travel time versus no build, at **minimal investment**
- **Highway improvements can save 31 minutes** versus no build at **significant investment**

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Highway Congestion: Level of Service

- Local transportation needs balanced with function of state highway
- Lower LOS in Special Transportation Areas and Town Centers
- LOS levels in the Oregon Transportation Plan are goals, may not be achievable in all segments
- Access Management and TSM improvements relieve congestion
- Improvements to local street systems reduce need for Highway 30 improvements
- Railroad paralleling highway limits access points
- Consistent policy on raised medians in congested areas
- Consistent access management plans for entire corridor

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Access Management Categories

Category	Access Treatment	Level of Importance	Urban/ Rural	Intersection: Public Road Type	Intersection: Public Road Spacing	Intersection: Private Drive Type	Intersection: Private Drive Spacing	Signal Spacing	Median Control
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	1/2-1 mi.	None	NA	1/2 - 2 mi.	Full
			R	At Grade/ Intch	1-5 mi.	None	NA	None	Full
3	Limited Control - Expressway	Statewide	U	At Grade/ Intch	1/2-1 mi.	Rt. Turns	800'	1/2 - 1 mi.	Partial
			R	At Grade/ Intch	1-3 mi.	Rt. Turns	1200'	None	Partial
4	Limited Control	Statewide/ Regional	U	At Grade/ Intch	1/4 mi.	Lt./Rt. Turns	500'	1/2 mi.	Partial/None
			R	At Grade/ Intch	1 mi.	Lt./Rt. Turns	1200'	None	Partial/None
5	Partial Control	Regional/ District	U	At Grade	1/4 mi.	Lt./Rt. Turns	300'	1/4 mi.	None
			R	At Grade	1/2 mi.	Lt./Rt. Turns	500'	1/2 mi.	None
6	Partial Control	District	U	At Grade	500'	Lt./Rt. Turns	150'	1/4 mi.	None
			R	At Grade	1/4 mi.	Lt./Rt. Turns	300'	1/2 mi.	None

Access Management Categories on US 30

Category	Access Treatment	Level of Importance	Urban/ Rural	Public Road Type	Public Road Spacing	Private Drive Type	Private Drive Spacing	Signal Spacing	Median Control
2	Full Control - Expressway	Statewide	Rural	At Grade/ Intch	1-5 mi.	None	NA	None	Full
3	Limited Control - Expressway	Statewide	Rural	At Grade/ Intch	1-3 mi.	Rt. Turns	1200'	None	Partial
3	Limited Control - Expressway	Statewide	Urban Growth	At Grade/ Intch	1/2-1 mi.	Rt. Turns	800'	1/2 - 1 mi.	Partial
4	Limited Control	Statewide/ Regional	City Limits	At Grade/ Intch	1/4 mi.	Lt./Rt. Turns	500'	1/2 mi.	Partial/None

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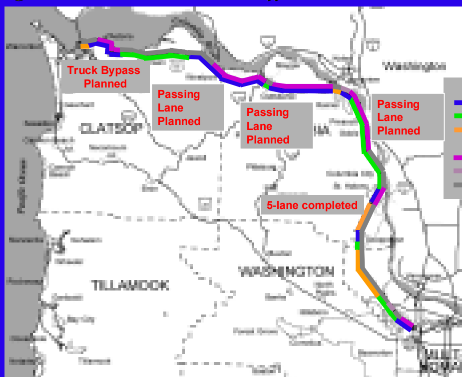
Congestion Levels vs. Cost Effectiveness to Mitigate



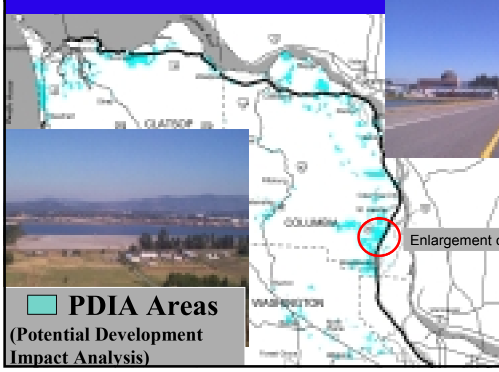
Special Transportation Area eases some standards
Non-STA stricter access standards and higher speeds

- Education, cooperation
- Through traffic is important to the state
- Good traffic flow, ability to get around town important to Cities.

- Parallel city street improvements
- Slower speeds in the downtown Main Street core
- Higher speeds and fewer accesses in commercial strips and undeveloped areas inside the UGB.

Portland-Astoria (US 30) Corridor Plan

Rural Growth Management

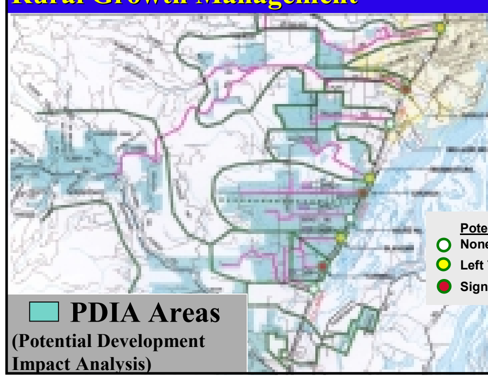


PDIA Areas

(Potential Development Impact Analysis)

Portland-Astoria (US 30) Corridor Plan

Rural Growth Management



PDIA Areas

(Potential Development Impact Analysis)

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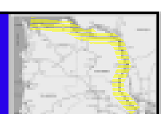
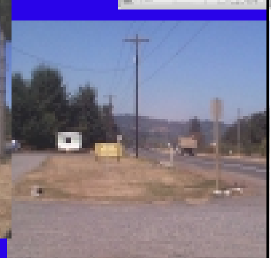
Rural Centers Growth Management...



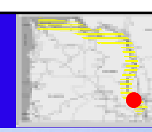


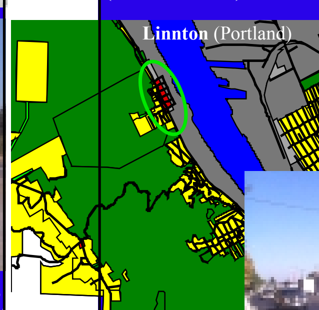
Access Management

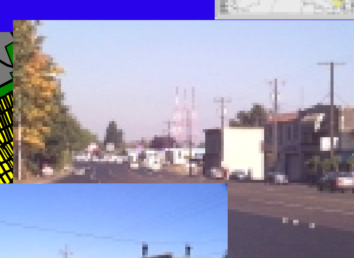
Portland-Astoria (US 30) Corridor Plan

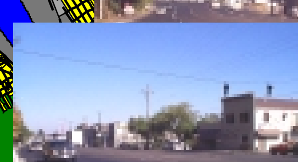
Urban Growth Management

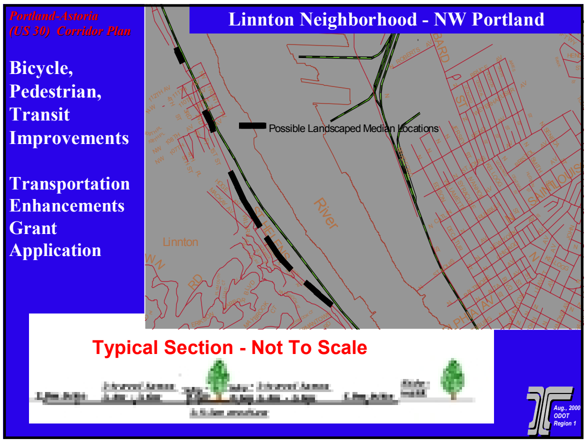
Potential Land Use Overlay (STA or UBA)










Portland-Astoria
(US 30) Corridor Plan
Linnton Neighborhood - NW Portland
Bicycle,
Pedestrian,
Transit
Improvements
Transportation
Enhancements
Grant
Application
Possible Landscaped Median Locations
River
Linnton
Typical Section - Not To Scale
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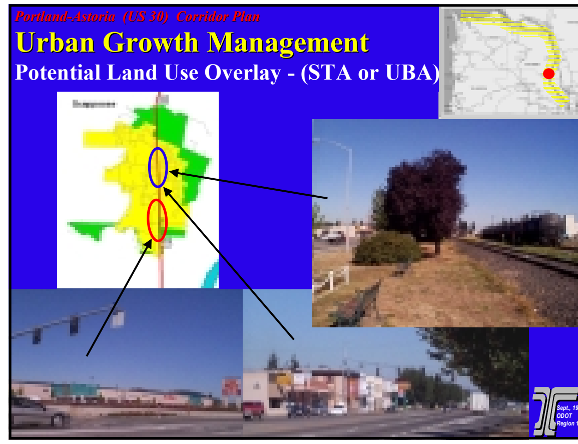
Portland-Astoria (US 30) Corridor Plan
Urban Growth Management
Potential Land Use Overlay - (STA or UBA)
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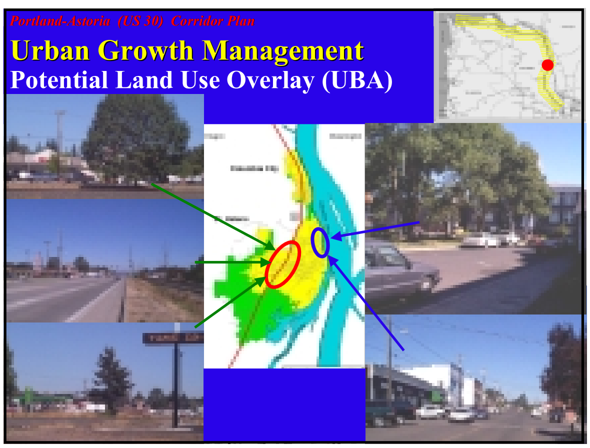
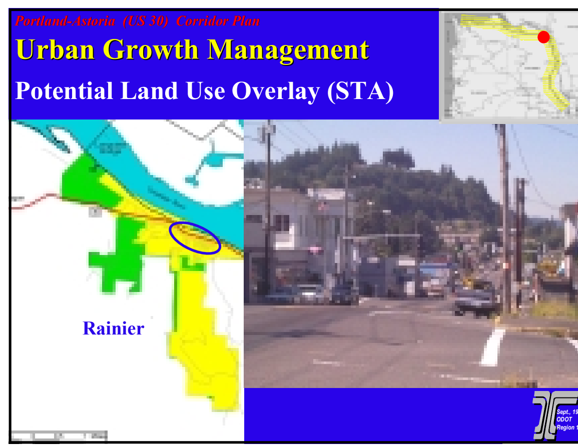

Portland-Astoria (US 30) Corridor Plan
Urban Growth Management
Potential Land Use Overlay (UBA)


Portland-Astoria (US 30) Corridor Plan
Urban Growth Management
Potential Land Use Overlay (STA)
Rainier
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Portland-Astoria (US 30) Corridor Plan
Urban Growth Management
Potential Land Use Overlay
Clatskanie
US30 Looking West
Nehalem Ave


Portland-Astoria (US 30) Corridor Plan
Urban Growth
Management
Potential Land Use
Overlay (STA)
Potential STA
Astoria
Proposed Astoria Truck Route
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Portland-Astoria (US 30) Corridor Plan
Prioritization of Projects...
Mobility/ Travel Time
Passing Lanes / Intersection Improvements
Washington
CLATSOP
COLUMBIA
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Access Management Program at State Level (cont.)

Paper
Slides

5A. Montana's Statewide Access Management Program

David Rose, Dye Management Group

Paper

5B. Symbiotic, Opportunistic, Omnivores:
A Retro-Perspective on New York's Arterial Access Management Initiative

Ken Carlson, New York State DOT

Paper
Slides

5C. Integrating Transportation Management

Steven Buckley, Kansas DOT

Paper

5D. Status Report of Minn DOT's Access Management Program

Lisa Freese, Minnesota DOT

Access Management in Montana: From Statewide Planning to Implementation

Paper prepared for the
4th National Access Management Conference
Portland, Oregon

August 2000

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DYE MANAGEMENT GROUP, INC.

■

A. Introduction

This paper provides an overview of the outcomes from Montana Department of Transportation's (MDT) Access Management Project that was completed in February 1998. Through the Access Management Project, MDT has developed an enhanced approach to access management, designed the elements of an ongoing access management program, and prepared an implementation plan for initiating and maintaining the new approach.

1. Project Background

The Access Management Project took as its starting point the access management policy goals and actions established through the statewide transportation plan, TranPlan 21, that was completed in 1995. This plan established policy and specified actions that MDT should take to determine how improved access management can preserve the functional integrity of Montana's transportation system.

The policy direction for addressing access management was developed through a process that included an extensive stakeholder and public involvement process, technical work to evaluate issues, and the careful consideration of potential actions by the Montana Transportation Commission.

In brief, the statewide planning process reached the following conclusions:

- Citizens (primarily in western Montana) are concerned that current development patterns and access management practices reduce the effectiveness of the transportation system.
- Citizens (primarily in western Montana) consider access management a tool that should be used to support corridor preservation.
- There is a lack of consistent, rigorous application of access management policies.
- There is a lack of consistency in the application of access management standards.

The statewide plan, TranPlan 21, concluded that MDT needed to enhance access management to help preserve the safety and efficiency of the highway system. The planning analysis found that the need to improve access management is most pronounced in the areas of the state that are growing more rapidly.

2. Project Objectives

The Montana Transportation Commission and MDT division administrators agreed with the findings of the statewide planning process and concluded that MDT should take action to strengthen access management in Montana. Their decision regarding access management was that MDT needed to improve on the existing plan in a very careful and deliberate approach. The Access Management Project implements this policy direction.

The overall objective of the Access Management Project was to implement the policy goals and actions specified in the statewide plan, TranPlan 21, adopted by the Montana Transportation Commission.

To that end, the Access Management Project had the following objectives:

- Implement TranPlan 21 actions adopted by the Montana Transportation Commission.
- Address citizen and stakeholder concerns about safety and system preservation.
- Focus on problem areas to increase the safety and preserve the functional integrity of the highway system.
- Develop an access classification system applicable to Montana and recommend acceptable access, spacing, and design criteria.
- Account for the diversity of Montana conditions.
- Identify access management methods for implementing the classification scheme.
- Develop an implementation plan that specifies the steps, authority, organizational responsibilities, and process for strengthening access management in Montana.
- Produce an illustrated guide and technical analysis to communicate the benefits of enhanced access management.

3. Project Approach

The project evaluated MDT's existing access control policies as they pertain to approach control, site development, and the state/local review process in addressing access along state highway facilities. This evaluation was to assist in the development of a systematic overall approach to access management. The primary focus of attention is on the impacts arising from increases in urban and suburban land use densities abutting state highways in the growing parts of the state. The statewide plan had concluded that as traffic volumes and trip generation increase, the influence of the frequency, location, and design of driveways and intersections is becoming a critical factor in the performance and safety of portions of Montana's system. The project was to develop a systematic approach to access management tailored to Montana's particular needs: its broad range of road types, development patterns, geography, and political jurisdictions.

The project involved the following work steps:

- Assessment of MDT's readiness for change.
- Evaluation of the effectiveness of the current approach.
- Review of the legal and administrative basis for access management in Montana.
- Assessment of the applicability of lessons learned in other states to Montana.
- Development of an access classification system.
- Development of recommendations for access spacing and design criteria for the access classifications.
- Preparation of implementation recommendations and an implementation plan.
- Involvement of MDT and FHWA employees through a project steering committee.
- Involvement of affected jurisdictions and stakeholders through a project advisory committee.

B. Organizational Readiness

At the outset of the Access Management Project, an assessment was performed to determine how ready MDT management, stakeholders, and partners were to address the difficult issues associated with improving access management.

The following describes the general perceptions of MDT employees who were interviewed regarding access management:

- It is important that MDT exercise its responsibilities to the motoring public by providing leadership to protect the functional integrity of the highway system in the growing parts of the state.
- MDT needs to be proactive in addressing access management. Interviewees are concerned that MDT is too reactive. They believe that in order to have a proactive approach MDT needs a clearly stated definition of the purpose and need for access management.
- There is general agreement that MDT does well in addressing access management issues in the design of projects.

- Access management problems arise mainly with requests for access to existing facilities. There is a belief that MDT is too weak in exercising its existing authority to manage access.
- MDT employees are concerned that the public and local government agencies should recognize that access management is not a substitute for land use planning and/or growth management.
- Education within MDT and among other transportation professionals in Montana about the purpose and benefits of access management will be critical for the success of strengthening MDT's access management planning.
- MDT employees believe that there are significant safety problems on the primary system in growing areas that should be addressed through access management.
- There is widespread concern that new access requests in growing areas are degrading the operating efficiency of the roadway. Further, MDT needs to get as much capacity out of existing facilities as possible. In the absence of effective access management, two-lane facilities will quickly need to be replaced with four-lane ones.

1. Access Control Resolutions

Under Montana Statute, the Transportation Commission has the authority to regulate highway access through establishing access control resolutions that limit access rights. The following describes the perceptions of MDT employees who were interviewed about the use of access control resolutions:

- No concern was expressed regarding the use of access control resolutions as an access management tool for reconstruction projects.
- In the past, it was assumed that all reconstruction projects would involve access control resolutions.
- Where used, the resolutions are considered to provide an effective tool. Currently, over 400 miles on the state system have resolutions applied to them.
- On occasion, the purchaser of property abutting the highway in an access controlled area may not read or take note of the fact that the property does not have right of access to the highway.

2. Driveway Approach Standards and Permits

The following describes the opinions of MDT employees who were interviewed about the use and issuance of driveway approach permits:

- There was a concern that MDT is not consistent within and between regions in the application of the existing driveway approach standards.

- Most interviewees believed that it is often difficult to deny applications for driveway permits. Interviews in the Missoula District found that the District is currently issuing between 250 and 300 permits a year. It is estimated that one-third of the original permit requests are modified during the permitting process. The District has denied permits in the past and will continue to do so where driveways do not meet MDT's approach standards.
- MDT's current approach to access management through the approach standards focuses on the right-of-way requirements for managing safe access to the highway. There is little focus on the impact that access has on traffic flow on the highway.
- There wa some concern that the approach standards do not provide for minimum spacing requirements between driveways or signalized intersections.
- The approach permit standards do not enable MDT to deny an approach permit to a "land locked" parcel. Interviewees believe this impedes access management.

3. Management and Organization

The following describes the perceptions of MDT employees who were interviewed about the management and organization of MDT's access management responsibilities:

- There was strong awareness of the safety and corridor preservation benefits from enhanced access management planning by MDT managers. MDT employees have a high level of readiness to implement more proactive access management.
- Responsibility for access management in MDT is fragmented across divisions and between regions and headquarters. This is not viewed as a problem; however, there is agreement that communication could be improved.
- Interviewees believe that employees with access management-related responsibilities would benefit from training and education to ensure that the existing guidelines are fully understood and applied consistently.
- There does not appear to be a systematic process for authorizing and recording variances or exceptions from approach standards.
- MDT works with local jurisdictions to review development permits that impact the state system. Where MDT is involved early in the process there are better opportunities to achieve access management goals. Interviewees believe that MDT needs to work consistently with local jurisdictions and educate them on the importance of being asked for input early on.
- It appears that the process for issuing building permits for unincorporated areas, which is undertaken in Helena, does not account for driveway permits. District staff indicate that this is a problem that could be rectified if a checklist item were

added to the building permit review. An example cited involved a drive-through bank with an approved building permit that included as yet unpermitted, non-conforming driveways.

- In addition to increasing MDT employees' understanding of access management, it is important to increase the understanding of the relevant local jurisdictions about how to more effectively address access management issues.

C. Access Classification System—Recommendations

A central element of the recommendations was to implement an access classification system.

1. Principles

The recommended access classification system is based on the following principles:

- Reflect the diversity of Montana conditions.
- Build on functional classification.
- Keep it simple.
- Ensure practical implementation.

2. Recommended System

The recommended access classification system provided in Exhibit 1 on the following page classifies the National Highway System and Primary System into developed, intermediate, rural, and rural very low volume routes, and distinguishes divided (median) routes from undivided ones.

Exhibit 1: Recommended Classification System

Category/Functional Classification System	Undivided or Divided	Area
National Highway System (2,657 miles) (Non-Interstate NHS, principal arterials)	Undivided (two-lane = 2,525 miles)	Rural - very low volume*
		Rural
		Intermediate
		Developed
	Divided (non-traversable)	Intermediate
		Developed
Primary System (Minor arterials) (2,833 miles)	Undivided (two-lane = 2,779 miles)	Rural - very low volume*
		Rural
		Intermediate
		Developed
	Divided (non-traversable)	Intermediate
		Developed

* Rural very low volume roads have a forecast 1997 AADT of less than 2,000 in the year 2007.

As background, Exhibits 2 and 3 describe current and future annual average daily traffic (AADT) on each system.

Exhibit 2:

Center Line Miles by AADT for Non-Interstate NHS, Primary and Secondary Systems

AADT	NHS (2,657)	Primary (2,833)	Secondary* (4,665)
Less than or equal to 2,000	1,727 (65%)	2,521 (89%)	4,525 (97%)
Less than or equal to 1,400	1,196 (45%)	2,266 (80%)	4,432 (95%)
Less than or equal to 1,000	717 (27%)	1,926 (68%)	4,292 (92%)

* The secondary system is not included in the access classification system.

Exhibit 3:

Center Line Miles by Future Factored AADT for Non-Interstate NHS and Primary System

Less than or Equal to 2,000	NHS Lane Miles (2,657)	Primary Lane Miles (2,833)
5 Years	1,514 (57%)	2,521 (89%)
10 Years	1,435 (54%)	2,408 (85%)
20 Years	1,249 (47%)	2,210 (78%)

3. Access Classification System Categories

a. Level of Importance/Functional Classification

The recommended approach uses function as the basis for determining the importance of the route. For the purposes of the classification system, this involves distinguishing between the non-freeway National Highway System routes (principal arterials) and the Primary System, which is comprised of minor arterials.

b. Divided or Undivided Cross Section

The access classification distinguishes between divided and undivided facilities. Divided facilities were defined as those with non-traversable medians. Montana has a very small number of divided lane miles. They are treated separately for access management purposes.

c. Area

The basis for implementing the classification system is that the different specified areas, developed, intermediate, rural and rural very low volume, will be treated differently. The Steering Committee concluded that the existing pattern of driveway access should provide the basis for classifying different roads. The most difficult implementation issues arise from determining how to establish these different access classes.

The following provides the working definitions:

(1) Rural Very Low Volume

The purpose of identifying very low volume rural areas is to avoid changing the status quo in those areas where, in general, the current access management plan and approach permit procedures are satisfactory. All non-interstate National Highway System and Primary System roads that are forecast to have below 2,000 average annual daily traffic (AADT) in ten years time will be in this classification. There will be periodic updates to account for changes in traffic volumes.

(2) Developed Areas

The purpose of the developed category is to recognize that developed areas are those with restricted amounts of vacant land for development. In these areas, implementation of access management is likely to be impractical. The current pattern of access on to the highway will only change through a reconstruction project or a project aimed solely at access management.

The key question is how to identify these areas. Establishing a criterion or threshold of existing approaches per mile provides the starting point for identifying developed areas. We tested a threshold of greater than 25 driveways per mile (on either side). This includes driveways and intersections. Initial testing of this threshold indicates that it provides a practical threshold.

(3) Intermediate Areas

These are key areas that we wish to target through the access management project. They are the areas that are not developed and where MDT is concerned that development without attention to access management will significantly affect the performance and the safety of the system. Therefore, it is important that we establish a systematic and fair basis for identifying these areas. They can be thought of as the transition from developed to rural; however, the boundary from developed is moving out toward the rural. As development occurs in these areas, the access classification system will be proactive and aim to avoid expanding the driveway and access characteristics that we currently see in the fully developed areas.

To identify these areas, they may be most simply defined as the areas where developed ends and before rural begins. Our testing of driveways per mile provides a criterion for this category of greater than five and less than or equal to 25 driveways per mile.

(4) Rural Areas

After initial testing, we recommend a starting point for defining the rural category as those areas that have an AADT greater than 2,000 in ten years and where there are no more than five "non-farm" approaches per mile. The adjacent land use would be agricultural or natural resource-based.

d. Application to Other Roads

The access classification system is applied to the Non-Interstate National Highway System and the Primary System. The Access Management Project steering and advisory committees believe that MDT's access management program should encourage local jurisdictions to adopt similar standards. In addition, implementation must be coordinated with other roadways. In particular, where the NHS or Primary System roads intersect with another roadway, it will be important to protect the roadway up to one-half mile away from the intersection. This will require coordination between the state and the responsible local jurisdictions

4. Approach to Developing the Classification System

The MDT has an image log of the entire system. Pictures are taken every ten meters and are tied to the milepost system. This videolog has been used to test the sensitivity of the classification system to different thresholds.

Among the considerations in establishing the criteria are:

- Ensuring a balance between the intermediate and rural categories in terms of road miles.
- Recognizing that as development takes place in the intermediate category, it could eventually become developed.
- Taking care not to include the many agricultural, seasonal, and rarely used rural approaches.

D. Recommended Access Guidelines

The consultant team developed recommendations to be used by MDT as the basis for driveway spacing and design criteria for the classification system. These recommendations address:

- Desirable access spacing standards and the number of accesses in each category. This does not include farm field or ranch approaches.
- Signal spacing.
- Allowable level of access. This addresses the denial of direct access.
- Access features that should be managed.
- Changes to existing driveway design and intersection criteria. This will include left turns, right turns, medians, and continuous two-way left turns.

The recommendations are presented in Exhibit 4. These recommendations will be refined by MDT and finalized as part of implementation. Stricter standards could apply on reservations or anywhere local conditions support them. In many areas there are access control resolutions already in place, which will be grandfathered.

Exhibit 4:
Recommended Montana Access Guidelines

Category	Cross Section	Area	Signal Spacing (mile) Bandwidth	Median Opening Spacing (mile)[1]	Minimum[2] Unsignalized Access Spacing (feet)	Denial of Direct Access When Other Available
NHS	Undivided	Rural-very low volume	N/A	N/A	N/A[3]	no[3]
		Rural	1/2 – 45%	N/A	660	yes[4]
		Intermediate	1/2 – 45%	N/A	660	yes[4]
		Developed Access	1/4 – 40%	N/A	250/300[5] – 325/375[5]	yes[4]
	Divided	Intermediate	1/2 – 45%	1/2 F – 1/4 D	550	yes[4]
		Developed Access	1/4 – 40%	1/4 F – 1/8 D	250	yes[4]
Primary	Undivided	Rural-very low volume	N/A	N/A	N/A[2]	no
		Rural	1/2 – 40%	N/A	660	yes[4]
		Intermediate	1/2 – 40%	N/A	440, 550, 660[6]	yes[4]
		Developed Access	1/2 – 35%	N/A	250/300[5] – 325/375[5]	no
	Divided	Intermediate	1/2 – 40%	1/2 F – 1/4 D	350, 440, 550[7]	yes[4]
		Developed Access	1/4 – 35%	1/4 F – 1/8 D	150	no

1 N/A = Not Applicable F = Full Movement D = Directional Only
2 Stricter standards could apply if supported by other jurisdictions and tribal governments.
3 Considerations other than unsignalized access spacing should govern, sight distance, etc.
4 If alternative access is unavailable, one direct approach may be allowed. For major traffic generators, more than one driveway may be allowed if it is proven to MDT's satisfaction that there will be a significant benefit to the highway network. This will require submission of a traffic impact study by the applicant.
5 Two-lane/multi-lane undivided with or without TWLTL, 250/300 applies to 35 MPH or lower, 325/375 applies to >35 MPH <45 MPH.
6 440 applies to 45 MPH posted, 550 applies to 50 MPH posted, 660 to 55 MPH or above.
7 350 applies to 45 MPH posted, 440 applies to 50 MPH posted, 550 to 55 MPH or above.

E. Access Elements to be Included in Montana Approach Standards and Roadway Design

The following access guidelines and design criteria will need to be established for implementing the classification system:

- Unsignalized access spacing.
- Traffic signal spacing.
- Roadway cross section (i.e., undivided two way left turn lanes (TWLTL) versus nontraversable barrier) and approach access type (i.e., full movement, right in/right out, etc.).
- Turn-lane warrants.
- Access separation distance at interchanges.
- Driveway off sets.
- Updated typical approach designs.
- Corner clearances.
- Thresholds for when traffic impact studies are required.
- Variance procedures for when established criteria cannot be met.
- Appeals process for when an application is not approved or the terms and conditions of the permit are not acceptable to applicant.
- Procedures for dealing with retrofit situations.
- Frontage road set back standard.

F. Implementation Plan

1. Implementation Plan

The major work elements required for implementation are summarized in Exhibit E-2 on the following page. The implementation elements include:

- Establishing the access classification system.
  - This involves pre-testing and applying the recommended categories to the system to establish the new access management plan.
- Developing and adopting new approach standards.
  - This requires public process to update 1983 Montana Approach Standards.

  - This requires defining MDT procedures, organizational roles, and responsibilities.
- Implementing access control resolution projects to purchase access rights in the NHS intermediate category.
- Establishing procedures for working with other jurisdictions.
  - These will be in the area of subdivision review and access management strategies.
- Incorporating access management-related design criteria into roadway design manual.

MDT will be proactive in areas that are classified as intermediate. This will involve purchasing access rights as part of access control resolution projects. Evaluations developed by the Right-of-Way Bureau, based on their experience in the recent Florence to Lola project, indicate that these types of projects will cost approximately $12,000 per mile.

In considering these costs, it is important to note that they are not net new costs to MDT. In practice it is expected that most access control resolution projects will take place on sections of the highway system that are likely to have reconstruction projects in the next ten years. Currently, when these types of reconstruction projects take place they involve access control resolutions and incur the same $12,000 per mile costs. The access control projects are, in effect, making the investment up front to preserve the corridor. It is also possible that in corridors where the land use will change over the next ten years that there could be a financial advantage to the state in undertaking the access control project in advance of reconstruction because access rights would be purchased based upon the current land use and cost.

The access guidelines would be applied to all new driveway permit applications and govern the design of driveways for reconstruction projects. The outcome from their application would be preservation of existing capacity and improved safety.

2. Implementing Authority

The access classification system will be implemented using MDT's existing authority. This will be in keeping with how MDT has applied standards in the past. Through its general police powers and responsibilities to protect the public health, safety, and welfare on state highways, the MDT and Commission may implement appropriate engineering standards and procedures to manage, by regulation, access on highways. MDT's current approach to regulating driveway access is specified in the Administrative Rules of Montana (Chapter 5, Preconstruction Bureau, Sub-Chapter 1, Highway Approaches).

It is recommended that the new access classification system is implemented through the same authority as the current approach standards that were established using MDT's administrative rule-making authority. This will be in keeping with how Montana has historically managed access. For example, the preface in Sub-Chapter 1, "Highway Approaches," Chapter 5 of the administrative rules states that the rules: "... apply to all highways under the Federal Aid System. The frequency, proper placement, and construction of points of access to highways are critical to the safety and capacity of those highways. Those regulations are intended to provide for reasonable and safe access to highways, while preserving the safety and utility of the highways to the maximum extent possible...".

3. Implementing Mechanisms

The basis for implementing the access classification system is through the following mechanisms:

- MDT reviewing, refining if necessary, and then adopting the access guidelines as the statewide access "plan" or objectives for the National Highway and Primary Systems.
- Undertaking access control projects using the access control resolution process. This involves purchasing access rights in areas classified as intermediate.
- Updating and amending the 1983 Driveway Approach Standards to establish the guidelines as standards that apply to issuing driveway approach permits.
- Applying the access guidelines as standards governing driveway spacing and other design criteria in projects that are subject to access control resolutions.
- Improving communication and coordination with the appropriate land use planning authorities.

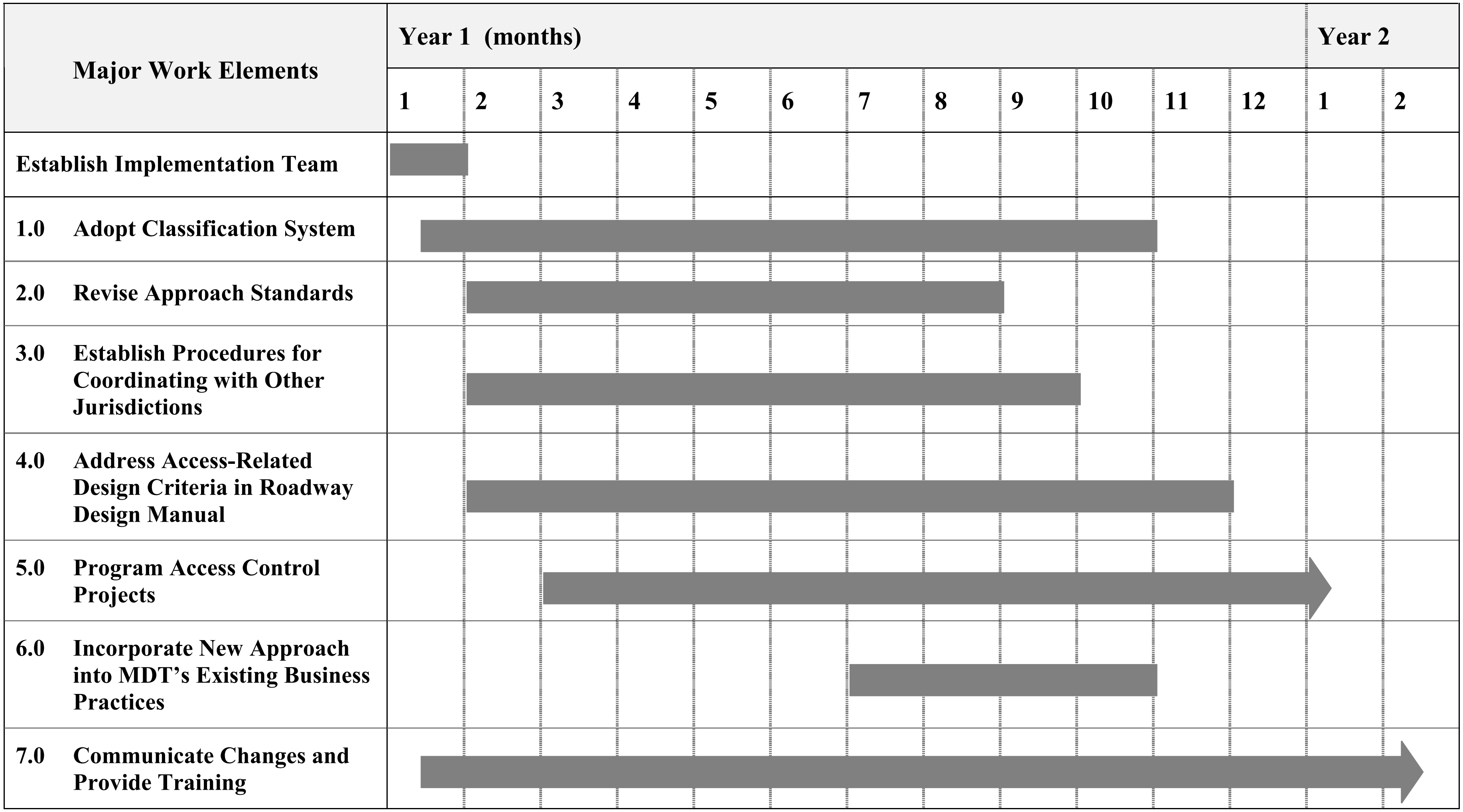
Ensuring that MDT employees in headquarters and the Districts are trained in and consistently apply the access guidelines.

4. Organization

The Steering Committee recommends appointing an access management coordinator. The coordinator would serve as team leader for implementation and then be full-time basis to the role of access management coordinator. It was recommended that this function be located within the Highway Division in Preconstruction.

A team-based approach is recommended for implementing the classification system that involves the affected Divisions and Districts.

Exhibit 5: Major Work Elements of Implementation Plan



Symbiotic, Opportunistic, Omnivores
A Perspective on New York's Arterial Access Management Initiative

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At its inception in 1993 NYSDOT's access management efforts focused on emulating the widely recognized, top-down initiatives of Florida, Colorado and New Jersey. By late 1994, however, this approach had been abandoned as there was little effective support for what was perceived to be an intrusion on local government prerogative in a home-rule State. Since then, however, New York's initiative has evolved into what is arguably one of the most successful, bottom-up, access management programs in the Northeast --with roughly 12 new and 24 on-going projects and direct interaction with over 30 new local project candidates in 1999.

This paper examines this initiative and simply asks the question, "How were three people with no defined role in transportation planning, project development or the highway work permit process, and no direct influence over local land-use planning and management, able to create a program with ongoing collaborations in well over 30 communities?" The answer, we (the Arterial Access Management Team) apply techniques that facilitate state-local collaboration in an environment where participation by the major actors is largely voluntary.

This paper discusses the five principal techniques that we employ: (1) be opportunistic - focus on high potential areas but be flexible and respond to unanticipated events; (2) use the right bait, self interest -- provide solutions that benefit all parties in their own terms; (3) focus on broader objectives -- recognize that the benefits of access management transcend traffic safety and efficiency; (4) recognize and overcome barriers to cooperation - devise ways to work with decentralized multifaceted organizations and resolve turf issues; finally (5) build teams using local leaders – achieve success by using local officials and regional staff as leaders, salesmen and catalysts ...in their community and beyond.

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Target Critical Areas Using Capital Projects as a Catalyst

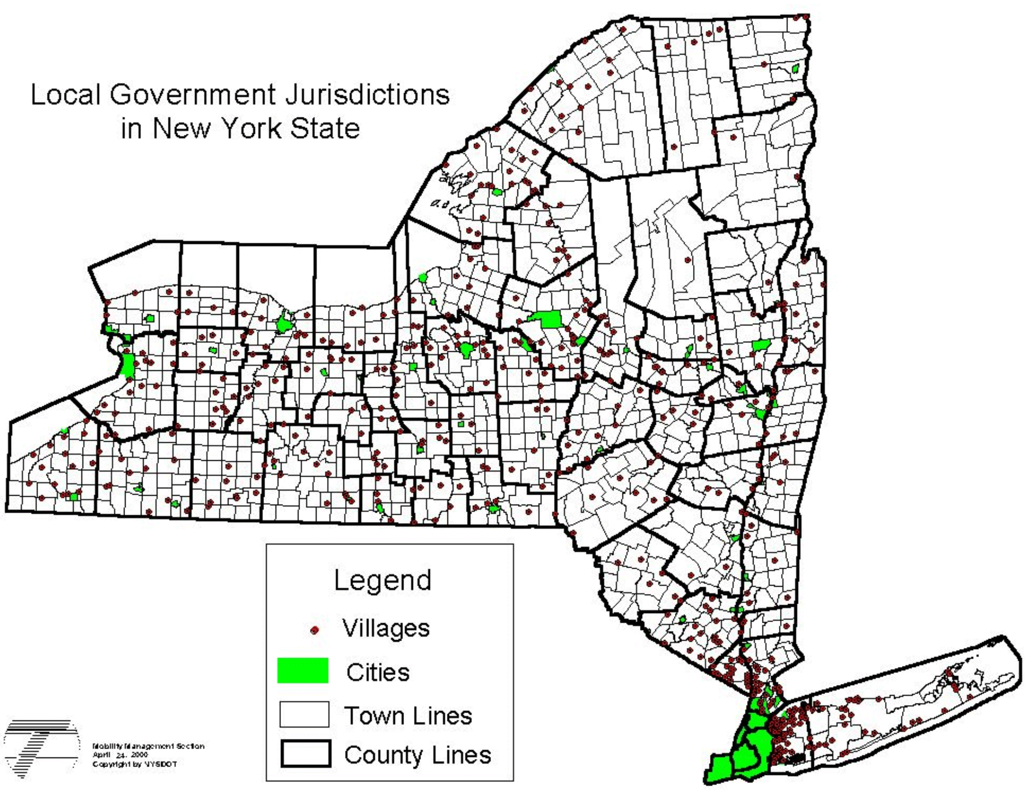
Because New York State contains over 1600 separate local governments with land use authority, we realized early on that we needed to target outreach efforts. Thus, we work with the Department's regional offices to identify growth corridors with the greatest potential for access management ....where our limited resources can be used to best effect.

State highway projects on these growth corridors further refine our focus, and often provide a catalyst to implement local initiatives. Reconstruction, widening and even pavement enhancement projects provide an influx of resources and create a sense of change that, in concert, provide impetus for local action. We routinely use projects to fund driveway consolidations and interconnections and a number of projects have also included elements to improve the local road system. This is especially important when local economic conditions are not favorable to retrofits; that is, the project provides an opportunity to implement access improvements that the private sector is not able or willing to fund on its own.

Effective use of a highway projects as a catalyst for a local access management initiative requires that outreach be carefully coordinated with the project schedule. In some of our earlier efforts,

Figure 1: Integrating Land-Use and Transportation Management: Transportation related land-use management in New York is dominantly a local government responsibility (below). There are, however, 1,609 localities in New York --62 counties, 62 cities, 932 towns and 553 villages (bottom) .... with very different developmental environments and transportation needs. These basic facts were fundamental in defining two elements of the Arterial Access Management Initiative: its focus on growth corridors and the necessity of tailoring each access initiative to the specific needs and objectives of the community involved.

Element	Local Authority	State Authority
Comprehensive Planning	Yes	No
Zoning	Yes	No
Subdivision Approval	Yes	No
Site Plan Approval	Yes	No
SEQRA (Lead)	Yes	State Projects
GEIS	Yes	?
Advance Acquisition (ROW)	Yes	Yes
Official Mapping (ROW)	Yes	No
Transportation Planning & Mgmt.	Local System	State System
Highway Work (Access) Permit	Local Roads	State Roads



we initiated outreach to local governments during the design phases of a project.[1] Unfortunately, this practice didn't always allow enough time for access management to be assimilated by the community, translated into actions to be added to the project, and "sold" to individual property owners.[2] Beginning this process during the design phase, thus, occasionally placed our regional offices in the uncomfortable position of choosing between a design which did not include access elements or delaying the project until these access elements had been approved by the locality.

As we don't want to cause project delays, we now work with our regional offices to schedule outreach well in advance of project scoping. This generally allows sufficient time for local consideration and the identification of access management elements that can be incorporated into the project. Projects do not have to be delayed while the community "digests" access management concepts and develops a program to implement them locally.

While alignment of our outreach activities with NYSDOT projects is our principal targeting tactic, other opportunities abound. Participation in the local government comprehensive planning process is also very important and can lead to a broader and more effective set of solutions than might be achieved through alignment with a NYSDOT project alone. In other communities the specter of rapid commercial development and/or deterioration of the village/city core has been enough to spark a willingness to initiate an access management program. It often comes down to being opportunistic: participating in local planning and development activities to keep ideas "floating" until the situation is ripe to implement access management.

Customize Outreach to Each Community

A large part of our time is spent developing and delivering access management presentations and training materials to local governments and NYSDOT staff. These presentations are designed to familiarize audiences with basic access management concepts and to present access management projects that illustrate the potential benefits. These presentations provide a venue to engage local governments in discussions about access management in a way that, when the conditions are right, leads to further collaborations and eventually access management projects.

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[1] The project development process in NYSDOT generally follows a sequence from needs assessment, through project scoping, to various preliminary-to-final design phases, and finally the initiation of construction. This sequence can take from 2 to 8 years depending on the scale and complexity of a project; and occasionally more for projects of regional or state significance.

[2] Attaining local acceptance for an access management plan can also take years as it involves selling a variety of entities on its benefits. These entities often include the town supervisory and planning boards; the town attorney, public safety and code compliance officers; (and) business organizations and public interest groups. As their interests almost always differ and more than occasionally conflict, this can be a complex undertaking.

Customizing each presentation to reflect the situation of the particular audience and community adds greatly to its effectiveness. Adapting generic presentations by adding real local examples and by addressing real local problems (and omitting the irrelevant) is much more effective in engaging the audience. Thus, we take the time to visit the locality and take pictures to illustrate good and bad access configurations, and utilize local aerial photography, zoning and plat maps to illustrate larger concepts. The access management projects that we use for examples are those that most closely reflect local conditions and potentials. Doing this, of course, takes time and effort but, in our experience, it is time well spent.

Figure 3: Outreach is Most Effective in the Local Context – In this case, a number of accidents between vehicles turning right and vehicles exiting the facing driveway served to illustrate the problems associated with inadequate corner clearance.

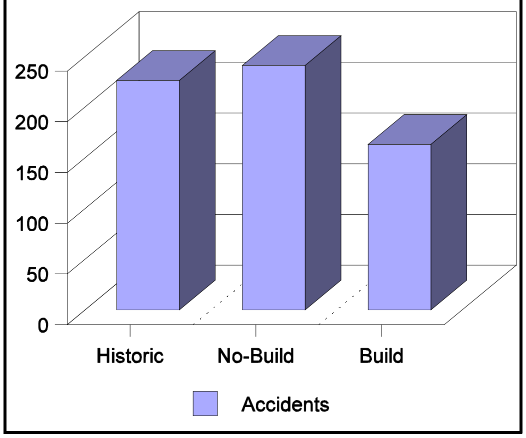
Win/Win Solutions Are Essential

The only truly sound basis for successful, cooperative state-and-local projects is the achievement of real benefits by both parties. Access management makes for good cooperative projects because, in general, both state and local officials share an interest in keeping traffic moving safely and efficiently. Once shared goals have been identified, however, it is important to articulate them in terms that are specific to the project and clearly understandable to the participants. For example, we are currently involved in a project in the towns of Clarance, Lancaster, Cheektowaga and Amherst along 1.5 miles of a highway that is already largely built out with retail development. The project involves reconstructing the roadway to add an additional travel lane in each direction, converting the two way left turn lane to a raised median, adding sidewalks, and consolidating commercial driveways to reduce the total access points from 65 to approximately 45. Because both the Department and the Towns recognized the importance of selling the need for driveway closures and consolidations to the affected property owners, we decided to emphasize the project's safety benefits, as shown in Figure 4.

Shared transportation goals are not always present, clearly identified or valued sufficiently by all parties to sustain cooperation, however. In such cases we may employ a variety of tactics.

We always accentuate the positive. We have, for example, worked with communities where local interests strongly advocate reduced speeds but where NYSDOT staff have often spent years resisting speed reductions in an effort to preserve mobility. Generic pamphlets and presentations emphasizing the safety, mobility and speed benefits of access management are not useful in the face of such conflicts, so we tailor the approach to emphasize the benefits that are shared by both the state and local government.

Figure 4: Amherst and Cheektowaga – Safety Unified the Towns and Department



Quite often, the key to defining a commonly acceptable project in the face of differences over the value of "transportation" benefits is as simple or complex as defining "value" in the other party's terms. For example, we participated in a cooperative effort to develop an access management plan in conjunction with a proposed highway widening project in on Rt. 332 in the Towns of Farmington and Canandaigua. The original project scope developed by the Department called for widening from 2 to 4 lanes and intersection and drainage improvements. The planning process established a project team that included representative of the town governments, the access management team and NYSDOT regional staff and resulted in the addition of a restrictive median, preconstruction of future intersections and the cooperative development of new access roads. These elements had value to both the Towns and NYSDOT, but different value, as shown in Figure 5.[3] A classic win/win situation was defined and resources used in a way that allowed each party to contribute what it could best afford, thus broadening the project's overall benefits.

This type of project is more common than not, as in many projects each participant has distinct objectives and values, a distinct value system, and distinct responsibilities. It is not necessary to have the same goals to achieve symbiosis. All that is needed is to define actions from which each participant benefits in their own terms.

Another technique we use is to increase goodwill by finding non-traditional ways to help a community. For example, in one case the NYSDOT regional office initiated a reconstruction

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[3] As the Department could not absorb the full cost of constructing the local roads, the Project Team worked out an agreement whereby the towns would acquire the ROW and construct the base and NYSDOT would pave the roads during its highway project. This allowed the towns to use resources available to their highway departments and NYSDOT to access economies of scale by including the paving as part of a bigger project.

Figure 5: Value Is A Matter Of Perspective and Objective – the Case of Rt. 332

Access Elements	Value to NYSDOT	Value to Towns
Restrictive Median	Safety – reduces and manages left turns	Improved aesthetics and better control over the type and size of development
Preconstruction of Future Intersections	Predictability in the development of local roads and better intersection spacing at full build-out	Reduced local costs for advanced completion of local road network
Access Roads	Safety, mobility, capacity – fewer turning movements and reduced local traffic on Rt. 332	Reduced local costs for advanced completion of local road network, improved opportunity to expand tax base away from Rt. 332

project at the same time that we'd been providing the village planning board with support in developing a comprehensive plan and access management ordinance. During discussions on the comprehensive plan we discovered that the Town had plans to fill a swale to provide a village park and was in the process of planning to replace its water main –which was under the road in a section we proposed to reconstruct. We linked the two and persuaded the regional office to use fill that would be generated by its project to fill the swale as well as coordinate its re-paving project with replacement of the water main ...which allowed the Town to save money. The goodwill, in turn, contributed to selling elements of the access management ordinance that might otherwise have been difficult to implement.

The strongest basis for sustained action is self interest. It follows that successful cooperative projects must have win/win characteristics and that the best projects have multiple benefits. Effective cooperation also magnifies benefits and stretches resources. And, the fact is that there are many potential opportunities for state and local cooperation. A major thrust of our efforts is, thus, identifying opportunities for cooperation and then articulating them in the form of projects that benefit both the Department and the communities involved.

Broaden the Perspective

The natural tendency within state transportation agencies is to focus on activities over which they have the greatest control ...and these are often the improvement of road and driveway configurations as part of a capital project. But, when a capital-project orientation to access management is over-emphasized, long range land use planning is often missing. And in high growth areas, the density, type and location of development and the quality of the developing local road system will have transportation impacts that can easily overwhelm the benefits of even the most well conceived highway capital project. Thus, state transportation agencies have good reason to support efforts to coordinate land development and transportation development.

Planning, management and control of development is based on a broad set of needs and objectives, however, and these are primarily local in nature. Aesthetic, quality of life, economic, environmental, and property tax base objectives are as important to local officials and citizens as transportation benefits, and often more so. Consequently, state transportation agencies need to broaden their traditional perspective if they are to work successfully in cooperative access management projects that encompass long term land use considerations.

By actively participating in town master planning we work to put these local objectives into terms that the Department can accept, support, and contribute to, often acting as advocates for the local government interests to the NYSDOT regional offices. And we act as transportation and land use planning consultants to the towns- helping them to define aesthetic, quality of life, economic tax base and environmental implications of transportation decisions and the transportation implications of land use decisions. In doing so, we often represent NYSDOT's interests in the local government arena.

An example of such broader considerations occurred in the case of the Town and Village of Livonia which are facing heavy growth pressure and a pattern of development which threatens their "quality-of-life" (Figure 6). To address these problems the Town developed a master plan emphasizing three over-arching objectives: enhancement of the existing village and hamlet environments as desirable locations to live; preservation of green-space and agricultural areas as both economic and social assets; and establishment of conditions enabling more robust and diverse economic growth. We participated in working session with the town planners and their planning consultant providing land use and transportation expertise.

The principal tool applied to accomplish the town's objectives was re-zoning, to concentrate: residential development in and around the Village and provide for very low density development with clustering incentives elsewhere; commercial and retail growth in areas that were already substantially developed; and industrial development in one area that could take advantage of multi-modal access.

Further, recognizing that a high quality transportation system is necessary to attract development and maintain a high quality of life, the Town worked with us to formulate a transportation strategy intended to reduce the traffic impacts of development. The strategy included a broad access management ordinance; the inter-connection of local roads, sidewalks and bikeways as development occurs; and, locating high-volume or truck generating users on a new road which would largely by-pass the existing arterial and collector network. We are now assisting the Town in developing a financial package to design and construct the new road

The communities we work with vary greatly in terms of size, location, needs, and capabilities. Because of these differences, the support and services we offer also vary and we tailor our assistance to the needs of the community. In some cases we may act as surrogate consultants broadly ....providing general transportation planning input with an access management perspective. In other cases, and particularly where greater planning resources are available, we may fill more circumscribed roles: walking the participants through the trade-offs inherent in linked land-use and transportation actions, providing information and peer-to-peer contacts, assisting in the management and review of consultant efforts, and supporting the drafting and completion of plans and ordinances.[4]

Team Building is Critical

With three staff members our ability to support active projects is limited. We have, thus, focused on developing local and regional capabilities to take leadership roles in access management. There are a number of techniques we using to encourage this kind of behavior.

We start by recognizing that we are, in most senses, simply *agents provocateurs*. That is, we may have a rational public objective but we do not have nearly as large a stake in the results as do the citizens and officials in the communities involved (or staff in our regional offices, for that matter). We use our outreach efforts to sell the desirability of implementing access management programs to local communities, but once they're ready to act we position local officials in the leadership roles. Their insight into local needs and objectives, understanding of what is and is not reasonable in the context of the community, and ability to "make and sell" decisions in the context of local politics are fundamental to implementing a successful project.[5]

Once we've completed a successful project we ask these local leaders (generally regional and local government officials and staff) to act as advisors to their peers in other communities. This is often simply accomplished with a phone call putting, for example, the supervisor in Town A in contact with the supervisor in Town B. Not only is this more efficient than trying to do it all ourselves, but the message is generally more credible when it comes from a peer with practical experience in the issue at hand.

We also offer a variety of hands-on training workshops for local government and regional personnel. These focus on specific, real world site plan and zoning subdivision reviews, for

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[4] Some of the more common themes in these collaborations include the identification of corridors for which access management plans are desirable; modification of zoning to concentrate commercial development; classification of roads and the development of appropriate frontage and driveway spacing standards; and analysis the local road system to identify desirable links as well as opportunities to interconnect subdivisions and construct new local roads.

[5] ALL our projects are collaborative. We will not participate in an access management project absent direct participation by local officials.

example, and begin to build the skills needed to implement access management plans at the local level. We include local officials and/or staff as case facilitators in all workshops.

Beyond that, we leverage our capabilities by tapping into other regional and state organizations. The metropolitan planning organizations are a significant source of professional talent and funding and we often work with them to reach local governments.[6] Academic venues, such as the Cornell Local Roads Program, provide entrees to local transportation officials and also serve as a source of expertise when specific issues arise. We collaborate with other state agencies such as New York State Department of State (which is has an extensive and ongoing training and assistance program for local officials) and a number of state-wide interest groups such as the New York State Association of Towns and the New York State Planning Federation.

Recognize and Overcome Barriers to Cooperation

While there are many good reasons for state/local cooperative projects, anyone who has worked to establish them knows that there are also reasons for not cooperating. One of the most pervasive obstacles to cooperation is the fact that both the NYSDOT and local governments are multifaceted, decentralized organizations. This can make it difficult to get commitments that hold for all parties over the life of a project. A planning board's willingness to work toward an access management ordinance, for example, does not mean that the town board will accept the ordinance. Similarly, adoption of a local access management ordinance does not automatically commit the NYSDOT regional traffic engineer to support the ordinance when making highway work permit (driveway) decisions on a state road.

One strategy that we commonly use to obtain a continuing and cooperative effort is to form a core project advisory committee consisting of representatives from all of the key groups in NYSDOT and the locality. This typically includes representation from the town board of supervisors, the planning board, public safety office, and highway department as well as the planning, traffic engineering and design groups from NYSDOT.

While we've called these groups "advisory", advice is not their most important activity. Instead, their key function is to build sustainable commitment to the project. And, typically, during the course of the project the advisory committee will be called on to help "sell" access management concepts and the merits of the project to ever widening constituencies. And, typically, they will develop loyalty to the core advisory group that is important in resolving differences in objective, approach and cooperation.

Obtaining initial commitments from the highest levels in the respective organizations can also be helpful, particularly where significant resource commitments are involved. On one cooperative

[6] One effective opportunity is, for example, through participation in the development of the MPOs' Unified Planning Work Program (UPWP), and several our MPOs now include access management activities in their work programs.

project involving two towns, for example, we decided that a memorandum of understanding stating the intention and objectives of both towns and the Department was necessary. The resulting memorandum was endorsed by the two Town Boards and signed by the NYSDOT regional director.

There are also turf issues to be addressed. As Main Office staff we must be sensitive to the prerogatives of our regional offices. As they are ultimately responsible for what goes on in their region, it is easy for them to view our involvement with some suspicion. To resolve this, we try to position ourselves as working “for” them by informing them of any contacts we have in there region, including them in correspondence (generally in advance of distribution to others), seeking their advise, actively involving them in projects, and defining strategies to advance their priorities. Our ultimate goal is for them to view us as a resource for regional success.

Finally, we recognize that personal relationships are important. We try to call or drop in on our access management friends whenever we’re in town. And, when the planning board or advisory committee meeting reconvenes at a local tavern after an evening of business, we try to be there because we value the relationships that are formed there and the work that sometimes gets done there. Who says access management isn’t a good time?

Conclusion

In our experience defining access management opportunities for any project from a technical perspective is relatively straight foreword. That’s not to say that it doesn’t require substantial expertise, knowledge or resources ...but simply that technical options are definable and lead to generally predictable solutions. It’s the institutional, political and human elements that are less predictable, less tangible, call for greater creativity and flexibility, and that ultimately determine whether an access management solution will be acceptable and implemented.

That being the case, we focus the majority of our effort in addressing these human and institutional issues. And, as discussed, there are five dominant tactics that we employ: (1) be opportunistic - focus on high potential areas but be flexible and respond to unanticipated events; (2) use the right bait, self interest -- provide solutions that benefit all parties in their own terms; (3) focus on broader objectives -- recognize that the benefits of access management transcend traffic safety and efficiency; (4) recognize and overcome barriers to cooperation - devise ways to work with decentralized multifaceted organizations and resolve turf issues; finally (5) build teams using local leaders – achieve success by using local officials and regional staff as leaders, salesmen and catalysts ...in their community and beyond.

For the 4th National Conference on Access Management
Category: Access Management in the Planning Environment
Presentation Option: Paper/Presentation

Title: Integrated Transportation Management

I. Introduction

Long range planning of transportation projects cannot be successful if land use is not considered in the equation. Typically, in the amount of time it takes for a major transportation initiative to go from concept through design and construction to completion, many years will pass. In that amount of time, changes in land use can be so significant that the best corridor options have been foreclosed. Changes in demand and travel behavior can be so significant that the project no longer offers an appropriate solution to the problems at hand. Preserving corridors through outright purchase is one way to approach this problem, however, it presents its own challenges. Attempts to preserve a corridor short of purchase are often frustrated by property rights concerns or shifting politics. *Integrated Transportation Management* answers this dilemma thru a series of related and often parallel stages that include the following:

- identification of critical corridors,
- partnering at all levels of government,
- alignment study,
- preparation of a legally binding corridor master plan,
- design study, including a management plan, and
- corridor management prior to construction.

II. Stages of Integrated Transportation Management

A. Identification of a Critical Corridor

A *critical corridor* is any transportation corridor that, due to developmental pressure, is in need of an increased level of management to preserve capacity and functional integrity. These can be corridors that are already operating above or near capacity with severe crash rates, or corridors that are currently under capacity with low crash rates where developmental and traffic volume growth is projected or anticipated. The latter, obviously, is the preferred exception; though in the real world, the former is the general rule as these corridors receive the greatest public attention and thus support. Regardless, designation of a specific corridor as critical and minimum standards of operation are mutually agreed upon across state, county, and city levels of government. Cooperation with local partners is critical. Political subdivisions of the State (e.g. counties, cities, etc.,) by statute, carry the authority to manage land use and so bring valuable abilities into the partnership. One such example is K-4, in Jefferson County, Kansas, north of Topeka, the state capital.

Case Study: The K-4 corridor designation consists of a 16 mile segment from the Shawnee/Jefferson county line to the north junction of K-4/K-16 near Valley Falls. This segment is designated based on a tremendous growth potential as well as a matter of route continuity. The new Oakland Expressway in east Topeka will connect K-4 with I-70 and will bring K-4 to the forefront both as a commuter route and a freight route between Atchison, Topeka, and the remainder of the state. Further, this segment is on the National Highway System, carries from 3000 to 8500 vehicles per day, and is already the subject of an advance preliminary engineering study.

B. Partnering Agreement

A *partnering agreement* is entered into by the Secretary of Transportation, county, and affected cities to specify critical corridors and to identify common interests and goals in the management of these critical corridors. This partnership is supported as needed by entering into agreement for projects to retrofit or otherwise improve critical corridors. The partners can reasonably expect mutually identified interests and goals to be upheld and implemented by one another. The partners agree to share information, resources and decision-making in the management of critical corridors. The purpose of this partnership is to enhance the management of the public investment in transportation by improving safety and traffic operations and encouraging uniformity in the management of critical transportation corridors.

Case Study: A partnership, which forms the basis for work on a corridor master plan, has been entered into between the KDOT, Jefferson County, and the cities of Meriden, Ozawkie, and Valley Falls. The partnership agreement document is known in Kansas as a *Memorandum of Understanding*; a copy is included in the appendix.

C: Advance Preliminary Engineering (APE) Study

Once the critical corridor has been selected and the partnership agreement signed, the *advance preliminary engineering (APE) study* can begin. The APE study is simply a study of possible alignments with recommendation. The first step in this alignment study is to analyze future conditions based on existing geometry and cross-section and projected traffic volumes. Understanding how the corridor might operate in the future under a no-build scenario directs policy decisions as to functional classification and cross-section (i.e. super-two, four-lane expressway, freeway, etc.) Once the facility type and cross-section have been established, possible alignments can be studied. The alignment study analyzes potential corridor alignments, with consideration given to horizontal and vertical features (such as drainage and grade,) structures, environmental factors, socio-economic factors, and future land-use. Typically, this will involve consideration of an upgrade to the existing alignment as well. Alternatives are narrowed to about three most feasible choices. The public is involved throughout the entire process and a public involvement plan is an integral part of this stage. The APE study concludes with recommendation of a preferred alignment. It does not, however, contain a sufficient level of detail to establish a project centerline, right-of-way limits, or environmental clearances.

Case Study: The advance preliminary engineering effort has already undertaken feasibility analyses on several corridor options and has eliminated several infeasible scenarios. Completion of the study is scheduled for autumn of 2000.

D: Corridor Master Plan

With the conclusion of the APE study, the corridor management effort can resume. This stage of the effort integrates the regulatory abilities of the partners toward a common end, namely the preservation of the adopted corridor and coordination of future developments. The *Corridor Master Plan (CMP)* is a contractually binding document upon all signatory parties and their successors that defines parameters for transportation management, access management, land use and development characteristics for a proposed corridor alignment. It documents the vision for the future corridor and utilizes the information in the APE study to formally adopt a corridor. The CMP is a dynamic document that begins in general terms and evolves over time to incorporate more specific design details, changes in industry standards, or other changes that may occur. It includes land use planning elements for newly developing or redeveloping areas to prevent or minimize new permanent structures in the corridor. It also includes operational features to attempt to retrofit established areas such as relocation and redirection of access or traffic circulation patterns. The plan does not identify specific projects, rather, it begins the process of preserving a corridor for future construction and identifies advance acquisition and retrofit priorities. From information contained in the CMP, specific projects and agreements can then be drawn

Case Study: A sample corridor master plan for the K-4 example is included in the appendix.

E: Design Study, Management Plan, and Access Plan

The *design study*, or preliminary engineering, carries a project from proposed corridor alignment to a set of construction plans ready for bid letting. The first step, naturally, is to establish the project centerline. Once the survey grade centerline is established, a *Management Plan* can be detailed, including right-of-way limits, setback limits, and an acquisition schedule. The management plan is adopted into the corridor master plan. The management plan will also include an *Access Plan*. The KDOT has recently adopted access planning as part of the design study process. Access planning is applied to any major construction project that is a) located on a segment of corridor with an existing CMP, b) located on the National Highway System, c) involves, approaches, or bypasses an incorporated area, or d) involves a new alignment. The access plan documents how access will be managed once the project is open to traffic. Factors such as minimum access spacing, location of intersections, and level-of-service thresholds are specified. The design study and management plan serve to integrate the implementation phase of the corridor preservation effort. Specific guidance can be given developers regarding required dedication of right-of-way or access control, future access to their property and setback for structures. This information will guide the site design process and result in development that is poised to take advantage of the corridor improvements rather than be victim of the process.

Case Study: A design study and management plan to preserve the corridor will follow completion of the APE study and CMP. It is recognized that funding for construction is not likely for at least 10 years, so preservation and coordination are top priorities. For example, while an APE study is progressing, land speculation and rezoning or platting applications tend to flood municipalities and counties as people along the proposed corridor scramble to "protect their interests." For this reason, the KDOT is suggesting in this case that a temporary moratorium on building permits within the corridor be put into effect until such a time as the study is concluded and the right of way limits defined. Needless to say, this is an extremely risky maneuver. Property rights issues are at stake and this proposal will very likely bring a flurry of legal and political challenges. One likely challenge is that KDOT is attempting to hold down the value of the real estate in expectation of future condemnation. This is not the case. The moratorium will not apply to zoning, platting or subdivision of property, it will apply only to building permits. It is recognized that the public will be obliged to pay fair market value based upon the highest and best use of the property whenever it is acquired. The goal is to prevent or minimize demolition of buildings and relocation of families and businesses. The next likely challenge is that KDOT is affecting a permanent restriction on the use of the property. It is very important that the moratorium have a date of expiration written into the resolution. This is needed to show that the regulation is temporary in its effect and will not unduly burden the property owners in the corridor. The expiration of the moratorium should be set at not more than 30 calendar days after the scheduled completion of the design study. This proposal has not gone forward yet, so the results of such an effort can only be speculated.

F: Management of the Corridor (prior to construction)

With detailed construction plans on the shelf, waiting for funding, management of the future corridor in the interim based on the corridor master plan is critical. Parcels of right-of-way are acquired in accordance with the prioritization schedule as opportunities arise and funding becomes available. Platted dedications and enforcement of setbacks will keep the corridor clear of permanent structures. New development should be positioned to take advantage of the new highway. Variances to the plan should be avoided wherever possible; though variances for temporary situations may be possible. When managed properly, the corridor will be free, or nearly free, of permanent structures, and will leave a path of least resistance to the construction of the new highway.

III: Conclusion

Given the status of property rights in most states, it is likely impossible for any one level of government to successfully preserve a transportation corridor and effectively coordinate land use at the same time. Commonly, state agencies have little or no land use management authority and county and city authorities have little or no influence over the state controlled transportation systems. Thus, as proposed by the American Planning Association's (APA's) *Legislative Guidebook*, a vertically and horizontally integrated approach is necessary. Vertical integration, as explained by APA, means that city, county and state planning documents (and federal, if applicable) should be logical and congruent when compared side by side.

The Kansas Department of Transportation has applied this concept to the problem of identifying and preserving future transportation corridors with the following anticipated benefits: Partners at all levels of government agree upon the transportation need and the most appropriate way to meet that need; public involvement is more thorough and better coordinated; environmental review and documentation receives better oversight; and finally, once the need is established and the best alternative adopted, land development can be coordinated to minimize impacts from the proposed project.

In summary, a plan to identify and preserve corridors for long-range planning purposes depends upon an integrated planning effort whether new alignments or upgrading existing alignment is involved. Integration must include purpose, planning and implementation in order to be effective. With such integration, long range transportation planning will prove to be worth the effort.

Minnesota

Land Use and Access Management Program Update - August 2000

Presented by Lisa J. Freese, Mn/DOT Office of Investment Management

Access Management Initiative 1997-1999

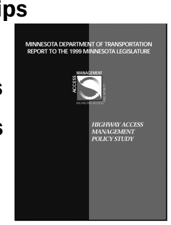
Research Conducted:

- Market Research-public attitudes
- Systems Thinking
- Legal Analysis
- Crash Rate Analysis
- Land Use Planning Analysis
- Permitting Practices
- Access Classification System
- Review of National Practices

1999 Report to Legislature

Recommended Mn/DOT Strategies:

- **Partnerships**
- **Education**
- **Guidelines**
- **Incentives**



Mn/DOT adds Access Management Unit

- Traffic Engineering Office-Spring 1999
- Initial Staff: 2 Planners & Engineer
- Office of Investment Management-July 2000
- Attorney hired-Aug. 2000.
- Consultants retained for assistance

Interregional Corridor System

- Roads linking state's major trade centers
- Key element in 2000 legislative funding proposal
- Corridor Management Plan process developed
  - Priority for MnDOT access management efforts

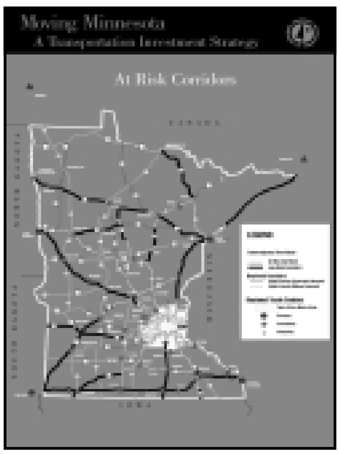
Minnesota Road System

Road Type	No. of Miles
All Roads	131,000
State Trunk System	12,000
Principal Arterials	5,200
IRC System	**2,900**
High Priority IRC's	**1,000**

Interregional Corridor System

IRC Performance Goals

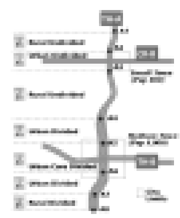
Corridor Type	Corridor Performance Target Speed (MPH)
High Priority	• 60+ MPH
Medium Priority	• 55+ MPH
Regional	• 50 + MPH



Draft Access Classification System Developed

Jurisdictionally Neutral

Components Included:
- Functional Class
- Median Treatment
- Land Use
  - Urban
  - Urban Fringe
  - Rural



Revising Guidelines to Support IRC System

- Originally based on Functional Class
- Differentiate Principal Arterials
- Added a performance component-speed based
- Emphasis on:
  - Minimizing signal proliferation
  - Maximizing signal operations for through movements on higher level roads

Revised Access Category System

Category	Roadway Function	Facility Type	Speed
1	Urban freeways & High Priority IRC's	Freeways (1a)	Metro: 55-65 mph Rural: 70 mph
		Expressways (1b)	Rural: 65 mph
2	Medium Priority IRC's & High Priority Regional Corridors	Expressways (2a)	Rural: 65 mph
		Two-lane (2b)	Rural: 55 mph
3	Rural Non-IRC Roadways	Two-lane	Rural: 45-55 mph Urbanized: 30-40 mph
4	Principal Arterials & some A Minor Arterials in the Metro area	Multi-lane divided	Urbanized: 45-55 mph
5	Minor Arterials .	Two-lane and Multi-lane Mostly undivided	Urbanized: 30-40 mph
6	Collectors	Two- & four- lane Mostly undivided	Urbanized: 30-40 mph
7	Access Management Plans adopted by both the road authority and the land use authority	Set by plan	Set by plan

(7/2000)

Access Guidelines - Issue Areas

Speed on IRC's through urbanizing areas

45 mph - high speed

Jurisidictionally neutral

- cities and urban counties v.
- rural districts and counties

Statewide consistency in a decentralized organization

Local Partners Demonstration Projects

Underway in 2000:

Trunk Highway 371 Land Use & Transportation Plan

Trunk Highway 7 Access Management Ordinance

Trunk Highway 371 Land Use & Transportation Plan

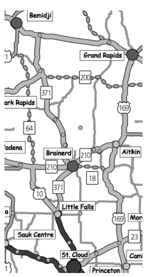
2 Counties-MN Lakes Region

Planning Grant-MN Planning

MnDOT added Funds for Local Transportation Plan- IRC

Project Challenges:

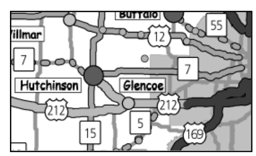
- **weak state planning environment**
- **no. of govt. units**
- **Commercial zoning**
- **environmental**
- **local implementation**



Trunk Highway 7 Access Management Ordinance

1995 Mn/DOT Corridor Study

- Recommended Local Regulatory Measures
- Never Implemented
- Local's Requested Assistance from MnDOT with Implementation



T.H. 7 Ordinance Challenges

Large # nonconforming accesses-Proposed Standards

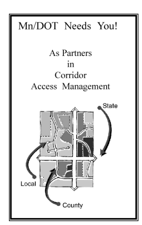
Conflicting Local Objectives

Rights - Further Land Subdivision

Planning Horizon & "Zoning" Roadway-existing v. future needs

Encouraging development of Supporting Road Network

Education & Outreach Efforts



Brochure - Local Elected Officials

Seminars & Speaking Engagements

- Internal
- External

Technical Assistance

Future Activities

- Guidance - IRC's
- Model Access Management Ordinance
- Legal Strategy
  - litigation
  - statutory
- Research
  - safety & mobility
  - purchasing access control
- Economic Impacts
  - before and after studies
- Training

MnDOT Land Use & Access Management

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Impacts of Access Management Techniques (Part 1)

Paper 6A. The Economic Impacts of Medians: An Empirical Approach

Jerome E. Gluck, Urbitran Associates

Herbert S. Levinson, Transportation Consultant

Paper / Slides 6B. Developing a Methodology to Determine the Economic Impacts of Raised Medians on Adjacent Business

Bill Frawley, Texas Transportation Institute

Paper 6C. Economic Impacts of Access Management

Kristine M. Williams, University of South Florida

Monday August 14, 2000 – 1:00 PM – 2:30 PM
Track 2 - Technical

THE ECONOMIC IMPACTS OF MEDIANS

An Empirical Approach

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Prepared for:

4th National Conference on Access Management
August 13-16, 2000
Portland, Oregon

CONTENTS

ABSTRACT

The Economic Impacts of Medians: An Empirical Approach
By:
Herbert S. Levinson, Transportation Consultant
Jerome S. Gluck, Urbitran Associates

The installation of physical (non-traversable) medians improves traffic operations and safety. However, by restricting or diverting left turns, medians may affect roadside businesses. Estimating these economic impacts becomes important in helping to decide when and where to install a physical median.

This paper describes the economic considerations associated with installing these medians. It presents a simplified procedure for quantifying the estimated impacts of installing a raised median based on upon the following factors: the number of vehicles that turn left into a roadside business, the proportion of these turns that represent pass-by traffic, and the estimated annual sales of the business. Examples are presented. The estimates derived from this procedure represent the maximum likely impacts, since normal traffic growth and overall economic growth are likely to offset some of the potential loss.

DISCLAIMER

The research reported herein was drawn from work performed for NCHRP 3-52, Impacts of Access Management Techniques. The opinions and conclusions expressed or implied in this report are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical committee, they are not necessarily those of the Transportation Research Board, the National Research Council, the American Association of State Highway and Transportation Officials, or the Federal Highway Administration, U.S. Department of Transportation.

1.0 INTRODUCTION

Physical (non-traversable) medians separate opposing directions of flow and provide refuge areas for left turns, and pedestrians. They improve safety with reported 10 to 15% fewer accidents per vehicle mile than other median alternatives. However, the installation of a physical median limits direct access to most land developments. The prohibition and/or rerouting of left turns may require longer travel distances and changed routes of access. This, in turn, can limit both the accessibility and effective exposure of a site. Conversely, improved traffic operations associated with installation of medians may improve accessibility and exposure.

The economic impacts of a physical median, therefore, largely reflect the extent to which access is improved, restricted or denied. This is because property acquires value because of its location, and the keys to locations are accessibility and exposure. Accessibility is measured by the ease that people and vehicles can reach, arrive at and depart from a site; exposure is measured in terms of the number of people and vehicles that pass a site.

Measuring and assessing the impacts of restricting left turns has been difficult. The impacts not only depend upon the extent that access to adjacent property increases or decreases, but also on the type of activity involved and the background economic conditions. (1) Some activities, such as a regional shopping center or office complex attract their clientele from a large area, and the overall access time to markets play a major role. Other activities, such as service stations and drive-in restaurants, rely on intercepting pass-by traffic; in such cases, left-turn restrictions and increased travel distances could adversely affect businesses. (2) The impacts of left-turn restrictions also depend upon changes in business conditions and traffic volumes, shifts in population and purchasing power, and the development of competitive business sites.

2.0 PREVIOUS STUDIES

Several studies have attempted to analyze the actual impacts of installing medians. Most, however, have been based on perceptions of impacts and attitudes of the various groups impacted.

<u>**Texas Cities**</u> **(1, 2, 3).** The impacts of raised medians on left turns and sales volumes were analyzed for Baytown, Pleasantville, and San Antonio in 1964. The key findings are shown in Table 1. (1) The total number of left turns as a percent of ADT declined, both before and after the restrictions as the ADT increases. This suggests a lower attraction of far-side (left turning customer) traffic under high volume conditions. (2) "Traffic serving" businesses that were <u>not</u> located at median openings reported a 44% decline in sales volumes after median construction, while non-traffic-serving businesses reported no change.

Georgia Studies. The economic impacts of installing raised (non-traversable) medians on Jimmy Carter Boulevard and Memorial Drive in Metropolitan, Atlanta Georgia were identified as part of ongoing safety and operations studies.

1. **Jimmy Carter Boulevard (4)**. A 3.5-mile (5.6-km) section of Jimmy Carter Boulevard was changed from five lanes (four through lanes, plus a continuous two-way left turn lane) to six lanes with a raised median in 1988. The new roadway provided six through lanes, protected left turning lanes at signalized intersections, and a 10-inch high 2-foot wide concrete median. (A "Jersey" barrier was used temporarily from April 1987 through August 1988). Except for one location, all median breaks were signalized, and "U" turns at median breaks were allowed. Daily traffic volumes on Jimmy Carter Boulevard increased between 20 and 37% since 1985. Flows in the "central" section exceeded 60,000 vehicles per day while on the northern and southern sections volumes exceeded 50,000 vehicles per day.

The economic impacts of the raised median were identified by comparing tax records of businesses along the roadway for a 1-year period with the two-way left turn lane (before) with a corresponding period "after" the raised median was built. Twenty-one businesses reported a decrease in sales receipts, with the decreases ranging from 0.25 to 56 percent. Fifteen businesses reported an increase in sales receipts, with the increases ranging from 0.32 to 848 percent. These comparisons suggest that the raised median did not result in any overall negative impact, although some individual mid-block businesses (i.e. businesses located between median openings) may have suffered some loss of sales. The businesses that were reported to suffer ended up on the "wrong" side of a median, such as a liquor store or grocery store located on the "going to work" side, and a breakfast restaurant located on the "coming to home" side.

2. **Memorial Drive (5).** Daily traffic volumes along the five-mile section of six-lane Memorial Drive range from 35,000 to 55,000 vehicles per day. During 1990, a 10-inch raised median replaced two-way left turn lanes. Median openings were limited to the 14 signalized intersections. Dual left turn lanes were often provided, with the inside lane signed specifically for "U" turns.

The changes in business activity along Memorial Drive reflected the overall economic climate as well as introduction of the physical median. A December 27, 1992 article in the Atlanta Journal and Constitution stated that, after the raised median was installed, several businesses (including Blockbuster Video and Ace Hardware) closed and one business (Citgo Food Mart), located on a cross road, had reportedly lost 50 percent of its business. However, the specific reasons for closing were not identified.

<u>Florida Experience</u>. Attitudes and impacts associated with medians were obtained for roadways in Fort Lauderdale, and in Broward, Orange and Seminole Counties.

1. <u>Oakland Park Boulevard - Fort Lauderdale</u> (6). This six-lane boulevard carries 50,000 vehicles per day. A 2.25-mile (3.6-km) section included 4 signalized intersections and 33 unsignalized median openings. Land use is primarily commercial.

A retrofit project eliminated 17 (approximately one-half) of the original 33 unsignalized median openings. The remaining 16 median openings were reconfigured to allow only two turning movements, the U-turn and left turn movements from only one direction of travel along the artery. The unsignalized left turn movement was alternated to serve opposing directions of travel. In addition, three new openings that allowed for only the U-turn maneuver were added.

Public opinion surveys were conducted of the various interest groups most directly affected by changes in median design and traffic operations along both roadways. The groups included through-travelers, delivery-truck drivers, nearby residents, adjacent merchants, and customers. The surveys obtained information regarding attitudes toward median changes as well as impacts on customer behavior and business activity. The findings relating to economic impacts are summarized in Table 2.

Some 63% of the 141 residents, customers, and truckers surveyed felt inconvenienced by U-turns, and some 44% of the residents and customers reported that U-turns affect the choice of businesses visited. Some 70% of the 96 responding merchants reported no adverse effect on business truck deliveries, and 84% reported making no change in their business operations. Most of the businesses (61 to 72%) reported no change in the number of customers, profitability, and property values. About 15% reported a reduction in property values and 28% reported a decrease in profit, while 6% reported an increase in profits. Thus, the reported losses were partially offset by increases.

2. <u>Broward, Orange and Seminole Counties, 1995</u> (7). Drivers and businesses were surveyed along State Routes 423 (Lee Road), 436, 520, and 600 during 1995 to obtain attitudes and perceptions regarding the effects of restricted medians. The results of these surveys are summarized in Tables 3.

- Drivers generally perceived the median changes favorably and believed safety and traffic flow were improved. However, 43% of the 201 respondents indicated they were unduly inconvenienced by U-turns. U-turns affected driver choice of destination -- the range was from 16% for offices to 43% for gas stations. About 21% reported major concerns with the design.

- Thirty-six percent of the 21 businesses surveyed indicated that the median changes adversely affected truck deliveries and 25% made business changes in response to the revised median design. Some 19% reported that business volume increased in the last two years and 38% reported no change in their business. Some 41% of the 21 respondents reported major problems with the design.

NCHRP 25-4 (8). This research analyzed the economic impacts resulting from restricting left turns. It included surveys and interviews with impacted businesses, as well as selected statistical analyses.

1. Perceptions. Attitudes and perceptions were mixed. Some business owners felt that the left turn restrictions limited access to their stores and resulted in lost businesses, while others reported that the turn restrictions reduced congestion and improved traffic flow to the point where their market areas actually expanded.

Businesses located at midblock locations (i.e., away from intersections) perceived the left turn restrictions as more detrimental than businesses located at places where left turns were permitted. In some cases, left turn restrictions appeared to cause some sales to shift from the restricted to the unrestricted business locations. Some businesses that reported losses because of left turn restrictions were ready to go out of business before the restrictions were implemented or were planning to go out of business for other reasons.

Perceptions of impacts also varied depending on the purpose of the project. There was some evidence to suggest that where safety had been publicly perceived to be a serious problem, the left turn restriction actually enhanced the number of customers coming into the area. However, where projects were intended to improve traffic speeds and flow, perceptions were mixed. Some businesses wanted customers to travel at slower speeds in front of their establishments. While other businesses reported that increased speeds allowed their market areas to be expanded.

Patron attitudes and travel behavior were obtained from 230 interviews conducted at 10 sites in New Jersey, New Mexico, New York, Oregon and Pennsylvania. About 110 (47 percent) were aware of the project. Some 49 of these (44 percent) were "pass-by convenience" trips while 62 trips (56 percent) were special destination trips. Fifty-three patrons visited businesses both before and after left turn restrictions were implemented. About 80% continued to visit establishments with the same frequency.

About 55% reported no change in travel times, 33% reported larger travel times and 12% shorter travel times.

2. <u>Sales Impacts</u>. The sensitivity of business sales as derived from this research is shown in Table 4. The key findings – based on limited statistical analysis – were as follows:

- Gas stations, food stores, and personal service businesses appeared to be the most adversely affected. These businesses showed the largest declines in sales and the highest rates of business failures. The declines in sales were statistically significant in both cases, while the business exits were statistically significant only for gas stations.

- Declines in sales and business exits for general service businesses, and durable goods retailers were not statistically significant.

3.0 GENERAL APPROACH

A simplified empirical approach was derived for estimating the economic impacts associated with left turns. This approach builds upon the preceding research efforts. It also draws upon available studies that quantify the proportions of "pass-by" traffic for various activities, and the likelihood of left turns under various traffic volume conditions.

Where direct left turns are prohibited, some motorists will change their driving or shopping patterns to continue patronizing specific establishments. Some repetitive pass-by traffic will use well-designed or conveniently located U-turn facilities. Retail sales may increase as overall mobility improves, or as economic conditions change, and as traffic volumes increase. It is also reasonable to expect that destination-oriented trips will find alternate routes to their destinations.

The <u>maximum</u> economic impact associated with installing a raised median and limiting certain access points to right turns will depend upon the following factors:

- Size and type of each abutting land use at the locations where left-turn access will be eliminated.
- The reliance of each land use on pass-by traffic.
- The number of vehicles turning left into the activity or land use.
- The average purchase per vehicle (or person).

Thus, for any site where left-turn access is denied, the maximum adverse impacts may be represented the product of (1) the number of left turn entrants and (2) the proportion of those turns that represent pass-by (intercept) trips. The economic loss would represent the average dollars per purchase times the number of trips involved.

The economic impacts over a section of highway should be summed for the individual establishments involved. Thus, the maximum loss would be:

$$\sum_{1}^{M} N_i P_i D_i \qquad (1)$$

where N_i = Number turning left at location i.
P_i = % pass-by at location i
D_i = Dollars/Purchase
M = Number of establishments where left turn entrance is denied.

The percent of pass-by traffic can be estimated based upon the proportions reported in various studies. Specific values are given in Table 5. The actual number of left turns can be observed in the field.

The resulting economic impact model is shown in Table 6. Column A in Table 6 gives generalized percentages of pass-by traffic for typical commercial uses. Typical proportions of pass-by traffic are as follows:

Service Station-Convenience Market	55%
Small Retail (<50,000 sq. ft.)	55
Fast Food Restaurant with Drive Through Window	45
Shopping Center (250,000 - 500,000 sq. ft.)	30
Shopping Center (Over 500,000sq. ft.)	20

Column B of Table 6 gives estimated proportions of left turns as a percentage of the total entering traffic. These percentages were derived from analyses of gas station customers in three cities. They show a declining proportion of left turn entrants as daily traffic volumes increase. At 10,000 ADT about 40% of the traffic entering an establishment would be estimated as entering from the left. At 30,000 ADT this proportion reduces to about 15 percent.

Several examples illustrate the application of Table 6.

- Assume that 500 vehicles per day turn left into a community shopping center of 300,000 square feet. From Column A of Table 6, 30 percent of these vehicles are estimated to represent "pass-by" traffic. Thus, the maximum daily loss in traffic would be about 150 vehicles per day. If the average purchase is $20 per vehicle, the daily loss is estimated to be $3,000. Note that the remaining 70 percent of the left-turn entrants would be expected to change their travel patterns to reach the community shopping center.
- Assume that left turns will be prohibited into a service station along a road with 10,000 ADT. From Column A of Table 6, the pass-by traffic is estimated to represent 55 percent of the total. Column B of Table 6 shows that 40 percent of the entrants are turning left. Thus, a maximum of 22 percent (i.e. 0.55 x 0.40) of the customers would be lost if left turns were prohibited.
- Assume that left turns will be prohibited into a high-turnover restaurant along a roadway carrying 30,000 vehicles per day. The pass-by traffic is estimated to account for 40 percent of the total entrants. About 15 percent of the customers are estimated to turn left into the restaurant. The anticipated maximum impact would be a 6-percent loss in customers.

To estimate the maximum daily and annual economic loss, information would be needed on the purchases per vehicle (or customer) at any given establishment – both on a daily and annual basis.

4.0 IMPLICATIONS

The suggested approach for estimating the maximum likely adverse impacts of restricting left turns is both straightforward and intuitive. It should be reiterated that impacts would be less where alternate left-turn access into a property remains open. Over a section of highway, sales at other establishments might increase because of the improved accessibility. Finally, there may be no overall impact on a community since business traffic would divert to other establishments.

A logical next step is to conduct field tests of the recommended approach. This would involve interviews with customers in selected establishments to determine:

1. How they entered various establishments (i.e. by turning left or right),
2. Whether or not they are pass-by traffic, and
3. How they would respond to changes in left-turn access

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LIST OF TABLES

TABLE 1

**REPORTED IMPACTS OF NON-TRAVERSABLE MEDIANS
IN THREE TEXAS CITIES**

A. Relationship Between Total Left Turns and ADT Before and After Construction

Location	Roadway ADT	Total Left Turns				
		Before	% ADT	After	% ADT	Change
Pleasanton	3,000	90	3.0	50	1.7	-56%
Baytown	6,000	101	1.7	50	0.8	-50%
San Antonio	21,000	237	1.1	95	0.5	-40%

B. Changes in Gross Business Sales During and After Construction

Location	Change in Gross Business Sales	
	During Construction	After Construction
Pleasanton	-6%	-14%
Baytown	-6%	- 3%
San Antonio	0%	+ 5%

Source: Adapted from References 1, 2, and 3.

TABLE 2

OPINIONS REGARDING MEDIAN CHANGES ALONG OAKLAND PARK BOULEVARD

A. Opinions of Merchants

96 Merchants Responded		Percent Response	
Questions		**Yes**	**No**
Has median changes adversely affected truck deliveries?		30	70
Has median changes caused major changes in business:		16	84
How have property values changed due to the median change?	Increased	13	
	No Effect	72	
	Decreased	15	
How has the median change affected profits?	Increased	6	
	No Effect	66	
	Decreased	28	
How has the median change affected the number of customers?	Increased	10	
	No Effect	61	
	Decreased	29	

B. Opinions of Residents, Customers, and Truckers

	TYPE OF RESPONDENT			
	Residents	**Customers**	**Truckers**	**Total/Average**
Number of Respondents	87	42	12	141
Questions	**PERCENT OF RESPONSE**			
Feel Inconvenienced by the Need for U-turns?	63	55	45	63
U-turn Affects Choice of Business Visited?	41	51	-	44

Source:
Long, G., and Helms J., Median Design for Urban Roadways, Transportation Research Center, University of Florida, Gainesville, Florida, October 1991.

TABLE 3

RESPONSES TO SURVEY QUESTIONNAIRES
REGARDING MEDIAN CHANGES
BROWARD, ORANGE, SEMINOLE COUNTIES, FLORIDA

A. Business Survey

Item		% Responding Favorably
Adversely Affects Truck Deliveries		36
Made Business Changes		25
Business Volume Changes within Last Two Years		
	Increased	19
	No Change	38
	Decreased	43
Major Problems with Design		41

Note: 21 responses

B. Driver Survey

Item		% Responding Favorably
Improved Safety		75
Better Traffic Flow		84
In Favor of Design		82
Unduly Inconvenienced by U-turns		43
U-Turns Affect Choice of Destination		
	Gas Stations	43
	Fast Food Restaurants	36
	Shopping Center	33
	Convenience Market	29
	Quality Restaurant	22
	Office	16
Major Problems with Design		21

Note: 201 responses

Source: Ivey, Harris & Walls Inc. Technical Manual -- Corridor Land Use, Development & Driver/Business Survey Analysis, District Wide Median Operations Evaluation, Florida Department of Transportation, November 1, 1995.

TABLE 4

ILLUSTRATIVE EXAMPLES OF BUSINESS SALES SENSITIVITY TO PASS-BY TRAFFIC

Proportion of Business Sales Coming from Pass-by Traffic	**Standard Industrial Class (SIC)**	**Sample Business Type**
Highest	549	Miscellaneous Food Stores
	554	Gasoline Service Stations
High	541	Grocery Stores
	721	Laundry, Cleaning and Garment Services
Moderate	525	Hardware Stores
	572	Household Appliance Stores
	753	Automotive Repair Shops
Lowest	527	Mobile Home Dealers
	555	Boat Dealers
	722	Photographic Studios
	802	Dentists

Source: Neuwirth, R.M., Weisbrod, G.E., Decker S., "Methodology for Evaluating Economic Impacts of Restricting Left Turns" in Compendium of Papers 1st National Conference on Access Management, Vail, Colorado, August 1995.

TABLE 5

REPORTED PASS-BY TRIPS AS PERCENT OF TOTAL (AVERAGES)

Land Use	No. of Sites	A AM Peak Hour	B PM Peak Hour	Source
Convenience Stores			71	9
Convenience Mart with Gasoline Pumps	15	62	66	10
Convenience Mart	20		60	11
Gasoline Service Station with Convenience Mart	9	61	56	10
Gasoline Service Station	6	58	52	10
High Turnover sit-down restaurant	6		40	10
Fast Food Restaurant with drive-through window	25	45	47	10
	7		43	
Supermarkets	5	5	27	12
Discount Stores			42	11
			22	12
Shopping Centers	67			11
50,000 sq. ft.			60	
100,000			45	
200,000			36	
300,000			31	
400,000			28	
500,000			27	
250,000			22	
1,000,000			21	

1,000,000			21	

TABLE 6

ECONOMIC IMPACT MODEL

Land Use	**(A)** **% Pass-by Traffic**	**(B)** **Estimated Left Turns As % of Total Entering Traffic**	
		ADT	**%**
1 Gasoline Service Station Convenience Market Small Retail < 50,000 sq. ft.	55	5,000 10,000 20,000	43 40 30
2 Fast Food Restaurant with Drive Through Window Supermarkets Shopping Center 50,000 - 100,000 sq. ft.	45	30,000 or more	15
3 High Turnover sit-down restaurant	40		
4 Shopping Centers 250,000 - 500,000 sq. ft.	30		
5 Shopping Centers Over 500,000 sq. ft.	20		

Source: (A) Estimated from Table 5, Column B

Source: (B) Herbert S. Levinson

CASE STUDIES OF ECONOMIC IMPACTS OF RAISED MEDIANS ON ADJACENT BUSINESSES: STUDY METHODOLOGY AND RESULTS

by

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ABSTRACT

The use of raised medians in urban areas has increased in recent years. Raised medians restrict access to businesses along a corridor by limiting turning movements to select mid-block locations. Therefore, a very common remark at public hearings related to the construction of raised medians is that there will be detrimental economic impacts on adjacent businesses. However, the restricted access allows more efficient signalization and traffic flow along the corridor, potentially providing more customers for the businesses. Although many studies on the affect on traffic operations exist, little research is available on the economic impact from raised medians on adjacent businesses and properties.

The authors of this paper have completed a four-year project developing and testing a methodology to collect and analyze data related to the economic impact of raised medians on adjacent businesses for the Texas Department of Transportation (TxDOT). This paper summarizes the findings of key economic indicators, as well as perceptions of business owners and managers. The research has found that installation of a raised median does not equate to economic losses by adjacent businesses. In fact, only two types of businesses (auto repair shops and gas stations) were found to generally experience losses in gross revenues. In almost all cases, employment did not change. This research is anticipated to be valuable for transportation professionals in both the public and private sectors who must provide estimates and expectations of the economic impacts of raised medians.

INTRODUCTION

Background

In recent years, transportation agencies have increased construction of raised medians on urban and suburban arterials. In addition to their use for access control, raised medians provide improved traffic operations and safety for a facility by separating opposing traffic flows and removing left-turning vehicles from the through lanes. With respect to access control, raised medians restrict left turns to mid-block and intersection median openings. While improving the operations and arterial signal coordination, the economic impacts of restricting these left turns may be felt by owners of businesses and properties adjacent to the arterial. Extensive research has investigated and quantified the costs and benefits of constructing raised medians with respect to initial costs and benefits to motorists in terms of reduced delay and increased safety. Prior to this research effort, however, limited research has been conducted to aid in estimating the economic impacts of raised medians on sales and property values for adjacent business and undeveloped landowners. The paper that follows is based upon the results of this four-year research effort (1,2,3,4).

Research Methodology

Participants in the survey included owners and managers of businesses adjacent to the corridors of interest. The research team first conducted a "windshield" survey to determine which businesses and land uses were present along the corridors in which the survey was to be administered. Business information (e.g., address and contact name) for each location was then obtained from the chamber of commerce, appropriate neighborhood/business groups, county appraisal district office, and/or telephone directories. For all but one of the corridors, the research team sent a letter of support from the local chamber of commerce or neighborhood association encouraging the business owners and managers to participate in the survey. Finally, reminder cards were sent to the five case studies where mail-out surveys were administered to encourage business owners to return the surveys. In the final year of the study, surveys of customers wee performed along one corridor in College Station to compare to business owner responses.

Corridor Descriptions

The case studies include corridors with a variety of business mixes. Most of the corridors are in suburban-type areas with shopping centers and strip retail development. One of the corridors, Grant Avenue in Odessa, is located in a central business district. The specific types of development on the individual corridors ranges from completely retail to a mix of office, institutional, and retail. These development mixes drove the numbers of potential survey participants on each corridor. In addition, the cities included in the study reflect a variety of population sizes. The populations range from approximately 35,000 in McKinney to approximately 1.8 million in the City of Houston. Table 1 summarizes several different characteristics of interest for each case study location.

RESEARCH RESULTS

Importance of Access to Customers

One question on the business survey asked business owners to rank "accessibility to store" with other factors including, distance to travel, hours of operation, customer service, product quality, and product price in order of importance that customers use when selecting a business of their type. The results of this analysis by business type are shown in Table 2. In all cases, the accessibility to the store ranked third or lower. Generally, accessibility was ranked lower than the items of customer service, product quality, and product price–all elements that business owners/managers themselves can directly influence. Customer surveys were also administered with this question as well. In all cases, the customers ranked accessibility with lower, or equal, value to the business owners. Accessibility is ranked as number two by the customers at one of the gas station locations after product price.

Impacts on Regular Customers

Another question of particular interest on the survey was business owner's perceptions of the impacts on regular customers due to the raised median installation. The business owners that were along the corridor before, during, and after the construction of the raised median indicated a smaller percentage of their regular customers would be less likely to visit their business as a result of the raised median compared to those business owners that were interviewed prior to the raised median installation (14.3 percent compared to 19.1 percent). Customers were also asked this question, and the majority of the customer survey responses match the business owner's selections at all five sites. Customers generally indicated that they would be less likely to visit the businesses during the construction phase of the project.

Impacts on Employment, Property Values, Accidents, and Traffic Volume

Impacts upon employment, property values, accidents, and traffic volume were also of interest. Results of these factors by business group are shown in Table 3. The "during" column in Table 3 indicates the impacts during construction relative to prior to the construction, and the "after" column indicates the impacts after construction relative to prior to the construction. For all the business groups, the number of full-time employees increases on average. Business group two–those interviewed prior to the raised median installation–indicate that they felt the number of full-time employees would decrease slightly during construction while it actually increased 8.6 percent for the group one business owners. The perception of business owners was that property values increased 6.7 percent after the median installation (group one), but those business owners interviewed prior to the median installation expected a 2.3 percent decrease. The business owners also indicated a perceived decrease of 10.2 percent in accidents along with a 31.5 percent increase in traffic volumes.

Impacts on Customers Per Day and Gross Sales

Table 4 illustrates the impacts on customers per day and gross sales for the four business groups. "Gross sales where the median installed" refers to a question posed to business owners in which they were asked what they believe was/is the impact of the raised median for all businesses along the corridor where the median was installed. "Gross sales in the area" refers to a similar question that asked about gross sales for all other businesses in the area (not necessarily just the corridor) due to the raised median installation. One can quickly notice from Table 4 that the construction phase did seem to impact customers per day and gross sales as evidenced from the values in the "during" columns. Perceptions seem to indicate a larger expected loss in gross sales during construction (18.6 percent) compared to the percent reduction of 11.6 percent by those businesses that were present before, during, and after the median installation. Group one businesses also indicated an increase in customers per day and gross sales after the median installation while the group two businesses believed that there would still be a decrease. Group one also indicated an increase after the median was installed for all businesses along the corridor where the median was installed and in the community surrounding the roadway improvement.

Impacts by Business Type

Table 5 provides results of analysis for group one businesses that have been present before, during, and after the median installation. The table presents the average percent change, standard deviation, and sample size by business type. One can see that the construction phase of the project appears to have a negative affect on many of the metrics of interest for many of the different business types. After construction of the raised median, gasoline stations, auto repair, and other services indicated a small negative affect on gross sales. These values are slightly lower for customers per day. Property values after construction are indicated as either rising or the same after the construction of the median, and there are only small changes in full- and part-time employees.

CONCLUSIONS AND RECOMMENDATIONS

It should be noted that the sample sizes upon which analyses were performed were often rather small; however, many observations and interesting points may be drawn from this research effort.

- ✔ The in-person surveys appear to provide more reliable data than the mail-out surveys, and these survey respondents appreciate the face-to-face opportunity to have their opinions heard. The average response rate for the in-person surveys was also much higher (55.0 percent) than the response rate for the mail-out surveys (9.0 percent).

- ✔ When asked to rank order the factors that affect customers endorsing their businesses, business owners generally ranked “accessibility to store” fourth or lower below some combination of customer service, product quality, and product price. According to business owners, it appears that the most important elements used by customers to determine what businesses they will endorse are factors that may be controlled by the business owners themselves to some extent. In surveys of customers at five selected businesses along the Texas Avenue corridor in College Station, it was found that customers ranked “accessibility to store” with lower, or equal, value to the business owners.

- ✔ When combining all business types, it was found that 85.7 percent of business owners whose businesses were present before, during, and after the median installation felt that their regular customers would be more likely (15.7 percent) or stay about the same in likeliness (70.0 percent) to endorse their business. In contrast, those businesses that were interviewed prior to the installation of the raised median indicated this percentage slightly lower (i.e., indicated more regular customers “less likely”) at 80.9 percent. Therefore, for the case studies investigated in this project, the perceptions appear slightly more negative than what actually occurred along corridors where business owners were present before, during, and after the median installation. A similar question was posed to customers in College Station at the five selected businesses, and it was found that a majority of the customer survey responses matched the business owner’s / manager’s opinions. Generally, customers did indicate they were less likely to visit the business during the construction of the raised median.

- ✔ A majority of customers indicated that while the median made access more difficult, they indicated that customer satisfaction was better or that it remained about the same for the five businesses where customer surveys were performed.

- ✔ There was generally no change in the number of total employees along several of the corridors. Those corridors that did experience a decrease in the number of employees only experienced a decrease for one year and not over consecutive years.

- ✔ The construction phase seemed to impact customers per day and gross sales. For all businesses, perceptions again seem to indicate a larger expected loss in the businesses that were interviewed prior to the construction of the raised median. These business owners indicated they expected an 18.6 percent reduction in gross sales, while those that were present before, during, and after the median installation indicated an 11.6 percent reduction. After the construction phase, a 17.7 percent increase in customers per day was indicated along with a decrease in gross sales of 0.03 percent for all businesses present before, during, and after the median installation. Business types such as durables retail, specialty retail, fast-food restaurants, and sit-down restaurants indicated increasing customers per day, gross sales, and property values. Gas stations, auto repair, and other service businesses indicated decreasing customers per day and gross sales after the raised median was installed.

- ✔ The construction phase appears to have the most detrimental impacts on businesses. Suggestions to alleviate these impacts include, 1) ensuring adequate and highly visible access to businesses during construction, 2) reducing construction time, and 3) performing the construction in smaller roadway segments (phases) to the extent possible.

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TABLE 1 Characteristics of Case Study Locations

Street Name	City and Population	Before Constr.	After Constr.	Study Limits	Length (miles)	Construction Years	Survey Type	Land Use	Number of Establishments
Texas Avenue	College Sta. 64,200	TWLTL	Raised Median	University Dr. to Dominik Dr.	1.5	1996 to 1998	Interview	Retail, University	59
South Post Oak Road	Houston 1,844,000	Undivided	Raised Median	I-610 to South Main Street	1.5	1988 to 1990	Interview	Retail, Industrial	155
Clay Road	Houston 1,844,000	Undivided	Raised Median	Hollister Rd. to Gessner Rd.	2.2	1994 to 1996	Mail-out	Retail, Industrial, Undeveloped	63
West Fuqua Road	Houston 1,844,000	Undivided	Raised Median	Hiram Clarke Rd. to Almeda Rd.	1.5	1987 to 1989	Mail-out	Retail, Undeveloped	68
Long Point Road	Houston 1,844,000	Undivided	Raised Median	Campbell Rd. to Hollister Rd.	0.7	Surveyed pre-constr.	Mail-out	Retail	41
Twin Cities Highway	Port Arthur 58,600	Raised Median	TWLTL	53rd Street to Griffing Park	2.0	1983 to 1985	Mail-out	Retail, Office	90
9th Avenue	Port Arthur 58,600	Undivided	Raised Median	Texas 365 to Lake Arthur Drive	1.5	1979 to 1980	Mail-out	Retail, Residential, Undeveloped	66
University Drive	McKinney 35,000	Undivided	Raised Median	U.S. 75 to Texas Highway 5	1.4	1991 to 1992	Interview	Retail, Residential	132
Loop 281	Longview 76,000	Flush Median	Raised Median	Spur 63 to Spur 502	0.6	1996	Interview	Retail	65
Call Field Road	Wichita Falls 98,200	Undivided	Raised Median	Kemp Blvd to Lawrence Street	0.3	Surveyed pre-constr.	Interview	Retail	55
Grant Avenue	Odessa 95,400	Undivided	Raised Median	2nd Street to 8th Street	0.6	1992	Interview	Retail, Office	42
Various	Amarillo 168,000	Raised Median	Undivided or TWLTL	Varies	Varies	Varies (1989-1995)	Interview	Retail	118

TABLE 2 Relative Importance Ranking of "Accessibility to Store" by Business Type

Business Type	Sample Size	Ranked Items					
		Distance to Travel	Hours of Operation	Customer Service	Product Quality	Product Price	Accessibility to Store
Durables Retail	2	5	5	2	2	1	5
Specialty Retail	23	6	5	1	2	3	4
Grocery	1	1	6	2	3	4	5
Gas Station	5	6	5	1	4	2	3
Fast-Food Restaurant	10	5	6	2	1	4	3
Sit-Down Restaurant	10	5	6	1	2	3	4
Medical	2	4	3	2	1	2	4
Auto Repair	6	5	3	1	2	4	6
Other Services	10	6	4	1	2	3	5

TABLE 3 Percent Change, Standard Deviation, and Sample Sizes of Full- and Part-Time Employees, Property Values, Accidents, and Traffic Volumes by Business Group

Business Group	Full-Time Employees		Part-Time Employees		Property Values		Accidents		Traffic Volume	
	During	After	During	After	During	After	During	After	During	After
1	8.6%	3.2%	-3.3%	-0.3%	1.5%	6.7%	5.5%	-10.2%	-12.5	31.5%
	28.3	20.0	19.7	12.2	10.3	15.8	23.7	27.1	21.1	50.7
	55	57	53	55	31	38	40	40	38	44
2	-0.3%	0.3%	-0.2%	-1.0%	-8.2%	-2.3%	-3.3%	-13.2%	-11.1%	7.9%
	1.1	7.8	0.9	4.9	22.5	11.8	23.0	33.5	25.0	20.5
	19	18	18	17	14	13	18	14	19	17
3	-6.3%	9.4%	-6.3%	0.0%	-5.8%	4.7%	-7.1%	-10.7%	-8.8%	28.8%
	17.7	26.5	17.7	0.0	14.3	7.7	18.9	28.3	27.5	20.5
	8	8	8	9	6	7	7	7	8	8
4	0.0%	7.1%	0.0%	6.3%	-15.6%	7.7%	0.0%	6.7%	-21.9%	37.7%
	0	18.9	0.0	17.7	22.4	12.9	0.0	18.6	23.9	89.3
	3	7	3	8	9	11	6	12	8	11

Note: Business Group 1 = businesses present before, during, and after median installation; Business Group 2 = businesses present before the median construction and construction is yet to begin; Business Group 3 = businesses present during and after median installation; and Business Group 4 = businesses present only after the median had been installed.

Note: The "during" column indicates impacts during construction relative to prior to construction, and the "after" column indicates impacts after construction relative to prior to construction.

TABLE 4 Percent Change, Standard Deviation, and Sample Sizes of Customers per Day, Gross Sales, Gross Sales Along the Portion Where the Median Was (Will Be) Located, and Gross Sales in the Area

Business Group	Customers per Day		Gross Sales		Gross Sales Where Median Installed		Gross Sales in the Area	
	During	After	During	After	During	After	During	After
1	-14.9% 30.6 54	17.7% 101.0 55	-11.6% 24.7 53	-0.03% 1.5 61	-16.4% 18.5 37	8.5% 20.5 35	7.6% 17.5 25	1.2% 7.1 22
2	-9.5% 31.8 18	-5.9% 10.0 16	-18.6% 24.8 19	-0.8% 1.6 16	-14.2% 17.2 13	5.4% 22.9 14	11.8% 14.5 14	2.7% 6.0 13
3	-15.6% 22.9 8	-3.9% 22.6 9	-17.9% 23.8 7	0.0% 1.2 9	-12.95% 18.7 7	13.6% 20.6 7	0.7% 15.9 7	0.7% 18.8 7
4	0.0% 0.0 2	50.0% 105.6 8	0.0% - 1	0.3% 1.5 7	-20.4% 17.8 12	12.9% 18.1 12	9.5% 13.7 11	5.9% 13.8 11

Note: Business Group 1 = businesses present before, during, and after median installation; Business Group 2 = businesses present before the median construction and construction is yet to begin; Business Group 3 = businesses present during and after median installation; and Business Group 4 = businesses present only after the median had been installed.

Note: The "during" column indicates impacts during construction relative to prior to construction, and the "after" column indicates impacts after construction relative to prior to construction.

TABLE 5 Summary of Average Percent Change, Standard Deviation, and Sample Size for Responses from Businesses Present Before, During, and After Raised Median Installation (Group One Businesses)

Business Type	Total Sample Size	Percent Change in Responses of Interest									
		Customers per Day		Gross Sales		Property Values		Full-Time Employees		Part-Time Employees	
		During	After	During	After	During	After	During	After	During	After
Durables Retail	2	15.0% - 1	5.0% - 2	15.0% - 1	1.0% - 2	1.0% - 1	17.5% 3.5% 2	- - 0	0.0% - 1	0.0% - 1	0.0% - 1
Specialty Retail	23	-6.6% 14.0% 19	8.1% 12.8% 18	-5.6% 15.6% 19	0.4% 1.2% 21	-1.0% 3.2% 10	3.7% 17.9% 13	22.0% 41.0% 20	1.0% 11.4% 20	0.9% 14.1% 19	-5.3% 16.8% 19
Gas Station	5	-20.4% 68.1% 5	-17.6% 23.3% 5	-40.4% 24.8% 5	-2.4% 1.3% 5	16.7% 28.9% 5	20.0% 26.5% 5	2.6% 19.1% 5	-5.0% 11.2% 5	-20.0% 44.7% 5	0.0% 0.0% 5
Fast-Food Restaurant	11	-19.9% 37.0% 8	108.9% 237.6% 9	-8.6% 36.1% 7	0.4% 1.5% 7	-17.0% 12.6% 3	16.7% 8.8% 6	-3.7% 26.6% 6	30.8% 46.3% 6	-15.3% 30.0% 7	3.0% 13.3% 7
Sit-Down Restaurant	10	-6.1% 8.8% 7	2.6% 3.6% 7	-3.6% 10.6% 7	0.8% 0.4% 10	0.0% 0.0% 4	0.0% 0.0% 4	1.8% 5.0% 9	3.5% 8.2% 10	1.8% 5.0% 9	5.0% 10.5% 10
Auto Repair	7	-24.0% 25.1% 5	-5.0% 11.2% 5	-20.0% 24.5% 6	-0.5% 1.2% 6	3.3% 5.8% 3	3.3% 5.8% 3	0.0% 0.0% 5	0.0% 0.0% 5	0.0% 0.0% 4	0.0% 0.0% 4
Other Services	12	-32.5% 35.7% 8	-8.4% 9.3% 8	-17.5% 36.6% 6	-1.0% 1.7% 8	2.0% 4.5% 5	7.6% 10.8% 5	3.1% 5.9% 8	-4.4% 18.8% 8	0.0% 0.0% 7	1.4% 3.8% 7

Note: Each cell contains the average percent change (top), standard deviation (middle), and number of observations (bottom).

LIST OF TABLES

Applying Access Management to Development Site Reviews

Slides Applying Access Management to Development Site Reviews

Moderator: John Taber, Tabermatics, Inc.

Monday August 14, 2000 – 1:00 PM – 2:30 PM
Track 3 - Workshop

Applying Access Management in The Site Impact Review

4th Annual
Access Management Conference
Portland, OR August 2000

John Taber, Ph.D., PE
jtaber@tabermatics.com

All Aboard! - Let's Get Going

Session 8
Site Design & Access Control

- Site Review Process
- Driveway Location Planning
- Driveway & Site Design
- Access Intersection Design
- Corridor Impacts

Site Review Process

- Agency Approach
- The Concept Review
- Layout Alternatives

Most Local Agencies Require Site Reviews for Proposed Developments

Local Jurisdictions and State DOT's Have Different Agendas

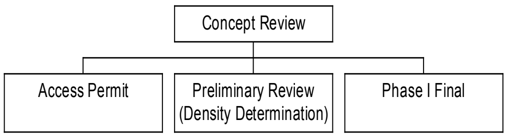
State DOT

- Limit Access Pts.
- Arterial Performance
- Maintaining State Standards

Local Jurisdiction

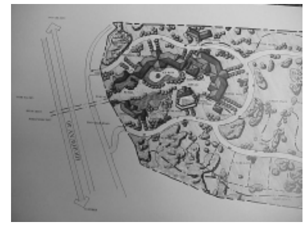
- Economic Potential
- Aesthetics
- Local Access
- Territorial Competition

The Site Review Process Has Several Stages

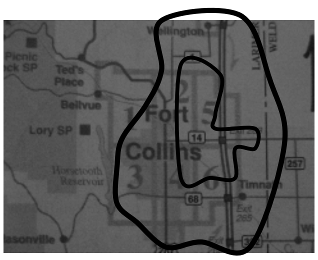


It's Critical To Get Involved At The Concept Plan Stage

- **Initial land use and access point determination**
- **No significant commitment yet with bankers, engineering**



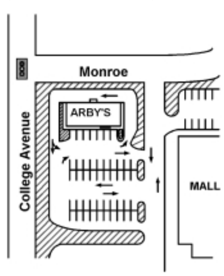
At The Concept Stage For Commercial Sites, Show The Improved Market Area w/ Access Control



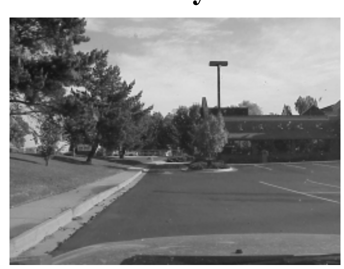
Issues Best Addressed at The Concept Stage

- **No. of Access Points**
- **Location of Access Points**
  - **(Functional Areas, Intersection Spacing, Turn Restrictions)**
- **Access Permit**
- **Impact Fees**
- **Potential Intersection Control**
- **Inter-Connects, Driveway Sharing**

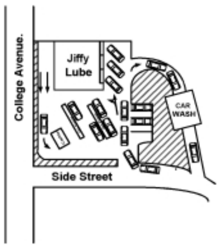
Look At Alternatives: Internal Corner Pods, Side Road, Back Access



Access Control From Internal Pods Can Beautify The Corridor



Side Roads, Back Access Are Great For Serving Locals

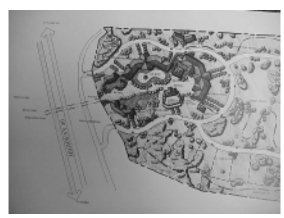


Rear Parking and Store Entrances Can Relieve Traffic On-Site

Site Traffic Can Be Worked Around The Environment

Get Involved Early !

- This is the Time!
- Too Late!



Now We're Gaining Steam

Issues in Driveway Planning (at early stage)

- No. of Access Points
- Driveway Locations
- Trip Generation
- Trip Distribution
- Interconnects

Driveway Planning Example

210,000 ft² Wal-Mart
Fri, p.m. peak hr.
Arterial: 35,000 ADT

Rough Planning Calculations

Trips: 210 x 42.92 = 9,013
@ 10% for peak hr: 901
@ 50% out: 450

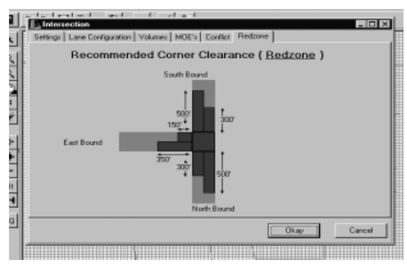
Arterial: 35,000 @ 10% for peak: 3500
@ 4-lanes: 875/lane, sat flow=1200/ln
need: 80% of green (incl. lost)

Driveway: assume sat. flow = 900/hr./ln.
@ 20% of 90 sec cycle (15 sec.): 180/lane
Lanes reqrd. = 3 out, 2-3 in

Check Corner Clearances (Your Mileage May Vary)

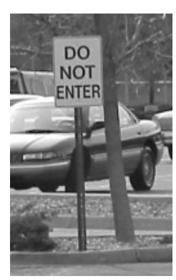
Minor Collector: 30 mph ~150 ft.
Res. Collector: 35 mph ~325 ft.
Major Collector: 40 mph ~525 ft.
Minor Arterial: 45 mph ~660 ft.
Major Arterial: 50 mph ~1320 ft.

Corner Clearances Can Be Illustrated With the "Red-Zone" Concept



Entrances Should Get Traffic In Quickly - Away From Collector

The Sign Message Illustrates The Poor Flow Pattern



Trip Generation Issues

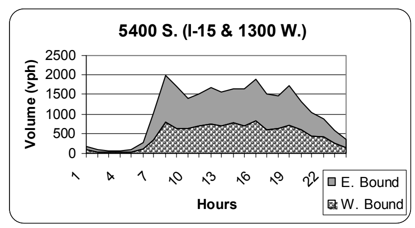
- **Whenever Possible, Compare to Similar Nearby Sites**
- **Trucks Should Be Considered, at Least As Auto Equivalents**
- **Carefully Evaluate Mixed-Use Trips**
- **Must Count By-Pass Trips in Internal Roadway & Access Intersection Design**
- **Is It Really Transit Accessible?**

Is It Really Transit Accessible?

Approximate Distribution - Perform Distribution Sensitivity (ie. 20%, 30%, 40% Left Turns)

- **Population Density**
- **Commercial Density**
- **Existing Similar Facilities**
- **Gravity Model, Reilly's Competing Retail**

Get Accurate Data Hourly Distribution, By-Pass (They May Be Different Than Expected)



Approximate Nearby Future Growth

- **Design Year**
- **Adjacent Zoning**
- **Consider Special Service District**

Non-Shared, Separate Driveways Result in More Arterial Conflicts

Interconnections Between Sites Are Critical For Minimizing Driveway Intersections But Require Good Traffic Flow Paths

Rolling Along

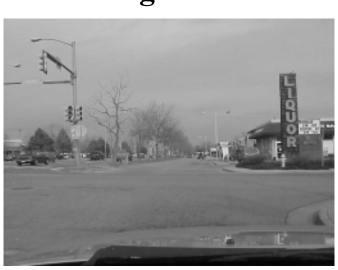
Elements of Driveway & Site Design

- Good Ingress/Egress
- Throat Depth
- Sight Distance
- Turn Lanes
- Drive-ins
- Pedestrian/Bike Access
- Service (Delivery, Emergency) Access

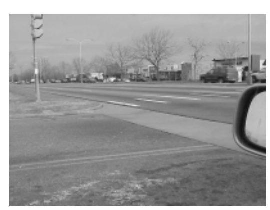
Entrances/Exits Should Be Well-Placed and Be Coordinated To Traffic Patterns

This is the main entrance for traffic from the right, yet the driveway is faced the wrong way.

Entrances/Exits In "Red Zone" Create Dangerous Conflicts



Deep Gutters Can Slow Entrance Speeds - Creating Sudden Stops



Hard To Read Signs At Entrance Can Cause Stopping on Street

Well Spaced, Well Signed Entrances Minimize Driver Slowdowns on Corridor

Sign is Highly Visible Yet Non-Obtrusive

Entrances Should Be Intuitive - Can Also Be Attractive

Throat Distance is Measured Between Roadway and 1st Parking Stalls or Internal Drive

Inadequate Throat Distance Can Back Up to Main Road

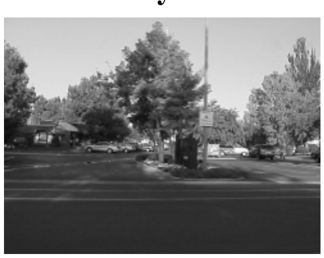
Parking Stalls Should Not Back Into Collector Streets

Throat Distance Must Allow For Projected Intersection Queues

Poor Delineation of Driveways Also Affects Throat Operations

Landscaped Driveway Medians Add Throat Depth & Are Attractive

Good Throat Depth Allows Decisions Away From Arterial

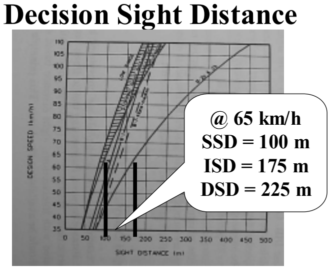


Even With a Frontage Road, Throat Distance Can Be a Problem

Frontage Roads Can Be Re-aligned To Increase Clearance

Sight Distance Is Too Often Ignored In Site Impact Reviews (Especially Vertical)

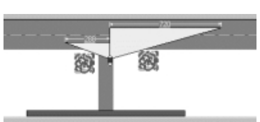
Minimum Safe Stopping Distance vs. Intersection Sight Distance vs. Decision Sight Distance

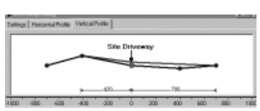


Source: AASHTO, 1994

Signal Box, Sign Can Block Sight Distance Along High Speed Arterial

Both Horizontal & Vertical Sight Triangles Should Be Checked





Combined Vertical & Horizontal Curves Create Problems

Turn Lanes Should Be Clearly Marked And Intuitive

Double Entrance Lanes Minimize Queue Spillbacks to Arterial

Exit Lanes Should Be Matched To Both Internal and External Intersection Calculations

Time For a Drink Break

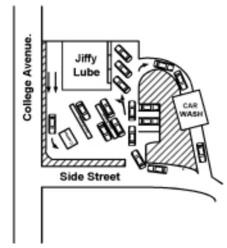
Avoid Excessive Curbing Around Entrance & Exit Points

Excessive Curbing or Obstacles Will Lead to Slower Ingress Speeds or Stops on the Corridor

Sufficient Drive-in Stacking Distance Avoids Spilling Out Onto Adjacent Roadways

Good !

Poor Site Layout Can Spill Traffic Onto Adjacent Streets



A Better Layout of The Same Land Use Keeps Queues On-Site

Basic Queueing Equations

N = No. of Svc. Positions

q = Arrival Rate

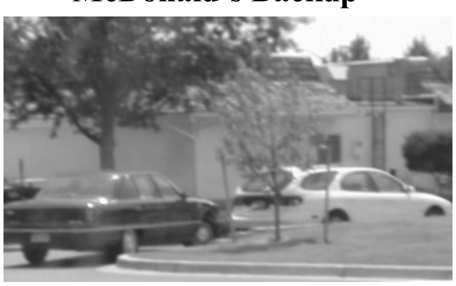
Q = Service Rate (inverse of service time)

Coeff. Of Util. = q / (NQ)

$$\text{Queue Storage} = \frac{\ln P(x>M) - \ln E(w) > 0}{\ln p}$$

Source: Koepke, Stover
Transportation & Land Development

McDonald's Backup



Car Wash Exits Have Acceleration Length, Sight, and Icing Issues

Avoid Major Movements Across Pedestrian Crossings

Provide Well-Defined Crossings and Vehicle Traffic Stopping Points

Pedestrian Crossing Into School Site With Signal

Use of Cobble Stones & Stop Sign For Pedestrian Access Into Site

Bike Racks on Sidewalk Are Out of Vehicle Harm's Way

Pedestrian/Bike Paths Must Make Sense If They Are To Be Used

Busy Service Points (ie. Trash) Should Not Interfere With Main Entrance

Truck Maneuvers Should Not Occur on Major Roadway

Loading Docks Should Allow Maneuvers Out of Traffic Flow

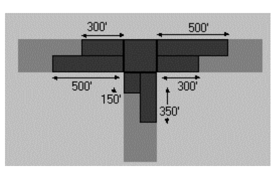
Dumpster Out of The Way of Main Access Driveway

Elements of Intersection Design

- **Functional Distance**
- **Turn Bay Design & Warrants**
- **Median Openings**
- **Channelization**
- **Control Devices**
- **Conflicts**

Intersection Functional Distance

- **Includes:**
  - **Deceleration**
  - **Lateral**
  - **Queuing**
- **Entering & Leaving**
- **TRR 1100 (Stover)**



Turn Bays Should Be of Sufficient Width For Lateral Transition

Right-Turn Bays Must Consider Any Existing Bike Lanes

Left Turn Bays Slow Traffic in Passing Lane - Design For High Speed

Offset Left-Turn Bays Improve Sight Distance For Turning Vehs.

Median Openings Need Adequate Stacking Room

Avoid Unnecessary Channelization

Painted Channelization Can Be Highly Effective in Same Direction

Attractive Channelization

Uh !

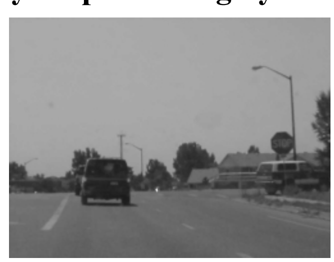
Carefully Evaluate <u>All</u> Options For Driveway Control Devices

- **Yield (Right-in, Right-out)**
- **Stop**
- **"Pork Chop"**
- **4-Way Stop**
- **Roundabout**
- **Actuated Signal**

Right-In, Right-Outs With Bay Avoid Most Conflicts But Increase U-Turns

"Pork Chop" Channelization Can Separate Conflicts

Where Most Movements Are Thru, 4-Way Stops Are Highly Efficient

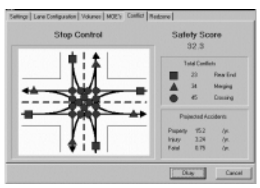


Roundabouts Can Handle High Volumes of Turning Conflicts

Roundabouts Must Consider Truck Movements

Intersection Design Should Consider Conflicts

- Measure Types
  - Conflict Points
  - Projected Conflicts
  - Projected Accidents

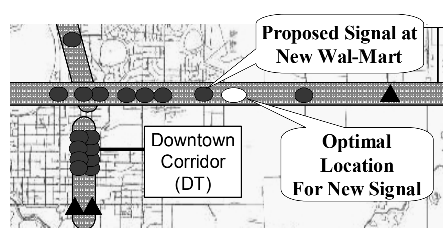


Coming Around the Bend

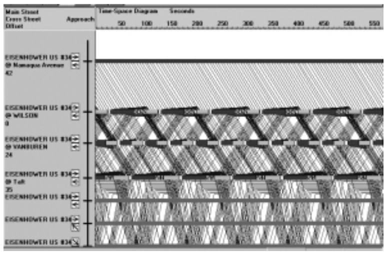
Corridor Impacts of Site Development

- Signal Spacing
- Median Design

Even Signal Spacing Requires Driveways to Match a Perfect Grid System - A Rarity!



Check Signalized Site Driveways To Maintain Corridor Bandwidth



Though Warranted, Poorly Spaced Signals Can Cause Gridlock

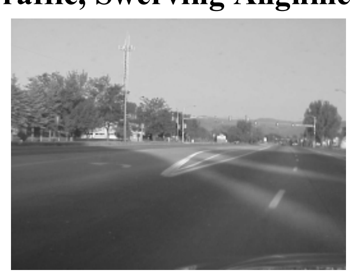
Median Design Should Be Corridor-Wide, Not on an Intersection Basis

- **Maintain Consistency & Driver Expectancy**
- **Median Types**
  - **Undivided**
  - **TWLTL**
  - **Raised**
  - **Jersey Barrier**

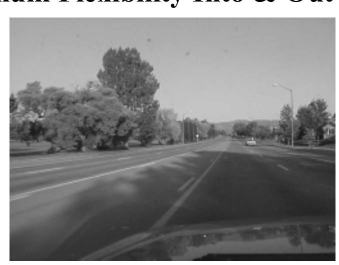
Several Good References for Median Designs

- **NCHRP 420**
- **Florida Median Design Manual**

Undivided Medians Result in Stopped Traffic, Swerving Alignment



Two-Way Left-Turn Lanes Allow Maximum Flexibility Into & Out Of Sites



Raised Medians Can Increase Safety and Capacity

- Creates Additional U-Turns
- Provides for Pole Locations & Landscaping
- May Limit Direct Access From One Direction

Site Access with Raised Medians Can Have Alternative Designs

- Completely Closed (Right In - Right Out)
- Left In
- Left Out

Completely Closed Medians Require U-Turns for Site Traffic

Left-In Median Openings Allow Site Traffic To Easily Get In Without the Left Out Conflicts

We're Not Just Blowing Smoke

Why is Access Management So Important At Site Review Time

- Access Control is Only as Good as The Weakest Link
- Access Control Can Increase Capacity 20-40%
- Access Control Can Increase Safety
- 20-40%

Have a Check List

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Key Points To Remember

- Get Involved At Concept Stage
- Put Effort Into Good Driveway Location Planning
- Design Good Ingress, Egress
- Lots of Alternative Intersection Designs
- Arterial Impacts = Signal Spacing, Medians

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Hope You Enjoyed Today's Journey Now Get Out There & Do It !

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Access Programs at the Regional and Local Level

Slides 8A. Innovative Tools and Techniques for Successfully Achieving Access Management through the MPO Process

Anne Benware, Capital District Transportation Committee

Slides 8B. How Access Management Works in the Planning Environment

Tom Kloster, Metro, Oregon/Gail Curtis, Oregon DOT

Slides 8C. Federal Way's Implementation of Access Management

Richard Perez, City of Federal Way, Washington

Slides 8D. Delaware Corridor Capacity Preservation Program for State and Local Levels

Mark Radovic, Gannett Fleming, Inc.

Monday August 14, 2000 – 3:00 PM – 4:30 PM

Track 1 - Administrative

Innovative Tools & Techniques for Successfully Achieving Access Management through the MPO Process

Prepared for 4th National Conference on Access Management
by
Capital District Transportation Committee (CDTC) Staff

Portland, Oregon
August 14, 2000

Background

- CDTC is the MPO for NY's Albany area (800,000 pop.)
- 4 cities, with major suburbs in-between
- Arterial system uses old "farm to market" roads
- Low to moderate density development along majority of corridors occurred incrementally

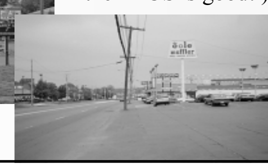
Challenges

- New York - a Home Rule state
- 79 distinct municipalities in the region often results in uncoordinated land use planning and development decisions
- Arterials carry increasing amounts of traffic & serve a variety of often conflicting functions

Toward Integrating Land Use& Transportation: Changing the dialogue from ...

"Every property has a right to as much access as it wants!"

(...as long as their driveways have sufficient radii & their LOS is good!)



… to an Increasingly More Common Approach ...

" NYSDOT includes arterial management as an integral component of its planning, traffic safety and project development activities and works in partnership with local governments …"

How has CDTC facilitated and encouraged this change in focus?

- increased communication between communities, CDTC and NYSDOT
- enhancement of CDTC's technical credibility both with NYSDOT and communities
- support for communities in achieving community goals through land use/transportation planning process

MPO Structure and Responsibilities: A Formula for Success

- Broad committee membership & consensus requirement = collaborative, inclusive environment
- TIP funding based on objective, technically sound project selection process
- Traffic Modeling/Technical Credibility

Initiatives Toward Integration

- Expanded policy structure beyond traditional counties' and cities' to include suburban towns and villages
- LRP - shift from new highway planning to developing localized solutions to critical problems
- CMS plan recognizes role of arterial management in preserving capacity investments

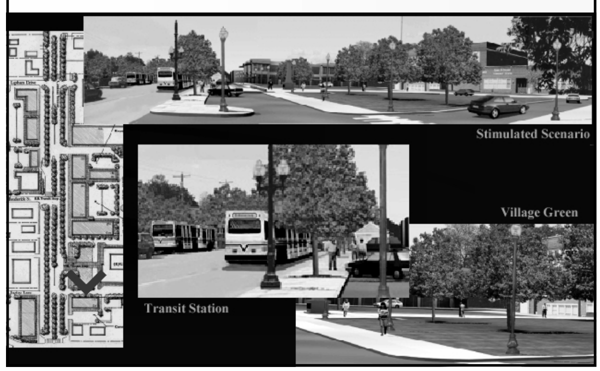
Cooperative Transportation Plans

- Contractual agreements to address local concerns and regional system planning
- 7 CTPs covering some of region's most congested corridors
- Elevated the discussion of arterial management

Resulting projects receive priority for federal funds

Access Management Plans

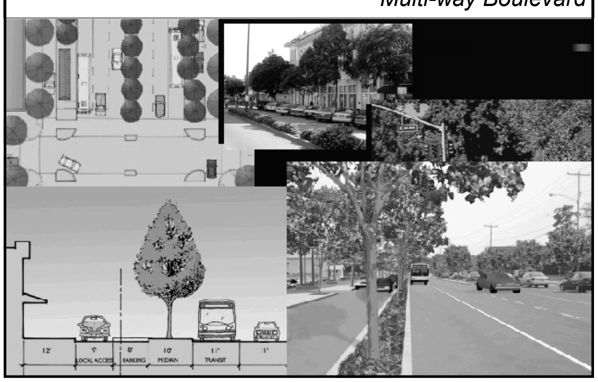
Rte 5 Corridor Study



Suburban Strip

Colonie Village Center

Multi-way Boulevard



Design Committees

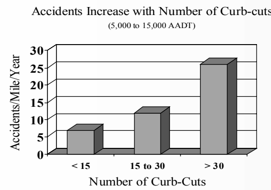
- Authorized by NYSDOT: members include NYSDOT, CDTC staff, design consultants, local community reps = More inclusive design process resulting in "community compatible" designs while meeting NYSDOT traffic objectives

New Visions - Guiding Principles

- Preserve & Manage
- Develop the Region's Potential
- Link Transportation & Land Use
- Plan & Build
  for All Modes

New Technical Tools

Arterial-Land Access Conflict



Residential Use-Traffic Conflict

LOC = distance between commercial or residential driveways and AADT

Earmarked TIP Funds

New Visions long range budget reflected in 1997 TIP process

3 Steps:

- $50 M setaside for previously under-represented categories
- $30 M selected solely on project merit (using new performance measures)
- $10 M reserved for projects id'd after public review of draft TIP

Linkage Planning Grants

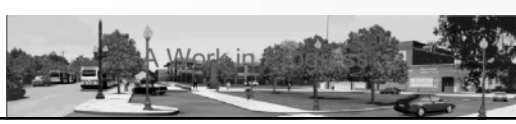
Provides funding to local governments for new land use & transportation integration studies

Grants made to 12 projects ranging from corridor plans, a town center master plan to a truck access study

Utilizing Institutional Credibility built upon

- Good will
- Technical ability
- Leverage of federal transportation law

Achieved modest, but growing success



Access Management
in the Portland Metropolitan Area
Methods to Manage Access Based on Land Use

Gail Curtis, AICP
Oregon Department of Transportation

Tom Kloster, AICP
Metro

Portland Region Access Management
Introduction

- Oregon has a long tradition of coordinated planning among governments
- Cornerstone of statewide planning program is providing certainty
- Access management policies viewed in the context of larger land use plans

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Portland Region Access Management
About Metro

- Elected regional government
- Manages growth, transportation, greenspaces and solid waste in Portland region
- Operates zoo, stadium, convention center, performing arts centers

Metro 2000

Portland Region Access Management
About ODOT

- Statewide agency that maintains Oregon Transportation Plan
- Builds and operates state highways
- Operates under Executive Branch
- Oversight by the Governor-appointed Oregon Transportation Commission

---

Portland Region Access Management
Developing 2040 Plan

- Developed in response to a transportation crisis
- Consensus-based process involves 24 cities, 3 counties and other agencies, including ODOT
- Major public outreach on issues of urban sprawl and congestion

Metro 2000

Portland Region Access Management
Implementing 2040

- Respond to expected growth with timely multi-modal improvements
- Ensure that street designs complement planned land uses
- Leverage development of centers and corridors

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Portland Region Access Management

Centers & Corridors

- Emphasize transit, pedestrian and bicycle travel in street designs
- Balance capacity needs on major streets with traffic calming to slow motor vehicles

Metro 2000

Portland Region Access Management

Industry & Intermodal Facilities

- Manage access to throughways to maintain acceptable levels of freight mobility
- Emphasize motor vehicle access on major streets serving industrial and intermodal areas

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Portland Region Access Management

Protect Rural Reserves

- Limit highway improvements outside UGB to green corridors
- Design rural roads to limit impacts on long-term viability of rural areas

Metro 2000

Portland Region Access Management

Why Focus on Street Design?

- Links land use and transportation
- Need to establish clear access management objectives
- Major streets are NIMBYs
- Growing cost and scale of streets
- Establishes modal expectations

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Regional Street Design Project

Creating a Classification System

- Use Street Design to implement 2040 Growth Concept
- Create a conduit for public involvement through design
- Use common terms to evoke design purpose

Regional Street Design Project

Creating a Classification System

- Build on best elements of local street designs
- Provide for local flexibility and creativity
- Define a process for implementation

Regional Street Design Project
Street Design Concepts


Throughways connect centers and major destinations and provide mobility across the region, and include freeway and highway design types.


Boulevards are transit, pedestrian, and bicycle-oriented designs that serve centers and main streets.


Streets balance all modes of travel in corridors and neighborhoods.


Roads are motor vehicle-oriented, and include urban roads that serve industrial areas and rural roads that serve urban and rural reserves.

Regional Street Design Project
Freeway Design

- Motor vehicle-oriented
- Limited access
- Separated grades
- Connect centers and industrial areas
- 62% of principal arterial system

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Regional Street Design Project
Highway Design

- Motor vehicle-oriented
- Limited access
- Mixed separate and at-grade intersections
- Connect centers and industry
- 38% of principal arterial system

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Regional Street Design Project
Urban Road Design

- Motor vehicle-oriented
- Key freight function
- Somewhat limited access
- Serves industrial and intermodal areas
- 9% of arterial system

Metro 2000

Regional Street Design Project
Boulevard Design

- Transit, pedestrian, and bike oriented
- Many pedestrian crossings
- Many intersections
- Located in centers and main streets
- 17% of arterial system

Metro 2000

Regional Street Design Project
Street Design

- Balances all modes
- Some to many intersections
- Access managed to protect motor vehicle mobility
- Serves urban corridors and neighborhoods
- 53% of arterial system

Metro 2000

Regional Street Design Project

Rural Road Design

- Motor vehicle-oriented
- Striped bike/ped shoulder
- Agricultural access
- Serves rural areas
- 21% of arterial system

Metro 2000

1999 Oregon Highway Plan Designations

Metro's Street Design Policies and the Oregon Highway Plan

Metro's Throughways correspond to **Interstate and Statewide Highways** in the Oregon Highway Plan, and do not have a special land use designation

Metro's Boulevards correspond to the **Special Transportation Areas** in the Oregon Highway Plan

Metro's Streets correspond to the **Commercial Centers** designation in the Oregon Highway Plan

Metro's Urban Roads correspond to the **Urban Business Area** designation in the Oregon Highway Plan.

1999 Oregon Highway Plan Designations

Special Transportation Areas & the Oregon Highway Plan

- Areas of compact, mixed-use development identified in State and local plans
- Located on regional facilities that connect to statewide routes
- Emphasis on street connections to state facilities

1999 Oregon Highway Plan Designations

Commercial Centers & the Oregon Highway Plan

- Areas of clustered commercial development identified in State and local plans
- Located at where regional and statewide routes connect
- Emphasis on joint access to state highways

1999 Oregon Highway Plan Designations

Urban Business Areas & the Oregon Highway Plan

- Businesses and buildings clustered along state-owned regional routes
- Access managed through IGAs, MOUs and local plans
- Emphasis on shared driveways and inter-parcel circulation

Regional Street Design Project

Step 1: Classification Matrix

Motor Vehicle Function and Land Use	Central City	Regional Center	Town Center	Station Community	Corridor	Main Street	Employment Center	Industrial Area	Inner Neighborhood	Outer Neighborhood	Green Corridor
Freeway Through-route	F	F	F	F	F	F	F	F	F	F	F
Arterial Through-route	H	H	H	H	H	H	H	H	H	H	H
Major Arterial	B	B	B	B	S	B/S	R	R	S	S	R
Minor Arterial	B	B	B	B	S	B/S	R	R	S	S	R

Regional Street Design Project

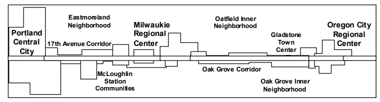
Step 2: Creating the Map

- GIS based mapping
- Reflect local design needs
- Build from land use plans

Regional Street Design Project

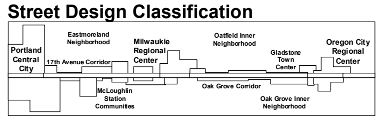
Creating a Street Design Map

Motor Vehicle Classification



1995 RTP Classifications
- Through-Route
- Major Arterial

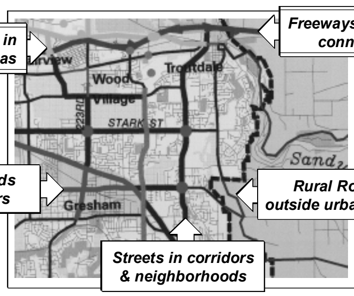
Street Design Classification



1997 Street Design Classifications
- Highway
- Regional Boulevard
- Regional Street

Regional Street Design Project

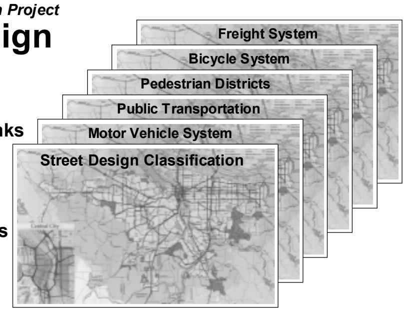
Regional Street Design Map



Regional Street Design Project

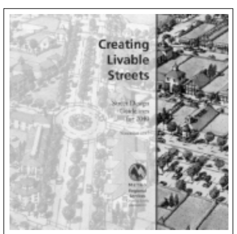
Street Design
and the RTP System Maps

- Street design links land use and transportation
- Street design map coordinates other modal systems



Portland Region Access Management

Making it Happen



- UGMFP - Cities and Counties must incorporate policies into local plans
- 2,000 copies of Creating Livable Streets distributed to local officials and citizens

Metro 2000

Portland Region Access Management

...making it happen

- Handbook serves as a threshold for regional funding
- Boulevards become funding category, with $10 million allocated to nine boulevard “retrofit” projects from TEA-21 funds

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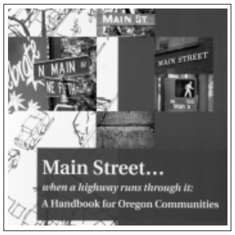
Portland Region Access Management

Making it Happen



- 1999 Oregon Highway Plan emphasis on land use and transportation connection
- 6,000 copies of Main Street... *When a Highway Runs Through It* distributed to local officials and citizens

Portland Region Access Management

Conclusion

- Access management should be based on land use plans
- Main tools in the Portland area are the 2040 Growth Concept and Oregon Highway Plan
- Metro street design maps and OHP developed to reflect land use plans

Metro 2000

Federal Way's Implementation of State Access Management Standards

4th National Access Management Conference

Portland, Oregon

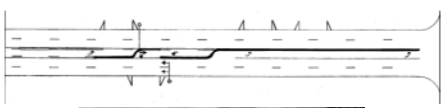
August 14, 2000

Richard A. Perez, P.E.
City Traffic Engineer
City of Federal Way, Washington

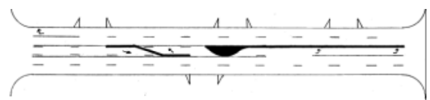
Background

- Previous experience in implementing access management standards in a smaller city
- Extensive use of C-curb

Retrofit #1
The Half-Signal Proposal



Retrofit #2
Part Time Left Turn Out



Issues Considered

- WSDOT Standards
- Access Classifications
- Access Spacing Standards
- Signal Spacing Standards
- Accesses per Parcel
- Timing of Implementation

WSDOT Standards

- Requires cities over 22,500 to adopt similar standards
- Most suburban arterials are Class 4
- 250 ft access spacing
- 0.5 mi signal spacing
- 1 access per parcel
- No median treatment

City's Goals

- Avoid problems of the past
- Minimize variances
- Consistent standards citywide
- Realistic for urban conditions
- Politically acceptable

Access Classifications

- ☐ Functional classification
- ☐ Volume
- ☐ Collision experience
- ☐ Planned cross-section

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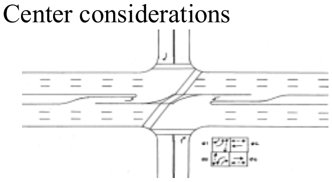
Access Spacing

- Basis: NCHRP 348 and TRC 456
- No deceleration length assumed
- Low right-turn collision experience
- Hierarchy of movements
- No left-turns across 95th percentile queues

Signal Spacing

- Generally inherited 0.25 mi
- Some as short as 600 ft
- Adopted minimum bandwidth standard
- “No net loss” bandwidth policy
- City Center considerations



Accesses per Parcel

- Super-blocks
- Unsignalized access

Timing of Implementation

- Street improvement projects
- Land use applications

Don’t Get Discouraged!

- Urban arterials need not look like expressways
- Pick your battles
- Consider the relative safety of different movements
- Easier to get improvements in development review than in capital projects

Corridor Capacity Preservation Program

Delaware's Program To Protect Existing Transportation Corridors

Program Establishment

1996

Delaware Code, Title 17, Section 145

- Reduce the need for the replacement of the transportation system
- Focus development toward existing municipal growth areas
- Advance the quality of life of Delawareans and the development policies adopted by the Cabinet Committee on State Planning Issues

DelDOT Acquisition Authority & Process

- Title 17 Delaware Code
  - Chapter 145: Grants authority to acquire land in fee simple or lessor interests for those long range plans requiring corridor capacity preservation, up to and including condemnation.
- Title 29 Delaware Code
  - Chapter 9505: Describes the procedure which DelDOT must adhere to when acquiring private property or property rights.

Title 29, Chapter 9505

- Complete an appraisal that establishes *just compensation . . . not less than the approved appraised fair market value*.
  - Just compensation, as in all real estate appraisals, is based on *Highest & Best Use . . . the use of land, which will bring the greatest economic return over a given time.*

* Under the Corridor Capacity Preservation Program, DelDOT will purchase development rights and/or access rights from property, if the highest and best use is for a traffic generator greater than the current use.

- Provide owner with copy of approved appraisal.

Title 29, Chapter 9505 (Cont.)

- If, after a reasonable period of time, negotiations do not result in mutual agreement, DelDOT must initiate eminent domain action.
- *Order of Possession* hearing is first scheduled by the Superior Court (usually within 6-8 weeks of DelDOT filing); at which time DelDOT must prove the public necessity for the purchase and deposit the just compensation offer.
- Upon grant of legal order of possession to DelDOT, the owner can petition court to withdraw deposit.
- *Compensation* hearing is scheduled by the Superior Court after possession is granted (usually 1-2 years).

Corridors Included in the Program

SR 1
45 Miles
Dover Air Force Base to Nassau Bypass

Route 48 (Lancaster Pike)
2 Miles
Hercules Road to Route 41

U.S. 13
46 Miles
DE 10 to Maryland State Line

U.S. 113
33 Miles
Milford to Maryland State Line

Delaware's Corridor Capacity Preservation Program

Policy Development Timeline

1992
- Department established pilot Corridor Capacity Preservation Program to proactively maintain capacity on SR 1

1996
- General Assembly formally established Corridor Capacity Preservation Program

1997
- US 13, US 113, Rt 48 (Lancaster Pike) & SR 1 Corridors were formally adopted into the Program
- Began public, state and local government involvement processes on US 13 Corridor

1999-2000
- Continued on-going concept development on SR 1 Corridor
- Began developing local concepts with Towns and Counties on US 13 Corridor

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Delaware's Corridor Capacity Preservation Program

Goals of the Program

Maintain an existing road's ability to handle traffic safely and efficiently

Coordinate the transportation impacts of increased economic growth.

Preserve the ability to make future transportation-related improvements

Minimize the need to build an entirely new road on new alignment

Sort local and through traffic

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Delaware's Corridor Capacity Preservation Program

Why is the Program Needed?

Applications for Access

- In the last 3 years there have been over 100 applications for new access onto US 13 Corridor.
- Just over half (53%) are outside of the Towns and their developing areas.
- Without the Program there would be significant increases in driveways and conflict points along the US 13 Corridor.

Pressure For New Signals

- There are 22 existing signals within the 46 miles of US 13 Corridor.
- Within the last two years 7 additional signals have been warranted, a roughly 30% increase in signals.

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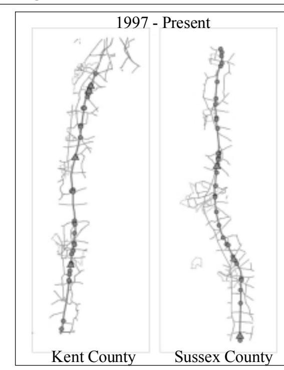
Delaware's Corridor Capacity Preservation Program

Development and Signal Pressures on US 13

○ Applications for New Access

△ Pressure for New Signals (7)

Since 1997
- 100 + applications for new access onto US 13
- (7) additional signals would represent a 33% increase to the existing 22 signals currently on this 46 mile section of US 13



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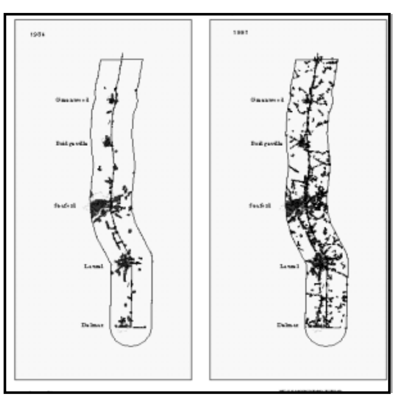
Delaware's Corridor Capacity Preservation Program



Sussex County Development From 1984 - 1997

Sussex County is expected to grow 26.7 % in the next 20 yrs.

Source: The News Journal

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Delaware's Corridor Capacity Preservation Program

Development Proposal: One property owner seeking to subdivide land for residential uses with direct access.

Direct Access

Corridor Capacity Preservation

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Direct Access

Corridor Capacity Preservation

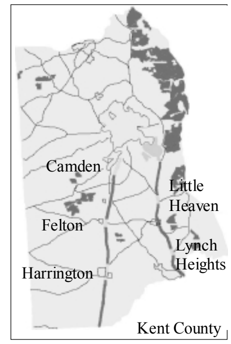
Delaware's Corridor Capacity Preservation Program

Original Program

"A" and "B" Area Designations on U.S. 13

- "A" Areas - No significant transportation investments. Low density lands where direct access to corridor is not permitted.
- "B" Areas - Lands in and around towns and settled areas, where development exists or is planned to occur.
- Focus transportation investments to "B" Areas
- "B" Areas in Towns on the Corridor: Camden, Felton, Harrington

Designations U.S. 13 - Kent County
- "B" Area 20%
- "A" Area 80%



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Delaware's Corridor Capacity Preservation Program

Recent Program Revisions

- Governor's Cabinet Committee on State Planning Issues adopts the *Strategies for State Policies and Spending* in December 1999
- Corridor Preservation Program addresses State-wide development designations, as well as County Secondary Developing Areas
- Revisions create a tiered approach to investments still focusing on towns and existing infrastructure

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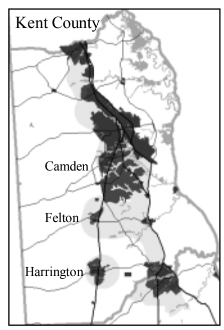
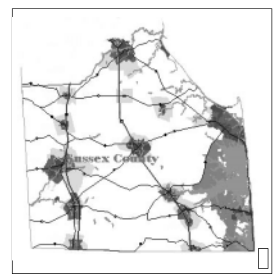
Delaware's Corridor Capacity Preservation Program





State Investment Areas
- Community Areas
- Developing Areas
- Secondary (County Growth) Areas
- Rural Areas

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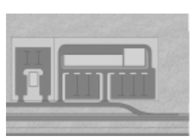
Delaware's Corridor Capacity Preservation Program

Access Application Process

Community & Developing Area

Develop Local Access Plans (Working Group)
- Service Roads
- Cross - Access Easements
- Temporary Entrances

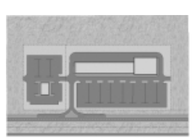
Department Will Concentrate Investment In These Areas



Example Service Road Access

Secondary Developing Areas

Some Development Allowed Base on Traffic Generation
- Low Traffic Generating Uses
- Combined Entrances
- Developer Funded Service Roads



Example Combined Entrance

Rural Areas

No New Direct Access Allowed

Department Will Compensate For Denial of Access.

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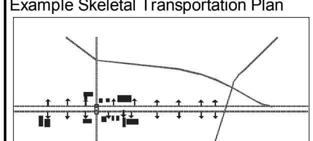
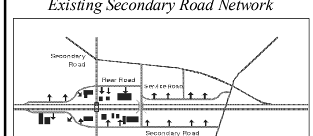
Delaware's Corridor Capacity Preservation Program

Transportation Planning In and Around the Municipalities

Example Skeletal Transportation Plan



Existing Secondary Road Network



Secondary Road Network Improved with Local Roads and Connections

- $5 Million/year (over next 6 years) budgeted for real estate & planning for Corridor Capacity Preservation Program.
- Local Plan under development in coordination with Seaford Working Group
- Plan establishes location of future road network and access points - new development can be designed around the plan

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Benefits of the Program

- Focusing Infrastructure and Accommodating Economic Growth In and Around the Towns & Within the Designated County Growth Areas
- Maintaining Viability of Regional Traffic, a Function of the Economic Viability of Growth Along the Corridor
- Improving Safety on the Corridor by Reducing Conflict Points and Sorting Local and Regional Traffic
- Promotes Controlled and Sustainable Growth of the Corridor While Providing Infrastructure to Support Economic Development

Summary

- Program Has Been Revised to Address State and County Designated Investment Areas
- Program Accommodates Development and Targets Investment Toward Municipalities
- Corridor Plans in Communities and Developing Areas are Being Developed Through Town Working Groups and County Coordination
- Corridor Access Plans are Reviewed for Economic Viability

Corridor Capacity Preservation Program

Delaware's Program To Protect Existing Transportation Corridors

9 Recent Research

Paper
Slides

9A. NCHRP 3-95 (Capacity and Operational Effects of Mid-Block Turn Lanes)

James Bonneson, Texas Transportation Institute

Slides
Traffic Operations Issues Related to Unsignalized Intersections on Urban Arterial Streets

Slides
Operational and Safety Effects of Alternative Median Treatments

Paper

9B. NCHRP 420 (Impacts of Access Management Techniques)

Jerome S. Gluck, Urbitran Associates

Monday August 14, 2000 – 3:00 PM – 4:30 PM
Track 2 - Technical

Operational and Safety Effects of Alternative Median Treatments

By

James A. Bonneson

Texas Transportation Institute

Background

1. NCHRP Project 3-49
   "Capacity and Operational Effects of Midblock Left-turn Lanes"
2. Operation, Safety, & Access
3. Raised-Curb Median
   Two-way Left-Turn Lane
   Undivided Cross Section

2

Overview

Traffic Operations
1. Effect of median treatment
2. Operations model

Traffic Safety
3. Effect of median treatment
4. Safety model

Conclusion
5. Guidelines
6. Additional reading

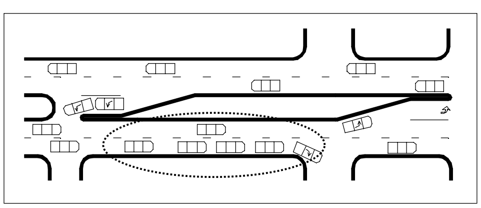
3

1. Operational Effects

- Delays due to right-turns from arterial.
- Delays due to left-turns from arterial.
- Delays due to high volume on arterial.
- Link spillback & resulting impedance.
- Other: platoons, lane utilization, u-turns...

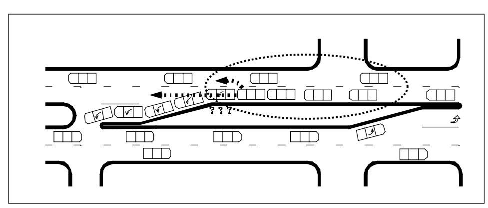
4

Delays due to right-turns from arterial.



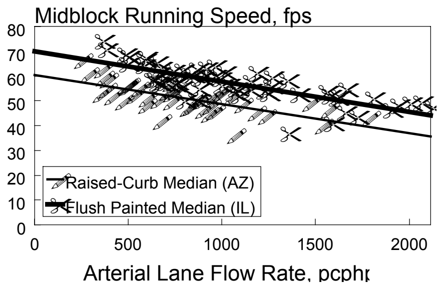
5

Delays due to left-turns from arterial.



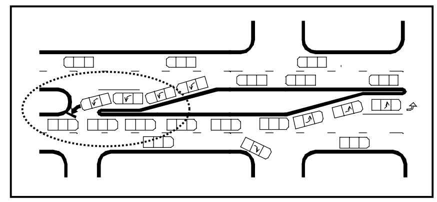
6

Delays due to high volume on arterial.



7

Link Spillback & resulting impedance.



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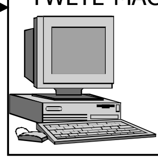
2. Operations Model

Input Data → TWLTL-MAC → Output Data

volume
geometry



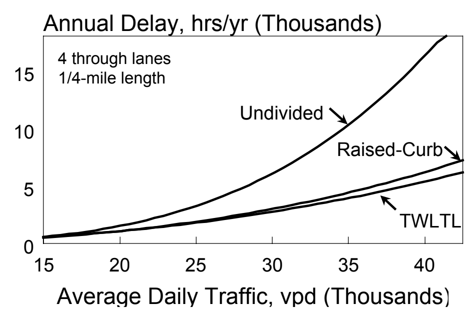
capacity
delay
queue

Model Calibration Data

- 32 studies in 4 states -- 5-hour study / site
- Data: lane volume, capacity, queue length
- Tape switch sensors & video cameras

9

2. Operations Model



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3. Safety Effects

- Raised-median has fewest crashes.
- TWLTL safer than Undivided at higher ADT's.
- Crashes more frequent with:
  1. Higher access point density
  2. Business or Office areas
  3. Parallel parking

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4. Safety Model

Six Regression Equations:

1. Raised-curb in residential & industrial.
2. Raised-curb in business & office.

: : : :

6. Undivided in business & office.

$$A_U = ADT^{0.910}\, Len^{0.852}\, e^{(-14.15\, +\, 0.570\, I_{Park}\, +\, 0.0077\, (DD\, +\, SD)\, +\, 0.0255\, PDO)}$$

Model Calibration Data:

- Omaha, NE & Phoenix, AZ -- 3 years/city
- 6,391 crashes on 189 street segments

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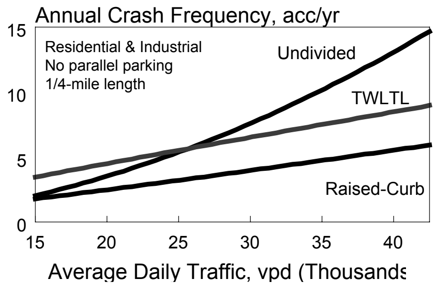
4. Safety Model



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5. Guidelines

Undivided to Raised-Curb Median

ADT	Access Density	Left-Turn Percent 0	5	10	15	20	30
17,500	30	U	U	U	U	U	
	60	U	U	U			
22,500	30	U					R
	60						R
27,500	30			R	R	R	R
	60			R	R	R	R
32,500	30		R	R	R	R	R
	60		R	R	R	R	R

5. Guidelines

Sample Calculation:

Existing cross section is undivided.
1760-ft segment length (0.33 miles).
9 active driveways per side.
Arterial ADT is 32,500 vpd.
Left-turn volume is 120 veh/day/drive.

$$\textit{Access pt. density} = \frac{18}{0.33} = 54\ \textit{ap/mi} \quad (\textit{say},\ 60)$$

$$\%\textit{Turns} = (2 \times 9 \times 120) \times \frac{1{,}320}{1{,}760} \times \frac{1}{32{,}500} \times 100 = 5\%$$

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6. Additional Reading

- NCHRP Report 395:
  Capacity and Operational Effects of Midblock Left-Turn Lanes.
- ITE Journal, March, 1998:
  "Median treatment selection for existing arterial streets."
- Transportation Research - A, V. 33(3/4), 1999:
  "Delay to major-street through vehicles at two-way stop-controlled intersections."
- Transportation Research - A, V. 32(2), 1998:
  "Delay to major-street through vehicles due to right-turn activity."

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Overview of NCHRP Project 3-52
Impacts of Access Management Techniques

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Herbert S. Levinson, Transportation Consultant

4th National Conference on Access Management
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Overview of NCHRP Project 3-52
Impacts of Access Management Techniques

Jerome Gluck, Herbert Levinson

ABSTRACT

This paper presents an overview of NCHRP Project 3-52 -- Impacts of Access Management Techniques. The project classified access management techniques, identified the "priority" techniques, and suggested safety, operation, and economic impact measures. The impacts and benefits of "priority" techniques were quantified based upon an extensive literature review, case studies of good and poor practice, and special field studies. In addition, the salient planning and policy implications were set forth.

ACKNOWLEDGMENTS

This research was performed under NCHRP Project 3-52 by Urbitran Associates in association with Herbert Levinson, S/K Transportation Consultants, and Philip Demosthenes. Jerome Gluck served as principal investigator with major support from Herbert Levinson. Urbitran staff members who made significant contributions to the research include Vassilios Papayannoulis, Greg Haas, Ben Jobes, Robert Michel, Jamal Mahmood, Kathleen Feeney, and Gail Yazersky-Ritzer. Subcontract work at S/K Transportation Consultants was performed by Vergil Stover and Frank Koepke. Philip Demosthenes provided insights from his many years of experience with access management.

State, local, and other agencies were very helpful by providing information on their access management practices and procedures. In particular, the support of the following state departments of transportation in providing accident information is acknowledged: Delaware, Illinois, Michigan, Oregon, New Jersey, Texas, Virginia, and Wisconsin.

The insights, guidance, and suggestions of the NCHRP Project 3-52 panel are greatly appreciated. Panel members included Mr. Arthur Eisdorfer (Chair), New Jersey Department of Transportation (DOT); Mr. Gary Coburn, Ohio DOT; Mr. Ronald Giguere, Federal Highway Administration; Mr. Del Huntington, Oregon DOT; Ms. Denise Kors, British Columbia Ministry of Transportation and Highways; Mr. Kenneth Lazar, Illinois DOT; Dr. William McShane, Polytechnic University; and Mr. Michael Tako, Florida DOT. The support and assistance from Mr. Ray Derr of the National Cooperative Highway Research Program are gratefully acknowledged.

INTRODUCTION

The research objective of NCHRP 3-52 was "to develop methods of predicting and analyzing the traffic-operation and safety impacts of selected access management techniques for different land use, roadway variables, and traffic volumes. The methods to be developed are for use by state departments of transportation, city and county traffic departments, transportation-planning agencies, and private developers." A two-phase research approach was designed to achieve these objectives and to produce practical guidelines for the application, analysis, and selection of various access management techniques.

The first phase identified the various techniques that are available; showed how they can be classified in terms of functional objectives, roadway elements, and likely impacts; and suggested "priority" techniques for further analysis. Likely impacts were extracted based on a literature review, the Research Team's experience, and selected agency surveys. The need for further data collection was identified. First phase efforts concluded with the design of data collection plans that addressed the data voids for the priority techniques.

The second phase focused on the further analysis of priority techniques that included signalized and unsignalized access spacing, median treatments, left turns, separation distances at interchanges, and frontage roads. It involved collecting, analyzing, and synthesizing information obtained from secondary sources to develop methods for estimating impacts; preparing case studies that identified good and poor practices; and performing primary data collection. Findings are contained in a final report and are detailed in a series of technical memoranda.

1. Techniques and Impacts

More than 100 individual access management techniques were identified. These, in turn, were grouped according to policy and roadway design features as shown in Table 1. This system keys techniques to the type of improvements normally applied along highways and access driveways. It is simple to use and understand.

A series of "priority" techniques was identified for detailed analysis. These techniques (1) apply over a large portion of the roadway system, (2) can improve safety, speeds, and emissions, and (3) are generally amenable to measurement. These priority techniques are listed in Table 2. The research effort focused on techniques whose impacts can be measured. Where impacts could not be quantified, case studies identified good and poor practice.

A wide range of possible impacts was identified. These impacts were grouped into four broad categories: traffic operations, traffic safety, environmental, and economics. In reviewing these groups, it became apparent that many impacts are interrelated. For example, emissions largely depend upon traffic volume and speed of travel. Therefore, subsequent analysis for the specific techniques focused on traffic operations (travel times, speeds, capacities) and safety (accident rates). However, economic impacts were also identified where relevant.

Table 1
Recommended Classification System
for Access Management Techniques

I. Policy - Management

a. Access Codes/Spacing
b. Zoning/Subdivision Regulations
c. Purchase of Access Rights
d. Establish setbacks from interchanges and intersections

II. Design - Operations (by roadway features)

a. Interchanges
b. Frontage Roads
c. Medians - Left Turns
d. Right Turns
e. Access/Driveway Location - (Mainly Retrofit -- consolidation, reorientation, relocation)
f. Traffic Controls
g. Access/Driveway Design

Table 2
Priority Techniques Analyzed

1a	Establish Traffic Signal Spacing Criteria
1b	Establish Spacing for Unsignalized Access
1c	Establish Corner Clearance Criteria
1d	Establish Access Separation Distances at Interchanges
2a	Install Physical (Restrictive) Continuous Median on Undivided Highway
2b	Replace Continuous Two-Way Left-Turn Lane with Restrictive Median
3a	Install Left-Turn Deceleration Lanes
3c	Install Continuous Two-Way Left-Turn Lane
3d	Install U-Turns as Alternative to Direct Left-Turns
3e	Install Jug-Handle and Eliminate Left Turns
6a	Install Frontage Road to Provide Access to Individual Parcels
6b	Locate/Relocate the Intersection of a Parallel Frontage Road and Cross Road Further from the Arterial Cross Road Intersection

2. Traffic Signal Spacing (Technique 1a)

The spacing of traffic signals, in terms of their frequency and uniformity, governs the performance of urban and suburban highways. It is one of the most important access management techniques. This is why Colorado, Florida, and New Jersey require long signal spacings (e.g. 2 mile) or minimum through band widths (e.g. 50 percent) along principal arterial roads.

Safety

Several studies have reported that accident rates (accidents per million VMT) rise as traffic signal density increases. An increase from two to four traffic signals per mile resulted in about a 40 percent increase in accidents along highways in Georgia and about a 150 percent increase along US 41 in Lee County, Florida. However, the safety impacts may be obscured in part by differing traffic volumes on intersecting roadways and by the use of vehicle-miles of travel for computing rates, rather than the accidents per million entering vehicles.

Travel Times

Each traffic signal per mile added to a roadway reduces speed about two to three mph. Using two traffic signals per mile as a base results in the following percentage increases in travel times as signal density increases. For example, travel time on a segment with four signals per mile would be about 16 percent greater than on a segment with two signals per mile.

Signals Per Mile	Percent Increase in Travel Times (Compared to 2 Signals Per Mile)
2.0	0
3.0	9
4.0	16
5.0	23
6.0	29
7.0	34
8.0	39

3. Unsignalized Access Spacing (Technique 1b)

Access points introduce conflicts and friction into the traffic stream. As stated in the 1994 AASHTO *Policy on Geometric Design of Highways and Streets*, "Driveways are, in effect, at-grade intersections .... The number of accidents is disproportionately higher at driveways than at other intersections; thus, their design and location merit special consideration."

It is increasingly recognized that spacing standards for unsignalized access points should complement those for signalized access. Potentially high-volume unsignalized access points should be placed where they conform to traffic signal progression requirements. On strategic and primary arterials, there is a basic policy decision of whether or not access should be provided entirely from other roads.

Safety

Many studies over the past 40 years have shown that accident rates rise with greater frequency of driveways and intersections. Each additional driveway increases accident potential. This finding was confirmed by a comprehensive safety analysis of accident information obtained from Delaware, Illinois, Michigan, New Jersey, Oregon, Texas, Virginia, and Wisconsin.

About 240 roadway segments, involving more than 37,500 accidents, were analyzed in detail. Accident rates were derived for various spacings and median types. The accident rate indices shown below were derived using 10 access points per mile as a base. (Access density is a measure of the total number of access points in both travel directions.) For example, a segment with 60 access points per mile would be expected to have an accident rate that is three times higher than a segment with 10 access points per mile. In general, each additional access point per mile increases the accident rate by about 4 percent.

Total Access Points Per Mile (Both Directions)	**Accident Rate Index**
10	1.0
20	1.4
30	1.8
40	2.1
50	2.5
60	3.0
70	3.5

Representative accident rates by access frequency, median type and traffic signal density are summarized in Table 3 for urban and suburban areas. Tables 4 and 5 show how accident rates rise as the total access points per mile (both signalized and unsignalized) increases in urban and rural areas, respectively, as a function of the median treatment. In urban and suburban areas, each access point (or driveway) added would increase the annual accident rate by 0.11 to 0.18 on undivided highways and by 0.09 to 0.13 on highways with TWLTLs or non-traversable medians. In rural areas, each point (or driveway) added would increase the annual accident rate by 0.07 on undivided highways and 0.02 on highways with TWLTLs or non-traversable medians.

Travel Times

Travel times along unsignalized multi-lane divided highways can be estimated using procedures set forth in the *1994 Highway Capacity Manual* (HCM). Speeds are estimated to be reduced by 0.25 mph for every access point up to a 10 mph reduction for 40 access points per mile. The HCM procedure is keyed to access points on one side of a highway, but access points on the opposite side of a highway may be included where they have a significant effect on traffic flow.

Table 3

Representative Accident Rates
(Accidents Per Million VMT)
By Access Density
Urban and Suburban Areas

Unsignalized Access Points Per Mile	**Signalized Access Points Per Mile**			
	. 2	**2.01-4.00**	**4.01-6.00**	**> 6**
. 20	2.6	3.9	4.8	6.0
20.01-40	3.0	5.6	6.9	8.1
40.01-60	3.4	6.9	8.2	9.1
>60	3.8	8.2	8.7	9.5
All	3.1	6.5	7.5	8.9

Table 4

Representative Accident Rates
(Accidents Per Million VMT)
By Type of Median - Urban and Suburban Areas

Total Access Points Per Mile (1)	Median Type		
	Undivided	Two-WayLeft-Turn Lane	Non Traversable Median
. 20	3.8	3.4	2.9
20.01-40	7.3	5.9	5.1
40.01-60	9.4	7.9	6.8
>60	10.6	9.2	8.2
All	9.0	6.9	5.6

(1) Includes both signalized and unsignalized access points.

Table 5

Representative Accident Rates
(Accidents Per Million VMT)
By Type of Median - Rural Areas

Total Access Points Per Mile (1)	**Median Type**		
	Undivided	**Two-WayLeft-Turn Lane**	**Non Traversable Median**
. 15	2.5	1.0	0.9
15.01-30	3.6	1.3	1.2
> 30	4.6	1.7	1.5
All	3.0	1.4	1.2

(1) Includes both signalized and unsignalized access points.

Curb Lane Impacts

Detailed analyses were made to estimate curb-lane impacts on through traffic resulting from cars turning right into driveways at 22 unsignalized locations in Connecticut, Illinois, New Jersey, and New York.

Impacted Vehicles. The percentage of through vehicles in the right (curb) lane that would be impacted at a single driveway increases as right-turn volumes increase as shown below.

Right-Turn Volume Entering Driveway (Vehicles Per Hour)	Percent of Through Vehicles Impacted
Less than or equal to 30	2.4
31 to 60	7.5
61 to 90	12.2
Over 90	21.8

Influence Distances. The influence distances were calculated adding driver perception-reaction distances and car lengths to the impact lengths. The percentages of right-lane through vehicles that would be influenced to or beyond an upstream driveway in a quarter-mile section were estimated for various right-turn volumes, driveway spacings, and posted speeds. The likely percentages of impacted vehicles that would extend to or beyond at least one driveway (upstream) per quarter mile (i.e., "spillback") for a 45 mph speed were as follows:

Right-Turn Volume Per Driveway (vph)	Unsignalized Access Spacing (Feet)				
	100	200	300	400	500
Less than or equal to 30	27.3	14.6	7.8	2.6	0.9
31-60	64.2	40.0	23.0	8.0	2.9
61-90	82.1	57.5	35.3	12.9	4.7
Over 90	96.1	80.1	55.5	22.1	8.3

This information may be used to identify the cumulative impact of decisions concerning driveway locations and unsignalized access spacing.

Right-Turn Lanes

Right-turn deceleration lanes should be provided wherever it is desired to keep the proportion of right-lane through vehicles impacted to a specified minimum. For arterial right-lane volumes of 250 to 800 vph, the percentage of through vehicles impacted was about 0.18 times the right-turn volume. This results in the following impacts that may provide a basis for decisions regarding provision of right-turn deceleration lanes:

Percent Right-Lane Through Vehicles Impacted	Right-Turn-In Volume (vph)
0	0
2	10
5	30
10	60
15	85
20	110

Criteria of 2 percent and 5 percent impacted suggest minimum right turn volumes of 10 vph and 30 vph, respectively. This range may be applicable in certain rural settings. Criteria of 15 percent and 20 percent impacted suggest a minimum of 85 vph and 110 vph, respectively. This range may be applicable in certain urban areas. The length of the deceleration lane is a function of the impact length and storage requirements.

Access Separation

Three factors influence the desired access separation distances -- safety, operations, and roadway access classification. Direct property access along strategic and principal arterials should be discouraged. However, where access must be provided, adequate spacing should be established to maintain safety and preserve movement.

"Spillback" is defined as a right-lane through vehicle that is influenced to or beyond the driveway upstream of the analysis driveway. It occurs when the influence length is greater than the driveway spacing minus the driveway width. The spillback rate represents the percentage of right-lane through vehicles that experience this occurrence.

The spillback rate should be kept to a level that is consistent with an arterial's function and desired safety and operations. Table 6 provides suggested access separation distances for spillback rates of 5, 10, 15, and 20 percent. For the lower speeds of 30 and 35 mph, access separation distances shown are based on the safety implications of driveway density. For roadways with a primary function of mobility, there should not be more than 20 to 30 connections per mile (both directions).

4. Corner Clearance (Technique 1c)

Corner clearances represent the minimum distances that should be required between intersections and driveways along arterial and collector streets. As stated in the AASHTO *Policy on Geometric Design of Highways and Streets*: "Driveways should not be situated within the functional boundary of at-grade intersections. This boundary would include the longitudinal limits of auxiliary lanes."

Table 6

Access Separation Distances (Feet) Based on Spillback Rate*

Posted Speed (mph)	Spillback Rate**			
	5%	10%	15%	20%
30	335	265 [(a)]	210 [(b)]	175 [(c)]
35	355	265 [(a)]	210 [(b)]	175 [(c)]
40	400	340	305	285
45	450	380	340	315
50	520	425	380	345
55	590	480	420	380

(a) Based on 20 driveways per mile.
(b) Based on 25 driveways per mile.
(c) Based on 30 driveways per mile.

* Based on an average of 30 to 60 right runs per driveway.

** Spillback occurs when a right-lane through vehicle is influenced to or beyond a driveway upstream of the analysis driveway.
The spillback rate represents the percentage of right-lane through vehicles experiencing this occurrence.

Corner clearance criteria assembled from various state, county, and city agencies showed values ranging from 16 to 325 feet.

Eight case studies of corner clearances were reviewed to illustrate current practices, problems and opportunities. These case studies indicated that (1) definition of corner clearance distances varied among locations; (2) distances ranged from two to 250 feet; (3) queuing or spillback across driveways was perceived as the most pervasive problem, making it difficult to turn left into or out of a driveway; (4) roadway widening to increase capacity sometimes reduces corner clearances; (5) placing driveways too close to intersections correlates with higher accident frequencies C sometimes up to half of all accidents involved are driveway-related; (6) corner clearances are limited by the property frontage available; (7) improving or retrofitting minimum corner driveway distances is not always practical, especially in built up areas.

The analyses suggested that adequate corner clearances can best be achieved where they are established before land subdivision and site development approval. Corrective actions include: (1) requiring property access from secondary roads; (2) locating driveways at the farthest edge of the property line away from the intersection; (3) consolidating driveways with adjacent properties; and (4) installing a raised median barrier on approaches to intersections to prevent left-turn movements.

5. Median Alternatives (Techniques 2a, 2b & 3c)

The basic choices for designing the roadway median are whether to install a continuous two-way left-turn lane or a non-traversable median on an undivided roadway, or to replace a two-way left-turn lane with a non-traversable median. These treatments improve traffic safety and operations by removing left turns from through travel lanes. Two-way left-turn lanes provide more ubiquitous access and maximize operational flexibility. Medians physically separate opposing traffic, limit access, clearly define conflicts, and provide better pedestrian refuge; their design requires adequate provision for left and U-turns to avoid concentrating movements at signalized intersections.

An extensive review of safety and operational experience and models provided guidelines for impact assessment.

Safety

The safety benefits reported in studies conducted since 1970 were as follows:

- Highway facilities with two-way left-turn lanes had accident rates that were overall about 38 percent less than experienced on undivided facilities (13 studies).

- Highway facilities with non-traversable medians had an overall accident rate of 3.3 per million VMT compared to about 5.6 per million VMT on undivided facilities (10 studies).

- Highway facilities with non-traversable medians had an overall accident rate of 5.2 per million VMT compared to 7.3 per million VMT on facilities with two-way left-turn lanes (11 studies).
- The estimated total accidents per mile per year -- based on an average of seven accident prediction models -- were as follows:

ADT	Accidents Per Mile Per Year		
	Undivided Highway	**Two-Way Left-Turn Lane**	**Non-traversable Median**
10,000	48	39	32
20,000	126	60	55
30,000	190	92	78
40,000	253	112	85

Operations

Several operations studies have indicated that removing left-turning vehicles from the through traffic lanes reduces delays whenever the number of through travel lanes is not reduced. Some 11 operations models developed over the past 15 years confirmed these findings.

Economic Impacts

The economic impacts of various median alternatives depend upon the extent that access is improved, restricted, or denied. The impacts to specific establishments also depend on the type of activity involved and on background economic conditions.

Where direct left turns are prohibited, some motorists will change their driving or shopping patterns to continue patronizing specific establishments. Some repetitive pass-by traffic will use well designed or conveniently located U-turn facilities. Impacts also will be reduced at locations where direct left-turn access is available. In some cases, retail sales may increase as overall mobility improves.

The maximum impacts resulting from median closures can be estimated by multiplying the number of left turns entering an establishment by the proportion of these turns that represents pass-by traffic. Typical proportions of this pass-by traffic are as follows:

- Service Station-Convenience Market 55%
- Small Retail (<50,000 sq. ft.) 55
- Fast Food Restaurant with DriveThrough Window 45
- Shopping Center (250,000 - 500,000 sq. ft.) 30
- Shopping Center (Over 500,000 sq. ft.) 20

Selecting a Median

Selecting a median alternative depends upon factors related to policy, land use, and traffic. These factors include: (1) the access management policy for and access class of the roadway under consideration; (2) the types and intensities of the adjacent land use; (3) the supporting street system and the opportunities for rerouting left turns; (4) existing driveway spacings; (5) existing geometric design and traffic control features (e.g. proximity of traffic signals and provisions for left turns); (6) traffic volumes, speeds, and accidents; and (7) costs associated with roadway widening and reconstruction.

6. Left-Turn Lanes (Technique 3a)

The treatment of left-turns is a major access management concern. Left turns at driveways and street intersections may be accommodated, prohibited, diverted, or separated depending upon specific circumstances.

Safety

A synthesis of safety experience indicates that the removal of left turns from through traffic lanes reduced accident rates about 50 percent (range was 18 to 77 percent).

Operations

Left turns in shared lanes may block through vehicles. The proportion of through vehicles blocked on approaches to signalized intersections is a function of the number of left turns per traffic signal cycle as shown below:

Left Turns Per Cycle	Proportion of Through Vehicles Blocked
1	0.25
2	0.40
3	0.60

The capacity of a shared lane might be 40 to 60 percent of that for a through lane under typical urban and suburban conditions. Thus, provision of left-turn lanes along a four-lane arterial would increase the number of effective travel lanes from about 1.5 to 2.0 lanes in each direction C a 33 percent gain in capacity.

Application of the *1994 Highway Capacity Manual* gives the following illustrative capacities for two- and four-lane roads at signalized intersections:

Condition	Capacity - Vehicles Per Hour Per Approach	
	Two-Lane Road	Four-Lane Road
No Left Turns	840	1,600
Shared Lane (50 to 150 Left Turns/Hour)	425-650	900 - 1,000
Exclusive Left-Turn Lanes	750-960	1,100 - 1,460

7. U-Turns as Alternatives to Direct Left Turns (Technique 3d)

U-turns reduce conflicts and improve safety. They make it possible to prohibit left-turns from driveway connections onto multi-lane highways and to eliminate traffic signals that would not fit into time-space (progression) patterns along arterial roads. When incorporated into intersection designs, they enable direct left-turns to be rerouted and signal phasing to be simplified.

Safety

U-turns result in a 20 percent accident rate reduction by eliminating direct left-turns from driveways and a 35 percent reduction when the U-turns are signalized. Roadways with wide medians and "directional" U-turn crossovers have about half of the accident rates of roads with TWLTLs.

Operations

U-turns, coupled with two-phase traffic signal control, result in about a 15 to 20 percent gain in capacity over conventional intersections with dual left-turn lanes and multi-phase traffic signal control.

A right-turn from a driveway followed by a U-turn can result in less travel time along heavily traveled roads than a direct left-turn exit when there is up to half a mile of additional travel.

Indirect U-turns may require a median width of 40 to 60 feet at intersections depending upon the types of vehicles involved. Narrower cross sections may be sufficient when there are few large trucks.

8. Access Separation at Interchanges (Technique 1d)

Freeway interchanges have become focal points of activity and have stimulated much roadside development in their environs. Although access is controlled within the freeway interchange area, there generally is little access control along the interchanging arterial roadways.

Separation distances reported by state agencies ranged from 100 to 700 feet in urban areas and 300 to 1000 feet in rural areas. Case studies reported separation distances of 120 to 1,050 feet. These distances are usually less than the access spacing needed to ensure good traffic signal progression and to provide adequate weaving and storage for left turns.

Desired access separation distances for free-flowing right turns from exit ramps should include the following components:

• Perception-Reaction Distance	100-150 feet
• Lane Transition	150-250 feet
• Left-Turn Storage	50 feet per left-turn per cycle
• Weaving Distance	800 feet, 2-lane arterials
	1200 feet, 4-lane arterials
	1600 feet, 6-lane arterials
• Distance to Centerline of Cross Street	40-50 feet

9. Frontage Roads (Techniques 6a and 6b)

Frontage roads reduce the frequency and severity of conflicts along the main travel lanes and permit direct access to abutting property. Along freeways and expressways, they can be integrated with interchange and ramping systems to alleviate congestion and to improve access. Frontage roads along arterials should be carefully designed to avoid increasing conflicts at intersections. Reverse frontage or "backage" roads with developments along each side may be desirable in developing areas. In all cases, arterial frontage roads must be carefully designed and located to protect arterial and cross road operations.

10. Policy Considerations

Several planning and policy implications emerged from the research. Some key findings follow:

- Comprehensive access management codes should indicate where access is allowed or denied for various classes of roads, specify allowable spacings for signalized and unsignalized connections, and set forth permit procedures and requirements. Codes may define or limit the application of specific techniques and establish procedures for an administering agency to use in removing access.

- There should be a sufficient network of supporting local and collector streets that provide direct access to adjacent developments. These secondary streets should connect to arterial streets at appropriate and well-spaced locations. They make it possible to minimize direct property access on major arterials.

- Access should be provided from strategic and primary arterials only when reasonable access cannot be provided from other roadways. In such cases, access should be limited to right turns wherever possible.

- Left-turn and cross egress should be well separated and placed at locations that fit into overall signal coordination patterns with high efficiency.

- Advance purchase of right-of-way and access rights is desirable. Access spacing standards (including corner clearance requirements) should be established in advance of actual development.

- Coordination of land use and transportation planning is essential. Zoning, subdivision, and access spacing requirements should be consistent. Better coordination of land use, interchange geometry, and arterial street operations are necessary to avoid “double loading” arterials and to minimize weaving movements and traffic congestion. Strategically placed supporting streets and frontage roads may play a major role in this effort.

- Wide medians that allow indirect U-turns in lieu of direct left turns should be considered for new arterials where space permits, since these medians improve safety and simplify intersection operations and signal timing/coordination.

- Any access control or management plan must be done on a route or system-wide basis to avoid transferring problems to upstream or downstream intersections.

Legal Issues in Access Management

Slides Case Law in Several States

Paper
Slides

Kansas:
Chris Huffman, Kansas DOT (For Tim Orrick)

Slides

Florida:
Pam Leslie, Florida DOT

Oregon:
Dale Hormann, Oregon Department of Justice

Monday August 14, 2000 – 3:00 PM – 4:30 PM
Track 3 - Workshop

POLICE POWER REGULATION OF HIGHWAY ACCESS AND TRAFFIC FLOW IN THE STATE OF KANSAS

Review of Kansas Case Law and Applications to Highway Design

January 2000

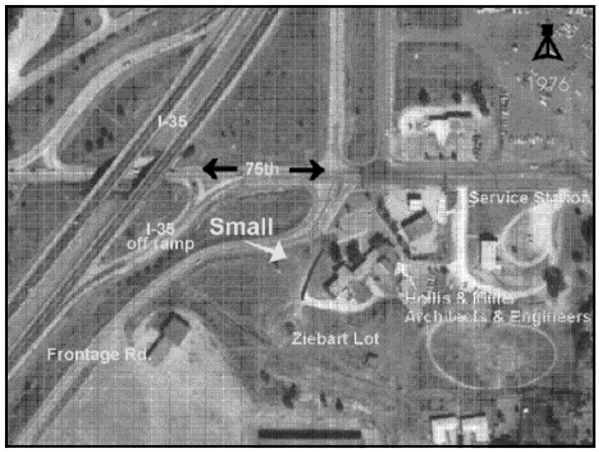
Summary of Cases

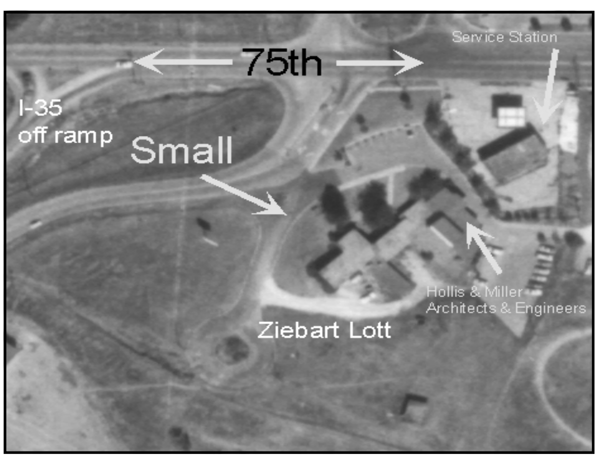
In Reverse Chronological Order

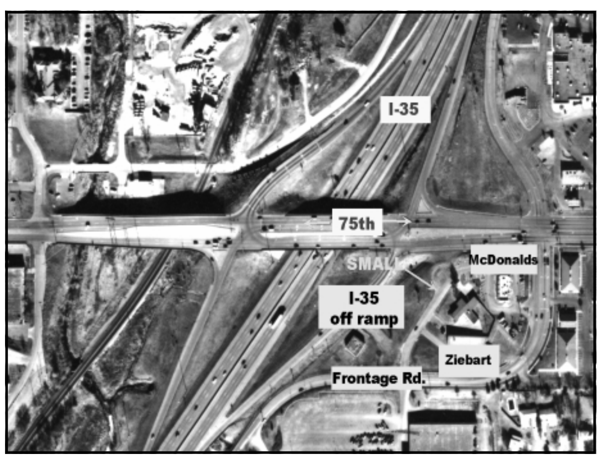
DATE	NAME	TYPE OF REGULATION	PREPROJECT USE	POSTPROJECT USE	SAME OR HIGHER USE	COMPENSABLE
1999	EBERTH	Median/Circuity	Speculative/Res.	Same	Y	N
1999	McDonald's	Flyover/Frontage Rd.	Retail Commercial	Same	Y	N
1996	Garrett	Circuity	Commercial	Commercial	Y	Y
1996	Pringle	Median/Circuity	Speculative	Same	Y	N
1991	Hales	Median/Circuity	Apartments	Same	Y	N
1990	Hudson	Driveway	Service Station	Same	Y	N
1986	Small	Circuity	Commercial	Same	Y	N
1977	Teachers	Circuity	Commercial	Partly the Same		Y
1977	Kohn	Driveway	Motel/Restaurant	Same	Y	Y
1974	McCall	Driveway	Service Station	Quick Trip	Y	Y
1968	Eastborough	Driveway	Apartments	Same	Y	N
1966	Ray	Frontage Rd.	Undetermined	Undetermined		N
1965	Brock	Frontage Rd.	Commercial	Same	Y	N
1959	Smith	Frontage Rd.	Ag./Comm.	Ag./Comm.	Y	Y
1959	Riddle	Circuity	Motel/House	Similar	Y	Y

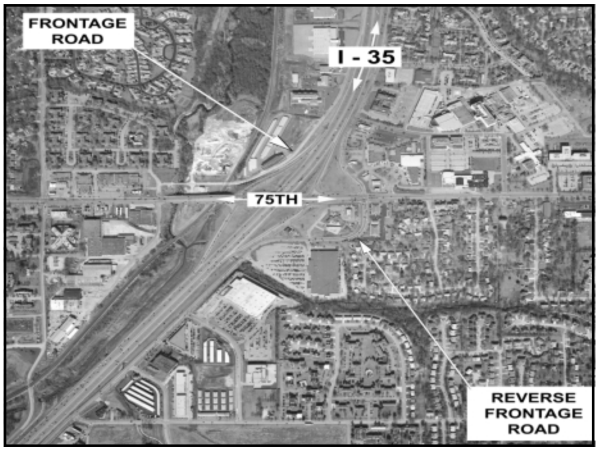
Small

Photo taken 10/97
SE Quadrant of I-35 & 75th St.
Overland Park, Kansas









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1986	Small	Circuity	Commercial	Same	Y	N
1977	Teachers	Circuity	Commercial	Partly the Same		Y
1977	Kohn	Driveway	Motel/Restaurant	Same	Y	Y
1974	McCall	Driveway	Service Station	QuickTrip	Y	Y
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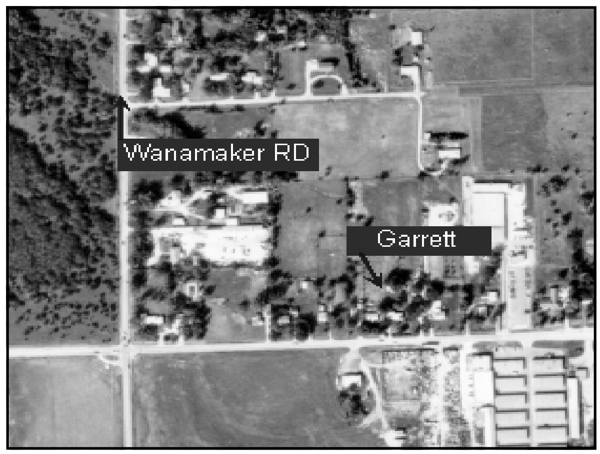
1966	Ray	Frontage Rd.	Undetermined	Undetermined		N
1965	Brock	Frontage Rd.	Commercial	Same	Y	N
1959	Smith	Frontage Rd.	Ag./Comm.	Ag./Comm.	Y	Y
1959	Riddle	Circuity	Motel/House	Similar	Y	Y

Garrett

Photo taken 10/97
NE Quadrant of 21st and Wanamaker
Topeka, Kansas



"Economic Balancing" Test

"Where the government's exercise of its police power has an economic impact on private property, a balancing test is applied to determine if the regulation of private land is <u>too unfair or goes too far</u>."

Summary of Cases

In Reverse Chronological Order

DATE	NAME	TYPE OF REGULATION	PREPROJECT USE	POSTPROJECT USE	SAME OR HIGHER USE	COMPENSABLE
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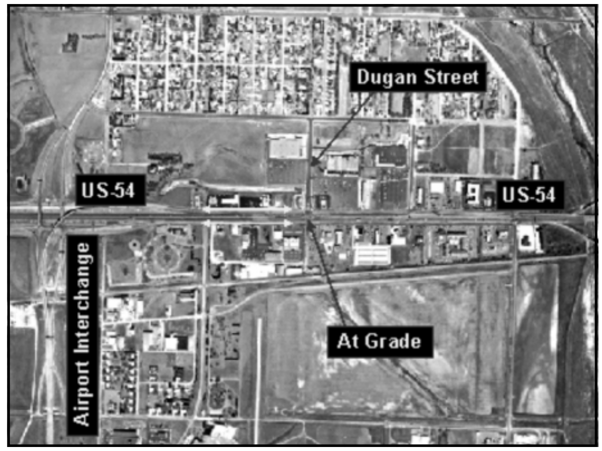
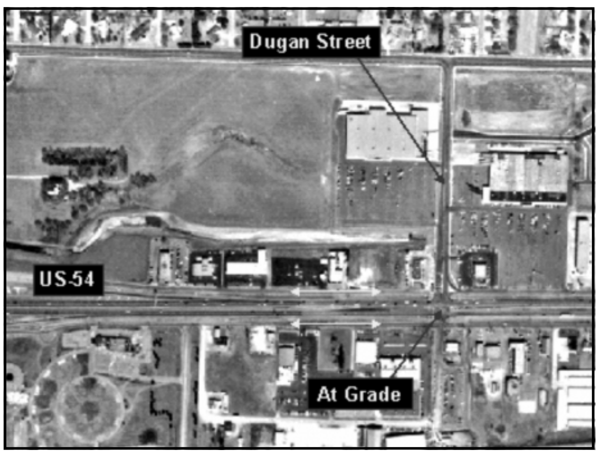
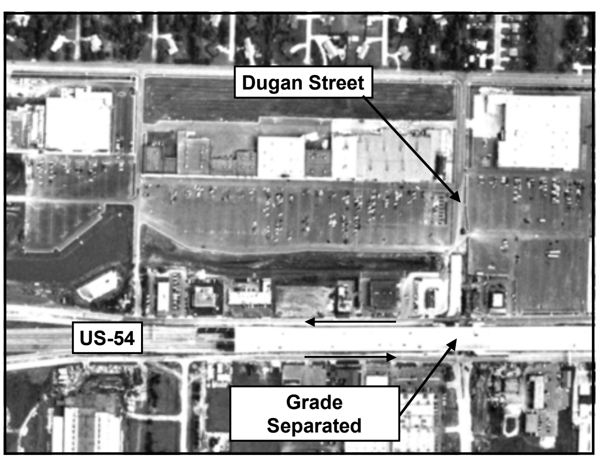
1959	Riddle	Circuity	Motel/House	Similar	Y	Y







OMSI TRIP

Other

11 Access Management Plans

Paper | Slides

11A. Applying Context Sensitive Highway Design to Achieve Access Management

Tim Bevan, CH2M Hill

Paper | Slides

11B. Access Management in the Planning Environment, Lane County Interchanges

Nick Arnis, Oregon DOT

Paper | Slides

11C. Land Development and Access Management Strategies for Interchange Areas

Laurel Land, University of South Florida

Tuesday August 15, 2000 – 8:00 AM – 9:30 AM
Track 1 - Administrative

National Conference on Access Management

ABSTRACT

Topic of Paper and Presentation:

"Applying Context Sensitive Highway Design to Achieve Access Management Improvements."

Authors:

Tim Bevan and Todd Slind / CH2M HILL

Kirk McKinley / City of Shoreline

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Telephone: (425) 453-5005 x5903 Fax: (425) 462-5957
email: tbevan@ch2m.com

Abstract of Presentation:

Context-sensitive design is an interdisciplinary approach to developing a transportation project that takes into consideration not only the traditional parameters of traffic capacity and geometric standards, but the entire range of issues and impacts related to community stakeholders. Context-sensitive design represents a new evolution in community and agency involvement where citizens and affected agency staff work alongside planners and engineers to create a solution that best fits with community goals and values. The FHWA and state departments of transportation as well as local governments across the country are embracing this new approach in order to arrive at designs that are compatible with communities and consider the diverse interests associated with roadway projects.

CH2M HILL was selected by the City of Shoreline to develop a new multimodal corridor design for a 3-mile stretch of urban arterial (signed State Route 99) within the City. On the Shoreline project, we chose to use the context-sensitive design practice in order to more efficiently and effectively deliver a preferred alternative that would have support and constructability. One of the key goals of the project from both the city's and the state department of transportation's point of view was to address access management on a segment of highway that experiences some of the highest accident rates in the state and suffers from a general lack of access controls.

This paper and presentation will provide a case example of the Shoreline experience. It will illustrate how context-sensitive design facilitates "thinking beyond the pavement" to accomplish access management treatments on roadway design projects. It presents a new design approach where citizens and agency representatives forge a cooperative team that achieves a level of acceptance and excellence in the roadway design that provides lasting value to the community.

Applying context sensitive design to achieve access management improvements

FOURTH ANNUAL NATIONAL CONFERENCE
ON ACCESS MANAGEMENT

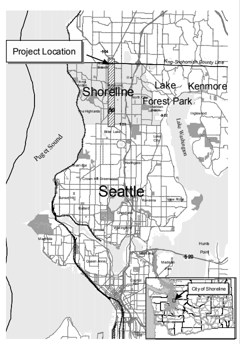
Tim Bevan and Todd Slind/ CH2M HILL

Presentation outline

- Aurora Avenue project background
- Context sensitive design process
- Examples of access management planning tools

Project Background

- Three miles,
  5 lanes with TWLTL
- Traffic congestion
- High accident rates
- No sidewalks
- Poor aesthetics
- Activist community



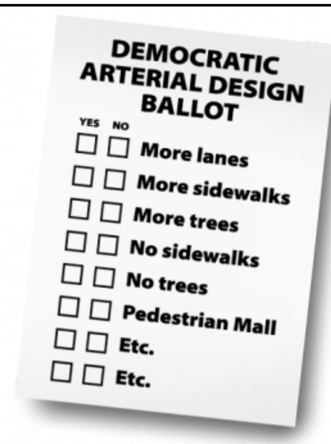
Competing objectives

- Downtown commercial street vs. regional arterial
- Business access vs. traffic safety
- Auto-oriented vs. multimodal
- Revitalization/image vs. neighborhood impacts
- Traffic capacity vs. neighborhood impacts
- Sidewalks vs. loss of parking

The dictator approach

Worked well for Moscow Transportation System design

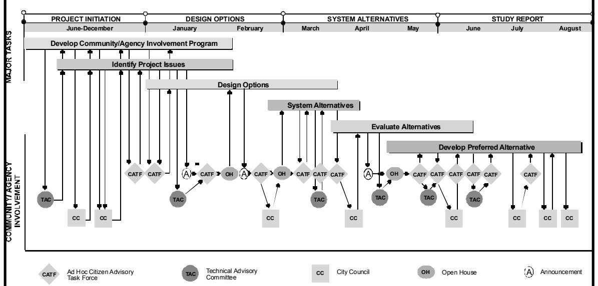
Vote on it?



Context-Sensitive Highway Design

- *"Thinking beyond the pavement"*
- Asks about the *purpose and need* of a transportation project, and then *addresses equally:*
  - safety
  - mobility
  - preservation of
    - aesthetic
    - historic
    - environmental
    - and other community values
- Context-Sensitive design involves a *collaborative, interdisciplinary* approach in which *citizens and agencies* are part of the design team.

Design Study Approach



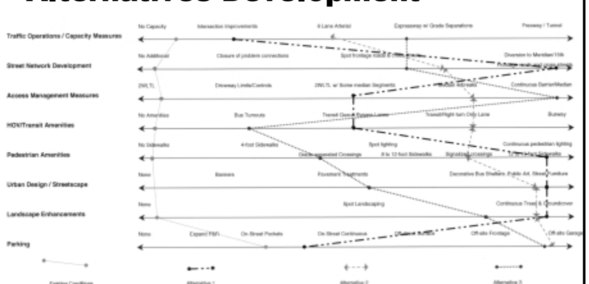
Identification of Design Issues

Design Issues and Options Matrix

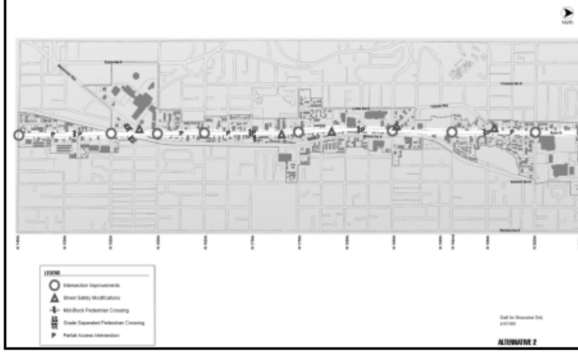
CORRIDOR STUDY ISSUES & CONCERNS	1. Intersection/Signal Improvements	2. Overhead Utility Relocation/Undergrounding	3. Street Network Development	4. Illumination Improvements	5. Right-of-Way Information	6. Construction Traffic Control	7. Access Management Measures	8. HOV/Transit Amenities	9. Environmental Considerations	10. Urban Design/Streetscape	11. Landscape Enhancements	12. Pedestrian & Bicycle Facilities
A. Pedestrian & Bicycle Access/Safety				✓		✓	✓	✓		✓	✓	✓
B. Congestion/Capacity	✓		✓		✓	✓	✓	✓	✓			
C. Aesthetics/Image		✓				✓				✓	✓	
D. Traffic Safety	✓		✓	✓		✓	✓					✓
E. Urban Design/Development		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
F. Construction Traffic			✓			✓						
G. Landscaping										✓	✓	✓
H. Environmental Quality	✓					✓			✓			
I. Traffic Access/Circulation	✓		✓			✓	✓					
J. Neighborhood Traffic	✓		✓			✓			✓			
K. HOV/Transit	✓		✓	✓		✓	✓	✓		✓	✓	✓
L. Security				✓				✓		✓	✓	✓
M. Right-of-way	✓	✓	✓		✓		✓			✓		

DESIGN OPTION INVESTIGATIONS

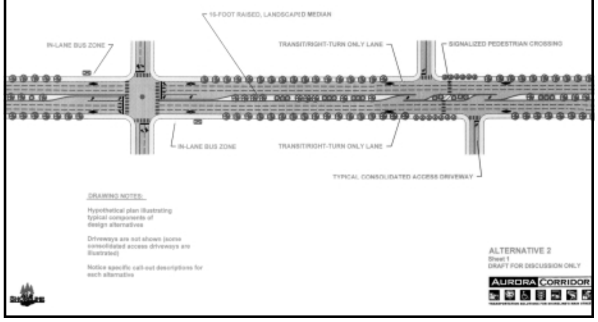
Alternatives Development



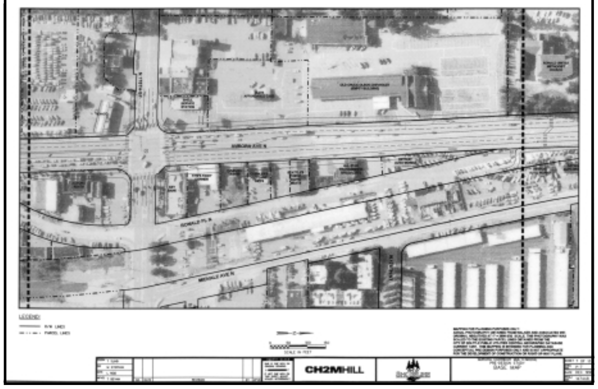
Opportunities Diagram



Conceptual Plan Drawing

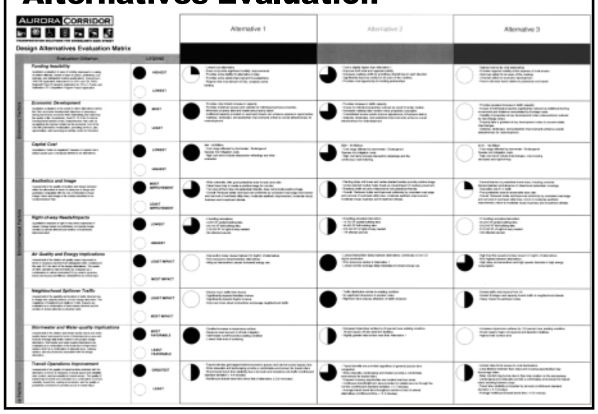


Conceptual Design Illustrations



Project Alternatives

Alternatives Evaluation



Preferred Alternative

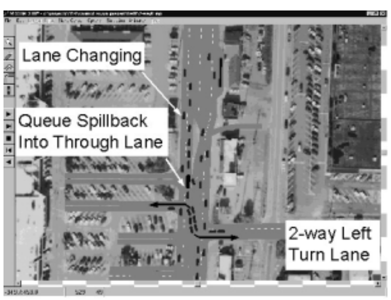
Elements of preferred alternative

- Intersection Capacity
- Business Access/Transit Lanes
- Pedestrian Crossings
- Safety/Access Management
- Left/U-turn lanes
- 12-foot wide Sidewalks
- Transit Signal Priority
- Landscaping
- Public Art
- Water Quality Treatments

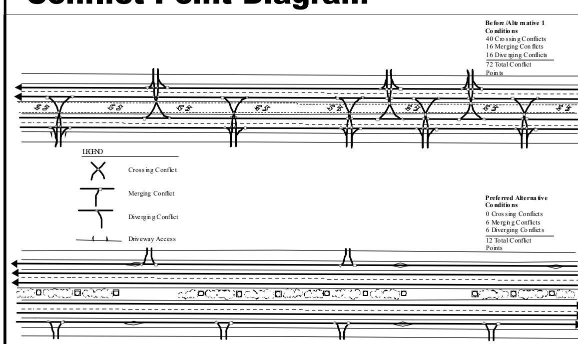
Resolving access management issues

- Understanding the problem
  - Video tape
  - VISSIM
  - Conflict point diagrams
  - Data and statistics
- Misperceptions and compromises
  - Space needed for medians
  - Access breaks
  - Site access opportunities

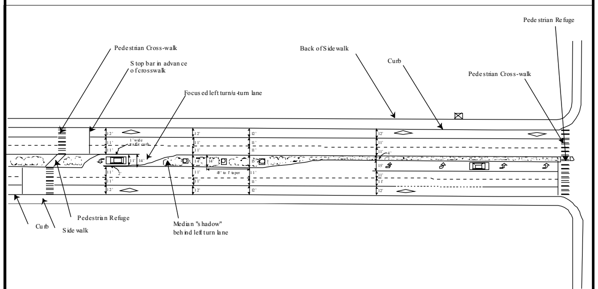
Visual Traffic Simulation

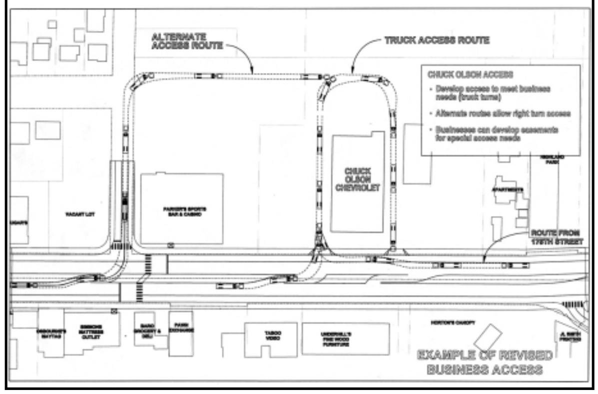


Conflict Point Diagram



Design for Minimum Median Width





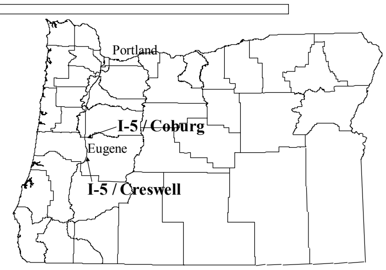
Shoreline/Aurora Avenue - Battle History

Access Management in the Planning Environment Case Studies in Lane County, Oregon

4th National Access Management Conference
Portland, Oregon
August 2000

Presented by Nick Arnis, Oregon DOT, Region 2 Planner

Interchange Locations



Presentation

- Review I-5 Interchange Plans in the Cities of Coburg and Creswell
- Critique and evaluation of the plan process in relation to Oregon Department of Transportation Access Management Policies

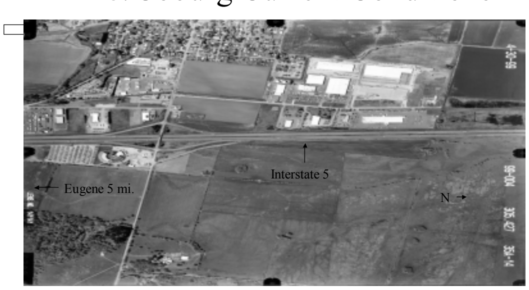
Interchange Plan Objectives

- Involve the public
- Adopt an interchange refinement plan at the local level
- Consistency with Oregon Highway Plan Access Management Standards
- Create short and long term implementation strategies

The Process

- Conduct public involvement
- Define issues and problems
- Create possible solutions
- Select a preferred alternative
- Adopt and implement the plan

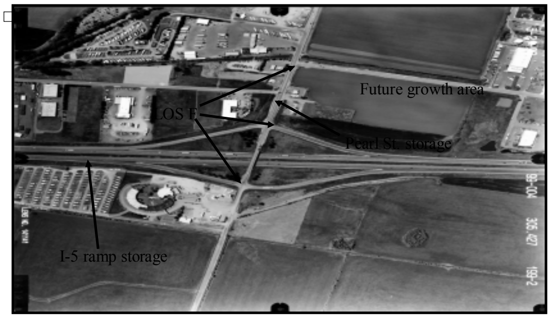
I-5/Coburg Current Conditions

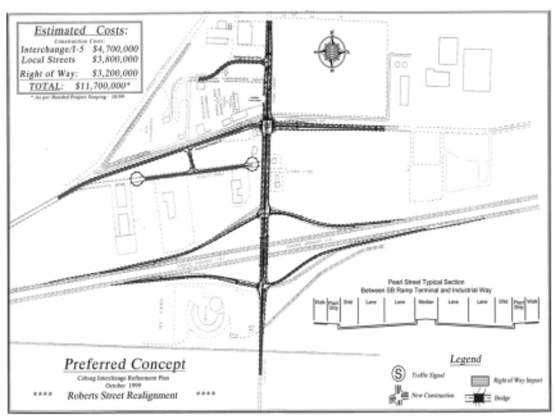


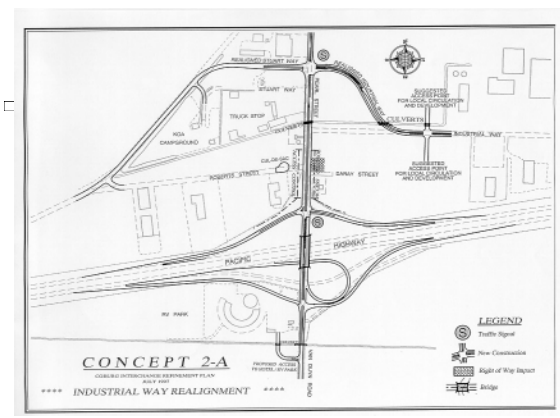
I-5/Coburg Interchange Issues

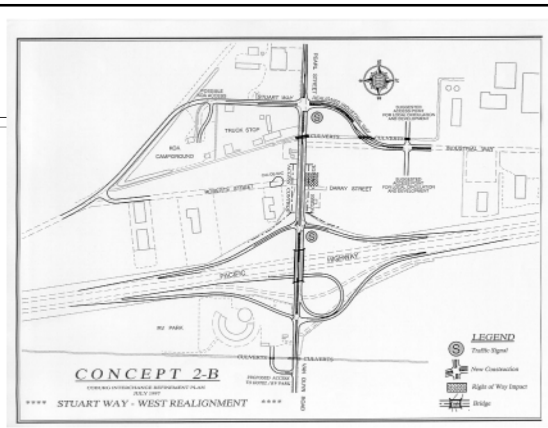
- Employment growth and large vacant parcels
- Meeting ODOT access standards
- High percentage of truck traffic
- Neighborhood concerns

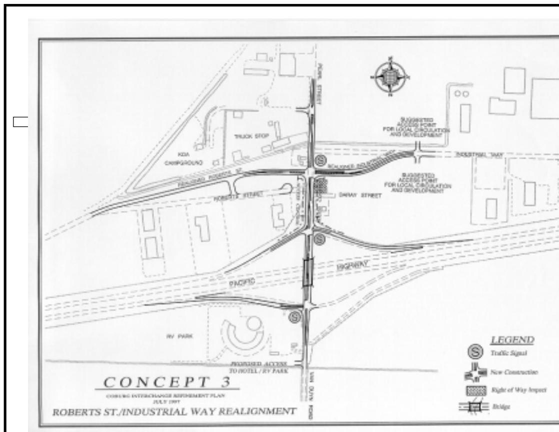
I-5/Coburg Future Conditions

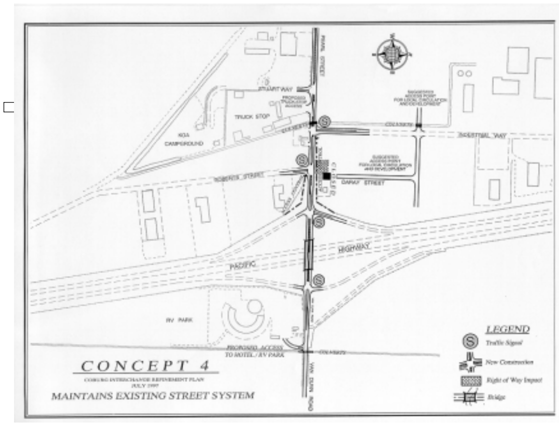












I-5/ Coburg Outcome

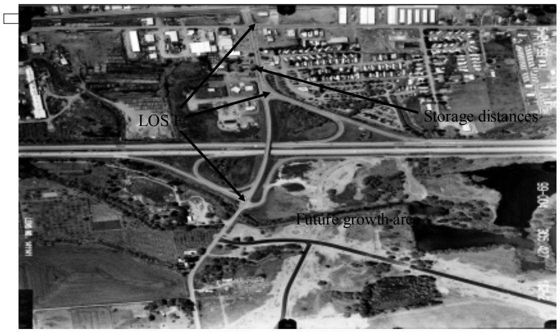
- **Facilitation process with neighborhood to resolve issues**
- **Reduced access standard but safety and operations maintained**
- **Long and short range preferred alternative selected**

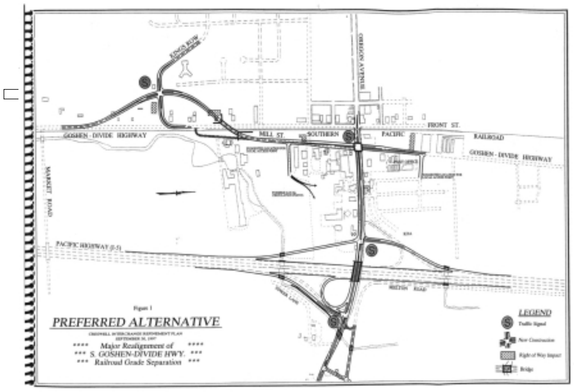
I-5/Creswell Current Conditions

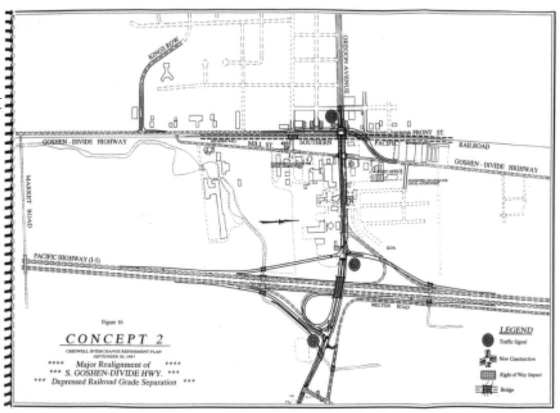
I-5/Creswell Interchange Issues

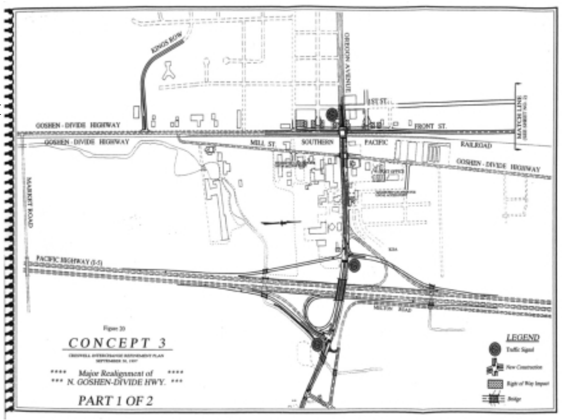
- **Large vacant parcels**
- **Meeting ODOT standards**
- **Access to existing parcels**
- **Impacts and cost**

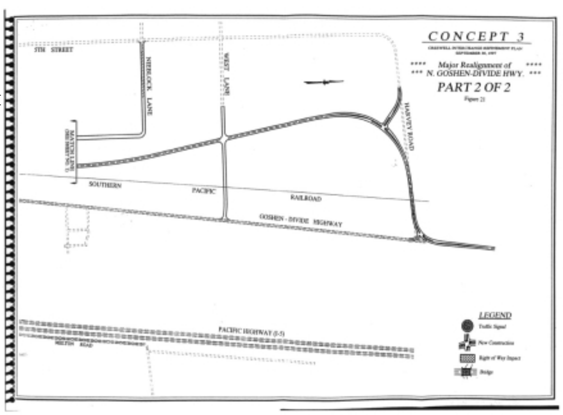
I-5/Creswell Future Conditions











I-5/ Creswell Outcome

- **Preferred alternative adopted but alignment ROW not protected**
- **Preferred alternative very costly**
- **Adopted a plan the public was willing to support**

Summary and Lessons

- Engage the public to solve the problem
- Simplify technical policies and standards
- Seek compromises but maintain safety and operations
- Create short term solutions that lead to long term goals

LAND DEVELOPMENT AND ACCESS MANAGEMENT STRATEGIES FOR INTERCHANGE AREAS

by Laurel A. Land, AICP

Interchanges are a vital link in the transportation system. They connect surface streets and freeways, and may be required to handle very high traffic volumes during peak travel periods. They are also a critical interface between the freeway and the surface street, providing a transition from high-speed travel to lower speeds.

An interchange can have a substantial impact on the intensity of land development in the surrounding area. It provides accessibility, which increases land value and encourages development. When land development and access are not properly managed, it often results in safety hazards and interferes with the efficient flow of traffic through and around the interchange. Too many choices (such as merge, through, and turn lanes, traffic signals, driveways, and median openings) create confusion, causing drivers to slow down or make erratic movements. This can impair accessibility to businesses and result in the need for costly retrofit projects. Bob Layton, Professor of Engineering at Oregon State University, asserts that the "interchange area is an extension of the freeway. … [It] presents conditions that are complex, unexpected and significantly different from other nearby surface street conditions." Perhaps if we thought differently about interchange areas, we could plan them more effectively.

The Florida Department of Transportation (FDOT) asked the Center for Urban Transportation Research (CUTR) at the University of South Florida to study land development and access management in interchange areas. The project reviewed policies and practices of local and state governments, identified issues and problems in managing interchange area development, and sets forth strategies for improvement.

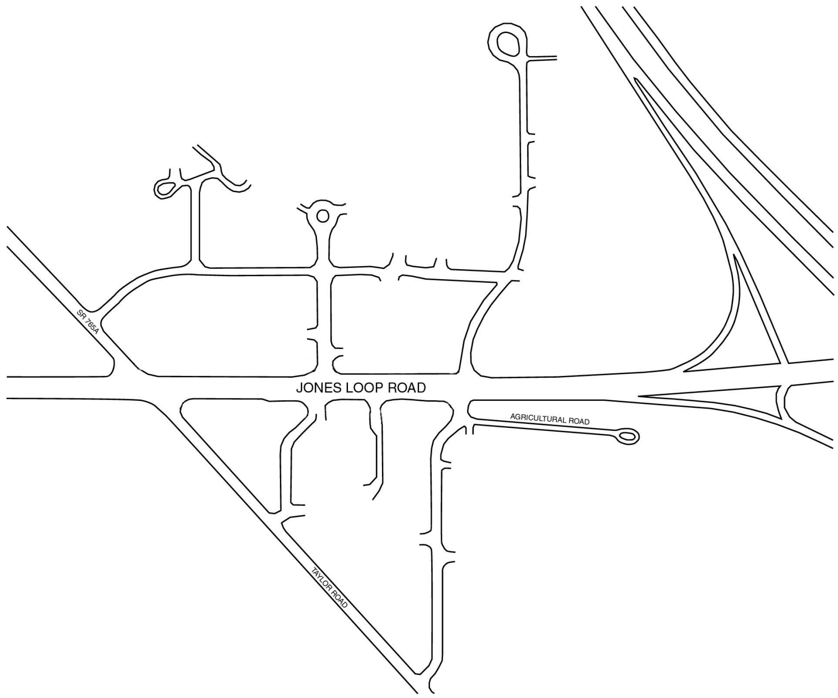
The study concludes that it is critical to create an uncluttered environment in the interchange area, with consolidated signage, median controls, and clearly identifiable access points. One way to achieve this is through the development of local access roads, as an alternative to successive driveways on the arterial. Access roads reduce driver confusion and improve traffic flow and safety.

Local policymakers are concerned that access controls would impede development. The study found, however, that effective planning and access management helps, rather than hinders, the development potential of interchange areas. Local access roads open up more land for development, provide ease in accessing property, and preserve safety on the surrounding roads, thereby increasing development potential and encouraging more efficient land use.

The interchange at I-75 and Jones Loop Road in Punta Gorda, Florida, is an example of how access roads can be used to direct development while preserving the function and safety of interchange areas (Figure 1). The access road, as shown, is a consolidated drive serving commercial development that includes a hotel, restaurant, trucking facility, and other commercial uses. Figure 2 shows how the local roads, interparcel access, and connectivity with side streets maximize the accessibility of businesses, while channeling turning movements off the arterial and away from interchange ramps.

Figure 1
Access Road in Punta Gorda, Florida

Figure 2
Interconnection of Access Roads to Local Roads



When considering a new interchange or modification to an existing one, it is important to look beyond capacity analysis and place greater emphasis on access management measures. Most access management classification systems require varying degrees of access separation at interchanges, according to the extent of urbanization and whether the cross roads are two-lane or four-lane facilities. While this may work in some states, Florida's rapidly-increasing population and its booming tourism can turn a rural interchange area into a development frenzy in a few short years. If development is not anticipated, and the interchange is designed for a continuing rural environment, problems will result. High standards provide an environment for economic activity to flourish, while maintaining a safe and efficient flow of traffic. For these reasons, it is suggested that signalized intersections should be separated from interchange ramps by at least 1320 feet, and access connections should not be allowed within 660 feet of a ramp.

Access management in interchange areas can be accomplished through advance planning and a range of regulatory and non-regulatory techniques. This requires cooperation with property owners, developers, and local governments. Regulatory methods require certain actions, while non-regulatory methods encourage or drive desired actions. Non-regulatory techniques are subtle in their direction of development, often taking the form of agreements or incentives. Using a broad range of powers is more likely to accomplish a desirable outcome.

The need for improved access management is clear, but the separation of state and local jurisdiction has made it difficult to accomplish. No single land use control or governmental entity can achieve the desired results. Effective interchange area management requires a combination of techniques involving land use/zoning, sub-division regulation, sign control, access management, and intergovernmental coordination. Coordination has always been (and continues to be) the most difficult part of the process. This may be due, in large part, to the involvement of many players and political interests.

Some states (California, Minnesota, Oregon, and Arizona are the most noteworthy) have adopted legislation that fosters intergovernmental coordination through joint exercise of powers. This enables two or more agencies to combine powers under a joint authority. The resulting authority has availability to the powers of all representative agencies. Therefore, an authority established to manage interchange areas could become a special purpose public entity with the powers of transportation and land use planning, implementation, and operations. This type of authority offers powers to local public and private entities, independence, and a high degree of permanence. A written agreement governs operations and specifies the terms and conditions for decision-making.

There are many ways to accomplish the goal of free-flowing interchange areas, but it is essential that we begin to view them as a vital link in our transportation and economic systems. Interchanges affect land use, land values, development, employment opportunities, travel patterns, and taxes, in turn affecting local and state governments, private citizens, landowners, motorists, and other taxpayers. Therefore, everyone has a stake in improved management of interchange areas, which ultimately preserves safety and quality of life.

A copy of the final report can be found at:
www.cutr.eng.usf.edu/research/access_m/publicat.htm. Or, for further information contact Laurel Land, AICP, land@cutr.eng.usf.edu, 813-974-1446, or Kristine Williams, AICP, kwilliams@cutr.eng.usf.edu, 813-974-9807.

12 Impacts of Access Management Techniques

Tuesday August 15, 2000 – 8:00 AM – 9:30 AM
Track 2 - Technical

October 21, 1998

Mr. Mark J. Stuecheli
Senior Transportation Planner
City Hall
8500 Santa Fe Drive
Overland Park, KS 66212

Re: 135th Street Corridor Traffic Study

Dear Mr. Stuecheli:

In response to your request and authorization, TranSystems Corporation has completed a traffic study of the 135th Street corridor in Overland Park, Kansas. The primary objective of the study was to evaluate alternative access schemes or strategies to determine if changes to the current street network and access concept are warranted. That concept was developed over ten years ago and is documented in the K-150 Corridor Study.

The study program included the development of 2020 land use plans in the study area which extended to Blackbob Road in Olathe and State Line Road in Leawood; estimating and assigning traffic volumes anticipated with future development using the Overland Park Traffic Model; conducting detailed operational assessments of 135th Street and intersecting thoroughfares, including the use of simulation modeling of future traffic conditions; and determining whether some or all of the alternative access concepts were appropriate for the corridor.

The analysis of future traffic operations showed that the current street network and access scheme for 135th Street and the parallel access roads will result in desirable service levels through implementation of planned improvements. Full access is recommended at one additional intersection on 135th Street and analyses suggest that additional right-in access on 135th Street to serve abutting properties could be allowed. In general, this study affirmed the current access strategy.

We trust that this report has properly and adequately addressed current and future traffic conditions along the 135th Street corridor. We appreciate the opportunity to work with you on this important issue and will be available to review this matter with you at your convenience.

Sincerely,

TranSystems Corporation

By:________________________________
Thomas G. Swenson, P.E.

TGS:ts:1019803000
Enclosure

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INTRODUCTION

Purpose

The purpose of this study was to assess the street network and access management strategy currently employed by the City of Overland Park along the 135th Street corridor. It has been over ten years since the corridor, including the parallel access roads to the north and south, has been evaluated in a comprehensive manner. Prompted by recent actions in the City of Leawood and questions raised by property owners along the corridor within the City of Overland Park, a specific objective of this study was to determine if access restrictions should be relaxed to enhance traffic operations along intersecting thoroughfares and collector streets and increase access to abutting property owners.

K-150 Corridor Study

In March 1984, the Cities of Overland Park, Leawood and Olathe joined with Johnson County to conduct a comprehensive land use and transportation study of the 135th Street (then K-150) corridor. The purpose of the study was to establish consistent guidelines and policies for the coordinated and planned development of the corridor.

At that point in time, development patterns had not reached K-150 and city planners viewed the study as an opportunity not only to plan for and promote orderly development but as an opportunity to preserve the next major transportation corridor south of Interstate 435. Not too long before, the K-150 corridor was envisioned as the next perimeter highway because of its connection to Interstate 35 in Olathe and its extension into Missouri. Once the search for the next perimeter highway shifted to the south, it was still deemed desirable to plan the corridor to not only serve extensive development but to provide a high level of service for through traffic. In other words, what was the proper balance between property access and mobility for K-150.

The design configuration recommended in the study included limiting full-access intersections (to eventually be controlled by traffic signals) along K-150 to one-half mile spacing, allowing right turn in and right turn out access at one-quarter mile spacing, and developing the reverse frontage roads (now referred to as "parallel access roads) to parallel K-150 approximately two blocks to the north and two blocks to the south. This street "network" was deemed to provide the best balance between access and mobility for the K-150 corridor.

A joint resolution endorsing the K-150 Corridor Study was approved by the city councils of Overland Park, Leawood, and Olathe in 1986.

Evolution of 135th Street Corridor

The K-150 Corridor Study was conducted generally prior to significant development either near or directly along what is now 135th Street. As residential development approached the corridor and commercial development was initiated along the corridor, some deviations from the original concept were approved by the City of Overland Park. The Cities of Leawood and Olathe have, to varying extents, taken different directions compared to the City of Overland Park. Therefore, this section provides discussion about practices along the corridor within each community, particularly as they pertain to access relative to the originally approved concept.

Overland Park

The section of 135th Street in the City of Overland Park extends from Pflumm Road on the west to Nall Avenue on the east, a distance of five miles. Thoroughfares intersecting with 135th Street include Pflumm Road, Quivira Road, Switzer Road, Antioch Road, Metcalf Avenue, and Nall Avenue. The unique aspect to the 135th Street corridor is the interchange with U.S. 69 approximately midway between Antioch Road and Metcalf Avenue. The current intersection access planned for each intersection along 135th Street, the reverse frontage roads, and intersecting thoroughfares and collector streets are shown on Figure 1.

Since the City adopted the K-150 Corridor Study guidelines, several development applications have been made and some deviations to the original guidelines accepted to compensate for projected traffic operating conditions. The most significant development proposed along the corridor were the two malls - one on the southeast quadrant of 135th Street and Metcalf Avenue and one in the northeast quadrant of 135th Street and Antioch Road. Other commercial developments are already in place along the north side of 135th Street at Antioch Road and Quivira Road.

The accommodations approved for proposed development include an additional full-access intersection between Metcalf Avenue and Lamar Avenue for one of the malls, and a full-access intersection (Riley) between the U.S. 69 interchange and Metcalf Avenue. This decision to approve full access at Riley was based in part on the east/west travel restrictions imposed by the U.S. 69 freeway. The freeway precludes the typical half-mile full access and forces some traffic to travel in the opposite direction to reach or leave the area between Metcalf Avenue and U.S. 69. Further, this extra travel would primarily be made through the 135th Street and Metcalf Avenue intersection which is projected to be one of the most heavily used intersections in the corridor.

Leawood

The section of 135th Street in the City of Leawood extends from State Line Road to Nall Avenue, a distance of approximately two and one-quarter miles. Following contentious debate over proposed commercial development near 135th Street and Mission Road, the city council appointed the “K-150 Review Committee” in June, 1996. The committee, comprised of homes associations, developers, city staff, and city officials, was charged with developing “a vision and rationale for effective urban design along the 135th Street corridor”. In early 1997, the city planning commission and council adopted a new set of design standards and development guidelines for the area along with a detailed land use plan. All of these actions were apparently taken without notice to or input from the City of Overland Park or the City of Olathe; effectively voiding the agreement made in 1986.

The K-150 Corridor Study included a land use plan that served as the basis for the street network developed as a part of that study. The new planning guidelines and land use plan developed for the City of Leawood included the potential for significantly more commercial development compared to the previous plan. Due to the significant revisions to the future land use, a traffic study was commissioned to address these changing conditions. The general street network and access management strategy from the original K-150 Corridor Study served as the starting point for analyzing the impact of the revised land use plan.

The study results were somewhat inconclusive in that an access scheme was recommended and lane configurations were identified, but an unspecified reduction in land use intensity was recommended to ease traffic congestion. The most significant aspect of the Leawood study relative to the discussion in Overland Park was the recommendation to provide full-access intersections along 135th Street at one-quarter mile spacing as opposed to the half-mile spacing contained in the access scheme developed as part of the K-150 Corridor Study. Since traffic signals will likely be needed at every full-access intersection at some point in time, the eventual signal spacing in Leawood will be one-quarter mile.

The basis of this recommendation was that levels of service (LOS) at major intersections under the half-mile signal spacing scheme would be extremely poor (LOS F). This conclusion was supported with simulation modeling results showing that overall travel distances, delays, and travel times along the corridor would be reduced.

While the traffic study report did not include supporting information by which to evaluate the analysis and conclusions, there is evidence that the level-of-service analysis of major intersections and simulation modeling along the corridor were not based on the number and types of lanes eventually recommended at the end of the study. Therefore, by neglecting to base the analyses on the number of lanes recommended to serve future traffic, it is not surprising that the quarter-mile signal spacing looks better.

The study report, in a roundabout manner, recommended that additional driveways on 135th Street could be allowed but that they be limited to right turns from 135th Street into abutting properties. There was no mention made of driveway spacing or right-turn or deceleration lanes associated with these right-in driveways. Egress onto 135th Street was not recommended at these additional driveways based on the disruption to signal coordination, possibility for accidents, and potential traffic congestion.

Olathe

The section of 135th Street in the City of Olathe (known locally as Santa Fe) originally included in the planning area for the corridor extends from Brougham Drive to Pflumm Road, a distance of approximately one and one-half miles. A full-access intersection has already been approved one-quarter mile west of Blackbob Road and another one one-quarter mile east of Blackbob Road is under consideration. In a few locations west of Blackbob Road additional right-in only and right-turn only driveways have been constructed. It is unknown if other full-access intersections will be considered between Blackbob Road and Pflumm Road. For this study, however, it was assumed that intersection access along this one-mile segment is being planned in accordance with the original guidelines.

STUDY PROCESS

The evaluation of alternative access strategies for the 135th Street corridor was based on traffic operations associated with Year 2020 projected P.M. peak hour traffic conditions. Whenever a future year is considered, assumptions have to be made as to the type, intensity, and location of development and the street network that will be available to serve it.

The following text summarizes the study area, the land use and access alternatives considered, as well as the tools used to assess traffic operations along the 135th Street corridor.

Study Area

The study area is generally defined to include 135th Street and the north and south parallel access roads (typically 133rd Street and 137th Street) from Blackbob Road in Olathe on the west to State Line Road in Leawood to the east. The study area is shown on Figures 1 and 2. While the segments of the 135th Street corridor in Leawood and Olathe were included in the study processes, this report focuses on the results in the City of Overland Park.

Development Alternatives

The evaluation of future traffic operations along the 135th Street corridor was conducted using two separate sets of assumptions regarding land use in the area. The first set of land use assumptions is that included in the updated Overland Park Traffic Model (OPTM) for Year 2020. The information contained in Table 1 was prepared to provide a perspective of these land use assumptions for the 135th Street corridor (between the parallel access roads from Pflumm Road to Nall Avenue) in Overland Park relative to current and full development.

Table 1
Summary of 2020 Land Use Projections - Overland Park
135th Street Corridor

Land Use	Existing	Full Build Out	Estimated to Occur By 2020	Percent of Build Out
Multi-Family Res.	546 du	2,001 du	2,001	100%
Office	0 sf	3,465,864 sf	193,864	6%
Retail	362,224 sf	3,714,170 sf	2,965,876	80%
Industrial	0 sf	1,657,202 sf	802,312 sf	48%

The second land use scenario was created to test the access alternatives under more extreme conditions. The “high intensity” land use assumptions, show in Table 2, include a significantly higher intensity of development between now and 2020.

Table 2
Summary of 2020 "High Intensity" Land Use Projections - Overland Park
135th Street Corridor

Land Use	Existing	Full Build Out	Estimated to Occur By 2020	Percent of Build Out
Multi-Family Res.	546 du	2,001 du	2,001	100%
Office	0 sf	3,465,864 sf	1,905,855 sf	55%
Retail	362,224 sf	3,714,170 sf	3,678,904 sf	99%
Industrial	0 sf	1,657,202 sf	1,628,312 sf	98%

The projected land uses in this study are consistent with either approved development plans or the latest master plan for each of the cities within the area covered by the OPTM The type, intensity, and location of these land uses were determined by City of Overland Park staff and are documented in the Technical Appendix.

Access Alternatives

Compared to other thoroughfares in Overland Park and elsewhere, the current access management strategy along the 135th Street corridor could be deemed to be extremely strict. While staff and public officials understand the reasoning behind the strategy, it certainly has caused property owners and developers to shift their paradigms regarding property access and circulation. The result has been that land planning along the 135th Street corridor has had to consider entire land areas between the quarter-mile access points and between 135th Street and the parallel access road. This study examined a number of alternative access schemes, each designed to increase the frequency and type of access afforded adjacent property.

The five access schemes evaluated in this study are listed in Table 3.

Table 3
Access Alternatives - 135th Street Corridor

Scheme(1)	Description
1	1/2-Mile Signals, 1/4-Mile Right In/Right Out (Current Strategy)
2	1/2-Mile Signals, 1/4-Mile Right In/Right Out, 1/8-Mile Right In
3	1/4-Mile Signals
4	1/2-Mile Signals, 1/4-Mile Left In, 1/4-Mile Right In/Right Out, 1/8-Mile Right In
5	1/4-Mile Signals, 1/8-Mile Right In/Right Out

(1) - For all of the access schemes, the additional median breaks previously approved at Riley and Glenwood in Overland Park and the additional access points approved in the Cities of Leawood and Olathe were assumed to be in place by the year 2020.

Transportation Model

The Overland Park Traffic Model (OPTM) was recently updated to reflect Year 2020 projected conditions. The previous version of the model was for Year 2014. The OPTM is a travel demand model that distributes projected P.M. peak hour traffic over a street network. This iterative and complicated process attempts to distribute traffic such that drivers take the most direct path that offers the shortest travel time. This distribution of traffic takes into account the capacity of each street segment and some attempt is made to balance traffic loading to avoid a situation where one street might become oversaturated while a nearby parallel street is underutilized.

In order to provide more accurate modeling along the boundaries of Overland Park, the OPTM actually extends into the Cities of Prairie Village; Kansas City, Missouri; Lenexa; Olathe; Leawood; and Johnson County to the south. City staff coordinated with each jurisdiction to determine land use types and intensities appropriate for the land area contained in the model.

The OPTM was used to distribute traffic projected with each of the land use alternatives. The traffic analysis zones included in the OPTM for the 135th Street corridor are illustrated on Figure 3. The model worked reasonably well for street or driveway spacings of one-quarter mile or more. In those case where driveways were considered at less than one-quarter mile spacing, traffic assignments were made manually using engineering judgment as to likely travel paths.

It is also important to point out that the nuances of a model are such that the output should not always be taken at face value. For example, with full access considered at one-quarter mile spacing, traffic that might otherwise stay on a thoroughfare would, in some cases, divert along one parallel access road, cross 135th Street, then return to the thoroughfare via the other parallel access road. The output of each model run was carefully scrutinized for such patterns and adjusted to reflect what was believed to be more typical driving conditions. While one advantage of more access could be to lessen travel demands on thoroughfares, it is more important to be as realistic as possible to create a worst-case scenario for evaluation.

The traffic model was also used to measure total travel distances and travel times for the entire model area based only on changes made within the study area. These factors, for the study area as a whole, provide another perspective to the impact of each access strategy.

Level of Service Analysis

In order to conduct a fair assessment of access alternatives, an assessment based primarily on traffic operational characteristics, it is important to first develop lane configurations for each street and intersection that yield acceptable levels of service. That is exactly the approach taken in this study.

The level-of-service analysis of intersections followed the methodologies outlined in the 1997 Highway Capacity Manual published by the Transportation Research Board. The operating conditions at an intersection are graded by the “level of service” experienced by drivers. Level of service (LOS) describes the quality of traffic operating conditions and is rated from “A” to “F”. LOS A represents the most desirable condition with free-flow movement of traffic with minimal delays. LOS F generally indicates severely congested conditions with excessive delays to motorists. Intermediate grades of B, C, D and E reflect incremental increases in the average delay per stopped vehicle.

For signalized intersections, level of service and average delay relate to all vehicles using the intersections. The City of Overland Park strives to achieve LOS D as the minimum desirable rating for a signalized intersection.

The latest version of the Highway Capacity Manual changed the method of measuring average delay at signalized intersections. Whereas the previous version measured only delay incurred by vehicles that fully stopped, the new methodology estimates the total delay experienced by drivers at an intersection. The additional component of delay is related to the deceleration of traffic that does not stop. Accordingly, the threshold values of delay associated with each level of service have been modified. Table 4 shows the upper limit of delay associated with each service level for both the 1994 and 1997 study methodologies of signalized intersections.

Table 4
Signalized Intersection Level of Service Delay Thresholds

Level of Service	Maximum Delay (sec) 1994	Maximum Delay (sec) 1997
A	5.0	10.0
B	15.0	20.0
C	25.0	35.0
D	40.0	55.0
E	60.0	80.0
F	>60.0	>80.0

The determination of the appropriate number of lanes on each intersection approach along 135th Street and intersecting thoroughfares and collector streets began by assuming that, as a minimum, a separate left-turn and right-turn lane would be needed at each full-access intersection. Left-turn lanes are generally always desirable on each intersection approach under traffic signal control due to the desire to keep slowing or stopped traffic from impeding through traffic. The result of the use of left-turn lanes is safer and more orderly traffic flow. A right-turn lane is also desired on each approach but for different reasons. On 135th Street, a separate right-turn lane is desired to remove decelerating traffic from the through traffic stream. This allows through traffic to maintain tighter platoons and travel more efficiently along the corridor. Separate right-turn lanes also minimizes the potential for rear-end and sideswipe accidents frequently associated with right-turn traffic turning from a thoroughfare with moderately high speeds. Right-turn lanes are desired on intersecting thoroughfares and collector streets to enhance overall intersection efficiency, minimize vehicle queuing, and to maximize the green time allocated to 135th Street through movements.

From that point additional left-turn lanes were added as needed to either serve projected left-turn volumes in excess of 300 vehicles per hour or to improve the overall intersection level of service to an acceptable rating.

The number of through lanes was consistent with the street widths estimated in the OPTM. The basic street segments widths, e.g., four-lane or six-lane, used in the level of service analyses for 2020 conditions, for both land use intensities, are illustrated on Figure 4.

Traffic Simulation Modeling

The evaluation of future traffic operating conditions was conducted using CORSIM, a microscopic simulation model used to evaluate surface street networks. The advantages to using CORSIM is that it takes into account factors either not included or not adequately covered by conventional traffic analysis methodologies, most of which are included in the Highway Capacity Manual published by the Transportation Research Board. Some of these factors include closely-spaced intersections, actuated traffic signals, and unsignalized intersections adjacent to signalized intersections.

A CORSIM model was created for each of the access strategies using both of the two land use scenarios. The model included the 135th Street corridor from Blackbob Road to State Line Road and each intersecting thoroughfare and collector street. The full extent of the parallel access roads were not included in the models due to space limitations. A minimum of six simulation runs were conducted for each access strategy and each land use alternative.

Since CORSIM is intended to simulate actual operating conditions on the street network, it is first necessary to develop traffic signal timings for the 135th Street corridor and intersecting thoroughfare and collector street. The TRANSYT-7F (Version 8) signal optimization software was used to develop coordinated traffic signal timings. TRANSYT-7F is based on a philosophy of minimizing delay to all drivers using a street corridor or network. Therefore, the simulation modeling, and hence comparison, of each alternative access strategy was based on a well-coordinated traffic signal system.

Measures of Effectiveness

The common method for measuring the effectiveness of intersections is the average delay incurred by drivers. Other measures selected for comparison of alternative access strategies in this study were average vehicle speeds and travel time. The latter measures are typically used to assess the movement along corridors over longer distances.

The measures of effectiveness included in this study are all based on the P.M. peak hour, the time period experiencing the highest traffic volumes on the public street system. For that reason, design decisions are typically based on projected P.M. peak hour conditions.

COMPARING LAND USE/ACCESS ALTERNATIVES

The evaluation of each land use and access strategy combination included an iterative process of determining necessary lane configurations to achieve satisfactory levels of service at each signalized intersection along 135th Street and intersecting thoroughfares. Then simulation modeling was conducted for each access alternative and development combination to assess the impact on vehicle speeds, delays and travel times. Finally, total travel time and distance traveled are presented for the entire model area based on alternatives within the 135th Street corridor network in Overland Park.

Level of Service

The most restrictive access scenario and highest land use alternative was Scenario 1 (current strategy) with "high intensity" development. To determine the appropriate lane configuration for each intersection along 135th Street and intersecting thoroughfares, the iterative process described in the preceding section was followed until acceptable levels of service were achieved (LOS D).

The results of these level-of-service analyses are shown in Table 5 while the lane configuration developed to achieve these service levels are shown on Figure 5.

Table 5
Level of Service - Current Access Strategy - High Intensity Development

Intersection	Level of Service	Average Delay (sec)	Max. v/c
135th Street and Pflumm	C	26	82
135th Street and Rosehill	B	14	78
133rd Street and Pflumm	D	38	81
137th Street and Pflumm	C	25	74
135th Street and Quivira	C	26	93
135th Street and Nieman	C	31	85
133rd Street and Quivira	D	41	83
137th Street and Quivira	C	28	77
135th Street and Switzer	C	30	92
135th Street and Grant	C	20	79
133rd Street and Switzer	D	35	85
137th Street and Switzer	A	8	54
135th Street and Antioch	D	37	95
135th Street and Hemlock	B	15	80
135th Street and U.S. 69 SB	D	42	78
135th Street and U.S. 69 NB	A	5	81
135th Street and Riley	C	24	79
132nd Street and Antioch	A	3	43
133rd Street and Antioch	D	47	68
137th Street and Antioch	C	28	81
135th Street and Metcalf	C	27	80
135th Street and Glenwood	C	26	79
135th Street and Lamar	B	17	72
139th Street and Metcalf	A	9	66
138th Street and Metcalf	C	30	80
133rd Street and Metcalf	C	28	75
137th Street and Metcalf	D	45	81
135th Street and Nall	C	24	90
133rd Street and Nall	D	39	87
137th Street and Nall	C	31	82

The levels of service indicated in Table 5 show that the 135th Street network can function adequately with one-half mile signal spacing even with the 2020 high intensity land use forecast. Most importantly, these levels of service can be achieved without implementing any extraordinary measures. In other words, the lane configurations shown on Figure 5 are consistent with current planning for basic street segments, e.g., 4-lane or 6-lane, and the turn lanes recommended at each intersection - single or double left-turn and separate right-turn lanes - are consistent with typical design practices.

There is, however, one exception to this conclusion. The levels of service shown along 135th Street at Hemlock and Antioch Road and on Antioch Road at 132nd Street and 133rd Street are based on a non-standard method of dealing with the large traffic volumes encountered north of 135th Street between U.S. 69 and Antioch Road. The results in Table 5 are based on a traffic signal at Hemlock, a traffic signal that serves only a double right-turn movement from the north. While this solution could be implemented, it is perhaps not the best solution. It does, however, highlight the significant travel demands that need to be accommodated in this vicinity.

Without the traffic signal to serve right turns at Hemlock, the model shows extremely large traffic volumes westbound on 132nd Street and particularly 133rd Street attempting to turn south onto Antioch Road to reach 135th Street. This travel pattern was overloading the 133rd Street and 135th Street intersections along Antioch Road. The double right-turn on southbound Hemlock with the limited traffic signal operation on 135th Street was one means of resolving these deficiencies.

The travel patterns experienced in this vicinity are caused in large part by the U.S. 69 freeway which precludes the normal half-mile signalized access provided elsewhere along the 135th Street corridor. In light of the limitations imposed by U.S. 69 and a desire to better balance traffic loadings using conventional traffic control practices, the best solution for this area, on balance, would be to provide a full-access, signalized intersection on 135th Street at Hemlock.

The results of this study process suggest more favorable projected traffic conditions than has been indicated in recent traffic impact studies for proposed development in the corridor; particularly for intersections such as Antioch Road and Metcalf Avenue. There are several reasons to explain this result.

First, this study took into consideration the entire network of streets, not only in the 135th Street corridor but in the entire southern portion of Overland Park and adjacent communities. As previously noted, the transportation model seeks to balance traffic loadings throughout the entire network; thereby taking advantage of the alternative travel paths afforded drivers in this big picture. The process of conducting an impact study in Overland Park, in contrast, focuses on major intersections in the vicinity of the proposed development. The impact study process includes making the assumption that the development site as well as surrounding land areas have developed to their full potential by Year 2020. Table 2 shows that the land use assumptions in the OPTM for the 135th Street corridor do not approach full build-out by 2020. The traffic volumes estimated to be generated by the proposed development site and full build-out of surrounding land areas are then manually assigned through nearby major intersections. This process tends to produce a more conservative estimate of traffic volumes at these intersections because it does not take into account the alternative travel paths available to all drivers in the area. Put another way, if this assignment process were conducted with the model, the distribution of future traffic would likely be different because it is dealing with the big picture. This is not to say that the impact study process is flawed, it is simply important to recognize that the process results in a more conservative loading of traffic at nearby intersections. This process is followed because of limitations in the OPTM (and any transportation demand model) to distribute traffic at a microscopic level such as a development site.

Another primary factor in the differences between levels of service results in this study compared to recent traffic impact studies is that the processes included in this study reflect the benefits gained through well-coordinated traffic signal operations. In contrast, the intersection analyses conducted for traffic impact studies generally assume that the intersections function independently. That process results in more conservative estimates of future traffic operations, i.e., greater delays.

Simulation - Planned Development - Year 2020

The analysis of projected traffic operations along 135th Street and intersecting thoroughfares was made using the CORSIM simulation model. The initial analyses were conducted for each access strategy or scheme (refer to Table 3 for a description of each) based on the 2020 land use assumptions included in the OPTM.

Tables 6, 7 and 8 present a comparison of P.M. peak hour delay, travel time, and travel speed for the access strategies relative to the current strategy of one-half mile signal spacing and right-turn access at the quarter-mile points along 135th Street. The impacts on 135th Street itself are emphasized in these tables since a primary objective of the current access strategy is to emphasize through movements along this corridor.

Table 6
P.M. Peak Hour Delay Comparison - Planned Development

Access Scheme	Nall to Pflumm Through % Change	Nall to Pflumm All Movements % Change	Crossing Thoroughfares % Change	135th St. Network All Movements (1) % Change
1	(2)	(2)	(2)	(2)
2	+9	+5	-4	+2
3	+51	+42	-2	+15
4	+56	+37	+5	+17
5	+48	+33	+1	+16

(1) Includes all intersections along 135th Street and intersecting thoroughfares
(2) Baseline condition representing current access strategy on which other schemes were compared.

Table 7
P.M. Peak Hour Travel Time Comparison - Planned Development

Access Scheme	Nall to Pflumm Through % Change	Nall to Pflumm All Movements % Change	Crossing Thoroughfares % Change	135th St. Network All Movements (1) % Change
1	(2)	(2)	(2)	(2)
2	+4	0	0	0
3	+23	+22	0	+9
4	+25	+17	+3	+9
5	+23	+17	+2	+10

(1) Includes all intersections along 135th Street and intersecting thoroughfares
(2) Baseline condition representing current access strategy on which other schemes were compared.

Table 8
P.M. Peak Hour Average Vehicle Speed Comparison - Planned Development

Access Scheme	Nall to Pflumm Through	Nall to Pflumm All Movements	Crossing Thoroughfares	135th St. Network All Movements (1)
	% Change	% Change	% Change	% Change
1	(2)	(2)	(2)	(2)
2	-3	-4	+4	-1
3	-15	-14	+1	-6
4	-16	-14	-3	-8
5	-13	-12	+1	-7

(1) Includes all intersections along 135th Street and intersecting thoroughfares
(2) Baseline condition representing current access strategy on which other schemes were compared.

These analyses results indicate that the addition of right-in access at the eighth-mile points along 135th Street has seemingly little impact on traffic performance while the other schemes do tend to negatively impact 135th Street traffic flow. It is not surprising that crossing thoroughfares tend to function slightly better as the access schemes would tend to lessen travel demands on these streets.

Simulation - High Intensity Development - Year 2020
The second set of analyses were conducted for each access strategy or scheme based on the 2020 “high intensity” land use assumptions. The simulation modeling was conducted in the same manner and the results are presented in Tables 9, 10, and 11.

Table 9
P.M. Peak Hour Delay Comparison - High Intensity Development

Access Scheme	Nall to Pflumm Through	Nall to Pflumm All Movements	Crossing Thoroughfares	135th St. Network All Movements (1)
	% Change	% Change	% Change	% Change
1	(2)	(2)	(2)	(2)
2	+11	+10	+5	+7
3	+60	+47	-7	+16
4	+33	+26	+4	+16
5	+47	+37	-6	+14

(1) Includes all intersections along 135th Street and intersecting thoroughfares
(2) Baseline condition representing current access strategy on which other schemes were compared.

Table 10
P.M. Peak Hour Travel Time Comparison - High Intensity Development

Access Scheme	Nall to Pflumm Through	Nall to Pflumm All Movements	Crossing Thoroughfares	135th St. Network All Movements (1)
	% Change	% Change	% Change	% Change
1	(2)	(2)	(2)	(2)
2	+6	+3	+4	+3
3	+30	+26	-5	+10
4	+18	+12	+3	+9
5	+26	+20	-3	+9

(1) Includes all intersections along 135th Street and intersecting thoroughfares
(2) Baseline condition representing current access strategy on which other schemes were compared.

Table 11
P.M. Peak Hour Average Vehicle Speed Comparison - High Intensity Development

Access Scheme	Nall to Pflumm Through % Change	Nall to Pflumm All Movements % Change	Crossing Thoroughfares % Change	135th St. Network All Movements (1) % Change
1	(2)	(2)	(2)	(2)
2	-3	-6	-1	-4
3	-18	-16	+4	-7
4	-10	-11	-1	-7
5	-12	-13	+5	-5

(1) Includes all intersections along 135th Street and intersecting thoroughfares
(2) Baseline condition representing current access strategy on which other schemes were compared.

The analysis results with the more intense land uses reflect the same general impacts as the planned development - traffic performance for 135th Street movements is diminished to some extent.

Network Performance

The limitations in the size of the CORSIM model precluded simulation of the entire 135th Street corridor network that includes the parallel access roads. The OPTM, however, does measure vehicle-miles of travel and vehicle-hours of travel for the network. Tables 12 and 13 show the comparison of these factors resulting from the alternative access schemes relative to the current access scheme. The alternative schemes are grouped as shown due to the fact that the model could not distinguish the differences caused by the potential eight-mile access.

The measurements in these tables are based on P.M. peak hour conditions in 2020 for planned and high intensity land uses.

Table 12
Comparison of Network Vehicle-Miles and Vehicle-Hours of Travel
P.M. Peak Hour
135th Street Corridor - Planned Development

Access Scheme	Vehicle-Miles of Travel	Vehicle-Hours of Travel
1, 2	(1)	(1)
3, 5	-944	-146
4	-136	+38

(1) Baseline condition representing current access strategy on which other schemes were compared.

Table 13
Comparison of Network Vehicle-Miles and Vehicle-Hours of Travel
P.M. Peak Hour
135th Street Corridor - High Intensity Development

Access Scheme	Vehicle-Miles of Travel	Vehicle-Hours of Travel
1, 2	(1)	(1)
3, 5	-2,550	-394
4	-167	-51

(1) Baseline condition representing current access strategy on which other schemes were compared.

These results do reflect that overall travel and time spent traveling in the area could be reduced by increasing access along 135th Street, particularly by providing full-access, signalized intersections at quarter-mile spacing. However, these changes are relatively small when considering the entire model area.

CONCLUSIONS AND RECOMMENDATIONS

Traffic Operations Perspective

The analyses conducted in the course of this study provide mixed results from a traffic operations standpoint. On the one hand, movements along 135th Street are clearly impacted in a negative manner by significant changes to access on the corridor. On the other hand, more frequent access appears to lessen travel time and delay for other drivers in the 135th Street corridor network. These results for the 135th Street corridor are what would be expected with the current street network and access strategy. That is, more travel is necessary to access abutting properties in order to enhance through movements on the thoroughfare.

It is strongly encouraged that the results of this study be viewed from the context of assessing whether the current access strategy remains feasible. In other words, are there any fatal flaws to suggest that it be changed. From that standpoint, there is no compelling reason to indicate that the basic street network and access management strategy for the 135th Street network be changed. The relatively minor modifications suggested in this report are merely enhancements and do not represent a significant deviation from the primary objective of providing a superior thoroughfare.

Perhaps the primary reason to conclude that the current access scheme is still feasible is the fact that desirable levels of service can be achieved at the proposed signalized intersections by means of improvements already planned and typically designed by the City. No extraordinary measures are needed to provide adequate traffic service, although the analysis did assume that new US 69 ramps in the northeast and southwest quadrants of the 135th Street and U.S. 69 interchange would be in place by the year 2020.

The planning and investments that have been put into the 135th Street corridor, including the parallel access roads, are significant towards developing an exceptional thoroughfare for both personal mobility and effective land use. It is the freeway network that has allowed suburban communities like Overland Park to grow in the manner they have over recent decades. Past decisions that indicate additional freeways in southern Overland Park are unlikely make it necessary to develop a thoroughfare system that recognizes this absence. The 135th Street corridor location relative to existing freeways and possible major routes to the south makes it a logical candidate for a thoroughfare that emphasizes the through movements and longer-distance trips.

Alternative Access Considerations

The analysis of the access alternatives indicated that the provision of additional access, typically at the one-eighth mile points, would have minimal impact on through movements on 135th Street. Therefore, consideration of additional access at these locations would be consistent with the primary objective of preserving through movement service along 135th Street. This additional access would be limited to right turns, i.e., no median break would be considered, however, the key question is whether this additional access should allow right turns in or both right turns in and right turns out of adjacent development sites. The right-turn out, if allowed, would only operate under stop-sign control.

Three questions need to be asked and answered to determine if this proposition is reasonable. These questions include:

- Is there sufficient space to provide separate right-turn or deceleration lanes for each intersecting street and driveway?
- What alternatives are available for each of the movements that could be allowed at eighth-mile spaced driveways?
- Is it safe to allow right turns in and right turns out at these additional driveways.

Is there sufficient space to provide separate right-turn or deceleration lanes for each intersecting street and driveway?

Right turns from 135th Street would typically have no significant impact on other traffic if a right-turn or deceleration lane was provided at each of these driveways. It is recommended that if additional driveways are provided, that separate right-turn bays, not continuous right-turn lanes be used. The next question, therefore, is whether sufficient space exists to provide separate right-turn bays at the eighth-mile driveways, quarter-mile streets, and half-mile streets. Considering the width of intersecting streets and the large corner radii at thoroughfare intersections, there would typically be 500 to 525 feet available for constructing a right-turn lane and taper if streets and driveways were spaced at one-eighth mile. A minimum tangent section of 100 feet would be desirable to allow drivers to distinguish the separate turn bay; leaving 400 to 425 feet. A typical right-turn lane length of 200 to 250 feet with a 150-foot taper would provide sufficient length for drivers to exit the through lanes without disrupting through traffic. Therefore, under typical circumstances, there is sufficient physical space to construct separate right-turn bays to serve intersecting streets and driveways at one-eighth mile spacing.

What alternatives are available for each of the movements that could be allowed at eighth-mile spaced driveways?

Regarding the second questions, it seems reasonable to allow additional movements only where a significant benefit is perceived to be provided motorists. Again, the primary philosophy of the access management scheme is to enhance through movements on 135th Street.

If driveways are considered at eighth-mile spacing, a typical one-mile section of 135th Street could have four additional driveways in each direction. The streets spaced at one-mile intervals are thoroughfares while the street at the midway point (one-half mile) is typically a major collector street. Table 14 provides a description of the alternative movements that would likely be taken for each of the four driveways per direction per mile that could be added.

Table 14
Alternative Movements - Eighth-Mile Driveways

Driveway	Alternative Movement	
	Right-Turn In	**Right-Turn Out**
1/8-Mile	Travel beyond site to 1/4-mile driveway and double back.	Proceed to 1/4-mile driveway (same direction as destination), then right onto 135th Street.
3/8-Mile	Turn right at 1/4-mile driveway immediately prior to site.	Proceed to 1/2-mile street (same direction as destination) then use traffic signal at 135th Street.
5/8-Mile	Turn right at 1/2-mile street, proceed one block to full-access driveway, then left into site.	Proceed to 3/4-mile driveway (same direction as destination), then right onto 135th Street.
7/8-Mile	Turn right at 3/4-mile driveway immediately prior to site.	Travel to 3/4-mile driveway (reverse direction as destination), then right onto 135th Street.

The review of specific alternative paths indicates that the additional right in movement appears to provide the greatest benefit to the motorist using the first driveway immediately downstream of the thoroughfare traffic signal (one-mile spacing) while the right out movement is most beneficial one-eighth mile in advance of the traffic signal at the thoroughfare traffic signal.

A common consideration of driveway placement in Overland Park is the position of the driveway relative to the left-turn lane on the major street. Placement of a driveway directly opposite a left-turn lane is considered undesirable because drivers leaving the driveway might travel straight across the through lanes to reach the left-turn lane. If left-turn traffic is queued up, this vehicle could block through movements. The worst case along 135th Street would generally occur in advance of the thoroughfare intersections where left-turn bays on 135th Street will be the longest. Accounting for the width of the arterial and assuming a 300-foot long double left-turn lane with 175 feet of taper, the driveway one-eighth mile in advance of a thoroughfare would be approximately 100 feet in advance of the beginning of the taper for the left-turn lanes. While the driveway would not be directly across from the left-turn lane, drivers leaving a driveway serving the abutting development and destined for the left-turn lane would likely travel at nearly a right-angle to approaching traffic on 135th Street.

Is it safe to allow right turns in and right turns out at these additional driveways.

Right-turn movements from 135th Street into abutting properties are anticipated to be safe so long as separate right-turn or deceleration lanes are provided. The real question is whether the right-turn movement onto 135th Street would be safe and not disrupt through movements. This movement has the greatest potential to disrupt through traffic because traffic starting from a stop is turning onto a moderately high-speed thoroughfare. It is speed differential, not speed alone, that typically results in conflict.

If these driveways operate like most any other driveway in the area, safe operations would be expected. At a typical driveway, drivers would stop and wait for a gap in the traffic on 135th Street. Once traffic has cleared, drivers could turn.

While this sounds simple enough, there is no better evidence than accident experience on an established thoroughfare. To determine whether driveways limited to right turns in and out tend to cause problems, two years of accident statistics along College Boulevard between Lamar Avenue and Antioch Road were reviewed.

This segment of College Boulevard is one and one-half miles long, has 15 driveways limited to right turns only, and has no separate right-turn bay at any of these driveways. The accident experience recorded in 1996 and 1997 is listed in Table 15.

Table 15
Accident Summary - 1996 and 1997
College Boulevard - Lamar Avenue to Antioch Road

	No. of Accidents	
Type of Collision	**1996**	**1997**
Angle	5	2
Rear-end	2	3
Sideswipe	1	2
Unknown	1	0
Total	**9**	**7**

None of these accidents resulted in personal injury. All occurred on weekdays and a vast majority occurred during normal business hours. It is important to note, however, that traffic volumes on College Boulevard are lower than those expected on 135th Street. Further, the access management scheme used on 135th Street will likely also result in higher vehicle speeds than College Boulevard.

Since this information came from brief summaries of each accident, some speculation is necessary to assess the reasons for these accident types. Angle accidents generally involve a vehicle from each of the intersecting streets or driveway. Therefore it is likely that these accidents were caused by a driver turning onto College Boulevard without waiting for an adequate gap. Rear-end and sideswipe accidents, while possible to be related to drivers turning onto College Boulevard, are most often associated with vehicles turning off of the major street. In light of the fact that no separate right-turn lanes are provided on College Boulevard at any of these intersecting driveways or streets, it is likely that these collisions are related to vehicles turning right from College Boulevard.

On 135th Street, right-turn lanes are recommended at each and every cross street and driveway. Hence, few if any rear-end or sideswipe accidents on 135th Street would be expected at these locations. As for the right-turn movements from these driveways, experience on College Boulevard suggests that conditions could be reasonably safe, i.e., the frequency and/or severity of accidents would not be sufficient to warrant remedial action. On College Boulevard, the accidents attributed to drivers turning onto the thoroughfare without waiting for an adequate gap amounted to 0.23 non-injury accidents per year per driveway.

Conclusion to Alternative Access Considerations

The answers to these questions did not necessarily produce clear-cut conclusions as to the appropriateness of additional access at the one-eighth mile points along 135th Street.

An assessment of this information suggests that additional right-in access along 135th Street is reasonable and would be safe if separate right-turn or deceleration lanes are provided at each driveway. While the additional access location that would appear to yield the most significant benefit to drivers is one-eighth mile downstream from a thoroughfare, additional right-in access could be considered at the other eighth-mile points although a compelling reason should first be offered and accepted. The provision of additional right-in access should not substitute for comprehensive and coordinated planning of abutting properties between the quarter-mile driveways. Further, site-specific characteristics should be evaluated to determine if an additional right-in driveway will indeed result in better access and circulation. Where additional eighth-mile access is deemed appropriate, careful planning of the site and driveway are necessary to ensure that 1) inbound traffic is not impeded to the extent that it queues back onto 135th Street, and 2) the driveway design discourages if not physically prohibits movements onto 135th Street.

The assessment of potential conditions associated with additional access onto 135th Street at the eighth-mile points suggests that no egress be allowed from abutting properties at these locations. The only right-out driveway that would provide an appreciable benefit to drivers is one-eighth mile in advance of a thoroughfare. And whereas the evaluation of accident experience on a control street suggests that accident potential would be minimal, the higher volumes and somewhat higher speeds expected on 135th Street relative to the control street and the potentially awkward angle at which some drivers might enter 135th Street suggest that this deviation would be incongruent with an otherwise strict access management strategy.

Recommended 135th Street Corridor Policy Revisions

It is recommended that the current access management strategy for the 135th Street corridor be affirmed and continued with the following two exceptions:

1. Allow a full-access, signalized intersection midway between U.S. 69 and Antioch Road.

2. Allow additional right-in access to abutting properties at the eighth-mile points where conditions indicate that it will provide a benefit and will operate properly.

APPENDIX A

Figures

Evaluating Methods to Quantify the Safety Impacts of Access Management: Are Current Models Transferable?

August 15, 2000

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Introduction

- Access management requires a tradeoff between throughput and access.
- Variety of access management techniques exist.
- Controversial issues are signalized and unsignalized spacing.
- TRB indicates the need for additional research into this database.

Signalized Access May Impact

- Business
- Operations
- Safety

Background

Transportation administrators require assurance regarding the accuracy of projected safety impacts of access management decisions.

Several existing mathematical models quantify these impacts for selected access management techniques.

Premise

Since new models require substantial resources to construct, it is prudent to investigate the extent to which existing models can be applied in other locations.

Purpose

Evaluate transferability of existing crash prediction models, considering

--accuracy without any modification

--accuracy with site modification

--feasibility

--data needs

Objectives

- How accurately can we predict the actual crashes as a function of access density (signal spacing and driveway spacing) using existing techniques?
- What can be done to improve performance?
- How much data do the models require?
- How much time does it take to run the models?

Methods

- Select 5 models developed elsewhere
- Prepare 3 corridors for analysis (1990-1999)
- Apply the models without modification
- Apply the models with modification
- Compare predicted crashes to actual crashes
- Compare model characteristics

Example: (Model 1)

Total crashes = 0.494 • (Segment Length) • (Years) • (AADT/1,000) • exp (0.0285 • access density – 0.631 (if shoulder is present) + 2.520 • percent of traffic signals – 0.748 • (if TWLTL is present)– 0.604 (if median is present))

Example (Model 5)

Accident rate = (A) (access density) ^{B}

A and B vary by type of roadway

Data elements for other models include land use, median type, residential driveways, parking, left turn lanes, speed, individual spacing, PDO percentages, etc.

Model Summary

Model 1: one equation, several terms

Model 2: multiple equations

Models 3a, 3b, 3c: lookup tables/graphs

Model 4: single linear equation, several terms

Model 5: single equation, one term

Are the models the same?

- Vary by complexity
- Equations, lookup tables, and graphs
- Sensitivity to key parameters
- Different data needs

3 Virginia Corridors

Huguenot Road (Richmond)
Route 250 (Staunton)
Route 17 (York)
Key changes: increase in signal spacing
24 “cases” by time and place

Example: Model 1 Performance

Case	Dates	Actual Crashes	Predicted Crashes
1	Jan. 90 Apr. 91	54	28
2	Apr. 91 June 91	6	6
3	June 91 May 95	153	110

Percent Error for Case 1

$$Percent\ Error = \frac{computed\ crashes - actual\ crashes}{actual\ crashes}$$

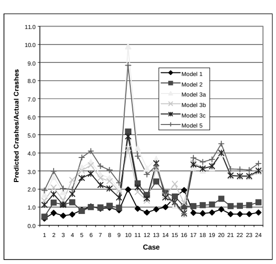
$$Percent\ Error = \frac{54\,computed\ crashes - 28\,actual\ crashes}{28\,actual\ crashes}$$

$$Percent\ Error = 93\%$$

Average Percent Error (24 Cases)

- Model 1: 33%
- Model 2: 49%
- Models 3a,3b, 3c: 141% - 198%
- Model 4: 367%
- Model 5: 219%
- But -- no calibration involved!

Can Site Specific Adjustments Be Made” ?



Examples of Site-Specific Adjustments

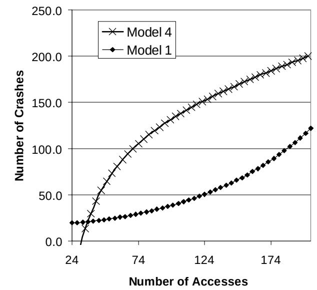
Crash rate = exp (0.12) • (**0.21** • access density) $^{(0.49)}$

$$\frac{\exp(0.12)\ \ (58\ \text{access points}/1.58\ \text{miles})^{(0.49)}}{\exp(0.12)\ \ (29\ \text{access points}/1.58\ \text{miles})^{(0.49)}}(...)$$

Site Specific Adjustments

Modification	Model 3a	Model 3b	Model 3c	Model 5
None	198%	155%	141%	219%
Site	27%	29%	27%	27%

Sensitivity of Models 1 and 4



Sensitivity to Access Points

	Model 1	Model 2	Model 5
2 X unsignalized access points	24	3	38
3 X unsignalized access points	64	6	67
2 X signals	19	58	3
3 X signals	39	117	7

Sensitivity to other Parameters

- **ADT**
  - **Crash rate vs. number of crashes**
  - **Not always a linear relationship**
- **Median Type**
- **Data Needs**
  - **Always need volumes and accesses**
  - **Some models need land use, median types, parking availability, percentage of PDO, etc.**

Conclusions (3 corridors)

- APE: 33% for best model (no adjustment)
- APE: 27-29% for select other models (w/adjustment)
- Data needs and sensitivity vary
- Variability of crashes

Recommendations for Practice

- Select Model
- Fit to study site if necessary
- Apply consistently
- Acknowledge error rates
  - 76±27%, or
  - Between 55 and 97 crashes
- Realize limitations

A Methodology to Evaluate the Impacts of Prohibiting Median Opening Movements

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1. INTRODUCTION

Left turns into/out of median openings/driveways account for 70 percent of crashes reported at driveway locations. One of the prevalent access management strategies to address this problem would be to modify the existing median opening and/or driveway to prevent the left-turns. As indicated in Figure 1, this would require the vehicles that used to make the left-turns and/or thru movements prior to modification to travel to adjacent median openings or intersections and make U-turns. Thus, the prevention of the left-turns at median opening/driveway locations increases the volumes at adjacent intersections and could affect the operation and safety at these intersections. In addition, the rerouted vehicles must change lanes between the median opening location and the adjacent intersections (see Figure 1). If the distance between the median opening location and the adjacent intersection is not sufficient for changing lanes, both the operation and safety of the arterial segment could be impacted. Furthermore, the prevention of median opening movements could impact adjacent business operations, truck delivery operations and even the adjacent property value.

Thus, when deciding on the prevention of left turn and/or thru movements at a median opening/driveway, a number of factors should be considered. These factors include the impacts on adjacent intersection operations, median opening/driveway operations, arterial weaving operations, overall system operations, rerouted motorist's convenience, safety, cost-benefit value, and public acceptance. The importance of these factors in the decision making process depends on the attitudes of the decision-makers towards the factors for the particular project under consideration.

This paper discusses a methodology for assessing the impacts of preventing left-turn and/or thru movements at median openings/driveway locations based on the above factors. As part of this methodology, the paper presents a new procedure to assess the impacts of U-turn vehicles and the conflicts between U-turn and right turn vehicles on the operations of adjacent signalized intersections. A case study is presented to illustrate the application of the methodology to a real-world problem.

2. METHODOLOGY

Below is a discussion of the factors that should be evaluated when deciding on the prevention of median opening movements and the methods that could be used in the evaluation. A discussion is also presented of the use of a utility analysis to decide between median opening modification alternatives.

Adjacent Intersection Operation

The operation of upstream intersection(s) should be analyzed to determine the impacts of preventing median opening movements on the operations at adjacent intersections. When preventing a median opening movement, the shift in traffic from the median opening to an adjacent intersection could have adverse impacts on the intersection operation measures such as delays, stops, queue lengths, fuel consumption, and levels of services. This could be attributed to: 1) the increase in intersection U-turn movement demand as a result of the traffic shift to the intersection, and 2) the reduction in saturation flow rate (and thus the capacity) of the mixed-use left-turn/U-turn lane due to the additional U-turn traffic. The reduction in saturation flow rate is due to the additional time required to make a U-turn movement compared to a left turn movement. This reduction in saturation flow rate is particularly high when there is a conflict between the U-turn traffic and an intersecting street right turn traffic (see Figure 1).

Signalized intersection operations are normally analyzed using an analytical procedure such as the one presented in Chapter 9 of the Highway Capacity Manual (HCM) [1], or using a macroscopic or microscopic simulation model such as TRANSYT-7F [2], CORSIM [3] and CORFLO [4]. In this study, the TRANSYT-7F signal timing optimization and simulation program was used to assess the operational impacts of prohibiting median opening movements on adjacent intersection operations. TRANSYT-7F was used to optimize the signal timing for each investigated scenario and calculate various traffic operation performance measures.

The inputs to the TRANSYT-7F model include traffic demands, saturation flow rates, network geometry, and other network, traffic, signal timing and model optimization and simulation parameters. To assess the operational impacts of the additional U-turn traffic, TRANSYT-7F runs were performed to evaluate the upstream intersection with and without the additional U-turn traffic. When evaluating intersection conditions with the additional U-turn traffic, the U-turn movement volume was added to the appropriate intersection left-turn movement volume and the saturation flow rate of the affected left-turn lane was reduced to account for the lower saturation flow rate of the U-turn movement. The results from TRANSYT-7F evaluations of the two scenarios (with and without the additional U-turn traffic) were compared to determine the effects of the shift in traffic. Additional TRANSYT-7F runs could be made to evaluate any proposed intersection design improvements that address the adverse impacts of the additional U-turn traffic.

As stated above, TRANSYT-7F requires turning movement saturation flow rates as inputs. The saturation flow rates for left, thru and right turn movements were calculated external to the program using the procedure presented in Chapter 9 of the HCM [1]. However, this procedure does not consider the effects of U-turn movement volume and the conflicts between the U-turn and opposing right-turn movements on the saturation flow rates of left turn/U-turn lanes. Available analytical and simulation models are also not capable of evaluating this effect. Furthermore, a review of the literature could not identify a model that could be used for this purpose. Thus, it was decided to employ a linear regression analysis to derive such a model based on field data.

The data required for this model were collected at the intersection of Boynton Beach Boulevard and Congress Avenue in Palm Beach County, FL. This intersection has a conflict between U-turn and right turn movements. The U-turn movement is made from a mixed-use left turn/U-turn lane that is controlled by a protected signal. The right-turn movement is made from an exclusive lane and has a green right turn arrow indication during the intersecting street left turn/U-turn green phase interval and a green ball indication during the adjacent thru green phase interval. Right-turn-on-red is not allowed at this intersection.

The JMP Statistical Analysis Package [5] developed by the SAS Institute, Inc. was used to derive the model parameters, test the statistical significance of the model and test the significance of the inclusion of independent variables in the model. The details of the model derivation will be presented in a separate paper.

The multiple linear regression model, that produced the highest multiple correlation coefficient (R^2), was:

$$SF = 1803 - 4.323 * UTURN - 0.484 * UTURN * RTOA \tag{1}$$

where

SF = saturation flow rate of mixed-use left-turn/U-turn lane in veh/hr/lane,
RTOA = right-turn volume during the U-turn phase in veh/min, and
UTURN = U-turn percentage in the mixed-use lane.

The R^2 for the linear regression model presented in the above equation is 0.51. The analysis of variance indicated that the F Statistic P value for the model is less than 0.0001. These results indicate that the independent variables included in the equation together help significantly in predicting the saturation flow rate of the mixed-use left-turn/U-turn lane. The Student's t test results show that each of the two variables is statistically significant in estimating the saturation flow rate.

Figure 2 shows the relationship between the right-turn volume, U-turn percentage and saturation flow rate as estimated by the regression model presented in Equation 1. With no conflicting right-turn volumes, the model estimates that increasing the U-turn percent from 0% to 60% reduces the saturation flow rate by about 14%, from 1803 vehicle per hour per lane (vphpl) to 1543 vphpl. With the presence of 720 veh/hr right-turn volume during the green arrow interval, the model estimates that the saturation flow rate of the mixed-use lane drops by about 33% (from 1803 vphpl to 1195 vphpl) when the U-turn percent increases from 0% to 60%.

As stated above, RTOA in Equation 1 is the opposing right turn volume in veh/min during the U-turn/left turn green phase. If, at the beginning of the U-turn phase, there is no opposing right turn vehicle queue (see Figure 3-a), the only right turn vehicles that oppose the U-turn movement are those that arrive at the stop line during the U-turn/left turn phase. In this case, RTOA in Equation 1 equals to the counted opposing right turn volume in veh/min (RTV). However, if there is an opposing right turn queue, as is in the case shown in Figure 3-b, the U-turn movement is opposed by vehicles in this queue as well as the right turn vehicles that arrive at the stop line during the U-turn phase. Thus, the calculation of the RTOA variable should account for this queue. The queue length in the beginning of the U-turn phase can be estimated based on field observations or calculated using a simple queuing equation. If the queue length is more than zero, then the opposing RTOA in veh/min is calculated as:

$$RTOA = RTV + Queue*60/LUG \quad (2)$$

where

RTV = counted opposing right turn volume in veh/min,
Queue = queue length in the beginning of the U-turn green phase in vehicles,
LUG = left turn/U-turn green phase length in seconds.

If the RTOA value calculated using Equation 2 above exceeds the maximum number of vehicles that can leave the right turn lane, it should be set equal to the maximum number. This number is the saturation flow rate of the right turn lane in veh/min.

Median Opening Operation

When deciding on the prevention of median opening and/or driveway movements, the operation of the movements that enter and leave the driveway before and after movement prevention should be examined. This could be performed using the unsignalized intersection analysis presented in Chapter 10 of the HCM [1] or using a microscopic or macroscopic simulation model such as TRANSYT-7F and CORSIM. If a simulation model is used in the analysis, the median opening operation can be modeled as a part of the overall arterial system, which includes the median opening, adjacent intersection(s) and the arterial segment between them. In this case, all arterial segment components could be evaluated using the same simulation runs.

The following could be considered when examining the analysis results:

- If a movement failed, consideration should be given to preventing that movement.
- If a movement failed, consideration should be given to preventing other movements to provide more gaps and thus higher capacity for the movement.
- Preventing a left-turn movement out of the driveway normally shifts this movement volume to the right turn lane. The operation of the right lane should be analyzed to determine the effect of this shift on the level of service of the lane.

Weaving Section Operation

As indicated in Figure 1, rerouted vehicles due to median opening prevention have to weave (change lanes) between the driveway/median opening location and adjacent intersection. A shorter distance to the upstream intersections results in an increase in the intensity of lane changing and the resulting level of turbulence. In this case, weaving vehicles find difficulty changing lanes, resulting in drops in the speeds of the weaving vehicles and non-weaving vehicles on the weaving section. In addition to the distance to the upstream intersection (weaving section length), several other factors affect the arterial weaving section operation. These includes: the number of lanes, arterial weaving and non-weaving traffic flow, arterial free flow speed, upstream signal timing, and downstream signal queue length.

Several analytical procedures are available to analyze the operation on freeway weaving areas. Chapter 4 of the HCM [1] includes such a procedure. However, the weaving operations on arterial segments differs from those on freeway segments, particularly due to the interactions with upstream and downstream signal operations and the lower free flow speeds on arterial streets. The analysis of this operation is a current area of research.

Macroscopic simulation models such as TRANSYT-7F and CORFLO are not capable of modeling the weaving operations of arterial streets. However, the CORSIM microscopic simulation model has a lane changing algorithms that can be used to evaluate how easy it is to change lanes between the driveway/median opening location and the adjacent intersection.

Motorist Convenience

As discussed above, preventing a left-turn movement at a median opening requires traffic to travel to an adjacent intersection and make a U-turn at the intersection. The change in delays (and thus the levels of service) due to this rerouting might not be acceptable to the rerouted motorists. These motorists compare the levels of service of their movements before and after the median opening modification. If the levels of service drop to unacceptable levels, the public will object to the median opening modification. To investigate this, a comparison should be made between the levels of service of the re-routed movements before and after the median opening modification.

Before preventing median opening movements, left turn vehicles experience delay while waiting for gaps in the opposing traffic. This delay could be obtained based on the median opening operational analysis discussed above.

The delay experienced by motorists, after preventing their movement at the median opening consists of three components. The first component is the delay experienced at the right turn lane of the driveway. This can be obtained based on the median opening/driveway operational analysis discussed above. The second component is the extra travel time required between the median opening and the adjacent intersection and back to the median opening. This extra time could be estimated based on the traveling distance and the cruise speed for the highway segment. The third component is the average delay at the mixed-use left turn/U-turn lane at the adjacent intersection. This could be estimated based on the adjacent intersection operational analysis discussed above.

System-Wide Operation

Another measure that can be used in the decision making process is the average delay in sec/veh for the whole system including adjacent intersections, median opening/driveway and the arterial segments between them. This measure can be calculated by dividing the overall system delay in veh-hr by the total number of trips that pass through the system. The overall system delay in veh-hr can be obtained from the operational analyses described in the previous sections.

Safety

Median opening crash data should be analyzed to determine if there is a pattern of crashes that can be prevented by modifying the median opening. Three to five year crash data should be used in the analysis.

It should be recognized that the shift in volumes to upstream intersections might result in an increase in intersection crashes, particularly in cases where there are conflicts between the additional U-turn vehicles and opposing street right turn vehicles. In addition, the additional weaving maneuvers between the median opening and adjacent signalized intersections might result in higher crash rates. These effects, however, have not been quantified yet.

Cost-Benefit Consideration

A cost-benefit analysis could be used to support the decision to prevent or allow left-turn movements at median openings. Several items should be included in this analysis as follows:

- The change in total operation costs due to movement prevention.
- The change in crash cost due to movement prevention.
- The costs of any required geometric or signal improvements.

The change in operation costs could be calculated based on the change in measures obtained from the operational analysis discussed above. If the analysis indicates that the increase in the operation cost due to median modification is higher than the reduction in crash cost, the analyst might want to determine the reason for the high operation cost. The higher operation cost could be due to high system volumes but minor changes in the average delays (in sec/veh). In this case, the analyst might want to put less weight on the cost-benefit analysis when deciding between different median opening modification alternatives.

Public Response

Public opinion surveys could be conducted in conjunctions with the operation and safety analysis to support the decision making process. The surveys should include various interest groups that are most directly affected by the median opening prevention. These groups could include through travelers, delivery truck drivers, nearby residents, adjacent merchants and adjacent business customers. The through travelers could be surveyed using postcard questionnaires, while the other interest groups could be surveyed using personal interviews. The various interest groups could be queried regarding perceptions of safety and operation problems in addition to perceptions of the anticipated effects on adjacent business operations and property values.

Decision Making Using Utility Analysis

The previous sections discuss various factors that should be considered when making decisions regarding median opening alternatives. A utility analysis could be used to take a decision based on the evaluations of these factors. In the Utility analysis, each of the factors is given a weight. This weight reflects the attitudes of the decision-makers regarding the importance of the factor. Next, each alternative is assigned a rating value between 0 and 10 for each of the factors based on the results of the analyses described in the previous sections. A rating of 0 indicates that the alternative does not perform well at all while a rating of 10 indicates that the alternative performance is excellent. By multiplying the individual rating and weight for each factor and summing the results over all factors, a utility value or performance index could be obtained for each alternative. The alternative with the highest performance index should be selected for implementation. The utility analysis is particularly useful when the consideration of some factors indicate that the

3. CASE STUDY

This section illustrates the use of the methodology described in the previous sections. The case study used in this illustration is a real-world investigation of the feasibility of the closure of a median opening located just south of the Griffin Road/University Drive intersection in Broward County, FL (see Figure 3). This median opening is a one-way directional median that serves northbound traffic turning left into a shopping center and northbound traffic making U-turn at the opening. Based on access management standards, this opening is 50% out of compliance to the north and 70% out of compliance to the south.

Closing the median opening would shift the northbound traffic that turns at the median opening to the Griffin Road/University Drive intersection (the upstream intersection) where it would become a northbound U-turn movement. Turning movement counts were collected at the Griffin Road/University Drive Intersection and the median opening in the Year 1998. These counts were used to estimate the 1998 peak hour demands. The year 2003 and 2008 demands for the intersection were estimated based on the 1998 demands using a 2% annual growth rate. A peak hour factor of 0.90 was used to estimate the peak 15-minute demands based on the peak hour demands as suggested by the HCM.

TRANSYT-7F signal timing optimization runs were performed to analyze the operation of the upstream intersection for the years 1998, 2003 and 2008 peak period conditions with no median closure. To analyze the impacts of the shift in traffic due to median closure, two separate sets of TRANSYT-7F analysis were performed and compared:

- In the first set, the additional U-turn volumes, that impact the intersection due to median closure, were added to the northbound left turn movement volumes for each of the analysis years and peak periods considered. Although this analysis considered the effect of the extra demand on the northbound left turn movement operation, it did not account for the effect of the U-turn movement on the saturation flow rate of the mixed-use left turn/U-turn lane. As stated in the previous section, this effect is very significant, particularly when a heavy intersecting street right-turn movement opposes the U-turn. This analysis is referred to in this paper as the "No SF Reduction" analysis.

- In the second set of analysis, in addition to adding the U-turn volume, the saturation flow rates were also modified to reflect the effect of U-turn movement on the saturation flow rate of the mixed-use left turn/U-turn lane. This analysis is referred to in this study as the "SF Reduction" analysis. The saturation flow rate of the mixed-use left turn/U-turn lane was calculated using the regression model presented in Equation 1.

The following is a description of the use of Equation 1 to calculate the saturation flow rate for the northbound left-turn/U-turn movement for the PM peak. This movement is a dual left turn movement. However, the U-turn movement is made from the inside left turn lane only. The U-turn percentage (UTURN in Equation 1) for the inside lane was calculated by dividing the U-turn volume by the total volume that uses the lane. This percentage was calculated to be 64% in the PM peak. The RTOA in the PM peak was set equal to the RTA value (4.5 veh/min), since the queue length in the beginning of the left turn/U-turn phase was estimated to be zero based on queuing analysis. Substituting 4.5 for RTOA and 64 for UTURN in Equation 1 results in a value of 1384 veh/hr for the inside lane saturation flow rate. The total northbound left turn/U-turn movement saturation flow rate could be calculated by adding this value to the saturation flow rate estimated for the outside left turn lane using the HCM signalized intersection procedure (1,800 veh/hr).

Tables 1 and 2 present the results of the operation analysis for the upstream intersection. The results indicate that closing the median would increase the average delay of the intersection, particularly during the PM peak period. The estimated northbound U-turn/left turn movement demands after median closure was particularly high for this peak. It was found that the effect of closing the median becomes more significant as the intersection demands (and thus the saturation levels) increase between the years 1998 and 2008.

Comparing the results for the analysis with and without saturation flow reduction (see Tables 1 and 2) indicates that not accounting for the effect of U-turn movement when estimating saturation flow rate values underestimates the impacts of median closure on intersection delays. This was particularly significant in cases with high U-turn percentages, significant conflicts between right turn and U-turn movements, and high intersection saturation levels.

The HCM analysis of the median opening and driveway operation, before median closure, indicated that for the year 2003 conditions, the left turn movement into the driveway will operate at acceptable levels of service (B In the AM peak and D in the PM peak). The right turn movement out of the driveway will also operate at acceptable levels of service (A In the AM peak and B in the PM peak).

For the PM peak, the delay of the left turn movement into the driveway was estimated to be 33.4 sec/veh based on the HCM analysis of the driveway operation. The TRANSYT-7F analysis of the upstream intersection conditions after median closure indicated that the rerouted vehicles would experience 103.6 sec/veh delay at the left turn/U-turn lane. In addition, these vehicles would have to travel to and from the upstream intersection, adding 19.6 sec/veh to the movement delay. Thus, the total delay to the vehicles would increase from 33.4 sec/veh (level of service D) to 123.2 sec/veh (level of service F).

Table 3 presents a benefit-cost analysis of the median closure. The analysis considers both crash and operation costs. The following is a discussion of the analysis:

- Based on the analysis of three year crash data, it is estimated that closing the median opening will result in a reduction of one crash per year at the opening location. The Florida Department of Transportation (FDOT) estimates the cost of one crash for four-lane urban highways at $63,000.

- The change in operation cost was calculated based on the change in upstream intersection delay, driveway delay and travel time between the driveway/median opening and upstream intersection for the AM, PM and off-peak periods. The change in the operation cost was calculated assuming $9 per vehicle-hour of delay. The annual change in operation cost was calculated by assuming two hours AM peak, two hours PM peak, eight hours off-peak and 260 working days per year.

The result of the cost-benefit analysis indicated that closing the median would increase the overall cost of the system.

Based on the above analysis it appears that the driveway would operate at acceptable levels of service for the year 2003 conditions without median closure. Closing the driveway would impact adversely the operations of the upstream intersection and worsen significantly the levels of service of the rerouted motorists. The analysis also indicates that closing the median is not desirable from a benefit-cost analysis point of view. These results indicate that the median should remain open.

4. CONCLUSIONS

The method developed in this study can be used to assess the prevention of median opening movement taking into consideration several factors that are important to the decision-makers. As part of the study, a model was developed to estimate the saturation flow rates of mixed-use left turn/U-turn lanes. However, the model is based on data from one location. Data from other locations would be useful in validating and enhancing the model. In addition, the model was derived based on data collected at an intersection with a right-turn overlap phase, in which the right-turn signal indication is a green arrow during opposing intersecting street left-turn/U-turn green phase. Other conditions need to be investigated such as when the conflicts are between the U-turn vehicles and opposing right-turn-on-red vehicles.

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1. “Highway Capacity Manual”, Special Report 209, Third Edition, Transportation Research Board, National Research Council, Washington, D.C., 1998.

2. Wallace, C.E., K.G. Courage, M.A. Hadi and A.C. Gan, “TRANSYT-7F User Guide,” Prepared by the Transportation Research Center, University of Florida, Gainesville, FL, March 1998.

3. “CORSIM User’s Manual Version 1.03,” Prepared by Kaman Science Corporation for the Federal Highway Administration, Colorado Spring, Colarado, 1997.

4. “TRAF User Reference Guide—Version 5,” Federal Highway Administration, March 1995.

5. “JMP – Statistics and Graphics Guide,” Version 3.1, SAS Institute Inc., SAS Campus Drive, Cary, NC, 1995.

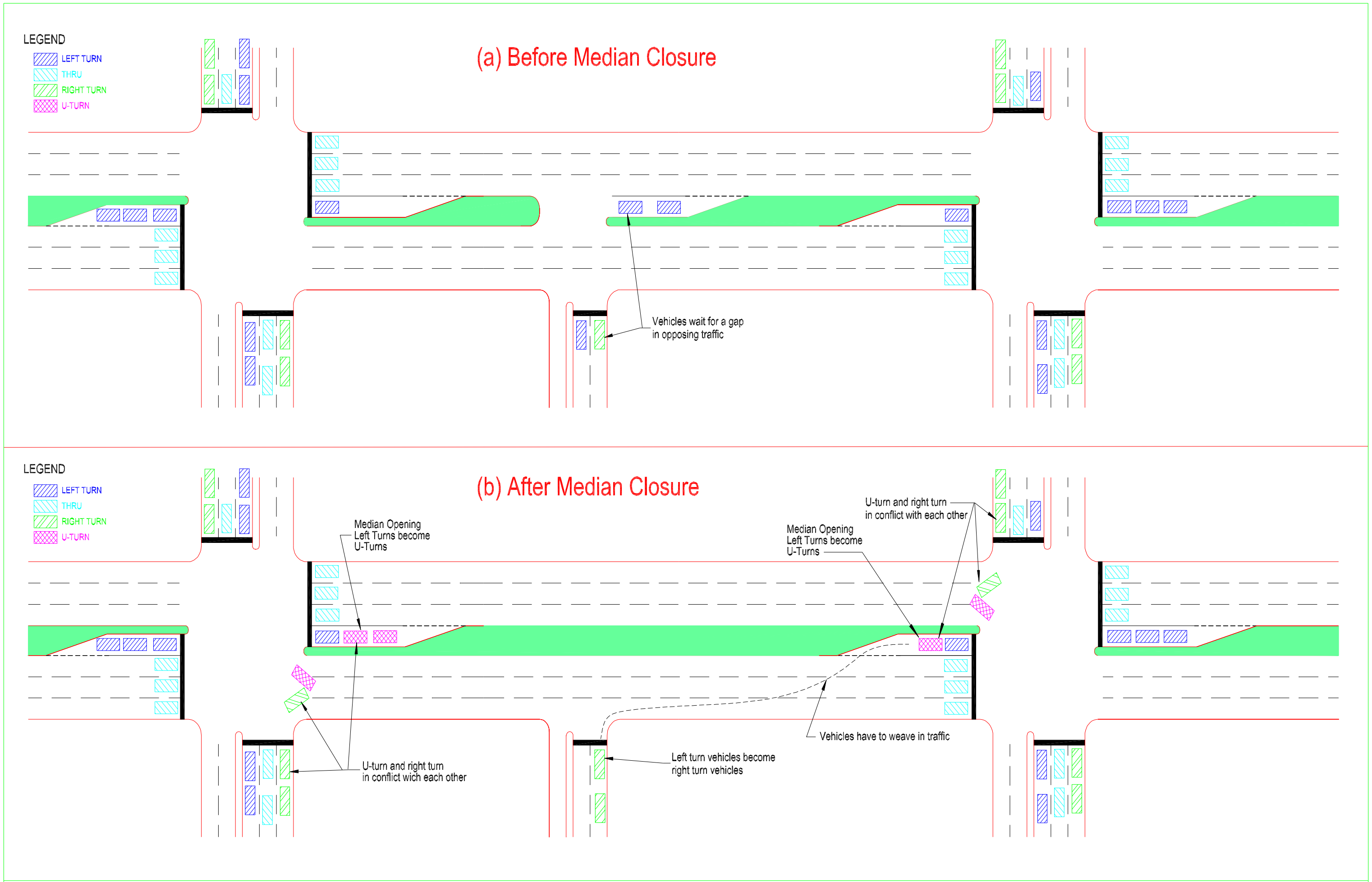


Figure 1 - Shift of Median Opening Movements Due To Median Closure

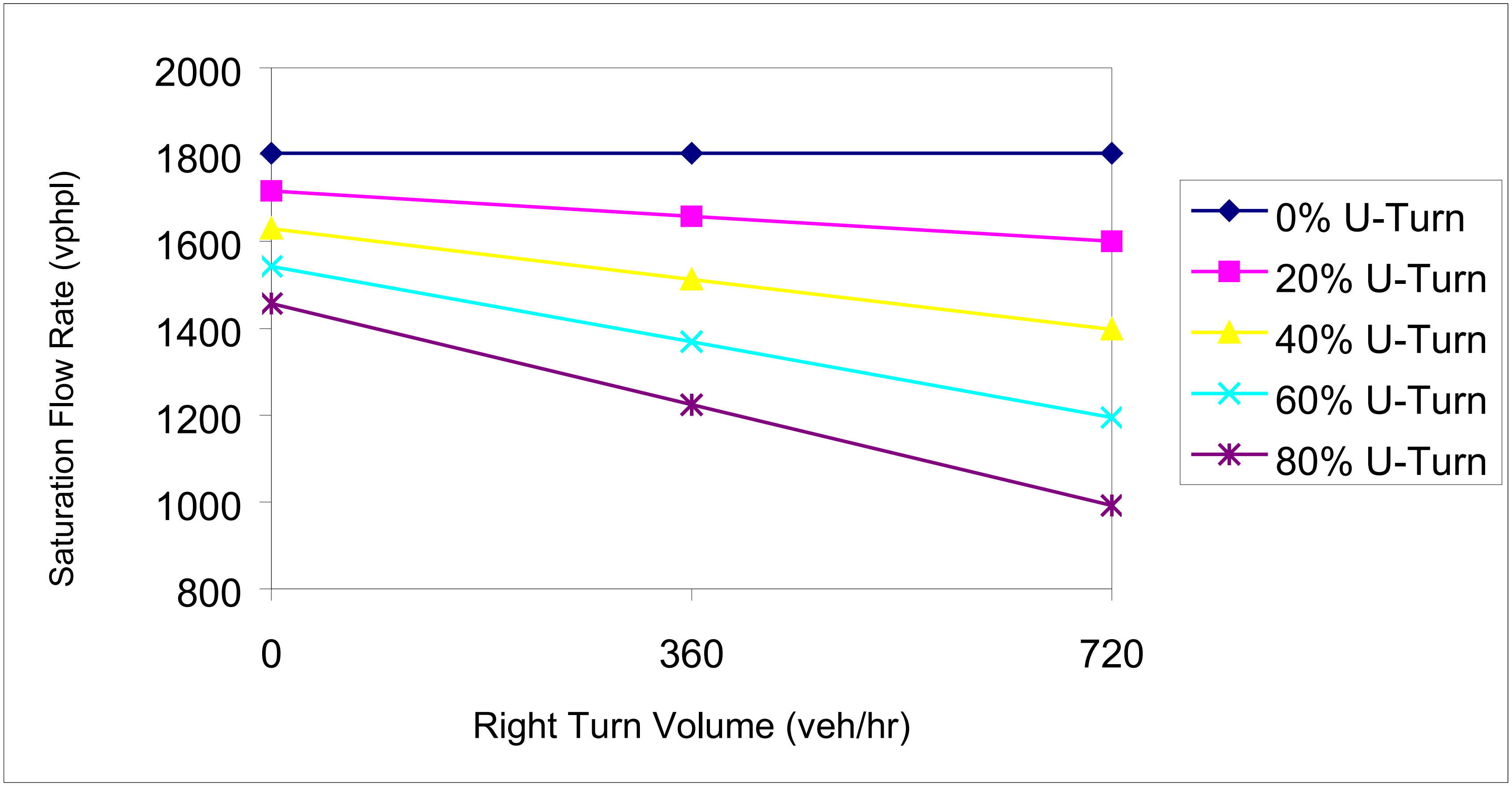


Figure 2. The Effect of Right Turn/U-Turn Movement Conflicts On the Saturation Flow Rate of U-turn/Left Turn Lane.

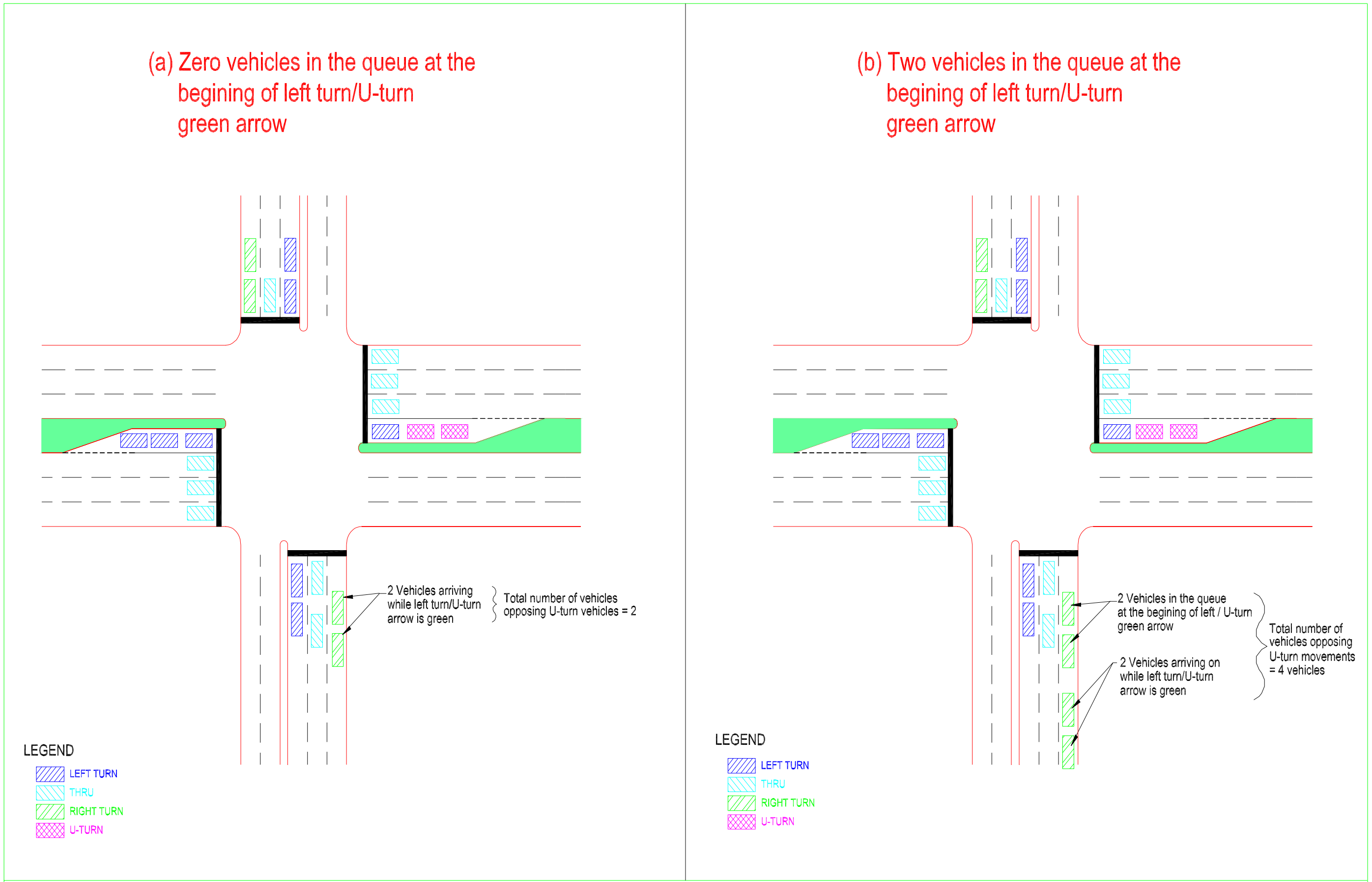


Figure 3 - The Effect of Opposing Right Turn Queue Length

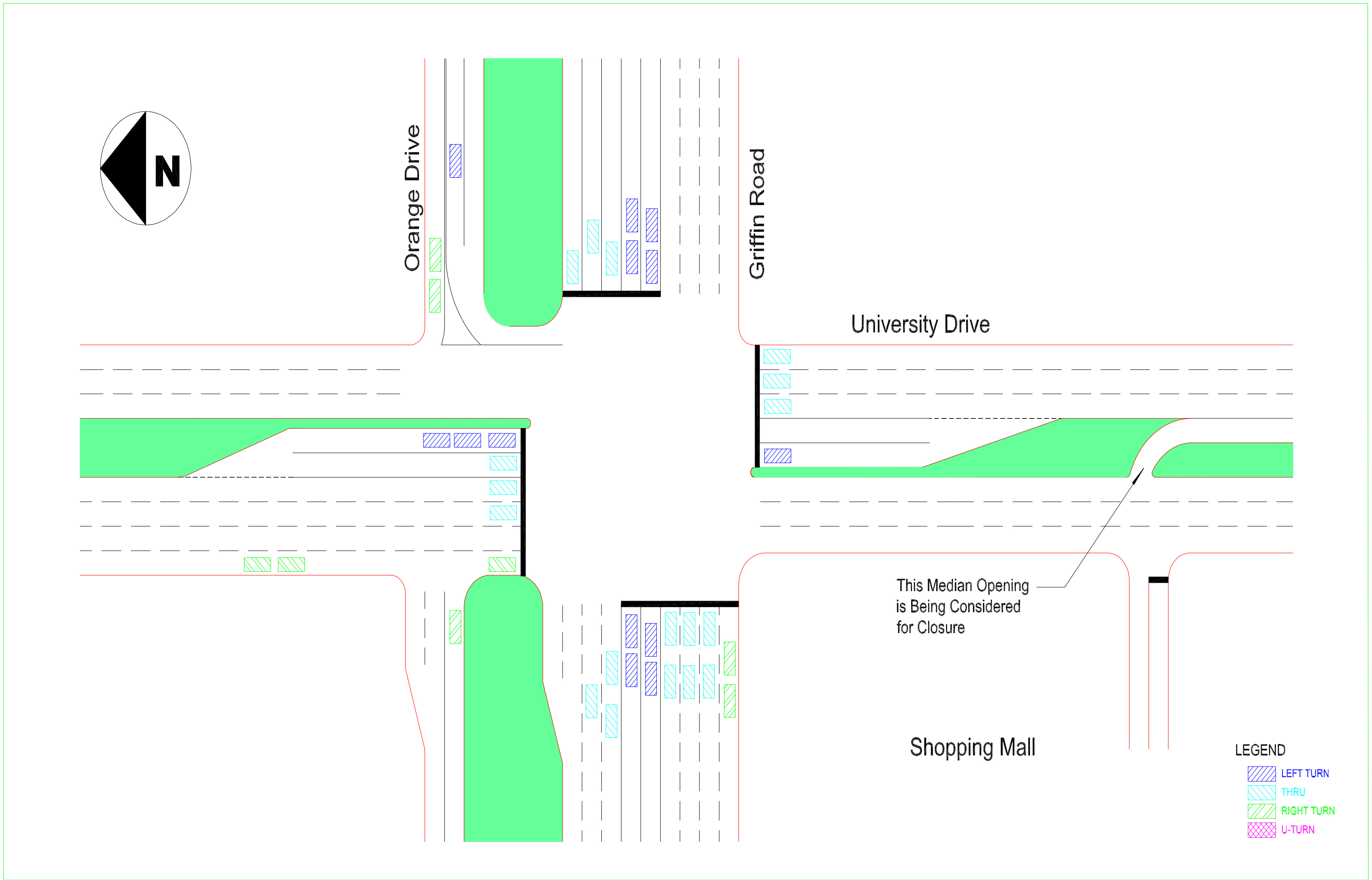


Figure 4 - University Drive / Griffin Road Intersection and the Adjacent Median Opening

Table 1. The Effect of Median Closer on Griffin Road/University Drive Intersection Delay.

Analysis Year	Delay (sec/veh) [a]			Level of Service [a]		
	Median Open	Median Close		Median Open	Median Close	
		No SF Reduction	SF Reduction		No SF Reduction	SF Reduction
1998	42.8 (44.4)	44.9(48.9)	45.9(51.9)	D (D)	D (D)	D (D)
2003	48.2 (50.4)	51.9 (60.0)	54.1 (64.9)	D (D)	D (E)	D (E)
2008	61.1(62.7)	68.5 (79.5)	72.4 (86.8)	E (E)	E (E)	E (F)

(a) The number outside the bracket is the AM peak delay and between the bracket is the PM peak delay.
(b) In this table, "No SF Reduction" refers to analyzing the impact of the increase in U-turn volume without considering its effect on saturation flow rate."SF Reduction" Analysis considers this effect.

Table 2. Effect of Turn Movement Volumes on Average Delay for the Year 2008 PM Peak

U-Turn (%)	RT-Turn (vph)	Average Delay (sec/veh)	
		No SF Reduction	SF Reduction
20	270	79.5	84.1
32	270	79.5	86.8
40	720	79.5	96.8

(a) In this table, "No SF Reduction" refers to analyzing the impact of the increase in U-turn volume without considering its efftect on saturation flow rate. "SF Reduction" Analysis considers this effect.
(b) The measured U-turn percentage is 32% and right-turn volume is 270 veh/hr.

Table 3. Cost-Benefit Analysis of Median Closure for the Year 2003.

Period	Signalized Intersection Operation Cost ($)		Driveway Operation Cost ($)		Travel Time Cost ($)
	Before Closure	After Closure	Before Closure	After Closure	
AM Peak Hour	555	615	4.6	2.1	3.5
PM Peak Hour	600	752	16.1	4.9	6.6
OFF Peak Hour	390	420	7.2	3.1	4.9
Yearly	1411800	1584440	25740	10088	15444

Operation Cost Increase	172432	dollars per Year
Crashes Saved	1	crash per year
Crash Cost Saved	63,300	dollars per Year
Net Cost increase	109,132	dollars per Year

MOVING FORWARD 13

What Would You Do With This Street?

Panel & Audience Participation

Slides

Panel Members:

Moderator: J.L. Gattis, University of Arkansas
David Hutchison, University of Arkansas
Phil Demosthenes, Colorado DOT
Paul Box, Paul C. Box & Associates
Stephen Ferranti, SRF & Associates
Donna Lewis, Mercer County, New Jersey
Glenda Radvansky, City of Albany, Oregon

Tuesday August 15, 2000 – 8:00 AM – 9:30 AM
Track 3 - Workshop

4th National Conference on Access Management
Session 13: *"What Would You Do With This Street -- panel and audience participation"*

Paul C. Box
Paul C. Box & Associates
Scottsdale, AZ

Philip Demosthenes
Colorado DOT - Traffic & Safety
Denver, CO

Stephen R. Ferranti, P.E., P.T.O.E.
SRF & Associates
Rochester, New York

David Hutchison, P.E.
Springfield Dept. of Public Works
Springfield, MO

Donna Lewis
Mercer County Planning
Trenton, N.J.

Glenda J. Radvansky, P.E.
City of Albany
Albany, OR

Moderator: J. L. Gattis, Ph.D., P.E.
Univ. of Arkansas
Fayetteville, AR

The session began with the moderator presenting information about a street. Then each panel member stated to what cross section (such as three lanes, four lanes with median, five lanes, etc.) and level of access management the street should be developed. Each panel member also explained and defended their opinion.

For each of the four streets, the moderator presented the following exhibits.

1. a brief verbal description of the present street, its surroundings, and projected development patterns
2. a street map of the area, also showing zoning and average daily traffic volume
3. an aerial photo of the street area
4. a series of photos showing the current streetscape

MISSION BLVD. (SH 45) from Crossover Road (SH 265) toward the east
~ 2.7 miles (~3.8 km) ADT = 7,000 predominate posted speed = 35 mph west end, 55 mph east end

Mission, despite its name, is not a boulevard but rather a two-lane asphalt concrete roadway with shoulders but no curbs. Traffic is comprised mostly of passenger car vehicles. The terrain is rolling.

Mission is part of the regional arterial network, extending into the next county and serving traffic coming into the metropolitan area from rural areas to the east. Traffic volumes are growing (see graph).

Most of the developed land abutting both sides of Mission is single-family residential or unsubdivided large tracts, many of which were formerly agricultural. The east end of the segment is typically rural, with a scattering of houses on acreage or small commercial and office properties. Near the city limits, subdivisions are springing up. Proceeding west, a large tract with two schools is on the north, and professional offices lie to the south. The commercial areas at the west end of the segment include two shopping centers with large grocery stores.

CROSSOVER ROAD (SH 265) - from Huntsville Road (SH 16) to Mission Blvd. (SH 45)
~ 2.4 miles (~3.8 km) ADT = 12,000 predominate posted speed = 40 mph

Crossover is currently a two-lane asphalt concrete roadway, without curbs or shoulders. Traffic is comprised mostly of passenger car vehicles, with infrequent heavy trucks, many of which have trouble negotiating the steep northbound grade in the middle third of the segment. Both the southern and the northern one-thirds have level or slightly rolling terrain. Traffic volumes are growing (see graph).

North-south oriented ridgelines parallel Crossover about 3000 ft (900 m) away on either side. Consequently, the probability is low that new through east-west streets will ever connect to Crossover between Huntsville Rd. and Mission Blvd. Since Crossover is the through north-south route on the east side of the metropolitan area, it serves as part of the regional arterial network in addition to providing access to subdivisions platted to feed to this street.

Most of the land abutting both sides of Crossover is single-family residential. The intersection at the north end of the segment has shopping centers anchored by large grocery stores on two corners. There are also small strip shopping areas along the north end. Proceeding south, there are some large lots that front the street, while other subdivisions back up to the street. Because of the rugged terrain in some parts of the corridor, lots are oversized and local street spacing is much greater than normal in some parts of the corridor. There is a steep grade in the middle part of the segment. There is one large apartment complex on the west, about 4000 ft (1200 m) from the south end. Small commercial tracts exist at the south end.

TOWNSHIP ST. from Gregg Ave. (west end) to College Ave. (east end)
~ 0.4 miles (~0.7 km)   ADT = 11,000   predominate posted speed = 30 mph

Township is a two-lane asphalt concrete roadway with no shoulders or curbs. Traffic is comprised mostly of passenger car vehicles. The terrain is level. Traffic volumes have remained constant in recent years.

Township functions as part of the city's arterial network. Although the west end of this segment is the west end of the street, it extends eastward almost 2 miles to a regional north-south arterial. The westward extension of this street is blocked by a building materials store and the University research farm fields.

The land on both sides is developed as low-traffic commercial or light industrial. Example uses include small retail stores, a car wash, a carpet store, and an automobile repair shop.

GREGG AVE. from North St. (south end) to Township St. (north end)
~1.3 miles (~2.1 km)   ADT = 181,000   predominate posted speed = 35 mph

Gregg Avenue differs from the other streets in that it already has been developed into a four-lane roadway with curbs. Therefore, the question is not how should the street be developed, but rather how should it have been developed -- do you agree with what was done? Traffic is comprised mostly of passenger car vehicles. The terrain ranges from quite rolling on the south end to level at the north end. Traffic volumes have remained constant in recent years.

Gregg functions as part of the city's arterial network, and also continues north from the north end of this segment into adjacent cities. The south end terminates in a maze of residential streets. In the absence of a continuous arterial route, traffic cuts through the neighborhood on two or three streets built to local street standards. For much of its length, Gregg is abutted on the west side by a railroad track, which limits the possibility of driveways connecting to the street on the west side.

At the north end, the street is abutted by light industrial tracts. To the south, land use changes to older single-family residences or duplex and small apartment developments. Near the south end, the street diverges from the railroad line, and there is a mixture of single family, apartment, and church land uses.

14 Permitting

Slides 14A. Permitting in Florida
Clark Turberville, Florida DOT

14B. Electronic Permitting
Slides Electronic Permitting - New Jersey
Slides Electronic Permitting - Colorado
Slides Electronic Permitting - Oregon

Slides 14C. Examples of FDOT Median Variances
Raj Shanmugan, URS Greiner Woodward Clyde, Inc.

Tuesday, August 15, 2000 10:00 AM – 11:30 AM
Track 1 - Administrative

Vehicular Access Permitting
with Access Management Rules

Third Access Management Conference

Portland Oregon

August 3, 2000

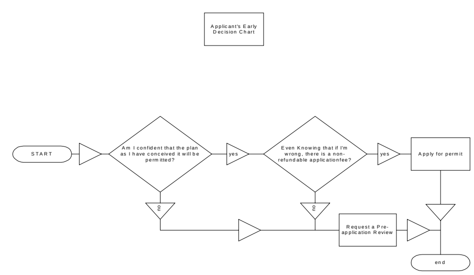
Vehicular Access Permitting
with Access Management Rules

- GOALS:
- Application of principles, laws, disciplines, and engineering to enhance vehicular access while maintaining highway safety and capacity.
- Gain Permit Applicants’ acceptance and support for the criteria of Access Management.

Vehicular Access Permitting
with Access Management Rules

- We, in Florida’s Fourth DOT District have focused on the “pre-application” period to attain these goals.
  - Pre-application Review Team
    - District Permits Engineer
    - An Assistant District Permits Engineer
    - District Access Management Engineer
    - Other persons invited for their specific issue input
  - District Variance Committee
    - District Design, Traffic, and Maintenance Engineers

Vehicular Access Permitting
with Access Management Rules



Vehicular Access Permitting
with Access Management Rules

- Requests to be placed on the Pre-application agenda are by phone, or by fax.
  - Our Administrative Professional maintains the agenda in electronic format
  - Meetings are held on Thursdays
  - Each is set for 25 minutes
  - Seven sessions per Thursday is our target limit

Vehicular Access Permitting
with Access Management Rules

- In 1999 we accepted 191 driveway (vehicular access connection) permits for review. During that same period we held 384 pre-application reviews.
- Apparently eliminating hours of permit review for requests that we could, finally, not permit.
  - Apparently reducing planning and design time and costs for applicants.

Vehicular Access Permitting
with Access Management Rules

- It is our intent to conclude each Pre-application session with a signed letter to either:
  - Approve as requested
  - Approve with comment or condition
  - Disapprove
  - Disapprove with comments of suggestion
  - Refer the issue to the District Variance Committee
- Approval means that we will review a permit request that is true to the approved concept.

Vehicular Access Permitting
with Access Management Rules

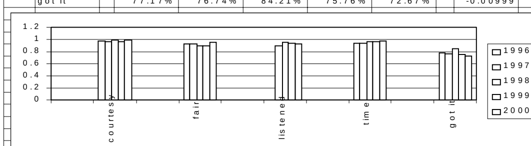
- Since 1996 we have entertained more than 700 issues at pre-application sessions.
- More particularly we have received more than 700 responses from the applicants as to the quality of those sessions.

Vehicular Access Permitting
with Access Management Rules

- We solicit applicant responses to:
  - Our courtesy to them
  - The fairness of our decision
  - Our Listening to their presentation
  - The length of time provided for the pre-application review
  - Result (their getting what they had requested)

Vehicular Access Permitting
with Access Management Rules

	1996	1997	1998	1999	2000	TREND
courtesy	97.33%	96.47%	98.54%	96.40%	98.53%	0.002327
fair	93.19%	93.19%	89.15%	88.94%	95.08%	-0.00047
listened		89.87%	95.63%	93.56%	92.65%	0.006258
time	94.57%	94.70%	96.16%	96.02%	97.43%	0.007052
got it	77.17%	76.74%	84.21%	75.76%	72.67%	-0.00999



Vehicular Access Permitting
with Access Management Rules

- If we recommend the issues to the District Variance Committee;
  - We may advise the applicant on the likelihood of favorable review by the committee
  - We may offer suggestions as to how to win approval or to compromise
  - At the applicant's request, we add the issue to the Variance Committee agenda
  - We solicit their responses at the close of the 55 minute session
  - We give them a signed letter approving or disapproving their variance request

Vehicular Access Permitting
with Access Management Rules

	1996	1997	1998	1999	2000	TREND
courtesy	97.33%	96.47%	98.54%	96.40%	98.53%	0.002327
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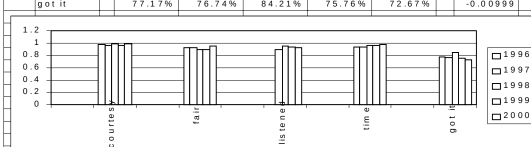


Vehicular Access Permitting
with Access Management Rules

- Our success depends upon
  - Computers
  - LAN
  - Information Technology
  - A great Administrative Professional
  - Professionalism in administration of the process
  - A measure of informality in discussing the issues
  - Personnel in the reviews with experience and knowledge
  - Focus (Meetings are only 25 or 55 minutes)

Vehicular Access Permitting
with Access Management Rules

- Thank you

Colorado - Electronic Permits

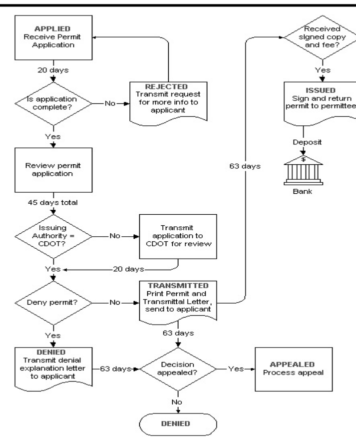
Philip Demosthenes
Access Program Administrator
Colorado Dept. of Transportation

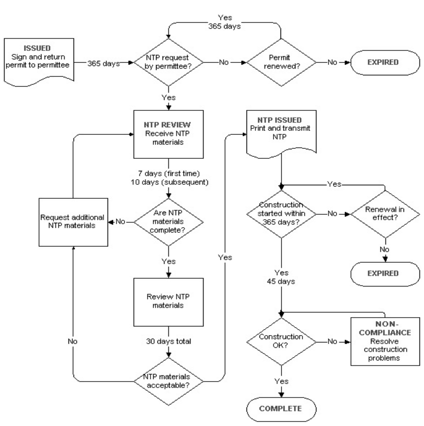
The Colorado Approach

- Establish a computer application to aid in the production of access permits.
- Reduce manual labor - save time
- Increase complexity without adding labor
- Increase accuracy and consistency
- Collect data

Software Tasks

- Input all application information
- Pull down lists for most inputs
- Produce Worksheets and Reports
- Produce standard letters and actual permit
- Track days and deadlines (clocks)
- Permanent data and records





What It Does NOT Do

- Does not link to other data warehouses
- No analysis

- WHAT WE WANTED
- Permit processing & production
- Keep it simple to revise and re-compile

WEB - Internet

- Forms, regulations, instructions, references, are posted on the CDOT web site.
- Soon to be added - design aids
- Also have Internal Web pages to provide materials to Region offices

Colorado References

- *Philip Demosthenes, Access Program Administrator*
- *Safety and Traffic Engineering Branch*
- *Colorado DOT*
- *4201 East Arkansas Ave, EP 770*
- *Denver CO 80222-3400*
- *Phone 303-757-9844   FAX   303-757-9219*
- *mailto:phil.demosthenes@dot.state.co.us*

- *http://www.dot.state.co.us/BusinessCenter/Permits/Access/index.htm*

CHAMPS

Central Hwy Approach & Maintenance Permit System
Oregon Department of Transportation
Darla Stoneman

Project Goals

- Create a consistent, efficient permitting process.
- Support the implementation of OAR.
- Capture business statistics .

Description

- Windows® look and feel, created a familiar environment.
- Deployed to workstations across the state through a central application server.
- "Stored procedures" validate the permit applications for issuance.

Details

- Construction & Use Permits
- Status History
- Standardized Specifications
- Form Letters
- Alerts & System Generated Emails
- Instant Reporting

CHAMPS

- Does
  - apply Business Rules to uniformly issue permits.
  - allow multiple users simultaneous entry.
  - allow sharing of information.
- Does not
  - automate analysis.
  - speed up the issuance process.

Additional Information

- Darla Stoneman
- ODOT Access Management Program
- Mill Creek Office Building
- 555 13th Street NE, Suite 2
- Salem, OR 97301-4178
- (503) 986-4372
- darla.s.stoneman@odot.state.or.us

FOR MORE INFO...

Poster Session : Willamette Ballroom

New Jersey
Highway Access Permit System

Arthur Eisdorfer

Manager, Bureau of Civil Engineering

NJDOT

The New Jersey Approach

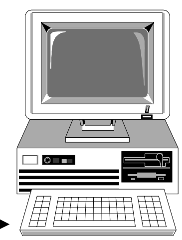
- **Automate permit administration and processing**
- **Improve service for applicants**
- **Do more work with limited staff**
- **Provide consistent results**
- **Generate reports**

Tool for:

- **Potential Applicants**
- **Other Agencies**
- **NJDOT Staff**

HAPS Input

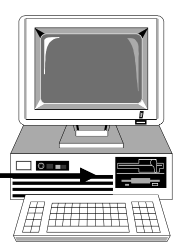
- **Route**
- **Direction**
- **Milepost**
- **Size and Type of Development**
- **Lot Size and Frontage**
- **Number of Driveways**



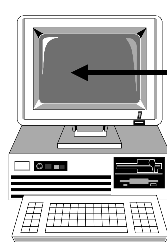
HAPS Databases

- **Access Levels and Classes***
- **Urban or Rural***
- **Speed Limits /Spacing Distances***
- **Municipalities and Counties***
- **ITE and NJDOT Trip Generation**

*** By Route and Milepost**



HAPS Output



- **Permit Timeframes**
- **Permit Type**
- **Fees**
- **Trip Generation**
- **Municipality and County**
- **Permits & Correspondence**
- **Conformance Analysis**

History

- **1992 Debut - $115,000**
  - **System of networked PCs**
  - **Dial in via 1-800 ADD A CUT**
- **1996 Added Street, Lot, and Concept Review Permits - $100,000**
- **2000 Upgrade to Windows - $120,000**
- **2001 Upgrade for Internet access - $?**

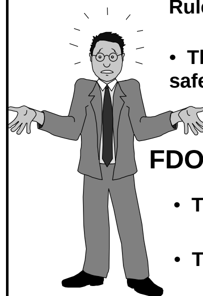
A Practical Approach to Access Management

Raj Shanmugam, P.E. - URS Consultants

Jan Thakkar, P.E. - FDOT D4 Access Management

URS

FDOT Access Standards and Intent



- Administrative Rule 14-97: “Standards Rule” adopted February 1991.
- The purpose is to “….protect public safety and general welfare,…..”

FDOT District 4 Variance Procedure

- The decision making process.
- The Variance Committee.

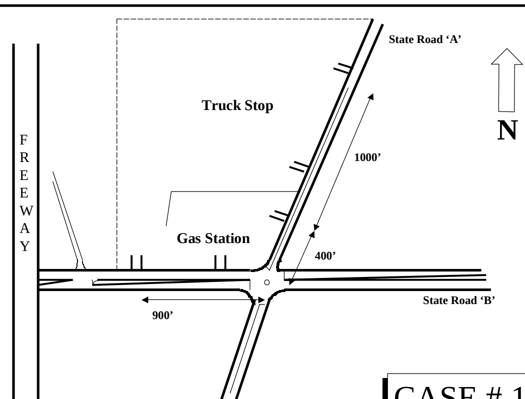
Median Opening Decision Process

- Formation of an Access Management Review Committee
- Minor deviations need not be reviewed by the Committee

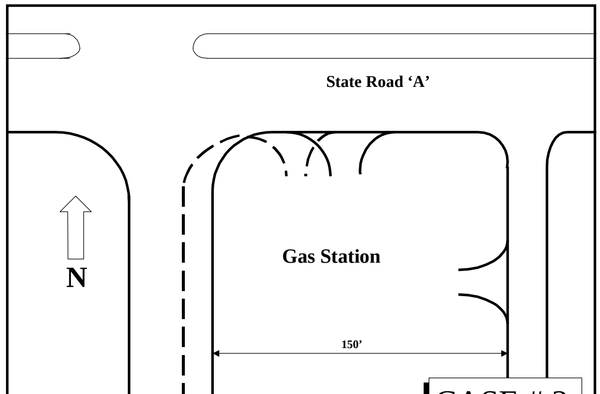
- Deviations of less than 20% may be approved by a registered Professional Engineer

FDOT Access Management - Arterial Classifications & Standards

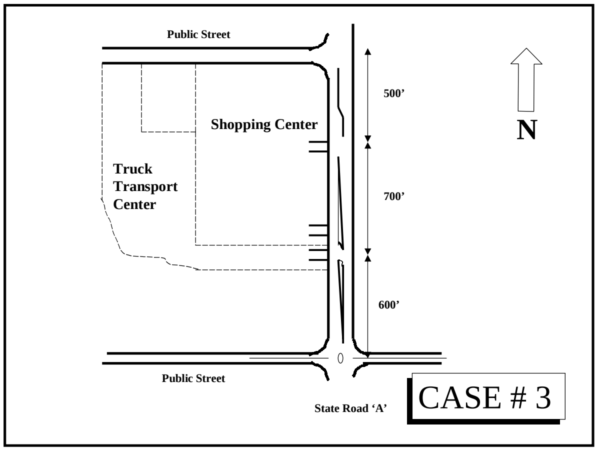
CLASS	MEDIANS	CONNECTION > 45 mph	CONNECTION < 45 mph	MEDIAN OPENING Directional	MEDIAN OPENING Full	SIGNAL
GENERALLY DEVELOPING OR UNDEVELOPED AREAS						
2	Restrictive w/ Service Roads	1320'	660'	1320'	2640'	2640'
3	Restrictive	660'	440'	1320'	2640'	2640'
4	Non-Restrictive	660'	440'			2640'
GENERALLY DEVELOPED						
5	Restrictive	440'	245'	660'	2640'/1320'	2640'/1320'
6	Non-Restrictive	440'	245'			1320'
7	Both Median Types	125'		330'	660'	1320'



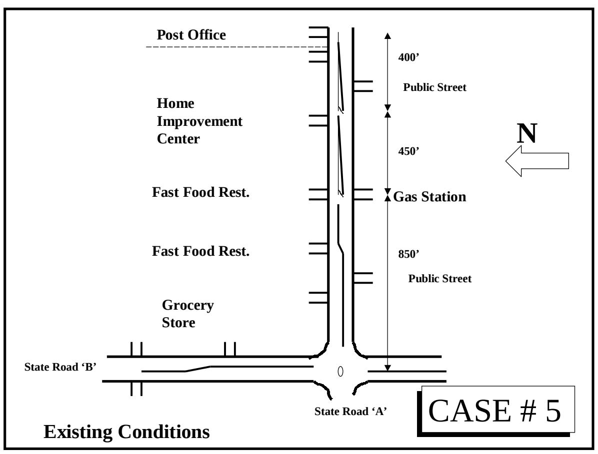
CASE # 1

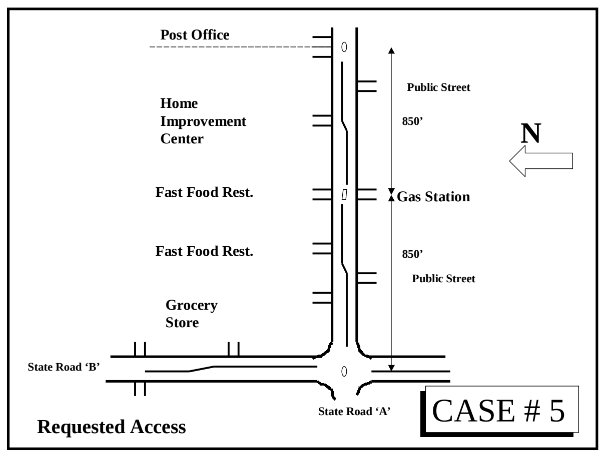


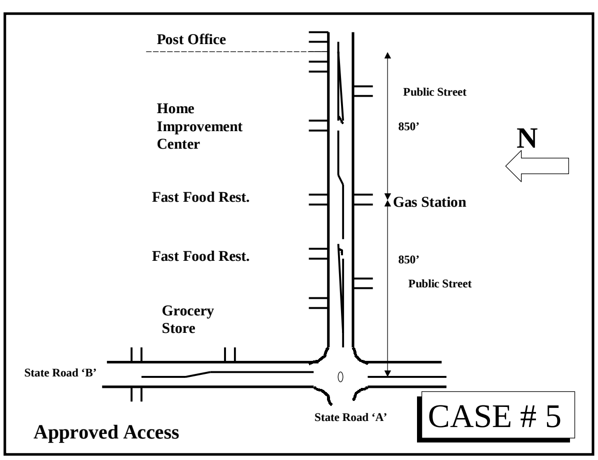
CASE # 2

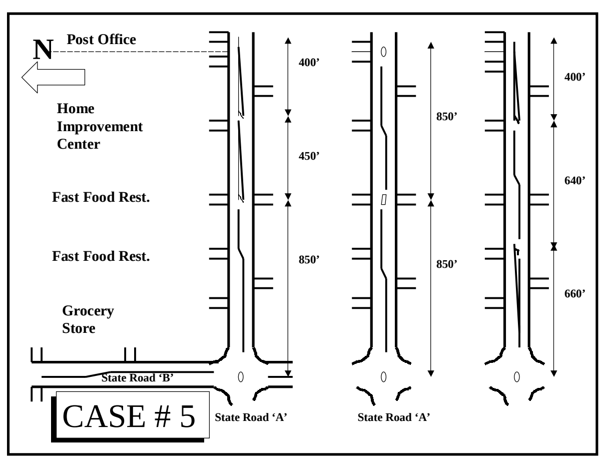

Public Street
Shopping Center
Truck
Transport
Center
500'
700'
600'
N
Public Street
State Road 'A'
CASE # 3

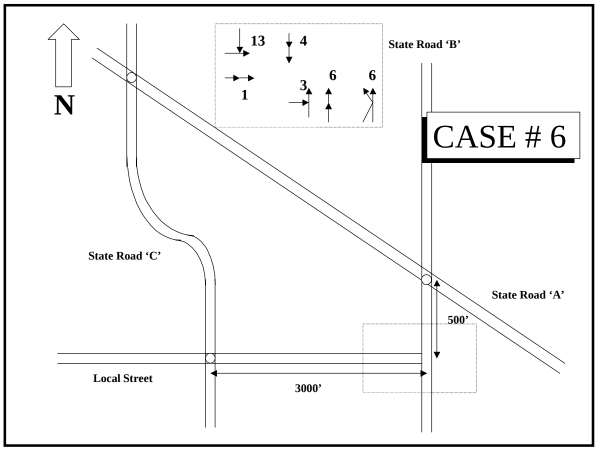

N
DRUG STORE
50'
190'
CASE # 4


Post Office
Home
Improvement
Center
Fast Food Rest.
Fast Food Rest.
Grocery
Store
400'
Public Street
450'
Gas Station
850'
Public Street
N
State Road 'B'
State Road 'A'
Existing Conditions
CASE # 5


Post Office
Home
Improvement
Center
Fast Food Rest.
Fast Food Rest.
Grocery
Store
Public Street
850'
Gas Station
850'
Public Street
N
State Road 'B'
State Road 'A'
Requested Access
CASE # 5


Post Office
Home
Improvement
Center
Fast Food Rest.
Fast Food Rest.
Grocery
Store
Public Street
850'
Gas Station
850'
Public Street
N
State Road 'B'
State Road 'A'
Approved Access
CASE # 5


N
Post Office
Home
Improvement
Center
Fast Food Rest.
Fast Food Rest.
Grocery
Store
400'
450'
850'
850'
850'
400'
640'
660'
State Road 'B'
State Road 'A'
State Road 'A'
CASE # 5


N
13
4
1
3
6
6
State Road 'B'
CASE # 6
State Road 'C'
State Road 'A'
500'
Local Street
3000'


Access Management - a great operational and safety tool.
"Use it sensibly !!!!!!!"

15 Roundabouts

Slides | 15A. Roundabouts and Access Management

Bruce Robinson, Kittelson & Associates, Inc.

Joe Bared, FHWA

Paper

Slides | 15B. Modern Roundabouts as an Access Management Tool

Richard Perez, City of Federal Way, Washington

Tuesday, August 15, 2000 10:00 AM – 11:30 AM

Track 2 - Technical

Roundabouts and Access Management

Bruce W. Robinson
Principal Investigator
Roundabouts: An Informational Guide
http://www.tfhrc.gov/safety/00068.htm

Kittelson & Associates, Inc.
Portland, Oregon USA

Agenda

- Introduction
  - FHWA Project Overview
  - Roundabout Categories
- Performance
  - Operations
  - Safety
- Design Principles
- Access Management Issues and Applications

Project Overview

- Project began October 1997
- Variety of sources
  - Best practices internationally
  - Current research in U.S.
  - Adaptation to U.S. standard practice
  - Judgment of authors and reviewers

Project Team

- Prime: Kittelson & Associates, Inc.
- Researchers
  - University of Florida
  - University of Idaho
  - Penn State University
  - Queensland Univ. of Technology (Australia)
  - Ruhr-University Bochum (Germany)
- Practitioners
  - Hurst-Rosche Engineers, Inc. (MD/PA)
  - Buckhurst Fish & Jacquemart, Inc. (NY)
  - Eppell Olsen & Partners (Australia)

Publishing schedule

- Electronic version
  - Available on Internet at the Turner Fairbank Highway Research Center website
  - http://www.tfhrc.gov/safety/00068.htm
- Paper version
  - Expected September
  - Fax order requests: (301) 577-1421

Organization of the Guide

- Chapter 1: Introduction
- Chapter 2: Policy Considerations
- Chapter 3: Planning
- Chapter 4: Operational Analysis
- Chapter 5: Safety
- Chapter 6: Geometric Design
- Chapter 7: Traffic Design and Landscaping
- Chapter 8: System Considerations

Agenda

- **Introduction**
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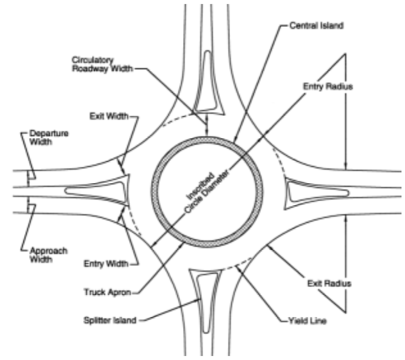
Key Dimensions



Roundabout Categories

Minimum Sizes Determined by Design Vehicle – but automobile speed (safety) tradeoff, therefore keep "tight"

Site Category	Typical Design Vehicle	Inscribed Circle Diameter Range*	
Mini-Roundabout	Single-Unit Truck	13 – 25 m	(45 – 80 ft)
Urban Compact	Single-Unit Truck/Bus	25 – 30 m	(80 – 100 ft)
Urban Single Lane	WB-15 (WB-50)	30 – 40 m	(100 – 130 ft)
Urban Double Lane	WB-15 (WB-50)	45 – 55 m	(150 – 180 ft)
Rural Single Lane	WB-20 (WB-67)	35 – 40 m	(115 – 130 ft)
Rural Double Lane	WB-20 (WB-67)	55 – 60 m	(180 – 200 ft)

* Assumes 90-degree angles between entries and no more than four legs.

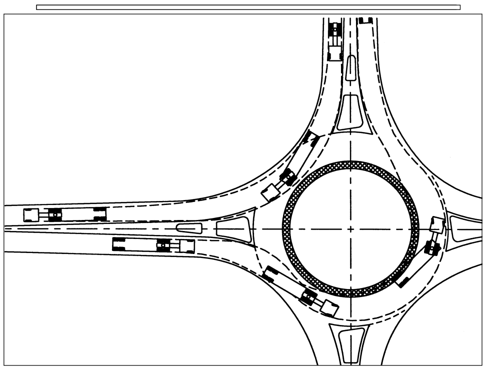
Design Vehicle


Good design

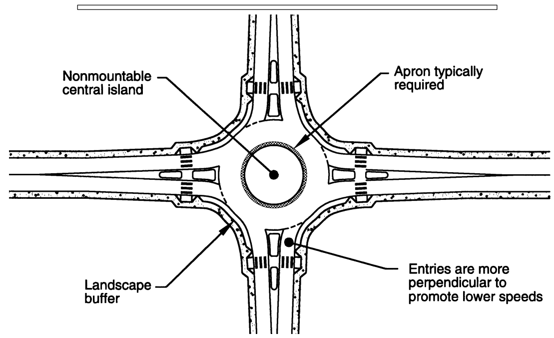
- **May require use of truck apron**
- **Minimizes damage to curbs, signs, landscaping**


Poor design

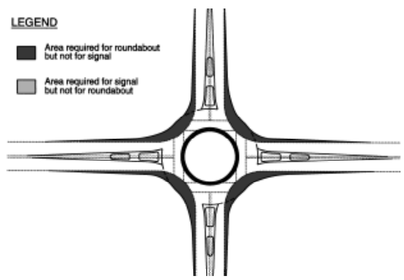
Design Vehicle



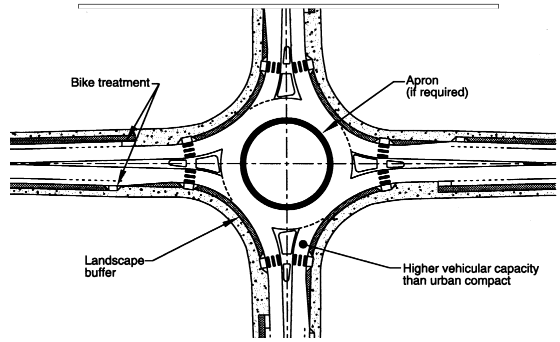
Urban Compact Roundabouts



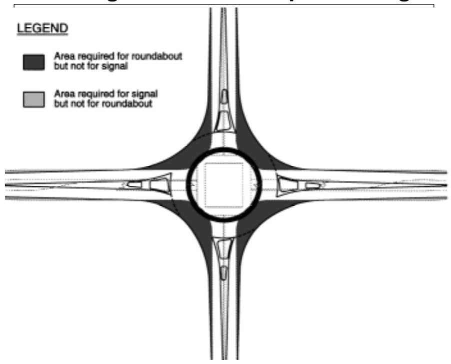
Space Requirements
Urban Compact vs. Comparable Signal



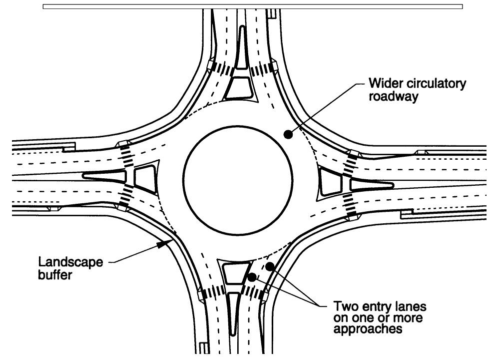
Urban Single-Lane Roundabouts



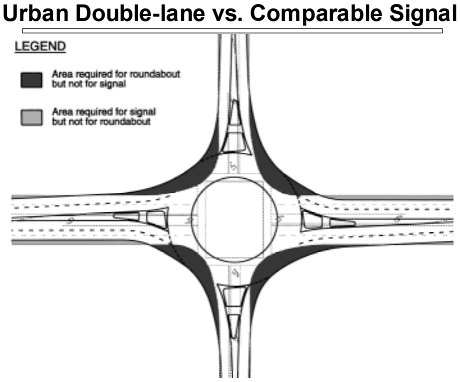
Space Requirements
Urban Single-lane vs. Comparable Signal



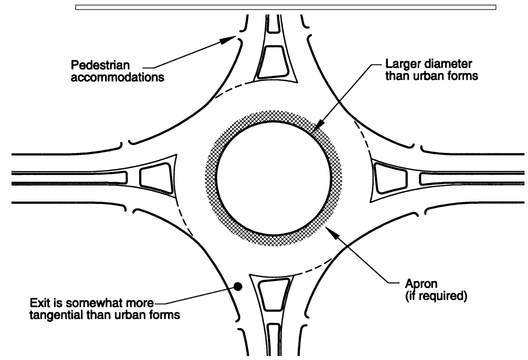
Urban Double-Lane Roundabouts



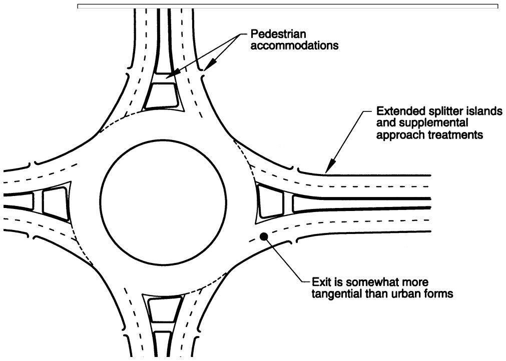
Space Requirements
Urban Double-lane vs. Comparable Signal



Rural Single-Lane Roundabouts



Rural Double-Lane Roundabouts



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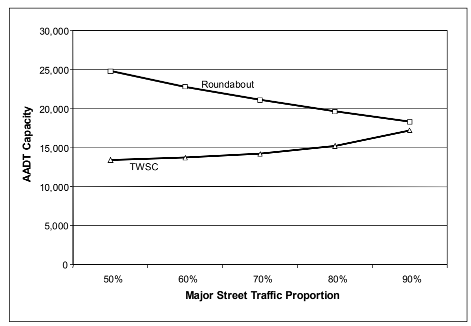
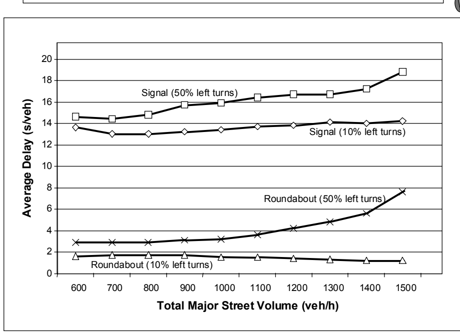
Comparisons with Other Control

- Higher capacity & lower delay than AWSC
- No improvement on TWSC if minor movements have no operational problems
- Single-lane roundabout is within capacity when peak hour volume warrants for signals are not met
- If Rbt .within Capacity - generally lower delays and queues than Signals

Roundabouts versus TWSC



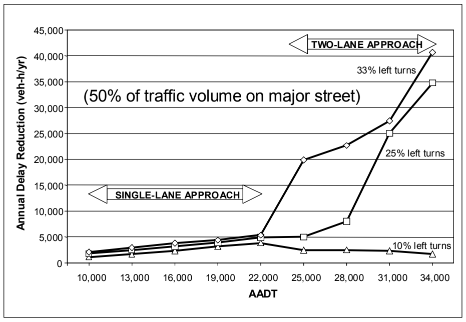
Roundabouts at MUTCD Peak Hour Signal Warrant Volumes



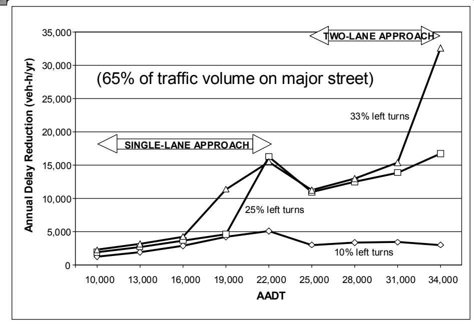
Roundabouts versus Signals

- Roundabouts produce less delay than comparable signals if operating within their capacity
- Heavy left turn - good candidates
- Off-peak periods are important in comparing annual delay savings

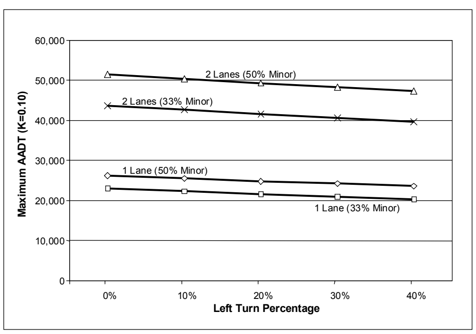
Roundabouts versus Signals 50/50



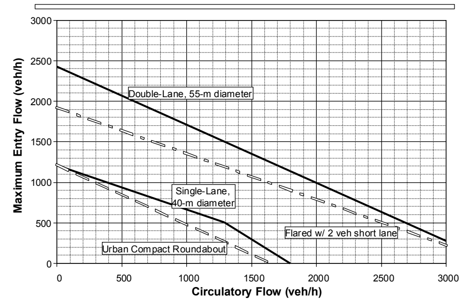
Roundabout versus Signals 65/35



Maximum ADT (4-legged intersection)

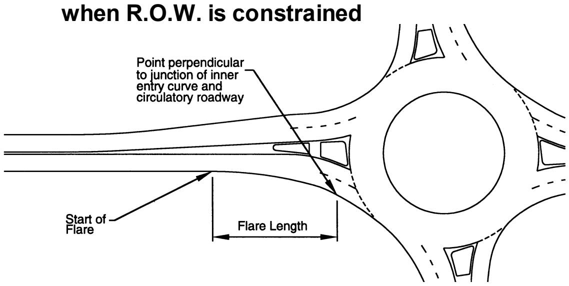


Capacity Comparison



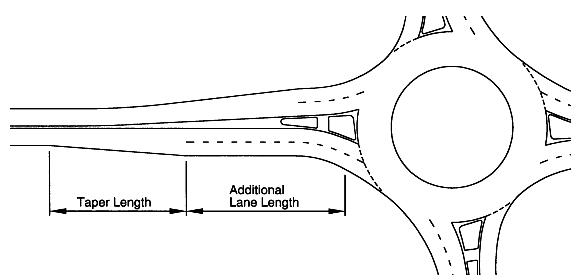
Flared Entry

- Entry flaring is a tool to increase capacity when R.O.W. is constrained



Flare: Alternative Short Lane Design

- Widening by adding a full lane

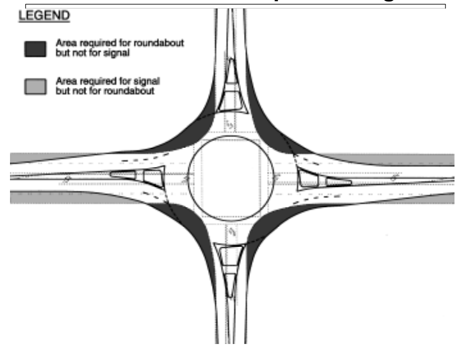


Capacity adjustments: Short lanes

- **Short lanes are the additional partial lanes added when flaring a roundabout from one to two lanes**

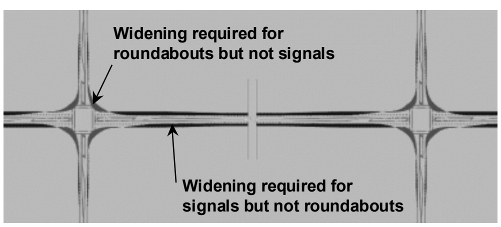
No. of vehicle spaces in short lane	Capacity factor (applied to double-lane approach capacity)
0 (single-lane approach)	0.500
1	0.707
2	0.794
4	0.871
6	0.906
8	0.926
10	0.939

Space Requirements
Urban Flared vs. Comparable Signal



Wide Nodes and Narrow Roads

- **Roundabouts provide opportunity to minimize widening between intersections**



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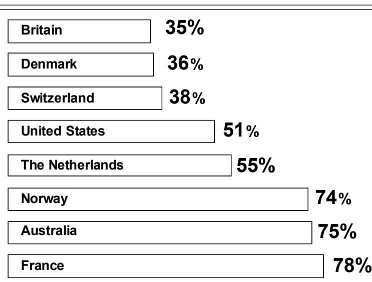
Injury Crash Reductions



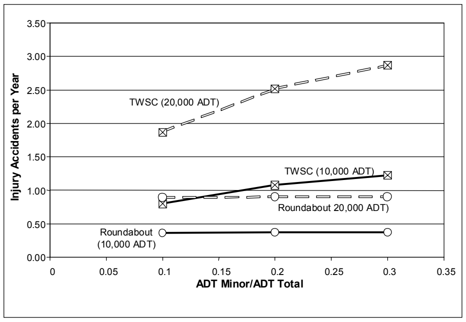
Source: Maryland Department of Transportation; NCHRP Synthesis 279

U.S. Before-After Experience
Insurance Institute for Highway Safety

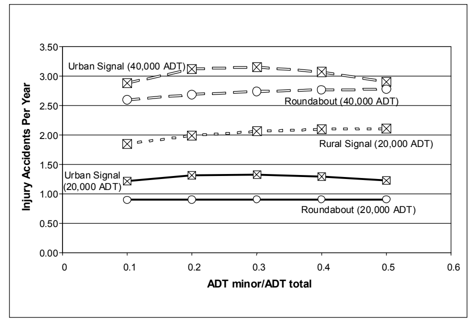
- **March 2000 study (Persaud, et al.)**

Group characteristic before conversion (sample size)	% reduction in all crashes	% reduction in injury crashes
Single-lane, urban, stop-controlled (9)	61	77
Single-lane, rural, stop-controlled (5)	58	82
Multilane, urban, stop-controlled (7)	15	N/A
Urban, signalized (3)	32	68

Predicted Injury Crashes Rural Roundabouts versus TWSC



Predicted Injury Crashes Urban Roundabouts versus Signals



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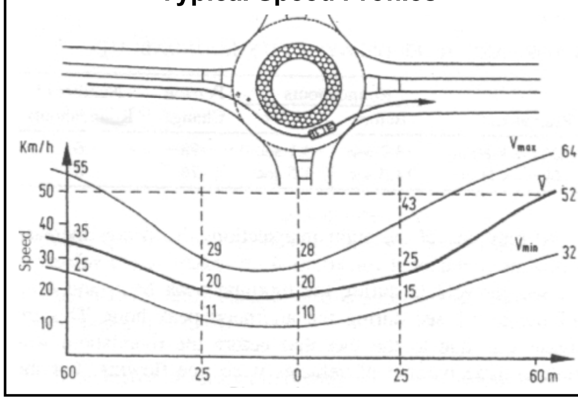
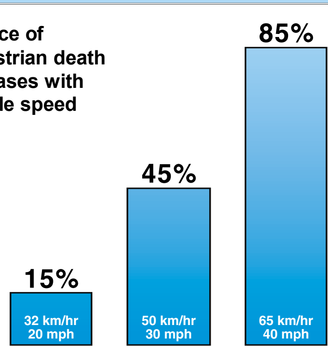
Typical Speed Profiles



Speed and Pedestrians

Chance of pedestrian death increases with vehicle speed



Vehicle Path Radii

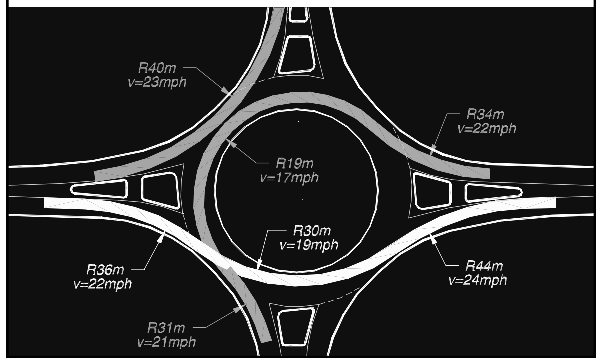
Site Category	Recommended Maximum Entry Design Speed
Mini-Roundabout	25 km/h (15 mph)
Urban Compact	25 km/h (15 mph)
Urban Single Lane	35 km/h (20 mph)
Urban Double Lane	40 km/h (25 mph)
Rural Single Lane	40 km/h (25 mph)
Rural Double Lane	50 km/h (30 mph)

Vehicle Path Radii

- **Speed – curve relationship**
- **Based on AASHTO Green Book**
- **Metric:** $V = \sqrt{127R(e+f)}$
- **U.S. Customary:** $V = \sqrt{15R(e+f)}$

where:
V = Design speed, km/h (mph)
R = Radius, m (ft)
e = superelevation, m/m (ft/ft)
f = side friction factor

Speed Consistency



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Access Management

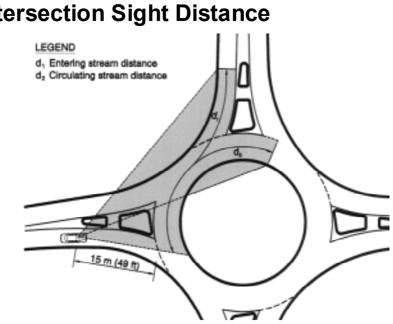
- **What to do with driveways?**
- **Three typical cases**
  - Driveways entering roundabout
  - Driveways near roundabout
  - Midblock driveways between roundabouts

Driveways Entering Roundabout

- **Generally should avoid**
- **High-volume driveways should be designed as regular approach**

Horizontal Geometry

- **Intersection Sight Distance**



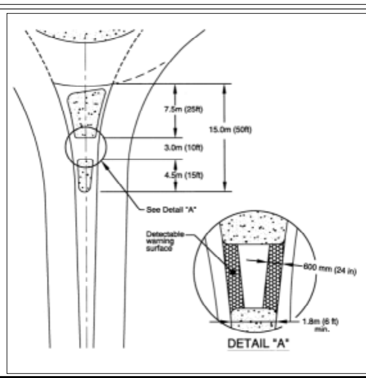
Driveways Near Roundabout

- In general, same principles as for driveways near signalized intersections
- Should not locate driveways between pedestrian crossing and yield line
- Driveways blocked by splitter island restricted to right-in/right-out

Horizontal Geometry

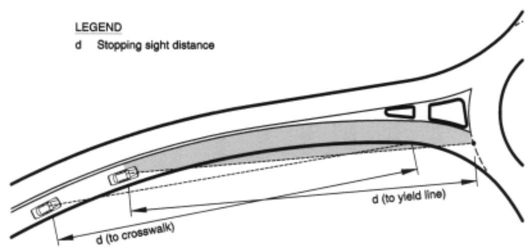
- Splitter Islands
  - should be provided on all but the very small roundabouts
  - purpose is:
    - provide shelter for peds
    - assist in controlling speeds
    - positive guidance
    - physically separate entering and exiting traffic streams
    - deter wrong way movements
    - placement of signs
  - larger splitter islands can enhance safety by providing separation between entering and exiting traffic streams

Splitter Island Length



Horizontal Geometry

- Approach sight distance



Rural Roundabouts

- Curbing
  - splitter islands

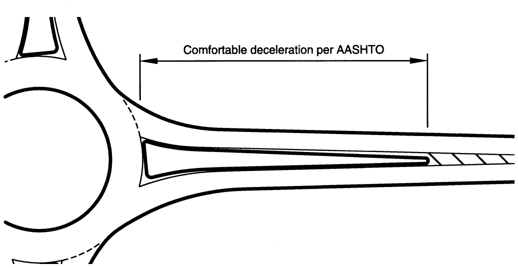


Photo: Maryland DOT

Photo: Maryland DOT

Midblock Driveways Between Roundabouts

- Ability to provide full access dependent on several factors:
  - Capacity for minor movements
  - Need for and ability to provide left-turn storage between splitter island and driveway
- Can provide U-turns at roundabouts

Midblock Driveways Between Roundabouts

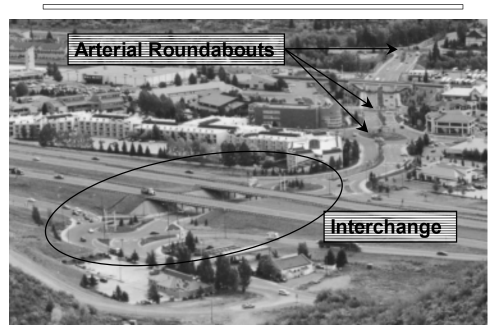
- Typical minimum centerline spacing from 120 ft roundabout for driveway with left turn storage on major street:
  - 60 ft (roundabout radius)
  - 35 ft (splitter island/pedestrian crossing)
  - 90 ft (transition)
  - 75 ft (left turn storage)
  - 30 ft (typical half-width of intersection)
- = 290 ft
- may vary depending on local standards)

Photo: Maryland DOT

Arterial Networks

- Operational effects to consider:
  - Platooned arrivals on approaches
  - Effects on downstream unsignalized intersections

Arterial Networks



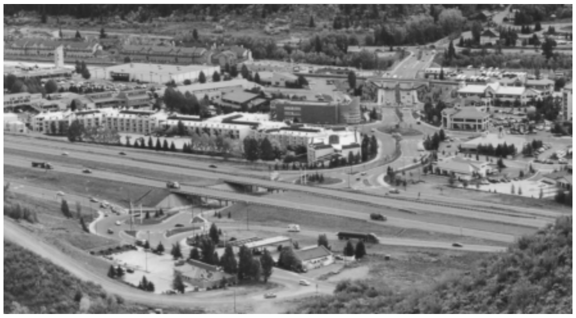
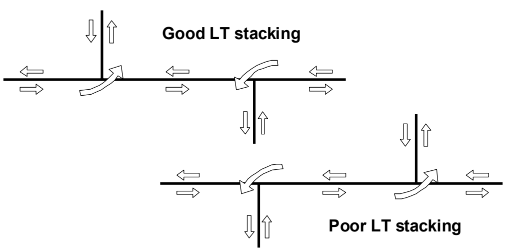


Photo: Lee Rodegerdts

Closely Spaced Roundabouts

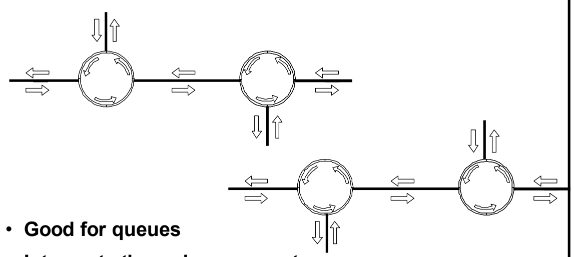
Staggered T-Intersections

- Classic problem: Where to store interior queues



Staggered T-intersections: Consecutive Roundabouts

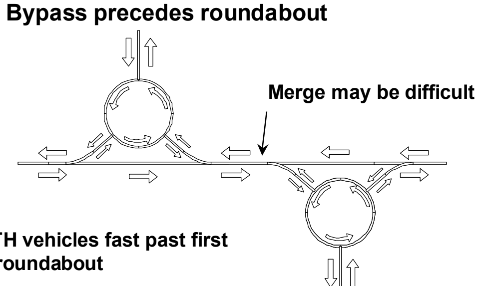
- Option A: Two roundabouts, no bypasses



- Good for queues
- Interrupts through movements

Staggered T-intersections: Through Bypass Lane

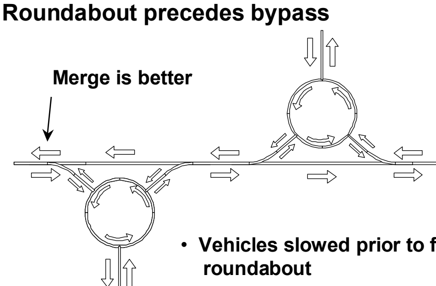
- Bypass precedes roundabout



- TH vehicles fast past first roundabout
- May create difficult merge

Staggered T-intersections: Through Bypass Lane

- Roundabout precedes bypass



- Vehicles slowed prior to first roundabout
- Better for downstream merge

Interchanges

- Number of bridges
  - Two bridges
  - One bridge
- Shape of roundabouts
  - Circular
  - Tear drop

Two Bridge Interchange

One Bridge Interchange

Circular Interchange Terminals

- Allows all movements, including U-turns
- Allows connection of frontage roads

Raindrop Interchange Terminals

- Restricts U-turns
- Makes wrong-way turns into the off-ramps more difficult

Conclusion

- FHWA Roundabout Guide allows informed decisions
- Guide supplements but does not replace fundamental documents (AASHTO, MUTCD)
- Design methods provide flexibility within guidelines
- relevant tools are provided for Access Management decisions

The future of roundabouts in the U.S.?

Swindon, England

Kittelson roundabout web site: roundabouts.kittelson.com

Modern Roundabouts as an Access Management Tool

Richard A. Perez, P.E, and Tasha Atchison

Weyerhaeuser Corporation's world headquarters is located in a semi-rural area known as East Campus in the Seattle suburb of Federal Way. Federal Way is a city of 77,000 that incorporated in 1990. East Campus annexed to the City in 1994 under an agreement wherein the City committed to maintaining a rural atmosphere in East Campus. East Campus occupies an area roughly 1 mile wide east of I-5 from approximately 2 miles long (from S 316th Street to S 349th Street).

Existing Conditions

I-5 is an 8-lane freeway on the west side of East Campus with interchanges at S 320th Street and SR18. SR 18 is a 4-lane freeway with an interchange at Weyerhaeuser Way S. S 320th Street is a 5-lane principal arterial with a signalized intersection at Weyerhaeuser Way S. Weyerhaeuser Way S is a two-lane minor arterial, with a posted speed limit of 35 mph and wide shoulders that vary between paved and gravel surfaces. S 336th Street, a minor arterial, enters East Campus from the west and ends at a wye-intersection at Weyerhaeuser Way S, locally known as "the Wye", approximately 1 mile north of SR 18. S 33rd Place, a minor collector, enters East Campus from the east and intersects Weyerhaeuser Way approximately 1/4 mile north of SR 18. The SR 18 interchange at Weyerhaeuser Way S is a diamond interchange with stop-controlled ramp terminals. S 344th Street intersects Weyerhaeuser Way S from the east just south of the SR 18 interchange.

East Campus had been developed by Weyerhaeuser with the Corporate Headquarters building (350,000 square feet) with one driveway to Weyerhaeuser Way between S 336th Street and 33rd Place S, and one driveway to S 336th Street just east of I-5. The Tech Center building, with 400,000 square feet of office space, had two driveways to Weyerhaeuser Way S north of S 336th Street. Weyerhaeuser Corporation is marketing East Campus as a location for corporate headquarters for multinational corporations. It's first success in the market was locating the headquarters of World Vision, at the south end of East Campus.

Proposed Development

Weyerhaeuser's development subsidiary, Quadrant Corporation, had identified East Campus as having a potential market for 1.5 million square feet of office space, and through further annexations, potential locations for 200 housing units. Parcels 1 and 2 (70 acres of commercial subdivision) are located on S 320th Street. Parcel 3 is located on the east side of Weyerhaeuser Way S between 33rd Place S and SR 18 and is planned for four office buildings with a total of 260,000 square feet of office space. Parcels 4, 5, and 6 are located south of SR 18 and each consists of one office building with 65,000, 48,000, and 80,000 square feet of office space, respectively. Residential North is proposed as an 82-unit detached condominium development north of S 320th Street and Residential South is proposed as a 90-unit single-family subdivision, located east of 33rd Place S northeast of Parcel 3.

Quadrant's traffic engineering consultant, The Transpo Group, was provided the task of analyzing the transportation impacts of the development. In addition to the City's concerns about mitigating the impacts of this level of development, the City was in the midst of an update of the Transportation Element of the Comprehensive Plan (including access management standards), and therefore wanted to assure that the appropriate roadway sections were provided for in the update. Weyerhaeuser Corporation also had several traffic-related concerns regarding the adequacy of the existing transportation infrastructure under existing conditions which would obviously be exacerbated by Quadrant's proposed developments. In particular, Weyerhaeuser s concerns were:

$ The use of Weyerhaeuser Way S and S 336th Street as cut-through routes for traffic avoiding the congested interchanges of I-5 at SR 18 and S 320th Street;
$ The speed of through traffic;
$ The lack of left-turn lanes at Weyerhaeuser's driveways;
$ The resultant poor levels of service for all stop-controlled approaches in East Campus;
$ Associated safety problems for Weyerhaeuser employees using any transportation mode: vehicular safety, pedestrian safety to access transit as well as street crossings of the network of trails in East Campus, and bicyclist safety due to the variable state of surfacing of roadway shoulders.

Subarea Plan
Transpo's first task was to identify any safety and capacity deficiencies and then provide a subarea transportation plan for full buildout of East Campus. Then, individual Transportation Impact Analyses were to be prepared for each development permit. However, market conditions were such that the majority of these developments ended up being fast-tracked in that draft TIA's were submitted prior to the completion of the City's review of the draft subarea plan. Nonetheless, the subarea plan was vital is reaching agreement between the City, Quadrant, and Weyerhaeuser regarding the appropriate level of improvements that would be necessary to address the transportation needs in a holistic fashion.

The existing conditions that were documented in the plan included the following:

$ Despite the 35 mph posted speed limits, the 85th percentile speeds were between 45 and 50 mph through East Campus;
$ The south intersection of the Wye was failing, and met warrants for signalization;
$ The east driveway from Weyerhaeuser Corporate Headquarters was failing and met warrants for signalization;
$ The 33rd Place S approach at Weyerhaeuser Way S was failing and would meet warrants for signalization when Residential South was constructed;
$ Left-turns out of either driveway from Parcel 3 (the dominant movement during the evening peak hour) would fail and would meet warrants for signalization;
$ The SR 18 westbound off-ramp was failing and met warrants for signalization;
$ The SR 18 eastbound off-ramp was failing and met warrants for signalization and had an accident rate of 1.25 collisions per million entering vehicles;
$ Weyerhaeuser Way S would need to have at least four lanes between the Wye and SR 18.

If all the locations where signal warrants were forecast to be met were signalized, the result would have been six traffic signals in slightly more than 1 mile of Weyerhaeuser Way.

City Standards
The City's access management standards (then draft, now adopted) can be summarized in the following table:

City of Federal Way Access Management Standards

Access Classification	Median	Through Traffic Lanes	Minimum Spacing (Feet)*					Minimum Signal Progression Efficiency***
			Crossing Movements	Left-Turn Out	Left-Turn in	Right-Turn Out	Right-Turn In	
1	Raised	6	Only at signalized intersections	Only at signalized intersections	330	150	150	40%
2	Raised	4	330	330	330	150	150	30%
3	Two-Way Left-Turn Lane	4	150	150**	150**	150**	150**	20%
4	Two-Way Left-Turn Lane	2	150**	150**	150**	150**	150**	10%

* Greater spacing may be required in order to minimize conflicts with queued traffic at the street s design year 95th percentile.
** Does not apply to Single Family Residential uses.
*** If the existing efficiency is less than the standard, new traffic signals may not reduce the existing efficiency.

$ Raised medians will be required if any of the following conditions are met:
1. There are more than two through traffic lanes in each direction on the street being accessed.
2. The street being accessed has a crash rate more than 10 crashes per million vehicle miles, if the street currently has a two-way left-turn lane.

$ Two-way left-turn lanes will be required if the street being accessed has a crash rate more than 10 crashes per million vehicle miles, if the street currently has no left-turn lane.

Weyerhaeuser Way S had been planned as a five-lane roadway, putting it in Access Class 3. Access Class 3 allows full access every 150 feet. However, attaining 20% signal progression efficiency would have been challenging at best had all the locations that would have met signal warrants been signalized.

All parties agreed that this level of signalization would have violated the annexation agreement's condition requiring that a rural atmosphere be maintained in East Campus. Quadrant was also concerned about the construction cost of this number of signals. The City was concerned about the additional maintenance expense (although the City had established a precedent of requiring benefiting developments to pay for the operation and maintenance expense of traffic signals installed at intersections for private access) and the difficulty in attaining adequate signal progression. However, left-turn movements onto Weyerhaeuser Way S would have been inherently unsafe due to the peak hour volumes being so far beyond capacity. If those movements were prohibited, U-turn volumes would have required left-turn phases at T-intersections, thus complicating further the attainability of adequate progression.

Proposal
Due to the Wye's nonstandard configuration and failing level of service, the City had a project listed in its 6-year Transportation Improvement Plan to realign and signalize this intersection. However, due to its unique availability of right-of-way and desire to maintain the rural atmosphere of East Campus, City staff was considering the Wye as a potential location for a roundabout. Knowing City staff was not vehemently opposed to the concept of a roundabout, Transpo considered the possibility of using a roundabout at other locations and concluded that one could be located at 33rd Place S.

The proposed plan would prohibit left-turns from driveways at Parcel 3 and Weyerhaeuser Corporate Headquarters east driveway onto Weyerhaeuser Way S. U-turns would be signed explicitly at the roundabout. It should also be noted that this will be the first roundabout operated as multi-lane in Washington State.

Design Guidelines
WSDOT has issued a draft "Roundabout Resource Reference" to local agencies. In it, WSDOT is recommending that multi-lane roundabouts not be constructed until more is learned about the operation of single-lane roundabouts. One of the leading proponents of roundabouts in the US, Leif Ourston of Ourston and Doctors in Santa Barbara CA, has suggested that such a policy is a major mistake. Ourston recommends that each agency start with an intersection with the biggest problems because if one starts with a small intersection, decision-makers may conclude that it can only work at small intersections. His point was borne out with respect to the first roundabout in Washington at University Place. University Place's City Council, in a resolution one year following the completion of the roundabout at Olympic Boulevard and Grandview Drive, concluded that it was a success, but they would not consider implementation of roundabouts on Bridgeport Way, their busiest arterial. Federal Way staff has concluded that roundabouts would not work at its two highest volume intersections (6300 and 6400 vehicles per hour), even as 4-lane roundabouts with right-turn bypass lanes, so there are definite limitations, but WSDOT's position may limit the political viability of roundabouts at locations where they may be the most appropriate solution.

Roundabouts have several advantages over stop-controlled and signalized intersections. These include:

$ Substantial reduction in delays over signalized intersections;
$ Improved capacity for side streets over two-way stop-control;
$ Improved capacity over signalized intersections;
$ Reduction in both collision rates and collision severity over other types of intersection control;

$ Potential for traffic calming effects;
$ Landscaping opportunities in the circular roadway.

These benefits are achieved as a result of particular design features that help distinguish roundabouts from more traditional rotary intersections as found in the East Coast or traffic circles as used for traffic calming. The biggest difference is that no approach has priority; all approaches yield to traffic in the circulating roadway. Deflection is an important feature that reduces travel speeds on approaches and around the circle, thus reducing the potential for rear-end collisions. The small circulating roadway radius ensures that travel speeds on the circulating roadway are less than 25 mph. Thus, small gaps (1.5 to 3.5 seconds) can be used for vehicles entering the circulating roadway. This is what provides greater intersection capacities for minor street approaches.

There are two general schools of thought regarding roundabout design: British and Australian. No national standards exist in the United States at this time, but Maryland and Florida have adopted guidelines that clearly prefer Australian principles. WSDOT appears to be heading that direction as well. In general, Australian designs appear more consistent with US design standards and capacity procedures. This is reflected in signing and marking primarily as Australia s standards appear more consistent with US driver expectancy. Capacity procedures are based on gap-acceptance studies consistent with Highway Capacity Manual procedures whereas the British methodologies are based on empirical equations developed from a data set that includes several roundabouts that do not conform to modern standards. Although the design of the 33rd Place S roundabout is based largely on Australian design procedures, we have attempted to consider British methodology as well in the design. Nonetheless, we have designed a roundabout that differs from Maryland and Florida (and draft WSDOT) standards in a couple instances.

One area of challenges to implement the basic precept of improving safety at roundabouts is the issue of deflection. Roundabouts are generally very effective at reducing both the number and severity of collisions compared to both signalized and two-way stop controlled intersections because drivers are required to deflect their travel paths around the splitter islands and the central island. The minimum radius of the shortest travel path defines the design speed of the roundabout. It is generally simple to maintain low design speed deflections with single-lane roundabouts. However, multi-lane roundabouts have a wider potential travel path (assuming all lanes are used), thus the deflection radius increases dramatically. This may be one of the reasons that WSDOT is recommending that multi-lane roundabouts not be constructed at this time. In this roundabout, deflection radii exist as large as 430 feet, corresponding to a design speed of 34 mph.

Because U-turns movements were to be encouraged to account for the traffic departing the office buildings, U-turns are signed explicitly using diagrammatic guide signs on the roundabout approaches, with 15 mph advisory speed plates mounted underneath. Also, lane use control signs will be installed to provide advance guidance through the roundabout. Yield signs will not include the standard "to Traffic on Left" riders as this appears redundant. Rhetorically, approaching on the stem of a T-intersection with a yield sign and a one-way sign pointing to the right, who else would one yield to? The Maryland guideline provides a diagrammatic roundabout warning sign, whereas the Florida guidelines consider this inconsistent with the MUTCD. Florida recommends using a Roundabout Ahead text warning sign instead, however, City staff decided that the diagrammatic guide sign would adequately warn drivers of something being very different, and after having driven one, would know what to expect.

One particular issue was the handling of bicycle lanes. As skill levels vary, the bicycle purist would prefer to have a bike lane striped through the roundabout, but all design guidelines discourage such treatment, as this striping might confuse users about right-of-way rules in crossing bike lane stripes. The lower-skill cyclist would prefer to use the sidewalk around the roundabout, but hardcore cyclists would not use it. Ultimately, the issue was decided by providing cyclists the choice of either staying in the roadway or using the sidewalk. Advance signing informs the cyclist "Bikes use sidewalk or merge left". At this location, a curb ramp is provided for cyclists wishing to use the sidewalk and the bike lane striping ends. At this point, the lane stripe tapers over to the widths provided at the roundabout yield line, which coincidentally, is 1 foot wider than the half street with the bike lane. Hence the pavement only widens one foot but the lanes are striped to taper from 11 and 12 feet (with a 5-foot bike lane) to 14 and 15 feet. Bike lane striping resumes after the crosswalk where bicyclists using the sidewalk would reenter the roadway.

Another issue of some discussion was the provision of sidewalks around the roundabout. As these sidewalks would be expected to be shared with some bicyclists (presumably traveling only counterclockwise), the original staff recommendation was for 8-foot sidewalks. Also, standards are very uniform in their discouragement of curbside sidewalks at roundabouts, as this might encourage pedestrians to cut across the roundabout through the central island; therefore 5-foot planter strips were also requested. However, due to right-of-way constraints, only 5-foot curbside sidewalks will be provided.

Pedestrian access is a concern at this location, as it will be the transit stop for both Residential South and Weyerhaeuser Corporate Headquarters (a CTR-affected worksite). The placement of crosswalks at roundabouts is not consistent with US practice at normal intersections. All standards suggest moving the crosswalk approximately 20 feet away from the yield line on approaches. The theory is that drivers at the yield line will be watching for gaps in the circulating roadway. Therefore, it is safer to have pedestrians cross where other drivers will be queued. The splitter islands, which help provide deflection to approaching traffic, also provide a center refuge island for pedestrians.

WSDOT is recommending that all crosswalks be marked at roundabouts. The City contends that marking crosswalks should be based on volume warrants, and that curb ramps and cutouts through the splitter islands would be adequate guidance for pedestrians to determine the appropriate place to cross. Furthermore, the City installs pedestrian warning signs at all marked unsignalized crosswalks and to add these signs would likely result in sign clutter, which would conflict with the rural atmosphere that we are attempting to preserve. Nonetheless, crossings and signing will be installed.

Summary

In this instance, the roundabout satisfied several concerns for all project partners. Access management will be implemented beyond the City's driveway spacing requirements and the issue of signal coordination is rendered moot. Construction costs will be less than the construction of several signals. Operation expenses will also be less than for signalized intersections. (As a side note, Weyerhaeuser will be responsible for maintaining the landscaping in the roundabout). Roadway safety will be improved over signalization due to reduced number of conflict points and the fact that roundabouts generally operate more safely than signalized intersections, and roadway speeds may be reduced as well. Finally, the rural atmosphere will be maintained by eliminating the need for signals and providing landscaping opportunities.

Conclusions

The roundabout at 33rd Place S will begin construction in the fall of 1999, with completion expected early in 2000. Assuming the project is successful, the Wye will be converted to a roundabout in 2001.

Roundabouts can be a useful access management tool. The goals of access management are improving roadway safety and preserving capacity. Advantages of roundabouts include:

$ Improved roadway safety;
$ Ability to accommodate high U-turn volumes;
$ Maintained arterial capacity;
$ Less usage of signalization;
$ Improved side street capacity.

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Acknowledgments

The design of this roundabout was a highly collaborative effort. All parties involved recognized the need to provide a successful design that would meet the project goals of maintaining a rural atmosphere in high volume conditions as well as encourage the appropriate use of roundabouts elsewhere in Washington State. The authors wish to acknowledge the following contributors to the design:

$ Maryann Olson, The Transpo Group, final traffic design
$ Hicham Chatila, P.E., The Transpo Group, conceptual and final traffic design
$ Steve Kitterman, P.E., ESM Consulting Engineers, final civil design
$ Ed Lagergren, P.E., Washington State DOT, conceptual design
$ John Diaz, P.E., KDD Associates, conceptual and final design

Authors

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Tasha Atchison has worked for the past four years at The Transpo Group, a consulting firm in Kirkland, Washington, specializing in transportation planning, design, and operations. Her focus has been shared between intermodal studies for transit systems, rail, transit-oriented development, and traffic planning studies. Her planning work often leads to the need for capacity and traffic control design measures, which in some cases has lead to the need for roundabout implementation.

Modern Roundabouts As An Access Management Tool

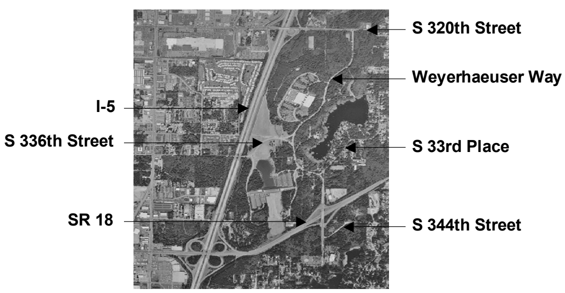
4th National Access Management Conference
August 15, 2000
Portland, Oregon

Richard A. Perez - City of Federal Way
Tasha Atchison - The TRANSPO Group

Why Roundabouts?

- Background
- Conditions
- Alternatives
- Application

Background

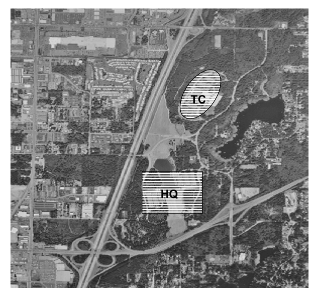


Background

Weyerhaeuser
<u>East Campus</u>

HQ Headquarters

TC Technical Center

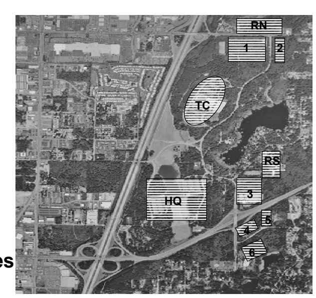


Background

<u>Quadrant Development</u>

1. 50 Acres Commercial
2. 10 Acres Commercial
3. 260,000 SF Office
4. 65,000 SF Office
5. 65,000 SF Office
6. 120,000 SF Office

RN 82 Townhomes
RS 90 Single Family Homes



Conditions

- Congestion
- Poor Level of Service
- Need for Roadway Widening

Conditions

Signals Warranted at

- "The Wye"
- Headquarters Driveway
- S 33rd Place
- Parcel 3 Driveway
- SR 18 Westbound & Eastbound Ramps

Conditions

Safety

- High Travel Speeds
  - 85th Percentile = 45 MPH
  - Posted Speed = 35 MPH
- Poor Sight Distance
  - "The Wye"
  - S 33rd Place
  - Headquarters Driveway

Conditions

Safety continued…..

- Minimal Non-Motorized Facilities
  - Gravel Shoulders
  - No Bike Paths
  - Transit Zones not ADA Compatible
- High Accident Rates
  - SR 18 Eastbound Ramp - 1.25 acc/mev

Alternatives

Stakeholders Goals

- City of Federal Way - Address Transportation Needs
- Weyerhaeuser - Maintain Safety & Rural Character
- Quadrant - Economic Feasibility

Alternatives

Design Considerations

- Provide Traffic Progression
- Left-Turn Capacity from Private Access and Minor Collectors
- Maintain Rural Character
- Low Maintenance Costs

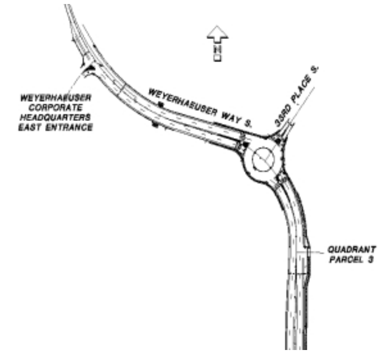
Alternatives

- Six Traffic Signals
- Alternate Access Management

Application

- Roundabouts
  - At “The Wye" Intersection
  - At Weyerhaeuser Way/S 33rd Place
- Roadway Widening
- Turn-Lane Improvements

Application



Application

Roundabout Advantages Over Other Types of Intersection Control

- Reduction in Vehicle Delay
- Improved Capacity
- Reduction in Collision Rates and Severity
- Potential for Traffic Calming
- Landscaping Opportunities

Application

Design Features

- Approaches Yield to Circulating Traffic
- Deflection on Approaches to Slow Entering Traffic Speeds
- Roundabout Radius Regulates Circulating Travel Speeds
- Accommodate Pedestrians & Bicyclists

Application

Methodology for Design

- British
- Australian
  - Adopted by Maryland & Florida

Application

Design Features

- Deflection
- Approach signs
- Bike Lanes

Application

Design Features

- ◆ Sidewalks
- ◆ Crosswalks

Acknowledgements

The TRANSPO Group

- Mary Ann Olson, P.E.
- Hicham Chatila, P.E.
- Bruce Haldors

ESM Consulting Engineers

- Steve Kitterman, P.E.

WSDOT

- Ed Lagergren, P.E.

KDD Associates

- John Diaz, P.E.

Conclusions

Project Status

- ◆ Opened May 2000
- ◆ Potentially Roundabout Constructed at ”The Wye" in 2002

Conclusions

Roundabouts For Access Management

- ◆ Improve Safety
- ◆ Accommodate High U-Turn Volumes
- ◆ Maintain Arterial Capacity
- ◆ Reduce Number of Traffic Signals
- ◆ Improve Side Street Capacity

16 Public Involvement Workshop

Slides

Other

16A. Public Involvement Workshop

Moderators: Kristine Williams, University of South Florida

Gary Sokolow, Florida DOT

Paper

Public Understanding of State Highway Access Management Issues - MN

Tuesday, August 15, 2000 10:00 AM – 11:30 AM

Track 3 - Workshop

WELCOME

Public Involvement Workshop

National Access Management Conference
Portland, Oregon August 2000

Florida Department of Transportation
Systems Planning Office

Center for Urban Transportation
Research, Univ. of South Florida

Access Management
Can Be Controversial

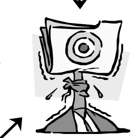
We need strategies to:

- Foster public trust
- Minimize conflict
- Create positive outcomes

Potential Sources of Conflict

Process Issues

Competing Interests



Uncertainty of Outcomes

Rules and Regulations

Interdependence of Solutions

Question

1. What are some of the problems you face when working with the public on access management issues?

Principles of Public Involvement

Communicate Clearly

Listen

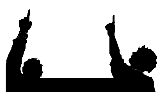
Satisfy Process Values

Be Inclusive

Tell the truth

Understanding Opposition

- Opposition becomes active when:
  - people feel the decision making process is unfair
  - people feel the outcome will be much worse than doing nothing



Gaining Public Acceptance

- People are more likely to *oppose* a project or action they feel is being imposed on them.
- People are more likely to *accept* a decision if they have been fully informed, treated fairly, and involved in decision-making.

Typical problems

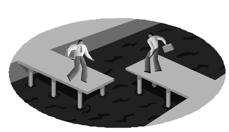
- The agency did not follow its own procedures
- The public was not involved early enough
- Affected parties were not adequately notified
- Inadequate response times

Satisfying Process Values

- Begin early and parallel decision process
- Prove to the public their concerns will be considered
- Achieve clear resolution and provide prompt feedback

Maintain Continuity

- "Publics" may change
  - More people get involved as a project progresses
- Establish linkages with past decisions and commitments



Question

1. How have these principles applied to a public involvement process you were involved in?

Public Involvement and Outreach Strategies

Use Networks

- Get to know the key players
- Build relationships
- Keep the lines of communication open

Don't forget to brief elected officials.

Regional Symposiums


Bluegrass Tomorrow's News

Bluegrass Choices – The Corridors That Connect Us

Participants' Viewpoints


What Are Corridor Access Management Plans?

Involving Minority and Low-Income Populations

- Barriers include:
  - Low literacy levels
  - Cultural and language barriers
- Standard approaches are often inadequate
- Determine how various groups receive information and target those forums

Project Newsletters


Route 104

Rebuilding Ridge Road

Project Update


PRELIMINARY CORRIDOR ALTERNATIVES

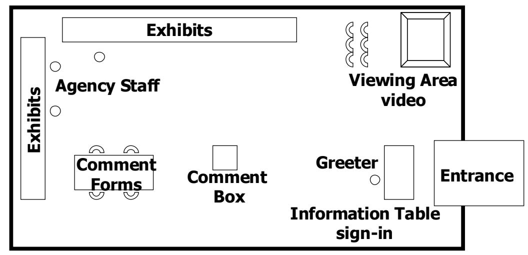
Joint Assessment

- Involve stakeholders in:
  - Assessing the problems
  - Developing solutions

Open House Meetings

- No need for formal presentation
  - Displays and handouts "speak for themselves"
- Project manager and specialists answer questions

Open House Meeting Format



Flyers

- Flyers supplement published notices
- Keep them brief
- Use everyday language
- Mail, hand deliver, and post

Effective Communication

- Know your audience
- Focus on their interests when conveying your message
- Anticipate the questions or concerns

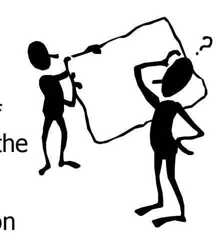
Active Listening

Listening is the most important skill in conflict management.

- Summarize, don't judge or editorialize
- Acknowledge, don't agree or disagree
- Be aware of body language

Addressing Concerns

- Acknowledge the concern
- Assess the impacts of the action in light of the concern
- Use creative mitigation and partnering

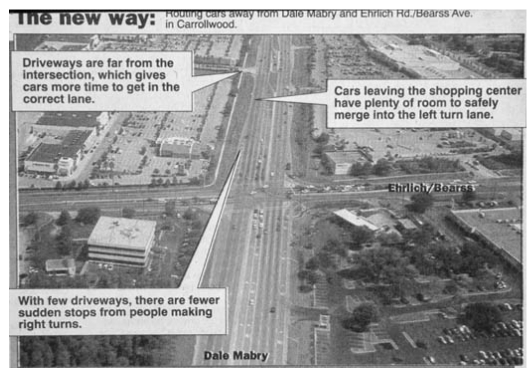


Meeting Follow-up

- Update the mailing list
- Analyze comments and prepare responses
- Tell them what happens next
- Respond in writing

Working with the Media

- Meet with the local editorial board
- Prepare a press kit
- Simplify your message

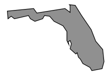


Question

1. What are some techniques you feel are helpful when working with the public on access management?

Public Involvement Issues and Strategies in Florida

Median Projects



Problems

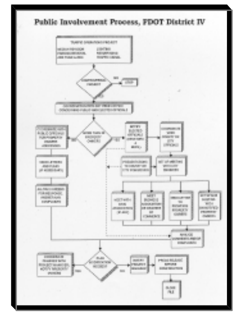
- Median issues "fall through the cracks"
- Reliance on public hearings
- Inconsistent decisions

Solutions

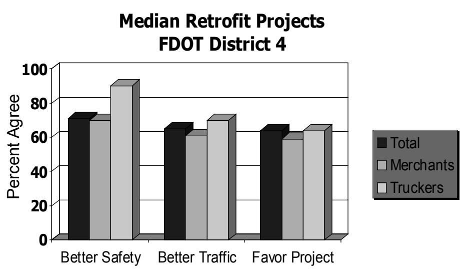
- Continuous involvement (PD&E through Design and Construction)
- Public involvement and open house format
- Median Opening Procedure

FDOT District IV CAP

- Controversial project?
  - Contact FDOT press office
- More than 30 property owners?
  - Brief elected officials
  - Public meetings
  - Analyze comments
- Plan changes needed?
  - Notify property owners

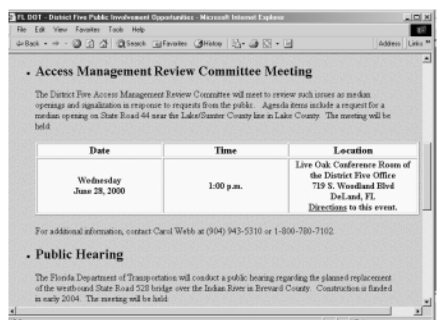


Public Opinion Surveys



Source: FDOT District 4 Traffic Operations
Freddie Vargas

The Internet



FL DOT - District Five Public Involvement Opportunities - Microsoft Internet Explorer

- **Access Management Review Committee Meeting**

The District Five Access Management Review Committee will meet to review such issues as median openings and signalization in response to requests from the public. Agenda items include a request for a median opening on State Road 44 near the Lake/Sumter County line in Lake County. The meeting will be held:

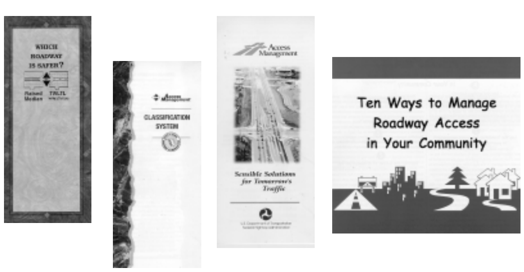
Date	Time	Location
Wednesday June 28, 2000	1:00 p.m.	Live Oak Conference Room of the District Five Office 719 S. Woodland Blvd DeLand, FL Directions to this event.

For additional information, contact Carol Webb at (904) 943-5310 or 1-800-780-7102.

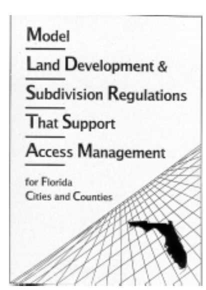
- **Public Hearing**

The Florida Department of Transportation will conduct a public hearing regarding the planned replacement of the westbound State Road 528 bridge over the Indian River in Brevard County. Construction is funded in early 2004. The meeting will be held:

Brochures



Local Government Outreach



- Model Regulations
- Training workshops
- Technical assistance

Overall Objectives

Legitimacy	Responsiveness	Effectiveness
….of Agency	Know the interests	Protect your credibility
…of Process	Ability to see from their point of view	Maintain 2-way communication
…of Assumptions	Identify problems and solutions	Find the basis for agreement
…of Decisions	Clarify key issues	Mediate

Thanks for Coming!

For more information, visit
www.cutr.eng.usf.edu

Administrative Rulemaking

Paper 17. Development of Oregon's Access Management Rules

Margaret Weil, Oregon DOT

Panel Members:

Craig Greenleaf, Oregon DOT

Sam Imperati, Institute for Conflict Management

Mark Whitlow, Perkins Coie LLP

Lynn Peterson, 1000 Friends of Oregon

Tuesday August 15, 2000 1:00 PM – 2:30 PM

Track 1 - Administrative

Institute *for* Conflict Management, Inc.

Dispute Resolution Services
Mediation, Facilitation, Team Building, ADR Training

OREGON'S NEW ACCESS MANAGEMENT RULES:
A Study in Process, Politics and Pragmatism

I. EXECUTIVE SUMMARY

The Oregon Department of Transportation (ODOT) charged the Access Management Advisory Committee (AMAC) with the task of addressing issues related to implementation of the access management[1] portions of the 1999 Oregon Highway Plan (OHP). AMAC commenced its work on February 19, 1999 and held eighteen meetings between that date and December 14, 1999. The AMAC process included facilitated assessment of complex, interrelated transportation planning issues, development of draft rule language and recommendations for changes to the OHP. Committee members communicated with their respective stakeholder groups and ODOT staff worked tirelessly to produce a comprehensive set of administrative rules. AMAC submitted its draft rules to ODOT in June of 1999, followed the subsequent public hearing process through October, reviewed ODOT's subsequent edits, and considered the hearing officer's report of public comments during its December 1999 meeting. The final written public comment period concluded January 7, 2000 and the Oregon Transportation Commission (OTC) adopted the rules without amendment on February 9, 2000. The new Chapter 734 Division 51 Access Management Administrative Rules were filed with the Secretary of State on February 14, 2000 with an effective date of April 1, 2000.[2]

ODOT contracted with Sam Imperati of the Institute *for* Conflict Management, Inc. (ICM) to facilitate the work of AMAC. Alison Kelley participated on the ICM team as an independent consultant. In addition to managing the AMAC process, ICM assisted ODOT with the post-AMAC, pre-adoption public hearings process and with the initial implementation phase

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[1] The Oregon Court of Appeals has defined "access" in the following manner: "'Access' has been construed narrowly as referring to the common law right of access to a 'conventional road or highway' from land that *abuts* the highway . . . In earlier cases, the common law right of access has been called an 'easement of access.' In rural areas an easement of access implies a reasonable right of ingress and egress from and to the highway from the property, and not at all points along the highway.'" Witten v. Murphy, 71 Or. App. 511, 515-16, 691 P.2d 715, 719 (1984)(citations omitted) (cited in Timothy V. Ramis and Andrew H. Stamp, *Integrating Procedural Aspects of Transportation and Growth Management in Oregon: A Critical Look at the Oregon Department of Transportation's Role as a Growth Management Agency,* 77 OR. L. REV. 845, 846, n. 3 (1998). "In addition to the regulation of driveways and approach roads, the term 'access management' encompasses the planning and permitting of medians, turn lanes, proper spacing of traffic signals, freeway interchange design, and other measures designed to improve the safety and efficiency of the highway system." Ramis and Stamp at 846, n. 3.

[2] The new rules clarify the management of access on state highway facilities. They consolidate and organize procedures for addressing access management issues into a single set of indexed rules. For the public, these efforts increase the level of predictability in obtaining an approach to a state highway. For ODOT, the new rules increase the level of consistency within the permitting process.

208 S.W. First Ave., Suite 360 Portland, OR 97204-3532 $ (503) 224-9014 $ imperati@teleport.com

of the new rules. ICM worked with trainers from ODOT's Access Management Group to develop operational procedures implementing key rule provisions. Finally, it assisted ODOT staff in preparing training materials covering the perspectives of stakeholders, new rule content and corresponding new procedures to help field personnel make a smooth transition to the new rules.

Upon adoption of the Division 51 Access Management Rules, the OTC approved a fifteen-month review to assess the effects of key rule provisions. ODOT has launched a new electronic permitting program (Central Highway Approach/Maintenance Permitting System – CHAMPS)[3] that will collect data pertinent to this review.[4] ODOT looks forward to continued feedback from interested stakeholders[5] regarding Division 51 Rules, and anticipates that the collaborative attitudes developed during the AMAC process will provide an important framework for continued productive communication regarding access management and other issues involving ODOT's stakeholders.[6]

II. BACKGROUND

Access management generally involves "balancing access to developed land while ensuring movement of traffic in a safe and efficient manner."[7] The OHP policy goal is "[t]o

[3] This electronic permitting system will provide statistics regarding the number of applications received, number of approaches approved or denied, and the complexity of the approach requests. CHAMPS also is able to distinguish approaches by highway, district or county. The way in which the approach applications are entered into CHAMPS allows ODOT to evaluate and monitor the timeline in which approaches are processed. This is important with respect to the 120 calendar-day limitation on the approval or denial of an approach request. ODOT is keeping a log of issues identifying potential "problem areas" and "fixes" that may be necessary to the rules as implementation proceeds. ODOT intends to analyze how effectively 734-051-0080 (Criteria for Approving an Application for an Approach) is being applied. How grants of access are handled will be reviewed as well. Finally, ODOT will monitor the number of appeals and their outcomes.

[4] In addition to the types of analyses listed above, it may be possible, if the mapping of highway segment designations is available prior to July 2001, to overlay such a map with the locations where permits were issued over the previous year. This will provide information regarding permitting patterns in Urban Business Areas (UBAs) and Special Transportation Areas (STAs). It also will show what kinds of permitting activity is occurring along designated Expressways.

[5] The 15-month review and feedback from stakeholders will assist the OTC in responding to a concern that was raised by some AMAC stakeholders. The concern, as expressed by two Commissioners at the February 2000 OTC meeting during which the rules were adopted by a 4-1 vote, deals with coordinated use of the rules and the 1999 OHP, and whether more specific language is needed to ensure access management decisions are interpreted in line with OHP policies. The facilitators believe the rules were adopted, despite this concern, because AMAC's proposal was a "package" and it was important to demonstrate to its stakeholders the value the Commission placed on their collaborative work, thus setting a precedent for future negotiations. ODOT will provide feedback on the degree to which access management decisions are supporting the policies in the OHP at the OTC's July 2001 meeting. ODOT plans to seek input from AMAC in this assessment process. ODOT is committed to providing the data and analyses necessary for the OTC to determine whether the new Access Management Rules achieve the intended results.

[6] AMAC participants commented favorably upon the collaborative process at its conclusion, and it is anticipated that stakeholders will take advantage of improved communication with ODOT as they offer feedback regarding Division 51 Rules during the fifteen-month review period. Information regarding the comments of AMAC participants were recorded by the Policy Consensus Initiative (PCI) (http://www.agree.org). Contact PCI Co-Executive Director Chris Carlson of Santa Fe, New Mexico (505-984-8211.

[7] 1999 Oregon Highway Plan at 101.

employ access management strategies to ensure safe and efficient highways consistent with their determined function, ensure the statewide movement of goods and services, enhance community livability and support planned development patterns, while recognizing the needs of motor vehicles, transit, pedestrians and bicyclists."[8] Oregon Revised Statutes Chapter 374 governs management of access to Oregon state highways. Prior to adoption of Division 51 rules, Oregon Administrative Rules Chapter 734 Division 50 contained administrative guidelines to implement provisions of the statutes through a permit system.[9]

[8] 1999 OHP at 101. What follows is a brief version of the historical context surrounding access management. In the late 1940s, state transportation departments were given the authority to regulate ingress and egress to their highways by federal legislation called the "Throughway Law." This law provided DOTs the regulatory authority over where and how traffic could access their highway systems. As a result, some very innovative highway designs and concepts for limiting and controlling access were established throughout the nation. In the 1960s, money for highway construction flowed freely from Washington, DC, and the DOTs began building the interstate system. With ODOT and other DOT's focus on building the interstate system, access management policies became somewhat less important. This continued until federal highway funds became scarce, while environmental issues did not. In the 1970s, Oregon adopted its nationally recognized land-use law, a statute requiring cities and counties to adopt comprehensive land-use plans for their jurisdictions. This set the stage for a 20-year discussion among transportation interests, land-use officials, environmentalists and developers. In 1991, the Oregon Department of Land Conservation and Development adopted the Transportation Planning Rule (TPR). The TPR requires cities and counties to develop or bring current transportation plans that are consistent with their adopted land-use plans. It took a few years for ODOT to fully integrate the TPR's influence on how it did business. With the establishment of urban growth boundaries and the focus of urban development within them, came the need for a renewed emphasis on the role of access management policies. Commercial development patterns were also changing with larger sale development projects becoming more common. These projects needed large parking lots for their customers and soon requests for land-use permits were popping up all over Oregon, particularly at the outskirts of small towns. There was a dramatic increase in requests for access permits. Developers soon found that the department's access management policies were interpreted differently in ODOT's five regions. Simply stated, ODOT's access management policies were not predictable throughout the state. This disconnect caused ODOT to take a long, hard look at its access management policies and in the mid- 90s the department raised the possibility of rulemaking. Ultimately, the department decided that the problem was not significant enough to warrant undertaking the daunting task at that time. In 1998, ODOT was completing its proposed Highway Plan, which includes access management policies. The 1999 legislative session was convening in January and waiting in the wings were several bills addressing ODOT's regulatory authority for access management.

[9] For background regarding access management in Oregon, visit http://www.odot.state.or.us/tdb/planning/access_mgt/ This web site offers research papers that explain the analysis behind relevant policy provisions and includes a draft policy paper. As noted in the policy paper, "Oregonians benefit from access management because it:

1. Makes roadways safer. Lives are saved and accidents that cause injury or property damage are reduced. Access management projects in other states have reduced accident rates by as much as one-third.
2. Reduces the need for major road widening to meet increasing demands by prolonging the usefulness of existing roadways.
3. Maintains the statewide movement of goods and services necessary for economic prosperity.
4. Produces a more constant travel flow, which helps to limit congestion, reduce fuel consumption and improve air quality.
5. Provides increased safety and options for pedestrians and cyclists, and improved travel time for transit.
6. Encourages the coordination of land-use and transportation decisions which can:
   a. Stabilize land use patterns and help preserve private investments; and
   b. Support and maintain livable communities.
7. Establishes uniform standards and ensures fair and equal application for neighboring property owners."

Draft Management Policy pp. 3-4. Oregon is unusual in that transportation issues (Goal 12), along with 18 other elements, are combined into one comprehensive planning approach. (S*ee* http://www.lcd.state.or.us/backinfo/

Before convening AMAC, ODOT officials and the OTC recognized the need for improvement in Oregon's access management system. While reflecting regional and transportation system diversity, a wide range of operational permitting practices across the state led to inconsistency in permit decisions and resulted in frustration for property owners and developers. Regarding the effect of road approach denials for developing property, commercial stakeholders voiced concern over the practical ability of narrow "alternate access" routes to serve development adequately. Understanding that inverse condemnation laws did not guarantee property owners compensation[10] and that denial of access under certain circumstances would not necessarily trigger compensation for the property owner, many stakeholders grew increasingly frustrated with policies they felt were out of sync with legitimate development needs and transportation planning objectives. Additionally, many ODOT officials and stakeholders expressed the desire for an improved appeals process.

To address these issues, ODOT acknowledged the need to consult with stakeholders in order to understand their perspectives and solicit their input in developing appropriate administrative rules. When to convene the committee[11] became a central question; a new legislative session was approaching[12] and a major case was pending before the Oregon Court of Appeals.[13] ODOT determined it was in the best interest of the state and its citizens to proceed immediately, and ultimately charged the committee with the task of developing recommendations regarding implementation of the OHP policies relating to medians, spacing, deviations and permitting, with the understanding that such recommendations would likely address issues surrounding reasonable access and grants of access.[14]

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goals.htm for a list of the 19 Statewide Planning Goals.) For further background reading, *see generally* ATTORNEY GENERAL ADVICE LETTER OP-6457(1993); Timothy V. Ramis and Andrew H. Stamp, *Integrating Procedural Aspects of Transportation and Growth Management in Oregon: A Critical Look at the Oregon Department of Transportation's Role as a Growth Management Agency*, 77 OR. L. REV. 845 (1998); and Steven R. Schell, *Land Use Meets Populism: Citizen Control of Growth in Oregon*, 77 OR. L. REV. 893 (1998).

[10] "The mere fact that traffic has to use a more circuitous route to obtain access to Center from Front may be inconvenient, affecting the use, but it does not rise to the constitutional magnitude requiring compensation. A landowner is not entitled to compensation under eminent domain for the circuity of a route resulting from the construction of a limited access highway. Highway Com. v. Central Paving Co., 240 Or 71,74, 399 P2d 1019(1965)" Argo Investment v. Dept. of Transportation, 66 Or. App. 430, 674 P2d 620 (1984).

[11] *See* OAR 137-005-0020(2)(2000) (Assessment for Use of Collaborative DR Process) for guidelines in determining when a collaborative process might be appropriate. Available at http://www.doj.state.or.us/ADR/adr_mrules_0010.htm.

[12] During the 1999 session, two significant bills involving access management were passed. SB 773 directed ODOT to adopt rules governing the application for and issuance of permits for approach roads, requiring, in part, that rules adopted by the Department include a 120-calendar day time frame in which to allow or deny a permit, including resolution of internal appeals, and criteria for determining what constitutes reasonable access. SB 86 addressed the ability of property owners to claim relief if ODOT closes an approach road for which a permit was issued or denied an application for an approach road permit submitted pursuant to a grant or reservation of access contained in a deed, and the closure or denial was not the result of conditions contained in a contract, judgment, recorded deed or permit. ODOT has developed proposed administrative rules implementing SB 86, which are currently proceeding through the rulemaking process. (Draft OAR 734-ORI Rule A-6).

[13] ODOT v. Hanson, 162 Or. App. 38, 987 P.2d 538 (1999).

[14] AMAC *Agreement to Collaborate* at 3.

III. PRE-AMAC PLANNING

During the summer of 1998, ODOT staff held a series of work sessions to develop common objectives related to the agency's approach to access management. Simultaneously, work was progressing on the 1999 OHP. By the fall of that year, the internal work had produced decision points to guide managers in their efforts to improve the agency's approach to access management.[15] That November, ICM met with ODOT to discuss the process plan for the anticipated advisory committee. Throughout December of 1998 and January of 1999, ICM held additional meetings with ODOT, reviewed extensive background materials, and refined the process plan while ODOT began identifying interested stakeholders.[16]

Developing the *Agreement to Collaborate*[17] constituted a central component of the early planning stages. Articulating the legal authority,[18] the core charge, the operating procedures, and the ground rules, the *Agreement to Collaborate*[19] became a tool that would provide a clear focus for the committee. ODOT and ICM devoted hours of review and editing to achieve a balanced *Agreement* before it was presented to AMAC. The *Agreement* included the schedule of AMAC meetings as well as the subsequent rule adoption schedule. Although the *Agreement* contained a clear "core charge," some AMAC members expressed concern that the charge would preclude their consideration of collateral but interrelated issues.[20] Negotiation surrounding that question constituted the first major challenge for the committee. The resulting agreement was

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[15] *The ODOT Access Management Decision Package*, December 1998. Previously, ODOT and its external technical advisors had agreed in principal on the engineering standards that ultimately became part of the new rule. This saved considerable AMAC time and allowed it to focus on the policy/legal issues. *See* n. 20.

[16] ODOT's intention was to invite committee members from various stakeholder interest groups so that the membership of AMAC would reflect balance. The committee represented a wide range of interests, including:

a. Developers, represented by the International Council of Shopping Centers, the Oregon Association of Realtors, the Retail Task Force and the Oregon Small Business Coalition,
b. Land Use Groups, represented by Oregonians in Action and 1000 Friends of Oregon,
c. Transportation Interests, represented by the freight industry, alternative transportation groups, FHWA and the Alliance for Community Traffic Safety,
d. State Agencies, including DLCD and OEDD,
e. Local Government, represented by the League of Oregon Cities and the Association of Oregon Counties, and
f. Traffic Engineers.

[17] *See* Oregon Administrative Rules 137-005-0030 (2000).

[18] *See* Oregon Administrative Rules 137-001-0007 (1997). This is the rule under which AMAC was conceptualized.

[19] The *Agreement to Collaborate* may be found at http://www.odot.state.or.us/tdb/planning/access_mgt/amac/finalagree.doc.

[20] Discussion of the "core charge" in the *Agreement to Collaborate* occurred during the first few AMAC meetings, and included an effort to allow consideration of collateral yet interrelated issues while maintaining focus upon the central objectives for AMAC articulated by the OTC and ODOT. Ultimately, with the approval of OTC Chair Henry Hewitt, the core charge consisted of four elements: the primary objectives (process for implementation of the access management portions of the 1999 OHP including permitting, spacing, medians and deviations); specific recommendations regarding classifications of state highways and highway segment designations; any recommendations necessary to create consistency between proposed rules and the OHP; and *Other Recommendations* relating to system definition and access management but falling outside the first three categories.

instrumental in launching a collaborative process in which all participants realized their concerns would be heard.[21]

Organization and "mid-course" corrections continued throughout the AMAC process through frequent communication among ICM, Craig Greenleaf (ODOT's Deputy Director of Transportation Development and a non-voting member of AMAC),[22] and Margaret Weil (then-Public Policy Coordinator for Community Development Cluster and the contract administrator). Communication with other ODOT personnel and with AMAC members was arranged as necessary to address the legal, policy and technical issues that AMAC was considering.

Organizing basic meeting logistics comprised an important part of the AMAC process. ICM and ODOT agreed to the need for precise, complete meeting minutes because the topic was of statewide importance. AMAC meeting summaries were posted on ODOT's website[23] following each meeting, generally from a court reporter's transcript. Although time consuming, the detailed quality of minutes provided a valuable record for resolution of future questions and allowed a broad audience to track AMAC's progress. Additionally, because many AMAC meetings lasted nine hours or more and required several committee members to travel from outside the region, efforts were made to provide adequate supplies and suitable refreshments throughout each meeting. These small details assisted committee members in focusing on their immediate tasks. Between meetings, the use of email and the web site provided a timely communication system.

[21] AMAC members sought clarification from ODOT regarding the degree to which ODOT would support AMAC's recommendations. To address this concern, the *Agreement to Collaborate* included the following language: "AMAC recognizes that Oregon Administrative Rule 137-001-0007 does not require ODOT to adopt AMAC recommendations. However, the director understands and acknowledges the time, effort, and resources expended by the AMAC members in this collaborative process. In creating AMAC, the Director acknowledges that the recommendations from AMAC's charge will constitute the **fundamental basis** of ODOT's decisions relating to access management. Therefore, upon their receipt, ODOT, after consultation with the OTC, will take action consistent with its statutory charge in proposing future legislative concepts and policy, proposing administrative rules, and implementing operational changes through design and desk manuals. Finally, the Director will transmit to the OTC for its consideration any AMAC proposals to amend the 1999 Oregon Highway Plan necessary to create consistency with AMAC's adjusted implementation recommendations." (*Emphasis added.)* See *Agreement to Collaborate* at Section II.C and D, pp. 2-3. Upon conclusion of the process, AMAC's desire that ODOT would advance its recommendations unchanged to the OTC became a reality. Largely because of the high quality of communication between ODOT and AMAC during the process, the resulting recommendations constituted a product that carried ODOT's full support and prompted the OTC to adopt the proposed administrative rules without amendment.

[22] Mr. Greenleaf participated on AMAC as a non-voting member and negotiated on ODOT's behalf, conveying invaluable information for the benefit of the committee. A key to the success of the process was the judicious timing of ODOT's concerns. It let the stakeholders vent, brainstorm and negotiate before presenting its reasoned positions surrounding legal analysis, technical barriers and resource obstacles. Because Mr. Greenleaf's position did not include voting authority, AMAC's recommendations retained their status as external advisory committee recommendations to ODOT.

[23] Available at http://www.odot.state.or.us/tdb/planning/access_mgt/amac/index.html.

IV. AMAC EDUCATION

Participants on advisory committees typically bring differing levels of policy, technical and legal expertise to their work and AMAC was no exception. In the beginning, all members of AMAC faced the task of becoming acquainted with complex areas of policy, engineering and law in order to participate constructively in the process. ODOT provided extensive background material that ICM assembled into notebooks and encouraged AMAC members to read. Throughout the process Assistant Attorney General Dale Hormann explained the history of access management in Oregon and assisted AMAC members in understanding key aspects of relevant laws. The members also educated each other on economic, technical and operational issues.

Because the collaborative process would involve intensive negotiation, ICM devoted much of the first AMAC meeting to educating participants in useful communication strategies and pertinent conflict resolution concepts. ICM helped members to understand the objective of finding "common ground" and to utilize dispute resolution tools for overcoming conceptual gridlock. ICM utilized mediation techniques used in commercial disputes[24] as well as public policy strategies to manage potential impasses. As the AMAC process continued, ICM reinforced productive communication strategies and brainstormed innovative techniques to minimize unnecessary conflict and maximize the creative potential of the group.

The AMAC process involved multi-level education flowing in several directions simultaneously. Participants clarified their concerns and learned to appreciate the perspectives of their colleagues, while at the same time developing recommendations that would improve Oregon's access management system. The process also succeeded in demonstrating that complex transportation issues could be resolved more effectively in the collaborative arena that either the political or legal arenas.

V. NEGOTIATION/RESOLUTION

The eighteen AMAC meetings were all-day sessions (with three exceptions) held either in Portland or Salem. The committee agreed to working lunches during the last several meetings in order to utilize available time most productively. To explore difficult issues which were too complex or contentious for immediate decisions, ICM proposed that balanced subcommittees study the subject matter and develop draft recommendations to submit to the entire group. AMAC members volunteered to participate in subcommittee work depending on the degree to

[24] ICM used caucusing techniques to facilitate the resolution of process and substantive issues. Additionally, the participants were coached between meetings on negotiation styles ("You can get further with nice words and a gun than you can just with a gun!" A. Capone), option generation, and managing interpersonal tensions. ICM used these "off-line" conversations for "reality-testing" to help bridge the gap between positions and occasionally put forth "facilitator solutions" for the group to consider when it was struck.

which the question matched their interest or expertise.[25] Following subcommittee meetings, the next full AMAC meeting typically involved subcommittee members summarizing their work and presenting their recommendations to the other AMAC members. Subcommittee members typically developed a depth of knowledge about a particular area through their work together, and then set the context for the large group so all members could deliberate with the same level of information.

As described in the *Agreement to Collaborate*, ICM used a single-text, discussion draft process to facilitate the development of recommendations and draft rule language. Early in the process, ICM converted ODOT's draft rule concepts into a single document to which AMAC members could respond with proposed changes. Throughout the remaining months, ICM corresponded with AMAC members through electronic mail, sending "red-lined" drafts to the committee and to ODOT following meetings, collecting further edits and feedback, and incorporating suggestions into the single-text discussion draft in preparation for the next AMAC meeting. ICM used a consensus voting procedure[26] that allowed AMAC members to register their responses to proposals and included an opportunity to offer suggested edits to textual development while explaining their reasoning. The consensus voting procedure included the possibility for a minority report in the event the committee did not reach consensus on a particular point.

From a process perspective, the complex nature of the subject matter produced a tendency for members to include collateral issues in their explanation of reasoning behind a vote. This dynamic highlighted the need to balance consideration of interrelated concerns with the need for a focused discussion. To manage this balance, ICM used classic facilitation tools to assist members in focusing on the point at issue while recording collateral concerns on flip charts for later consideration. The team approach to facilitation became invaluable during these sessions as one facilitator managed the discussion while the other kept track of rapidly developing concepts and proposed changes using a laptop and an InFocus projection system. This allowed AMAC to craft rule language on the spot, keeping members focused and on-task

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[25] AMAC used such subcommittees to develop recommendations regarding relevant OHP provisions, to analyze the relationship between "reasonable access" and permitting, to develop permitting criteria, and to study draft language involving medians and spacing.

[26] The *Consensus Voting Procedure* is described in Exhibit B of the *Agreement to Collaborate.* During the process, ICM articulated proposed recommendations for consideration. Each voting committee member responded by showing a card displaying the number "1," "2," or "3." "1" indicated full support for the proposal as stated. "2" indicated that the participant generally agreed with the proposal as written, but preferred to modify it in some manner to give it full support. "3" indicated non-support for the proposal. ICM then invited those members voting "2" or "3" to explain the reasons for their vote and to offer suggested edits. ICM facilitated simple majority voting on suggested edits, and once the edits were complete, took a second consensus vote on the issue. For the purposes of this process, "consensus" was defined as all AMAC members voting "1" or "2." Following the opportunity to consider an issue, ICM recorded a vote as majority/minority if any AMAC members continued to vote "3," and offered those voters the chance to submit a minority report explaining their position. Recognizing the interrelated nature of the issues, ICM called for a final vote at the end of the AMAC process on whether the final recommendations reflected accurately the work of AMAC.

during the grueling process. It also provided a real sense of accomplishment and progress at each meeting.[27]

In addition to keeping the OTC abreast of AMAC developments, a large portion of the work involved consistent communication among ODOT staff regarding emerging AMAC proposals. An internal group of advisors[28] met weekly with Mr. Greenleaf to explore the latest developments and to offer their feedback. ICM participated in many of these meetings as one strategy for process continuity. Although necessary to ensure the rules were workable from ODOT's perspective, this second set of weekly meetings placed additional strain on agency resources already consumed by the demands of ongoing work and the legislative session.[29] This should be a consideration for other agencies faced with the decision of whether to conduct a large-scale collaborative process during a legislative session. This issue also affects private sector stakeholders.[30]

VI. LEGAL & TECHNICAL OVERVIEW OF THE NEW ACCESS MANAGEMENT RULES

The administrative rules developed in this collaborative process reflect a comprehensive approach to access management. From a substantive perspective, the new rules:

a. Encourage early communication between the agency and the applicant to clarify expectations;
b. Provide consistency through the use of objective criteria for approving approaches;
c. Clearly define and assign specific responsibilities within ODOT;
d. Establish a 120 calendar-day time frame for approval or denial of an application;
e. Publish access management spacing standards and minor deviation limits;
f. Establish access management objectives for highway projects;
g. Establish an expedited appeals process and opportunities for collaborative discussions; and

[27] While most negotiations, this one included, have the "Oh, by the way!" stage, where participants bring something up toward the end of the process and other participants "cry foul," real-time crafting of language diminishes the negative impact of this stage. Facilitators and participants should make efforts to surface "Oh, by the way" concerns before the last 25-30% of the allocated process time.

[28] The Access Management Advisory Group, or "AMAG." If the timeframe had permitted, this group would have been convened three to six months earlier to avoid some of the time challenges created by the legislative session and to allow it to get ahead of the discussion issues presented to or raised by AMAC.

[29] In spite of the strain on resources, the value of this internal communication became clear in the subsequent implementation phase because some ODOT employees already had a working knowledge of the new rules.

[30] Conducting a collaborative process during a legislative session creates a negotiation in the shadow of the legislature. All participants have a second forum where they may get a more favorable result or have to defend against a collateral attack. This dynamic set the stage for the use of mediation techniques commonly used in commercial disputes as the parties assessed and reassessed their best alternatives to a negotiated agreement (BATNAs). It also created urgency to in the collaborative effort as the legislative session wound down and the politicians looked to AMAC for answers.

h. Encourage the use of access management plans and intergovernmental agreements in long-term comprehensive planning so projects are coordinated with local land-use processes.[31]

Prior to AMAC, ODOT determined whether to grant an approach road permit largely by assessing whether there was reasonable alternate access. This allowed ODOT to maintain mobility and safety on state highways by limiting the number of direct approaches, which studies had shown introduced conflict points leading to congestion and crashes. As the Oregon Court of Appeals had noted, "A landowner's access to a highway that abuts the landowner's property is subject to the state's authority to control and regulate the use of the highway."[32] Denial of an approach permit has not been held by Oregon Courts to entitle property owners to compensation as long as the owners had some other reasonable access, under the theory that any reduction in business or value of the property pursuant to such denial did not deny all economically beneficial or productive use of the land so as to amount to a "taking."[33] Similarly, property owners are not entitled to compensation for denial of an approach permit when such denial resulted in

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[31] During the development of the administrative rule, there was debate about whether access management plans for specific highway segments should be made mandatory. The rule does not make such plans mandatory but does encourage their use. The Transportation Development Division will work with the Region Managers to explore opportunities for development of access management plans. It is anticipated that these first plans will focus on facilities with high volumes, those that provide important statewide or regional connectivity and in areas where critical access management issues are occurring or may occur. The department encourages access management plans to be performed in concert with applicable corridor plans, transportation system plans, plan amendments or STA or UBA designations.

[32] ODOT v. Dupree, 154 Or. App 176, *rev. den.,* (1998), *citing* Curran v. ODOT, 151 Or. App. 781, 784, 981 P.2d 183 (1997). "[P]rivate rights of abutting land owners to access their property via the street or highway are 'subservient' to the primary rights of the public to the free use of the streets for the purpose of travel and incidental purposes.' Oregon Investment Co. v. Schrunk, 242 Or. 63, 69, 408 P.2d 89 (1965). 'To protect the public safety, public convenience and the general welfare, governments may qualify or restrict an abutting landowner's right of ingress and egress via that highway.' *See* State Highway Com. v. Burk, 200 Or 211, 265 P.2d 783 (1954), and Boese v. City of Salem, 40 Or. App. 381, 595 P.2d. 822, *rev. den.,* 287 Or. 507 (1979). . . . After World War II, the legislature adopted comprehensive legislation recognizing the state's police power to control access to public highways. . . Or. Rev. Stat. §374.310(2) allows the state to do anything "in the best interest of the public for the protection of the highway or road and the traveling public. Also, Or. Rev. Stat. 374.305 states that certain actions may be taken, including removal, alteration or change when 'the public safety, public convenience and general welfare' require such action. The quoted language is an implied limitation on the powers that this statute grants to state government. Another limitation, expressed in Or. Rev. Stat. §374.310(3), is that access control statutes may not be 'exercised so as to deny any property adjoining the road or highway reasonable access.' The negative implication of this restriction is that the state may exercise its regulatory powers to deny property adjoining the highway access when there is reasonable alternative access.'" *See* ATTORNEY GENERAL ADVICE LETTER OP-6457(1993) at 4.

[33] *See* Dupree, *supra* note 29 at 4, *citing* Gruner v. Lane County, 96 Or. App. 694, 697-98, 773 P.2d 815 (1989); *see also AG ADVICE LETTER* at 4.

inconvenience from traveling a more circuitous route.[34] Compounding this dynamic was an appeal process that precluded contested case hearings for certain types of actions.[35]

First at the subcommittee level and eventually in full committee, AMAC assessed the above issues and considered the feasibility of developing criteria for ODOT to use in assessing an application for an approach. Objectives included providing permitting guidelines that would be applied consistently throughout the state, thus assisting stakeholders in anticipating how permitting decisions would be made. New OAR 734-051-0080, *Criteria for Approving an Application for an Approach*, contains permitting criteria that distinguish public and private approaches, subject property that has reasonable access and that does not have reasonable access,[36] and rural and urban areas. Carefully crafted through months of intensive discussion and with internal feedback from AMAG, the private approach permitting criteria include two factors for urban or rural private properties without reasonable access that is not or cannot be made adequate,[37] nine factors for urban private properties with reasonable access,[38] and nine factors for

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[34] Highway Com. v. Central Paving Co., 240 Or. 71, 74-75, 399 P.2d 1019 (1965), *cited in* AG ADVICE LETTER (OP-6457(1993) at 4. "A landowner is not entitled to compensation under eminent domain for the circuity of a route resulting from the construction of a limited access highway." Argo Investment v. Dept. of Transportation, 66 Or. App. 430, 432-33, 674 P.2d 620 (1984).

[35] "ODOT access permitting does not trigger a contested case hearing. . .unless the department is revoking previously granted "reasonable access" or pre-1949 legally established access. . . ." Ramis and Stamp, 77 OR. L. REV. at 861. *See* n. 70, which observed that when ODOT uses its police power to close access, landowners might have been entitled to appeal the department's decision by requesting a contested case hearing.

[36] Whether a subject property has reasonable access in addition to the requested approach ("reasonable alternate access") constitutes a key issue in determining the effects of denying an approach application. The Oregon Court of Appeals has ruled that the state may restrict access to land, without compensation, so long as the landowner retains "reasonable and adequate access" to serve the land. *See* State Dept. of Transportation v. Shoppert, 82 Or. App. 311, 314, 728 P.2d 80 (1986). The Attorney General's office has noted, ". . .we believe that the courts would find a compensable taking when access restriction leaves a parcel landlocked. A parcel is landlocked when it lacks all access to public ways." AG ADVICE LETTER OP-6457(1993) at 6-7, note 8 (Landlocking a parcel would deny the abutting owner "all economically beneficial or productive use" of the land. Such takings are generally compensable. *See* Lucas v. So. Carolina Coastal Council, 112 S. Ct. 2886 (1992).

[37] OAR 734-051-0080(1) states, "The Department shall approve an Application for an approach for an applicant who applies for a private approach where the subject property has a right of access and the following requirements are met: (a) Where the applicant has no reasonable access to its property, the applicant demonstrates that each of the following requirements are met:

(A) The private approach to the state highway can be accommodated or mitigated consistent with the safety of the traveling public pursuant to the criteria in section (3) of this rule; and
(B) The private approach is consistent with the classification of the highway and the highway segment designation of the state highway facility."

[38] OAR 734-051-0080(1) states, "The Department shall approve an Application for an approach for an applicant who applies for a private approach where the subject property has a right of access and the following requirements are met: … (b) Where the applicant has reasonable access to its property, the private approach to the state highway is in an urban area, and the applicant demonstrates that each of the following requirements are met:

(A) The private approach to the state highway can be accommodated or mitigated consistent with the safety of the traveling public pursuant to the criteria in Section (3) of this rule;
(B) The private approach is consistent with the classification of the highway and the highway segment designation of the state highway facility;
(C) Those requirements set forth in OAR 734-051-0190 and 734-051-0200 are met or a deviation is approved in accordance with the standards set forth in OAR 734-051-0320 through 734-051-0350;

rural private properties with reasonable access.[39] AMAC concluded this approach was preferable to an attempt to redefine "reasonable access" in the administrative rule arena because it did not have the power to affect judicial or legislative pronouncements even if the latter option was politically viable.

Pursuant to SB 773, ODOT established rules providing for a 120 calendar-day limitation on approach permitting decisions, including internal appeals. (OAR 734-051-0070). Finally, appeals processes were implemented that included both informal collaborative discussions (OAR 734-051-0390)[40] and formal contested case procedures. (OAR 734-051-0400). Taken together, the new rules provide an innovative approach to access management in Oregon.

VII. RULE IMPLEMENTATION

ODOT initiated an in-depth training process to ensure staff would be ready to use Division 51 Rules prior to their effective date of April 1, 2000. ICM assisted ODOT staff in developing training objectives, materials and strategies. Training objectives included: learning to identify key timelines, applying permitting criteria, understanding the appeal process, determining specific individual responsibilities within regions, and understanding the relationship between Division 51 Rules and the 1999 Oregon Highway Plan. Training also included discussion of the interrelationship between the new database and permitting program (CHAMPS) and the permitting process.

To achieve these objectives, staff developed a training module that provided an overview of the rules and delivered detailed analysis of specific rule provisions. Combining audio-visual presentations with focused group discussions, staff facilitated a two-day session in each of the five ODOT regions. ICM facilitated debriefing sessions following each of these trainings to

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(D) The effect of the approach will meet traffic operations standards, signals or signal systems standards as set forth in OAR 734-020-0400 through 734-020-0500;
(E) The highway mobility standards as set forth in the 1999 Oregon Highway Plan are met;
(F) The site design does not rely upon the highway for internal site circulation, as shown in a site plan set forth in OAR 734-051-0170;
(G) The approach to the highway is consistent with an access management plan, as set forth in OAR 734-051-0360(8), for the segment of highway abutting the property, if applicable;
(H) The approach to the highway is adequate to serve the volume and type of traffic reasonably anticipated to the site, as set forth in OAR 734-051-0130; and
(I) Where additional approaches are requested, more than one approach is necessary to accommodate and service traffic as may be reasonably anticipated to the property."

[39] OAR 734-051-0080(1)(c).

[40] OAR 734-051-0390 states, "… (1) The Region Review process applies to appeals of any action on an application, Construction Permit, or Permit to Operate, Maintain and Use an Approach which is unsatisfactory to the applicant or permitee such as, but not limited to, appeals of denied applications, including denied deviation requests, closure of existing approaches, or appeals of conditions or terms included as part of a Construction Permit. . . .(9) If the Region Review or collaborative discussion does not result in agreement, the Department shall provide written notification to the applicant or permitee within 10 calendar days of the conclusion of the Region Review or collaborative discussion, including information on the applicant's or permitee's rights to request a hearing as provided by the Administrative Procedure Act (ORS Chapter 183). (10) If the applicant or permitee wishes to request a hearing, the applicant or permitee may do so through the procedures, in accordance with the hearings process for contested cases, as set forth in OAR 734-051-0400"

assess the prior session and prepare for the next. Staff then arranged for a third training day during which specific case examples were explored in detail, previous questions were answered, and careful attention was given to reviewing procedures. ICM and ODOT addressed written questions regarding both substantive and process issues from the first two days of the training in a *Question and Answer* handout.[41]

Evaluations collected from each of the regions revealed a strong overall satisfaction rate. Comments consistently reflected the desire to meet the needs of applicants while at the same time providing for the safety of the traveling public. Participants requested ongoing follow-up training, offered constructive suggestions regarding implementation procedures, and demonstrated general optimism toward using the new rules. In addition to follow-up staff training, ODOT is considering public informational sessions on the new rules.[42] At this time, a new brochure detailing the permitting process[43] and copies of an approach application[44] have been made available on ODOT's website.

VIII. CONCLUSION

AMAC fulfilled its task of addressing implementation of the access management portions of the 1999 OHP. Although the juxtaposition of the AMAC process with the 1999 Legislative Session created some logistical difficulties and political pressures surrounding this highly contentious subject, AMAC produced recommended administrative rules that have been widely viewed as representing a balanced approach to access management. Following the conclusion of the process, several AMAC members noted they did not achieve their "wish list" of access management policy changes, yet in the same breath these members expressed satisfaction with the process and generally with the result. The combination of AMAC's tireless efforts and the hard work of ODOT created a synergy that ultimately produced not only new rules, but also enhanced understanding between previously polarized groups.[45] ODOT's efforts to collaborate internally while AMAC was completing its tasks increased the likelihood of agency staff acceptance of the new rules.

This process exemplifies the benefits of carefully managed collaborative processes. The result is a credit to AMAC's sponsors and participants, who had the courage to negotiate

[41] Training will be a continuous process. To facilitate efficient communication, ODOT now has a central email address allowing region staff to communicate directly with Access Management Program Unit members regarding specific questions as they arise. The Access Management Program Unit is developing a distribution system to keep all staff up-to-date with the most current procedural developments. An Access Management Manual will be published soon.

[42] In many cases, this will be initiated by the regions in their direct communication with local governments and stakeholders.

[43] Copies of the new brochure, "Developing Property with an Approach to a State Highway" may be found at http://www.odot.state.or.us/tdb/planning/access_mgt/adopted_rules/8x11_brochure%20for%20approaches%204-10-00.pdf.

[44] Copies of the new approach application may be found at http://www.odot.state.or.us/tdb/planning/access_mgt/.

[45] ICM presented each AMAC participant with a t-shirt that read "Accessible, Not Manageable," in hopes of capturing, tongue-in-cheek, the new-found spirit of these professionals!

collaboratively on a range of technically complex and politically sensitive issues. The OTC's and ODOT's openness to input bolstered their credibility and effectiveness. Like the OTC and ODOT, the facilitators anticipate that the collaborative attitudes developed during the AMAC process will provide an important framework for continued productive communication regarding access management and other issues involving Oregon's transportation stakeholders.

18 Access Spacing

Paper
Slides

18A. Comparison of Three Arterial Segments Having Different Access Attributes

J.L. Gattis, University of Arkansas

G. David Hutchison, University of Arkansas

Paper

18B. Access Spacing and Safety

Jerome S. Gluck, Urbitran Associates

Herbert S. Levinson, Transportation Consultant

Paper
Slides

18C. Traffic Safety Versus Access Management

Raj Shanmugam, URS Greiner Woodward Clyde, Inc.

Paper

18D. Statistical Relationship Between Vehicular Crashes and Highways

Howard Preston, BRW, Inc.

Tuesday August 15, 2000 1:00 PM – 2:30 PM
Track 2- Technical

COMPARISON OF DELAY AND ACCIDENTS ON THREE ROADWAY ACCESS DESIGNS IN SPRINGFIELD

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ABSTRACT

A comparison was made of three urban arterial roadways in Springfield, Missouri, each having similar lengths, posted speed limits, volumes, and abutting land uses but different levels of access control. The three segments were close to each other. The street with the highest level of access management (a non-traversable median and a much greater access spacing) was found to have both a lower crash rate and less delay than the other two roadway sections with a center turn lane. A comparison of the two center turn lane roadways found that an increase in driveway spacing did not produce faster travel times or a lower crash rate.

key words: access management, crashes, geometric design, medians

COMPARISON OF DELAY AND ACCIDENTS ON THREE ROADWAY ACCESS DESIGNS IN SPRINGFIELD

by J. L. Gattis, Ph.D., P.E., and David Hutchison, P.E.

INTRODUCTION

Springfield is the quintessential American city name. One particular Springfield gives researchers an opportunity to evaluate the service and safety provided to the public by three urban arterial roadways, each having a different design and abutting land use pattern.

Springfield, located in southwest Missouri, is a city of about 150,000. It is the largest city between Tulsa and St. Louis, and between Memphis and Kansas City. The city has fairly level terrain, and the square-mile street grid common to many American cities laid out after the enactment of the Northwest Ordinances. In this study, the crash rates, travel times, and other attributes of three urban street segments were compared; two of the segments were parts of the same arterial roadway and the third segment was on a perpendicular, intersecting arterial.

DESCRIPTION OF THE THREE SEGMENTS

The roadways included in this study are shown in Figure 1, and photographs of each segment are shown in Figure 2. Two of the three roadway sections that were compared are segments of Glenstone Avenue, a north-south oriented roadway. The two segments were termed Glenstone-north and Glenstone-south. The third segment that was compared is a part of east-west oriented Battlefield Road. The three segments have 40 mph posted speed limits, with the exception that Glenstone south of Primrose has a 45 mph posted limit.

The segments were selected to contrast the three different types or levels of access control found along them. Glenstone-north, with lenient driveway spacing, has little access management. Glenstone-south has a high degree of access management. Battlefield, which has raised medians within 60 m (200 ft) of signalized intersections, is abutted by tracts exhibiting a newer style of land development which results in a driveway frequency of roughly half that of Glenstone-north. All three segments are similar in that they are lined by mostly commercial development along each side. Much of the traffic that traverses Glenstone-north also travels on Glenstone-south. The short roadway section separating Glenstone-north from Glenstone-south was eliminated from this study because it is fronted on one side by a large cemetery. The lengths of all three segments are similar, ranging from 2.44 to 2.58 km (1.51 to 1.61 mi).

Traffic Patterns and Characteristics

Glenstone-north and Glenstone-south are numbered as US 65 Business Route. Years ago, Glenstone was the primary north-south highway route through the area, but now regional traffic is more likely to be found on US 65, a freeway parallel to and about 3 km (2 miles) east of Glenstone. Still, Glenstone is a primary arterial for traffic within Springfield.

Battlefield intersects Glenstone-south. Battlefield is a primary arterial for city traffic, but regional traffic uses parallel US 60 freeway about 2 km (1.2 mi) to the south.

Abutting Land Use

Glenstone-north is lined with what by today's standards are relatively small- to medium-sized commercial tracts, with a scattering of highway-oriented business harkening to its past. Some of the tracts have been redeveloped with newer commercial buildings, but the majority appear to be many decades old. From reviewing video tapes of the abutting land uses, it was estimated that there were 21 fast food and restaurant sites, 9 gasoline service stations, 22 shopping centers (either strip or neighborhood) , 2 motels, and 32 bank/office/professional uses.

Glenstone-south is fronted with larger commercial tracts, including Battlefield Mall, the region's major shopping center. Nationally-known retailers and "big box" stores have a high visibility in this corridor. There were 3 freestanding fast food and restaurant sites, 0 gasoline service stations, 13 shopping centers (ranging from strip to regional), 3 motels, and 2 bank/office/professional uses. The majority of the development appears to be less than thirty years old.

Battlefield Road is abutted by a number of relatively large commercial tracts, with development styles typical of the late twentieth century, similar to those of Glenstone-south. It also passes along the side of Battlefield Mall. However, there are some smaller commercial tracts along this segment. There were 10 identifiable fast food and restaurant sites, 2 gasoline service stations, 15 shopping centers (ranging from strip to regional), 2 apartment complexes, and 14 bank/office/professional uses. There is one section of undeveloped land along the south side of Battlefield Road. Even though Battlefield Road is like Glenstone-north in that both have a flush median, center turn lane design, tracts along Battlefield are much deeper than those along Glenstone-north. The greater tract depth means a greater total land area funneling traffic to Battlefield, which potentially translates into a greater number of trips generated per length of street frontage. This means more turning movements into and out of parcels abutting Battlefield than parcels along Glenstone-north .

Volumes

Table 1 contains a summary description of the three segments and their volumes. City of

Springfield counts show that volumes on the three segments range from about 29,000 to 38,000 vehicles per day.

On all three segments, the majority of the intersections with cross streets were signalized. Approach volumes on these streets ranged from less than 2,000 to 18,000 vehicles per day. The sums of the approach volumes on all of the signalized intersection approaches were as follows:

Glenstone-north 70,200 Glenstone-south 66,100 Battlefield 97,900.

Intersections and Signalization

Along the Glenstone-north segment, six of the ten street intersections are signalized. All six Glenstone-south street intersections are signalized. Battlefield has seven signalized intersections and one unsignalized T-intersection.

Although the numbers of public street and signalized intersections along all three segments are similar, there is a striking difference in driveway frequency among the three sections. Table 2 shows that Glenstone-south has less than one driveway per km, Battlefield has about 24 driveways/km, and Glenstone-north has 43 driveways/km. All of these driveway frequencies are counting driveways on both sides, per length of roadway.

Geometric Characteristics

All three sections of urban arterial studied have four through lanes and relatively level grades. Battlefield and Glenstone-north are straight, while the southern part of Glenstone-south includes a large-radius horizontal curve.

Both Glenstone-north and Battlefield Road have curbs and gutters, and flush medians occupied by a center two-way left turn lane. Along Battlefield, the median is raised on the approaches to the signalized intersections; this has the effect of preserving the left turn area only for vehicles turning left at the intersection, and denying its use for any Battlefield Road driver intending to turn left into a driveway immediately upstream or downstream of the signalized intersection.

Glenstone-south has a depressed, non-traversable median along its entire length except at the northmost intersection, where the median transitions into a center turn lane. Left-turn and some right turn lanes exist at intersections. Instead of curbs, a narrow shoulder is present. There are privately-owned frontage roads along one-quarter of the frontage. Two of these frontage roads intersect a cross street (at Erie and at Peele) within 30 m (100 ft) of the Glenstone main lanes; two other intersections are well set back from the Glenstone-south main lanes. Including openings at either end of the segment, there are 6 median openings over a length of 2.58 km (1.61 mi), for an average spacing of 0.5 km (0.3

mi.).

Double-lane left turn lanes are present at some of the Glenstone-south and Battlefield intersections. All left turn lanes along Glenstone-north are single lane.

SERVICE ATTRIBUTES OF THE THREE SEGMENTS

Although one can identify a number of attributes that measure how well or how poorly a roadway is serving the public, two factors whose impacts are obvious and directly felt by the traveling public are travel time and safety. Travel speed is closely related to travel time over a roadway segment. To assess the performance of the three segments, travel speed and crash rate data were analyzed.

Travel Speeds

City of Springfield travel time data was employed to evaluate the quality of flow on each of the three segments. The Springfield Public Works Department collected this moving vehicle data in 1997, 1998, and 1999 to evaluate and improve signal timing along the segments. The data included trips made during all daylight periods, both peak and off-peak. The driver collecting the data attempts to stay with the flow of traffic; runs are made in both outside and inside lanes. The average travel times were calculated from data sets comprised of anywhere from 30 to 67 different runs made on the different segments in one direction. The average speeds shown in Table 3 were computed from average travel times over the segment length.

Average speed on Glenstone-north was about 32 km/h (20 mph). Interestingly, on the Glenstone segment to the south, average speed jumped to about 51 km/h (32 mph). Speed on Battlefield averaged 28 km/h (17 mph).

Travel speed on the three streets seems to be controlled more by signal spacing and timing than by access density. Along Glenstone-north and Battlefield, turning movement friction does have some effect. During low volume periods, one can travel these roadways with very few stops. During high volume periods, a vehicle may encounter the rear of the queue from a signal ahead that has already turned green.

Average travel speed may have been somewhat affected by the green splits along each of the arterials. Signals along all three streets are timed to provide progression. A review of the signal timing plans showed that the daily average percent green was slightly higher on Glenstone that on Battlefield. The least percent green on Glenstone was 33% at the Sunshine intersection, while the lowest percent green on Battlefield was 24% at the National intersection.

Crash Histories

The city of Springfield furnished four years of both intersection and midblock summary crash data for the three segments. The intersection crash data included accidents that occurred within 30 m (100 ft) of any of the approaches to the intersection. Crashes on the private frontage roads along some parts of Glenstone-south are not entered into the crash data base. However, crashes on the west-side frontage road intersection at Erie that is close to the main lanes are included with the Erie and Glenstone-south crash totals.

Glenstone-south had the lowest crash rate and Battlefield had the highest (see Table 4). The overall crash rate was 25% higher on Glenstone-north and 71% higher on Battlefield. The injury-plus-fatality crash rate was 28% higher on Glenstone-north and 60% higher on Battlefield. When considering only what were coded as mid-block injury and fatal crashes, Glenstone-north and Battlefield had rates of 2.5 times or more that of Glenstone-south.

All three street segments had similar signalized intersection crash rates. Taking the total number of intersection crashes and dividing it by the combined approach volumes at all signalized intersections, Glenstone-north had 1.5 crashes per million entering vehicles (MEV), Glenstone-south had 1.7 per MEV, and Battlefield had 1.9 crashes/MEV. The combined injury-plus-fatal crash rates were also similar, ranging from 0.42 to 0.48 per MEV.

A comparison of the types of crashes that occurred (see Table 5) is insightful. Considering only mid-block crashes, Glenstone-north and Battlefield traits were much different that those on Glenstone-south. On the first two, about half of crashes were categorized as "rear-end" or "following-too-close", and a quarter to a third were "angle" crashes. On the other hand, over 80% of mid-block crashes on Glenstone-south were rear-end or following-too-close, with angle crashes being almost non-existent. The percentages of "sideswipe" crashes on all three segments ranged from 9% to 13%.

A majority of intersection crashes on all three segments fell into the rear-end or following-too-close categories. Battlefield exhibited a proportion of angle crashes that was quite a bit higher than that of the other two segments. The percentage of sideswipes on Glenstone-north was almost double that of Glenstone-south.

COMPARISON WITH PREVIOUS STUDY

A somewhat similar analyses had previously been performed *(1)* on three arterial roadways in Muskogee, Oklahoma, a city with a population of about 40,000. In this study, each of the three roadway segments had a non-traversable median, but the frequency of access varied greatly. Segment A had 61.4 access points per km, Segment B had 7.8 points per km, and Segment C had 3.6 per km. Segment B had frontage road in close proximity to the main lanes for much of its length. Volumes on the three segments ranged from the low- to the mid-20 thousands per day.

Average travel times on Segments B and C were much less than those on Segment A. The Segment B crash rate (3.45 per 10^6 veh-km) was similar to that of Segment A (3.52 per 10^6 veh-km) , but Segment C had a crash rate (1.99 per 10^6 veh-km) that was about 40% less than the rate of the other two segments. The injury rate for Segment C was about half that of the other two segments. Segment C had a slightly greater proportion of rear-end crashes and a smaller proportion of angle crashes than did the other two segments.

OBSERVATIONS AND CLOSING

The lengths, nature of traffic, and type of abutting land development were similar for the three segments that were evaluated. The posted speed limit on all three was 40 mph, except for a small part of Glenstone-south, which was posted for 45 mph. Daily volumes ranged from 28,900 to 38,300. The degree of access management and the driveway spacing varied significantly. The comparison of travel times and crash histories on the three urban arterial segments led to the following observations.

- The average travel speed calculated from dozens of trips on these three segments was over 50% higher on Glenstone-south (the roadway with highly-managed access) than on the other two sections having much less management of access.
- Even though the average travel speed was much higher, Glenstone-south, the urban arterial segment having the high level of access management, had a lower crash rate than did the other two nearby arterial segments with little access management. The much lower mid-block crash rate on Glenstone-south seemed to reflect the improved safety performance of the access-managed roadway over the other two non-access managed roadways. The number of signalized intersections and the signalized intersection crash rates for all three segments were similar.
- Although Glenstone-north had a much higher frequency of intersecting driveways than Battlefield Road, Battlefield exhibited lower average speed and a higher crash rate. Comparing these two five-lane designs, an increase in driveway spacing from 39 m (130 ft) to 66 m (220 ft) on one side did not produce any observable corresponding decrease in the crash rate or improvement in travel speed. It should be noted that the higher cross street volumes and smaller green splits on Battlefield Road may contribute to the poorer performance of this street. Also, from the greater depth of the commercial properties along Battlefield, one could infer a higher trip generation rate per amount of street frontage and larger driveway volumes than those along Glenstone-north.
- Compared with the three segments previously analyzed in smaller Muskogee, Oklahoma, volumes on the three Springfield streets were roughly 40% higher. The crash rate on the safest Springfield

segment, the one with the non-traversable median, was about 2 to 3 times higher than the rates on the three Muskogee segments (each of which had a non-traversable median). The intensity of the abutting land uses and the resulting amount of traffic generated from driveways and side streets may be higher in Springfield than in Muskogee. Similar to the Muskogee study, the Springfield street with the highest level of access control had a smaller proportion of angle crashes than did the other two segments.

Typical running speeds on urban arterials of the type studied in Springfield often range from 35 to 45 mph. The average travel speed for the access managed arterial was slightly over 50 km/h (30 mph) and the other two were around 30 km/h (20 mph); none of these speeds are excessive. Therefore, one could hypothesize the better performance of the access managed arterial was not due to excessive speed but rather due to the elimination of causes of delay, such as slowing down for vehicles turning off of or into the through street from driveways.

The three segments of roadway investigated were chosen because they were in the same section of the city of Springfield, they were all lined by commercial development, and two of the three were almost end-to-end. A study of the four year crash rates and of the travel time measurements for all three segments revealed that the access-managed urban arterial provided improved safety with less delay. In this study environment, the four-lane urban arterial with the non-traversable median outperformed the two five-lane roadways with the continuous center two-way turn lane. A previous study *(1)* of three segments in a smaller city, Muskogee, Oklahoma, found that the urban arterial segment with the highest degree of access management had both a higher travel speed and much lower crash rate that a raised-median segment having segment frequent driveways and cross streets, and had a lower crash rate than a segment with a somewhat greater intersection frequency. These studies raise a question: does introducing a low level of access management create any measurable added safety or reduction in delay? The findings from these few cases suggest the need to identify what degree or level of access management is required to consistently produce benefits of greater safety and less delay that those of ordinary urban arterials.

ACKNOWLEDGEMENT

This research was made possible by the support of the Mack-Blackwell National Rural Transportation Study Center at the University of Arkansas, through a grant from the U. S. Department of Transportation Centers Program, and by the cooperation and participation of the City of Springfield, Missouri, Public Works Department. Vo Phong assisted with the data analysis. The views expressed herein are those of the authors alone.

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1. Gattis, J. L. "Comparison of Delay and Accidents on Three Roadway Access Designs in a Small City," Second National Access Management Conference Proceedings, Transportation Research Board, Washington, DC, December 1996, pp. 269 ff.

TABLE 1 Description of the Three Segments

Segment	Description	Length	Daily Volume (rounded)	Volume on Signalized Cross Streets
Glenstone-north	Little access management; continuous center left turn lane; frequent street and driveway intersections; abutted by many smaller commercial tracts	2.44 km (1.51 mi)	38,300	70,200
Glenstone - south	High level of access management; depressed center median, few median crossings; very few intersections; some continuous frontage roads; abutted by large commercial tracts	2.58 km (1.61 mi)	31,500	66,100
Battlefield	Some but not much access management; continuous center left turn lane with raised median at intersections; fewer intersections and driveways; abutted by a mixture of large and smaller commercial tracts.	2.51 km (1.57 mi)	28,900	97,900

Note: volumes in vehicles per day (vpd); frontage road volumes not included

TABLE 2 Main lane intersection characteristics

	Glenstone - north		Glenstone - south		Battlefield	
	#	per km	#	per km	#	per km
Signalized intersections	6	2.0	6	1.9	7	2.4
Median openings, total	na		6	1.9	na	
For streets			6	1.9		
For driveways			0	0		
Intersections, total	114	46.3	8	2.7	69	27.1
Streets	10	3.7	6	1.9	8	2.8
Driveways	104	42.6	2	0.8	61	24.3

Notes: Driveway intersections with frontage roads not included. Since signalized intersections were at both ends of all segments, spacing was calculated at one less than number of signalized intersections.

TABLE 3 -- Travel Speed

	Glenstone - north NB	Glenstone - north SB	Glenstone - south NB	Glenstone - south SB	Battlefield EB	Battlefield WB
Average - km/h	32.2	31.6	53.5	50.0	28.7	27.2
mph	20.0	19.7	33.3	31.1	18.0	17.0

TABLE 4 Crash Summary

	Glenstone - north	Glenstone - south	Battlefield
Total number of crashes	1159	813	1246
Non-intersection	463	163	417
Intersection	696	650	829
Proportion of non-intersection	39.9%	20.0%	33.5%
Proportion of intersection	60.1%	80.0%	66.5%
Severity			
Number of injuries	552	379	553
Number of injury crashes	342	234	335
Non-intersection	147	65	122
Intersection	195	169	213
Proportion of injury to all crashes	29.5%	28.8%	26.9%
Number of fatal crashes	2	0	0
Rates			
Crashes per million vehicle km (mvkm)	8.5	6.8	11.7
Number of injuries + fatalities per mvkm	4.1	3.2	5.2
Number of injury + fatal crashes per mvkm	2.5	2.0	3.1
Midblock Rates			
Crashes per million vehicle km (mvkm)	3.4	1.4	3.9
Number of injuries + fatalities per mvkm	1.1	0.5	1.1
Intersection Rates			
Crashes per million entering vehicles(MEV)	1.5	1.7	1.9
Number of injuries + fatalities per MEV	0.42	0.45	0.48

NOTE: Crashes totaled from 1995, 1996, 1997, 1998. Intersection crashes include crashes on intersecting streets.

TABLE 5 Crash Types

	Glenstone - north	Glenstone - south	Battlefield
NON-INTERSECTION			
Angle	123	2	139
Backing	3	1	3
Rear end/Following too close	261	135	207
Sideswipe	61	15	54
Other	15	10	14
TOTAL	463	163	417
INTERSECTION			
Angle	111	113	203
Backing	12	4	9
Rear end/Following too close	468	463	516
Sideswipe	80	41	70
Other	23	29	31
TOTAL	694	650	829

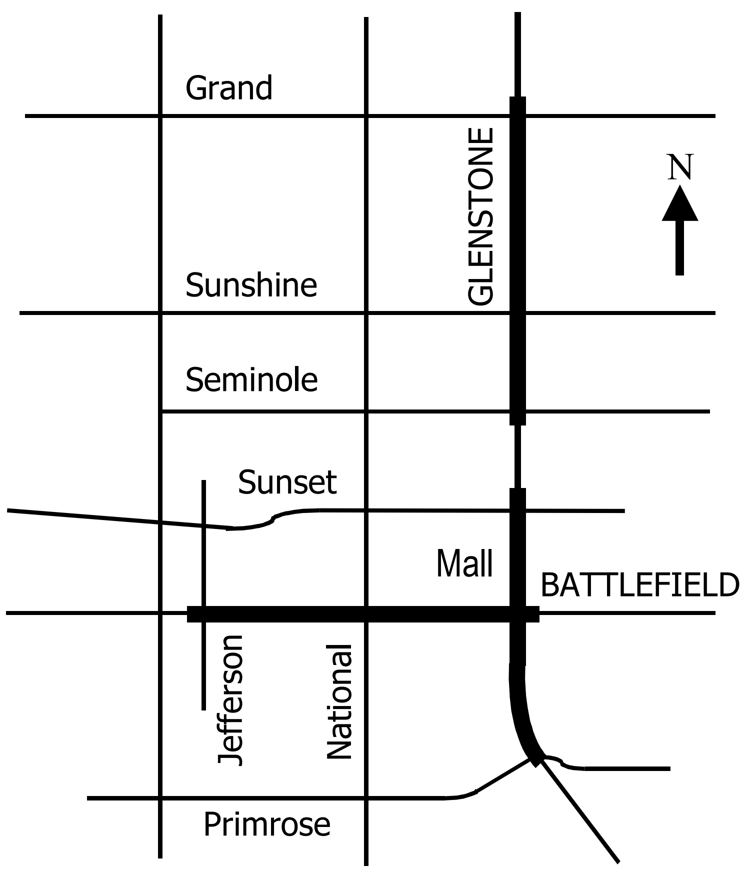

FIGURE 1 Schematic drawing of the three segments

COMPARISON OF DELAY AND ACCIDENTS ON THREE ROADWAY ACCESS DESIGNS IN SPRINGFIELD

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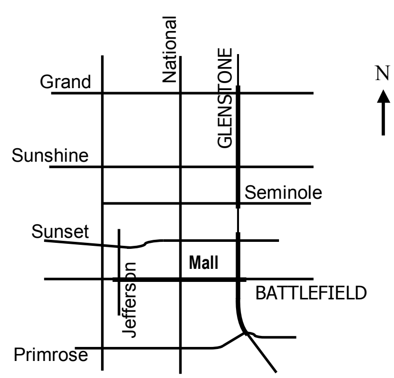
1

Introduction

- SPRINGFIELD, MO
  - POPULATION ~ 150,000
  - FAIRLY LEVEL TERRAIN
  - MILE-SQUARE GRID FOR ARTERIAL STREETS

2



- GLENSTONE (north) US 65 business
  a north-south arterial commercial on both sides
  40 mph posted older development
  little access management

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- GLENSTONE (south) US 65 business
  a north-south arterial commercial on both sides
  40 and 45 mph posted newer development
  high level of access management

5

- BATTLEFIELD
  an east-west arterial commercial on both sides
  40 mph posted newer development
  raised medians within 60 m (200 ft) of intersections

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Abutting Land Uses

- GLENSTONE (north)
  relatively small commercial tracts, scattering of highway-oriented businesses
- GLENSTONE (south)
  larger commercial tracts, big box stores, large shopping center
- BATTLEFIELD
  large commercial tracts and large shopping center, but also a few smaller commercial tracts

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Abutting Land Uses

- GLENSTONE (north)
  21 fast food and restaurant, 9 service stations, 22 shopping centers, 32 office/professional
- GLENSTONE (south)
  3 freestanding fast food and restaurant, 0 service stations, 13 shopping centers, 2 office/professional
- BATTLEFIELD
  10 fast food/restaurant, 2 service stations, 15 shopping centers, 14 office/professional

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Abutting Land Uses

NOTE:

- tracts along Battlefield are much deeper than those along Glenstone (north)

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Description of the 3 Segments

SEGMENT		LENGTH KM (MI)
Glenstone (north)	Little access management; Continuous center left turn lane; Many street & drive intersections	2.44 (1.51)
Glenstone (south)	High level of access mgmt.; Depressed center median; Few intersections	2.58 (1.61)
Battlefield	Some (not much) access mgmt.; TWLTL, raised median @ intersections; Fewer intersections than Glenstone (N)	2.51 (1.57)

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Volumes

SEGMENT	DAILY VOLUME	Σ of VOL. on SIGNALIZED CROSS STREET
Glenstone (north)	**38,300**	**70,200**
Glenstone (south)	**31,500**	**66,100**
Battlefield	**28,900**	**97,900**

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Intersections

	Glenstone (north) #	Glenstone (north) /km	Glenstone (south) #	Glenstone (south) /km	Battlefield #	Battlefield /km
SIGNAL	6 of 10	2.0	6 of 6	1.9	7 of 8	2.4
MEDIAN OPENINGS	na		6	1.9	na	
INTERSECT	114	46.3	8	2.7	69	27.1
STREET	10	3.7	6	1.9	8	2.8
DRIVE	104	42.6	2	0.8	61	24.3

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Geometric Characteristics

- All three streets have 4 through lanes.
- Battlefield and Glenstone (north) both have five-lane designs, w/ curb&gutter. Glenstone (south) has a depressed median, narrow shoulders, no curbs.
- All are relatively flat.
- Battlefield and Glenstone (north) are both straight. Glenstone (south) has a large radius horizontal curve.
- Glenstone (south) has some frontage roads.

Travel Speed

- Lowest percent green
  - Battlefield - 24% at National intersection
  - Glenstone - 33% at Sunshine intersection

Travel Speed

From moving vehicles in 1997-99, both peak and off-peak periods

Anywhere from 30 to 67 separate runs/direction

Segment ➔	Glenstone (north) NB	Glenstone (north) SB	Glenstone (south) NB	Glenstone (south) SB	Battlefield EB	Battlefield WB
AVG. km/h	32.2	31.6	53.3	50.0	28.7	27.2
Mph	20.0	19.7	33.3	31.1	18.0	17.0

4-year Crash Histories

	Glenstone (north)	Glenstone (south)	Battlefield
Crash / MVKm	8.5	6.8	11.7
Inj.+Fat. Crash / MVKm	2.5	2.0	3.1
Midblock Crash / MVKm	3.4	1.4	3.9
Intersection Crash / MVKM	1.5	1.7	1.9

4-year Crash Histories - MIDBLOCK

Glenstone S

- ~ 1/2 either rear-end or following too close
- 1/4 to 1/3 angle

Battlefield

- ~ 1/2 either rear-end or following too close
- 1/4 to 1/3 angle

Glenstone N

- >80% rear-end or following too close
- angle almost non-existent

4-year Crash Histories - INTERSECTION

- half or more on all 3 were rear-end or following too close
- Battlefield had higher proportion of angle crashes
- Glenstone (north) had almost double the proportion of sideswipe as Glenstone-south

Comparison

- Similar ...
  - Arterial street
  - Commercial development
  - Segment lengths
  - Posted Speed
  - Volume
  - Number of through lanes
  - Signalized intersection frequency

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Comparison

- Different ...
  - Level of access management
  - Driveway/access spacing

Try to maximize similarities, limit differences so that level-of-access is one of the few significant differences

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Comparison

- Travel speed : over 50% higher on the access-managed street
- Crash rate : lower on the access-managed street
  - Lower mid-block seemed to explain the difference

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Comparison of 5-lane Designs

- Glenstone (north) has much higher driveway frequency .
- Battlefield had lower speed and higher crash rate

Slightly higher level of access management did not seem to improve Battlefield (note: Battlefield probably has more trips entering from the side).

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Acknowledgment

- MACK-BLACKWELL NATIONAL RURAL TRANSPORTATION STUDY CENTER AT THE UNIV. OF ARKANSAS, THROUGH A GRANT FROM THE U.S. D.O.T. CENTERS PROGRAM
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ACCESS SPACING AND SAFETY:

RECENT RESEARCH RESULTS

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Portland, Oregon

CONTENTS

Access Spacing and Safety:
Recent Research Results

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ABSTRACT

Over the past 40 years, more than 20 studies have shown how accidents increase with decreasing access spacing. These results have been well documented. Within the past several years, a number of additional research efforts have provided a further analysis of this basic relationship. These efforts include: (1) the multi-state accident investigation reported in NCHRP Report 420, (2) an accident model prepared for Indiana highways, (3) a comprehensive analysis of accidents versus access spacing in Minnesota, and (4) a conceptual analysis based upon the product of conflicting traffic volumes.

This paper compares the results of these recent studies, showing similarities and differences. In all studies, accident rates increase as access spacing is reduced. The volume-product approach and some of the empirical studies suggest that accident rates increase at approximately the square root of the increase in access points per mile.

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ACCESS SPACING AND SAFETY: RECENT RESEARCH RESULTS

Introduction

Many studies conducted over the past 40 years have shown how accident rates increase as access spacing decreases. This paper briefly summarizes the results of these studies. It then describes and compares the results of additional research efforts. These efforts include:

(1) a multi-state accident investigation performed in NCHRP Project 3-52 and reported in NCHRP Report 420[1],

(2) a comprehensive analysis of accident rates versus access spacing in Minnesota [2],

(3) an accident model for Indiana highways [3], and

(4) a conceptual accident analysis based upon the product of conflicting traffic volumes[4].

Early Studies

The results of 11 research efforts conducted between 1952 and 1975 are summarized in Table 1. Table 2 summarizes the principal results of 11 more recent studies conducted since the mid-1980s. Most of these studies were performed to help identify the impacts of access management.

The specific relationships vary reflecting differences in road geometry, (e.g. turn lanes, presence or absence of medians), operating speeds, and driveway and intersection traffic volumes. Still, in every case, more accidents mean more accidents.

Reported accident rates from four areas -- British Columbia, Florida, Michigan, and Oregon -- were plotted on a common scale versus access density. A series of indices were then prepared that keyed accident rates with access density by using the accident rates for 10 access points per mile as a base (total access points per mile on both sides of the road). The indices were averaged for each access density. The composite accident rate indices from the research review are summarized in Table 3. These indices suggest that the doubling of access frequency from 10 to 20 per mile increases the accident rate by about 30 percent. An increase from 20 to 40 access points per mile would increase accident rates by more than 60 percent. These increases are similar to those reported in Australia.

NCHRP Project 3-52 Safety Analysis

Comprehensive safety analyses were performed for accident information obtained from Delaware, Illinois, Michigan, New Jersey, Oregon, Texas, and Virginia. Overall, some 386 roadway segments were initially analyzed to explore the relationship between access spacing and accidents.

The initial accident database was stratified by the number of access points per mile (signalized and unsignalized), the area type (urban/rural), and the median treatment (undivided, two-way left-turn lane, and non-traversable median). Road segments without access points, road sections less than 0.31 miles long, and states with anomalies in the accident rates were excluded from further analysis.

The resulting database included 264 road segments -- 170 urban and 94 rural. Collectively, these sections contained about 37,500 accidents. They included data for Delaware, Illinois, Michigan, New Jersey, and Wisconsin. The accident reporting threshold in these states was generally about $500.

Urban and Suburban Areas. The urban road segments were further analyzed to screen road segments for characteristics or accident rates that did not appear consistent with the rest of the data. After the potential outliers were removed from the database, statistical analyses were prepared for 152 of the 170 road sections. Based upon this analysis, strata were selected for total access points per mile, signalized access points per mile, and unsignalized access points per mile. The signal density strata were set at less than or equal to 2, 2.01 to 4.0, 4.01 to 6, and more than 6 signals per mile. The other access density strata were set in increments of 20 access points per mile; less than 20, 20.01 to 40, 40.01 to 60, and more than 60 to minimize the number of cells with few points.

Means, coefficients of variation, students 't' distribution statistics and p-values were computed and presented for each cell analyzed. The p-values represent the probabilities of differences between means occurring due to chance; thus, a 0.05 p-value is similar to a 5-percent level of significance.

A series of curves were derived based on the various cross-classification analyses. Figure 1 shows accident rates by median type and total access density for urban-suburban roadways. Representative accident rates by signalized and unsignalized access density are shown in Figure 2 for urban and suburban areas. These figures are shown for the midpoints of the unsignalized access spacing groups, and they reflect adjustments to eliminate apparent anomalies in the reported data.

In urban and suburban areas, each access points (or driveway) added would increase the annual accident rate by about 0.11 to 0.18 accidents per million VMT on undivided highways and by 0.09 to 0.13 on highways with TWLTLs or non-traversable medians.

Each unsignalized driveway may add about 0.02 to the accident rate at low signal densities, and from 0.06 to 0.11 at higher signal densities.

The generalized effects of access spacing on traffic accidents can be estimated by applying the suggested values of the accident rate indices, shown in Table 4, which were derived from the literature synthesis and safety analyses for urban/suburban areas. The suggested composite indices show the relative increase in accidents that may be expected as the total driveway density (in both directions) increases. These indices suggest that doubling the access frequency from 10 to 20 access points per mile would increase accident rates by 40 percent. A road with 60 access points per mile would have triple the accident rate (a 200-percent increase) as compared with a spacing of 10 access points per mile. Each additional access point increases the accident rate by about 4 percent.

Rural Areas. A similar analysis was performed for road segments in rural areas. Accident rates were stratified by total access density and median treatment. Signalized access density was not a separate variable, since the number of signalized access points in the rural database was small. Accident rates for Michigan were recalculated to remove animal-related and rail-crossing accidents.

After the potential outliers were eliminated form the database, some 89 segments were analyzed. Accordingly, three strata for total access points were identified to minimize cells with very few points -- less than 15 access points per mile, 15 to 30, and more than 30.

Means, coefficients of variation, and other statistical parameters were obtained for each of the three median types for each frequency. The curves shown in Figure 3 emerged from this analysis.

In rural areas, each access point (or driveway) added would likely increase the annual accident rate by 0.07 on undivided highways and by 0.02 on highways with TWLTLs or non-traversable medians.

Application. Accident rates will vary among states, because of different reporting thresholds and traffic conditions. Therefore, NCHRP Report 420 recommended that the accident rates should be obtained and used as the starting point for further analyses. The suggested values in Table 4 and graphs in Figures 1 to 3 may be used to assess the likely relative change in accident rates resulting from changes in access spacing.

Minnesota Accident Study, 1998

A comprehensive statewide accident study was prepared for the Minnesota Department Transportation by BRW. The study analyzed five rural and six urban road types. Some 432 road segments, involving 766 miles, 9,745 access points and 13,700 accidents were analyzed. A positive relationship between access density and accidents was found in 10 of 11 road categories analyzed. Accident rates increased with increasing street and commercial driveway access. An overview of principal findings follows

Table 5 describes the road categories analyzed. It also identifies the number of road segments, miles, accidents and the expected reliability for each category. Some 202 rural road segments and 230 urban road segments were analyzed with approximately 2,950 rural and 10,750 urban crashes, respectively. Access density averaged 7.8 access points per mile in rural areas and 27.9 per mile in urban areas. Accident rates were computed in the study for each road category as a function of the total access density.

Accident Rates. Table 6 summarizes the accident rates for the three rural road categories that had a high-expected reliability due to sufficient sample sizes.

Table 7 summarizes the accident rates computed for urban areas for the three arterial road types and one expressway road type with high-expected reliability. There is a consistent increase in accident rates as access density increases. These rates were then interpolated to obtain accident rates for specific access densities (i.e. 10, 20, 30, 40, 50, 60, and 70 access points per mile). The "over 50" category was assumed to extend from 50 to 80.

Table 8 gives the resulting accident rates and their corresponding indices. These indices are strikingly similar to those derived in NCHRP Report 420 (see Table 4 herein). In general, a doubling of access densities (i.e. from 10 to 20 per mile) results in a 40% increase in the accident rate.

Statistical Model. The BRW report also fit a negative binomial regression model to the accident data for each road category.

The basic model was:

$$\lambda_i = \lambda \, d_i^{\,b} \tag{1}$$

where:

λ_i = accidents per million VMT at site i
λ = base accident rate for all sites in the category
d_i = access density for site i
b = coefficient that governs access coefficient.

Table 9 summarizes the coefficients that were derived. The right hand column presents the ratio of accident rates resulting when the access density increases from 10 to 20 points per mile. Most of the ratios appear reasonably consistent with the 1.4 increase reported in NCHRP Report 420 and earlier analyses for Minnesota DOT.

Indiana Accident Study, 1999

Several studies in Indiana have analyzed the effects of cross sectional characteristics and access spacing on accidents. Research by Eransky, Tarko, and Sinha developed crash reductions factors for Indiana roads based on cross-sectional characteristics described in the state's road inventory database. (32) Separate negative binomial regression models were developed for rural two-lane, rural multi-lane, urban two-lane, and urban multi-lane highways. The level of access control was described by a qualitative variable with three levels.

Based on the initial results of the study, there were further investigations into the effects of access control and roadway features on accidents. (3) Negative binomial regression models were developed to predict the total number of crashes, number of property-damage-only crashes, and number of fatal and injury crashes. The exposure-to-risk variables include segment length, number of years, and AADT. The significant roadway factors include density of access points, proportion of signalized access points, presence of an outside shoulder, presence of a two-way left-turn lane, and presence of a median with no openings between signals.

Multi-lane road sections were selected for analysis in cooperation with the Indiana Department of Transportation. These sections were located in urban and suburban areas throughout the state and represent a wide array of geographic locations and levels of access control. Some 23 sections of road were analyzed along about 75 miles (120 km) of 18 state highways located in 12 counties. These road sections were subdivided into 155 segments that were homogeneous with respect to cross section and traffic volume.

Data Collection. A Road Inventory Data Bank maintained by Indiana DOT provided traffic and geometric data for the selected road segments. The number and type of access points were identified from a video log database. Accident information was obtained from Indiana DOT's crash database, and adjustments were made to account for missing accidents. In most cases, crash data for the 5-year period from 1991 to 1995 were used. However, for a few road segments that underwent improvements between 1991 and 1995, crash data for three years were used to ensure that the segments had consistent cross-section characteristics.

Statistical Models. Once the crash and segment data were collected, statistical models were developed to predict the number of total crashes, number of fatal and injury crashes, and number of property damage crashes. A negative binomial regression model was used; the access density was calculated as the total number of access points divided by the segment length. The total number of access points includes both signalized and unsignalized access points at a given location from one side or from both sides. For unsignalized intersections, a T-intersection (one-sided access point) was considered at one access point, while a four-leg intersection (two-sided access points) was considered at two access points. Signalized intersections were considered as two access points regardless of the number of legs, probably because signals stop traffic in either direction on the segment. Access points within 30m of the segment endpoints were not considered.

Separate models were developed using stepwise regression to predict the total number of crashes, number of property damage only crashes, and number of fatal/injury crashes. The resulting R^2 values were slightly below 0.5. These models were then rerun to account for missing crashes by applying an adjustment factor of 1.61.

The final equation for total accidents, after adjustments for missing accidents was as follows:

$$C = 0.494\ L * Y * V * \exp(0.0285A - 0.631S + 2.520p - 0.748t - 0.604m) \qquad (2)$$

where:

C = expected number of total accidents
L = length of road section (km)
Y = number of years
V = annual average daily traffic
A = access points per km
S = dummy variable to indicate presence of shoulder (1 if outside shoulder is present, 0 otherwise)
p = proportion of access points that are signalized
t = dummy variable to indicate presence of two-way left turn lane on segment (1 if two way left turn lane, 0 otherwise)
m = dummy variable to indicate segment without medians (1 if segment has no median, 0 otherwise)

Results. The coefficients of equation 2 confirm the results of previous safety studies, such as those set forth in NCHRP Report 420 (A positive coefficient indicates an increase in expected accidents, and a negative coefficient indicates a decrease).

1. Segments with more frequent access points experience more accidents.

2. The presence of an outside shoulder leads to a reduction in accidents. An outside shoulder may result in larger turning radii at access points.

3. The presence of traffic signals can lead to higher accident rates. This may reflect the higher likelihood of rear-end collisions where vehicles are stopped at traffic signals.

4. The presence of a two-way left-turn lane leads to a reduction in accidents by separating through and left turn vehicles.

5. The presence of a median with no openings between signals also leads to a reduction in crashes.

Equation 2 was also used to assess the effect of access density in two cases.

(a) Suburban arterial streets with shoulders and access onto arterial facilitated only through unsignalized right turns,

(b) Urban arterial streets without turning restrictions and with some access points signalized (a typical proportion of 8% was assumed).

The safety effect was measured by the number of reported crashes per million kilometers traveled.

The accident rates for urban streets are over four times higher than those for suburban roads. This is because there are restrictions on left-turning movements, availability of shoulders, and absence of traffic signals at minor intersections along the suburban arterials. The study reported that ten additional access points are associated with a 32% increase in the total number of accidents.

Accident rate indices were then derived, using 10 access points per mile as a base. These indices are shown in Table 10. These indices are comparable to those reported in NCHRP 420 for access densities of over 50 access points per mile, but are slightly less at lower access densities

Conceptual Analysis

A conceptual analysis for predicting the safety of arterial roads based on arterial traffic volumes, access volumes on intersecting streets and driveways, and access point density was developed by Levinson (4). This method applies the long-established relationship between intersection accidents and the product of conflicting volumes. The simplifying assumption that access points have approximately equivalent volumes made it possible to derive safety indices that relate directly to the change in access density.

The ratio of the expected accidents as a function of changes in access density was found to be expressed by the following equation.

$$\frac{N_2}{N_1} = \frac{n_2}{n_1}\left(\frac{n_1}{n_2}\right)^b \qquad (3)$$

where N_2 = accidents after
N_1 = accidents before

n_2 = access points after
n_1 = access points before
b = coefficient

If the exponent b=0.5, this relationship becomes:

$$N_2 / N_1 = \sqrt{\frac{n_2}{n_1}} \qquad (4)$$

This equation suggests that the relative change in accidents is approximately equal to the square root of the ratio between changes in access frequency. Thus, a change from 10 to 20 driveways per mile would result in a 41% increase in accidents.

Table 11 gives the relative changes in accident potential (exposure as the number of access points over a given section of road increases). The values assume that the total access driveway volumes remain constant and that the individual access volumes would be about equal. The table gives estimated changes for b coefficients of 0.5 and 0.633. Values were reported in past studies. (29, 30, 31)

Comparisons and Conclusions

The various safety analyses clearly indicate that accident rates rose with increasing access density. The relative rates of increase, expressed as accident indices presented in Table 12, show how remarkably consistent the patterns are. A doubling of access density from 10 to 20 access points per mile results in a 40% increase in the expected accident rates; an increase to 40 results in about a 2.0 time increase. The "square root rule"—in which accident rates rise with the square root of the ratio of the increase in access density provides a close approximation of reported rates, especially where access densities are less than 50 points per mile.

Obviously, site specific conditions will influence the actual accident experience along any highway. Horizontal and vertical alignment, sight distance, access road designs, and type of intersection controls will influence safety. However, the "exposure indices" provide a benchmark against which such factors can be assessed.

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Figure 1

ESTIMATED ACCIDENT RATES BY TYPE OF MEDIAN; URBAN AND SUBURBAN AREAS

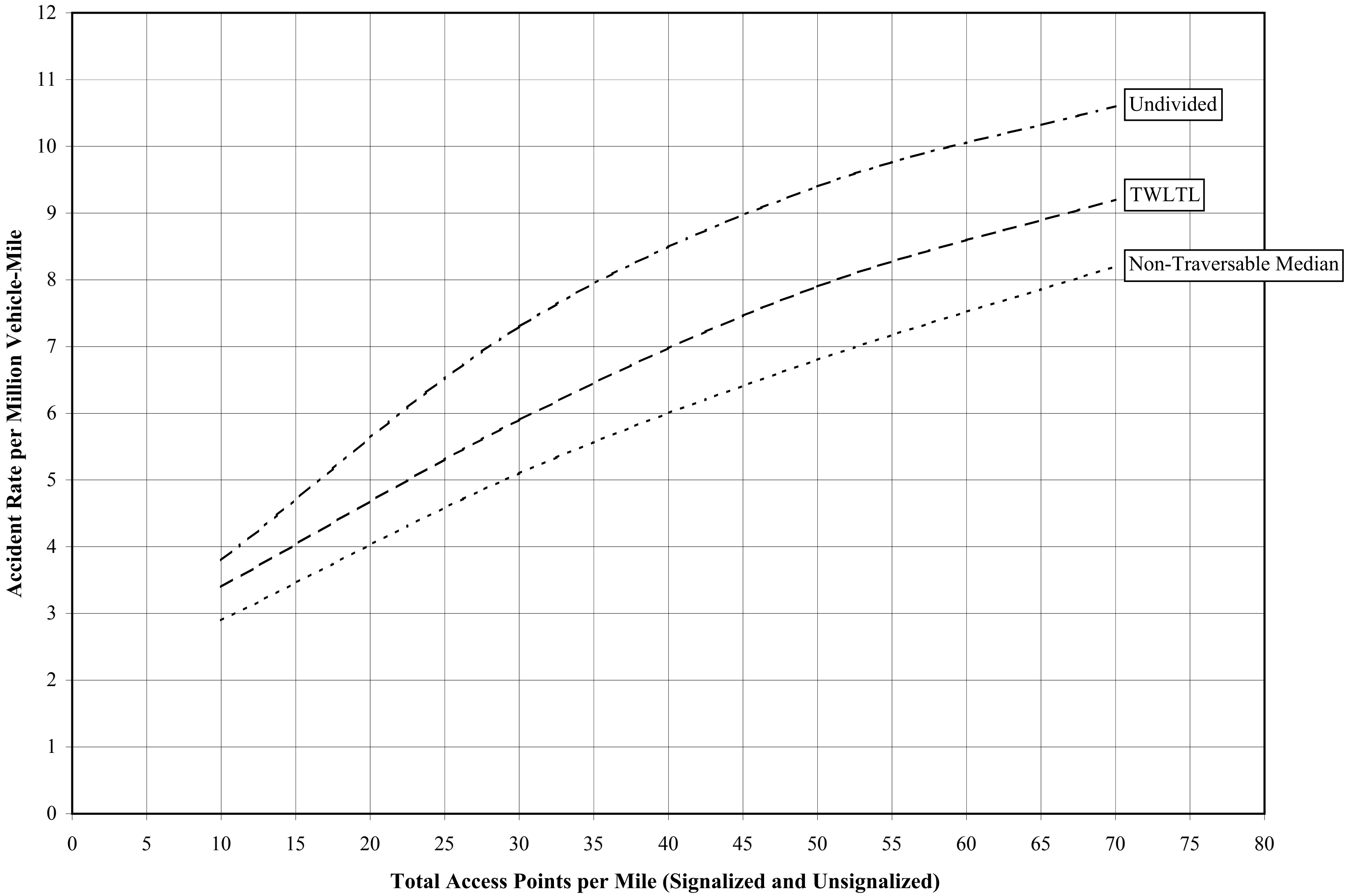


Table 1

Chronology of Accident Studies Relating to Access Spacing 1952-1975

Study No.	Year	Description	Findings	Source
1	1952	McMonagle, Michigan	An increase from 0 to 4 or more roadside features per 1,000 feet increases accidents/million VMT from 3.37 to 13.48	(5)
2	1953	Staffeld, Minnesota	Roadways with more than 20 access points per mile had more than double the rates of roads with less than 4 access points per mile	(6)
3	1957	Schoppert, Ohio	The number of access points along rural two-lane highways is a reasonably good predictor of potential accidents within an ADT group.	(7)
4	1959	Head, Oregon	Accident rates increased as the number of commercial driveways and/or commercial units per mile increased.	(8)
5	1967	Cribbins et al, North Carolina (92 road sections)	Accident and injury rates on multi-lane divided highways increased as the number of access points and their traffic volumes increased.	(9)
6	1967	Mulinazzi and Michael, Indiana (100 road sections)	The number of medium and heavy volume commercial driveways per mile was significantly related to the accident rates for sections with less than 5,800 ADT.	(10)
7	1970	Dart and Mann, Louisiana	Accident rates doubled as the traffic conflicts increased ten times.	(11)
8	1970	Interstate System – Accident Research	As intersections/mile increased from 1 to15: accident rates increased 4 to 5 times on urban highways and 2 to 3 times on rural highways. As business access points/mile increased from 1 to 40: accident rates doubled	(12)
9	1973	McGuirk, Indiana (63 miles)	Accidents per mile may decrease when the number of commercial driveways, traffic volumes, or travel lanes is reduced.	(13)
10	1974	Uckotter, Indiana (14 road sections)	Regression equations produced counter intuitive results.	(14)
11	1975	Glennon et al	An increase from low to high driveway frequency doubles annual accident frequency . An increase from low to high volumes (over 15,000 ADT) triples annual accidents.	(15)

Table 2

Chronology of Accident Studies Relating to Access Spacing Since Mid 1980s

Study No.	Year	Description	Findings	Source
1	1985	Arapahoe and Parker Roads, Denver (4.35 and 5.16 miles)	Two highly access managed roads had about 40% the accident rate of roads with frequent access.	(16)
2	1986	Waushara County, Wisconsin	Annual accidents per mile for access spacing less than 300 feet was about 2 to 3 times greater than for longer spacing.	(17)
3	1992-1993	Sokolow, Long et al, Florida	Accident rates doubled when driveways exceeded 20 per mile (Sokolow). Accident rates increased 70% as driveways per mile increased from less than 13 to more than 20 (Long, et al).	(18, 19)
4	1993	British Columbia (176 road sections, 465 miles)	Accident rates increased as access density increased. Each business access impacted accident rates about 50% of public road intersections	(20)
5	1993	Millard, Lee County, Florida	Doubling connections from 20 to 40 per mile doubled the accident rate. Doubling signals from 2 to 4 per mile, more than doubled the accident rate.	(21)
6	1994	Michigan	Midblock accident rates generally increased as the number of intersections per mile (including driveways) and the number of lanes increased.	(22)
7	1995	Fitzpatrick & Balke, Texas	Total and midblock accidents generally increased as driveways became more numerous.	(23)
8	1995	Lall et al, Oregon (US Route 101 – 29 miles)	Accidents per mile and driveways per mile followed similar patterns (except for road sections with a non-traversable median).	(24)
9	1996	Norwalk-Wilton, Connecticut (Route 7)	Accident rate per mile increased along roadway carrying 20,000 to 25,000 vehicles per mile as access density increased.	(25)
10	1996	Garber & White, Virginia (10 miles 30 locations)	Multiple regression analysis assessed effects of ADT/lane, average speed, number of access points, left-turn lane availability, average access spacing and average difference in access spacing.	(26)
11	1997	Australia	Each additional driveway per km increased accident rates about 1.5 % for 2-lane roads and 2.5 % for 4-lane roads.	(27)

Table 3

Composite Accident Indices
(Literature Review)

Access Points per mile	**Accident Index (Ratio to rates for 10 access points per mile)**
10	1.0
20	1.3
30	1.7
40	2.1
50	2.8
60	4.1

Source: (1)

Table 4

Suggested Accident Indices
For Unsignalized Access Spacing

Access Points Per Mile*	**(A) Literature Synthesis**	**(B) Safety Analysis**	**(C) Suggested Value**
10	1.0	1.0	1.0
20	1.3	1.4	1.4
30	1.7	1.8	1.8
40	2.1	2.1	2.1
50	2.8	2.3	2.5
60	4.1	2.5	3.0
70	---	2.9	3.5

*Total for both directions.

Source (1)

Table 5

Segment and Accident Data for Minnesota Road Sections

Road Class	**Description**	**Road Segments**	**Miles**	**Accidents (Crashes)**	**Expected Reliability**
Rural					
RC2NLT	2 lane	120	412	1191	High
RC2LT	2 lanes with left turn lanes	14	21	156	Moderate
RC4	4 lanes	36	68	793	High
RC6	6 lanes	7	7	130	Low
RE4	4-lane expressway	25	80	679	High
	Rural Subtotal	202	588	2949	
Urban					
UC2NLT	2 lanes	58	38	803	High
UC4NLT	4 lanes	48	29	2116	High
UC6	6 lanes	17	14	763	Low
UC2LT	2 lanes with left turn lanes	20	14	733	Moderate
UC4LT	4 lanes with left turn lanes	42	33	2613	High
UE4	4-lane expressway	45	50	3723	High
	Urban Subtotal	230	178	10751	
	Total	432	766	13700	

Source: (2)

Table 6

Summary of Rural Crash Rates by Access Density

<table>
<tr><th>Road Type</th><th colspan="4">Rural Density (Access Points Per Mile)</th></tr>
<tr><th></th><th>0-5</th><th>5-10</th><th>10-15</th><th>>15</th></tr>
<tr><td>RC 2 NLT</td><td>0.82</td><td>0.99</td><td>1.34</td><td>1.25</td></tr>
<tr><td>RC 4</td><td>0.93</td><td>1.10</td><td colspan="2">2.79*</td></tr>
<tr><td>RE4</td><td>0.62</td><td></td><td></td><td>0.80</td></tr>
</table>

*Over 10 points per mile

Source: (2)

Table 7

Summary of Urban Crash Rates by Access Density

Road Type	Density			
	0-10	**10-30**	**30-50**	**Over 50**
UC 2 NLT	1.68	2.64	4.91	6.02
UC 4 NLT	2.22	3.34	4.74	7.38
UC 4 LT	2.56	4.51	5.79	10.40
UE 4	1.23	1.77	N/A	N/A

Source: (2)

Table 8

Summary of Interpolated Urban Accident Rates by Access Density

Access Points Per Mile	Accident Rate					
	UC 2 NLT		UC 4 NLT		UC 4 LT	
	Rate	Index	Rate	Index	Rate	Index
10	2.00	1.0	2.40	1.0	3.20	1.0
20	2.64	1.3	3.34	1.4	4.51	1.4
30	3.78	1.9	4.04	1.7	5.15	1.6
40	4.91	2.5	4.74	2.0	5.79	1.8
50	5.32	2.7	5.70	2.5	8.00	2.3
60	5.75	2.9	6.62	2.8	9.25	2.9
70	6.02	3.1	7.34	3.1	10.40	3.2

Source: Computed

Table 9

Results of Statistical Analyses

Road Class	Description	λ	$a^{(1)}$	$b^{(2)}$	Estimated Ratio in accident rate – going from 10 to 20 access points per mile
Rural					
RC 2	Rural 2 lanes	0.500	0.265	0.39	1.31
RC 4 & 6	Rural 4 & 6 lanes	0.385	0.378	0.82	1.77
RE – 4	Rural 4 lane Expressway	0.330	0.137	0.47	1.38
Urban					
UC 2	Urban 2 lanes	1.340	0.421	0.32	1.24
UC 4 & 6	Urban 4 and 6 lanes	1.290	0.306	0.35	1.27
UE 4	Urban 4 lane Expressway	0.640	0.215	0.61	1.52

Source: (28)

Notes:

1. Measures over dispersion when compared to the Poisson models.
2. A coefficient that relates access density to accident rate.

Table 10

Derived Accident Rate Indices for Indiana Urban and Suburban Arterials

Access Points per mile	Index
10	1.0
20	1.2
30	1.5
40	1.8
50	2.1
60	2.5
70	3.0

Source: Computed

Table 11

ANTICIPATED SAFETY IMPACTS
FROM CHANGING DRIVEWAY SPACING
(For a given access volume)

Driveway Density Ratio After/Before	b=0.5		b=0.633	
	Exposure Index After/Before	% Change	Exposure Index After/Before	% Change
0.10	0.32	68	0.43	57
0.20	0.45	55	0.55	45
0.30	0.55	45	0.65	35
0.40	0.63	37	0.71	29
0.50	0.71	29	0.78	22
0.60	0.77	23	0.83	17
0.70	0.83	17	0.88	12
0.80	0.89	11	0.92	8
0.90	0.95	5	0.96	4
1.00	1.00	0	1.00	0
1.50	1.22	22	1.16	16
2.00	1.41	41	1.29	29
2.50	1.58	58	1.40	40
3.00	1.73	73	1.50	50
4.00	2.00	100	1.66	66
5.00	2.24	124	1.81	81
6.00	2.45	145	1.93	93
7.00	2.65	165	2.04	104

Source: Computed

Table 12

Comparison of Accident Rate Indices

	NCHRP 420 Literature Synthesis	NCHRP 420 Safety Analysis	Minnesota Study				Indiana Study	Square Root Rule
Reference Table	Table 3	Table 4	Table 8				Table 10	Table 11
Roads	All Roads	Urban-Suburban Roads	Urban-Suburban Roads				Urban-Suburban Roads	All Roads
			UC 2 NLT (1)	UC 4 NLT (2)	UC 4 LT (3)	Average		
Access Points Per Mile								
10	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
20	1.3	1.4	1.3	1.4	1.4	1.4	1.2	1.4
30	1.7	1.8	1.9	1.7	1.6	1.7	1.5	1.7
40	2.1	2.1	2.5	2.0	1.8	2.1	1.8	2.0
50	2.8	2.3	2.7	2.5	2.3	2.5	2.1	2.2
60	4.1	2.5	2.9	2.8	2.9	2.9	2.5	2.5
70	NA	2.9	3.1	3.1	3.2	3.1	3.0	2.7

Source: Computed

(1) 2 lanes – No left turn lanes.
(2) 4 lanes – No left turn lanes
(3) 4 lanes – With left turn lanes

Figure 2

ESTIMATED ACCIDENT RATES BY ACCESS DENSITY; URBAN AND SUBURBAN AREAS

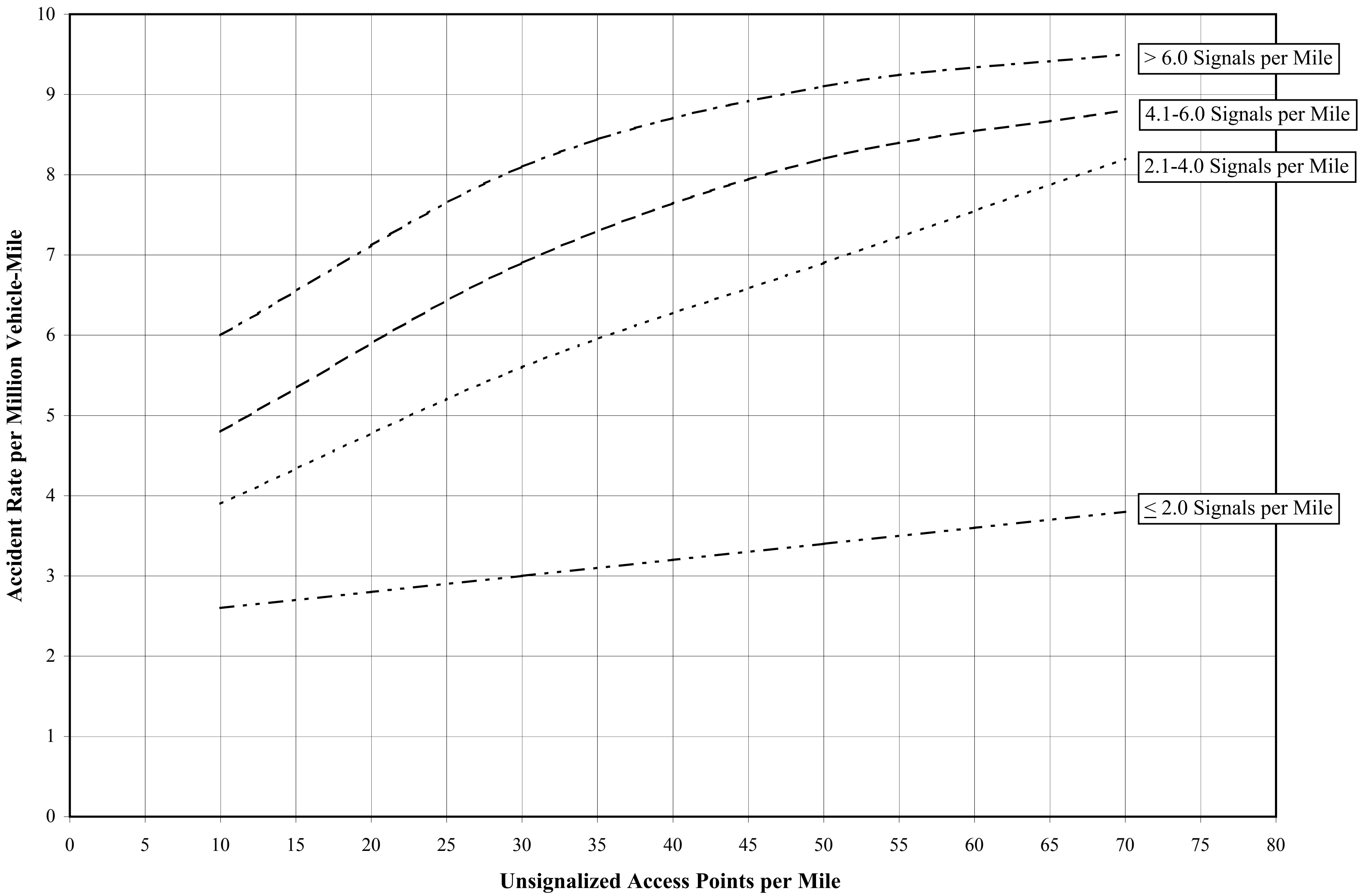
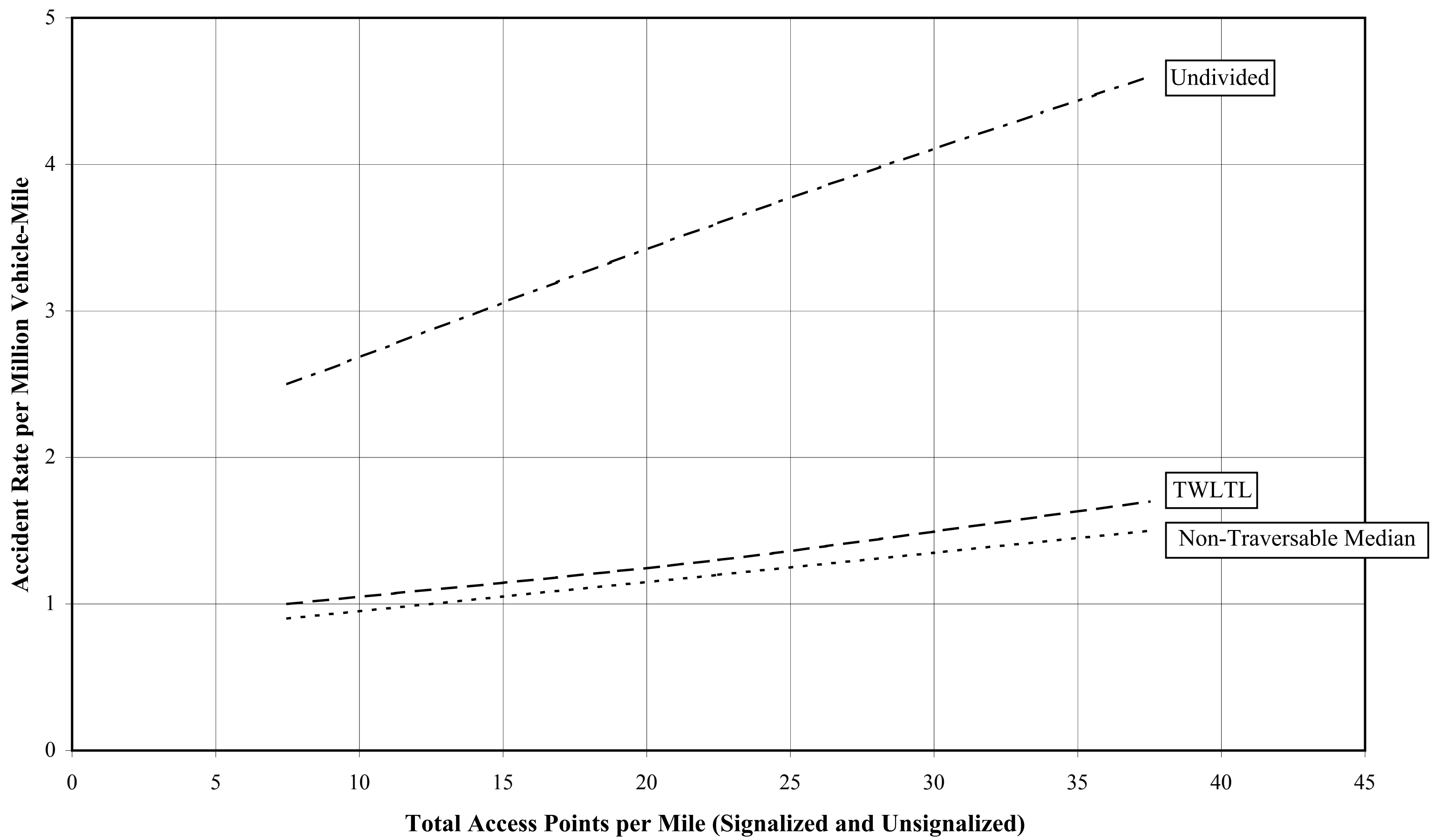


Figure 3

ESTIMATED ACCIDENT RATES BY TYPE OF MEDIAN; RURAL AREAS



Traffic Safety vs Access Management

By: Raj Shanmugam, P.E., and Jan Thakkar, P.E.

INTRODUCTION

Growing traffic congestion, concerns over traffic safety, and the ever increasing cost of upgrading our roads have given birth to a new interest in access management. By managing the access to the highway system, we can help to provide transportation that is more efficient and safe. A familiar example of inefficient and unsafe highway management is the "strip" development that present a driveway every few feet. It is not only stressful to know a vehicle could come out of each of this driveway at any time, but it is also costly and can wreck the efficiency and safety of our highway system.

A comprehensive access management means more than the control of driveways. Research have 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 vehicle miles traveled, increased capacity of our highways, and shorter travel time. Studies in Colorado, Florida and other parts of the country have shown that accident rate per million vehicle miles traveled can be 50% less on arterials that have good access management. In a study done for the Florida Department of Transportation, analysis showed that the typical 4-lane arterial with a high level of access management can handle 10,000 more vehicles per day than the same 4-lane road without a high level of access management. An analysis of major road improvements in Fort Lauderdale, Florida, showed significant benefits from the installation of more restrictive medians access points.

When Florida examined its options for access management standards, it took the concept of access separation and speed differential a step further. Designing accesses that only provide a short distance between crashes was not enough for our new highways. Florida's access spacing standards take into account a greater comfort for safety and also encourages "Functional Integrity". The standards were developed based on research conducted throughout the United States regarding safe stopping sight distances, speed differential and other factors.

On February 13, 1991, the Florida Department of Transportation (FDOT) adopted Administrative Rule Chapter 14-97 regarding access management standards for the State Highway System. This rule called the "Standards Rule" establishes the seven classifications for the state highways and the criteria and procedures for assigning these classifications to specific roadways. The rule sets forth a series of roadway classifications based on spacing between traffic signals, median openings and connections (i.e., driveways and public streets). Essentially, the Department of Transportation determines which roads are the most critical to providing high speed, high volume traffic, and these end up with the highest of standards. Those roads that serve a higher access function will receive a lower classification. This Rule was adopted by the State to implement the State Highway System Access Management Act which was passed by the Florida Legislature in 1988. The purpose for the legislation, as stated in Section 14-97.001 of the rule "....is to protect public safety and general welfare,......"

FDOT Access Management - Arterial Classifications & Standards

CLASS	MEDIANS	CONNECTION		MEDIAN OPENING		SIGNAL
		> 45 mph	< 45 mph	Directional	Full	
GENERALLY DEVELOPING OR UNDEVELOPED AREAS						
2	Restrictive w/ Service Roads	1320'	660'	1320'	2640'	2640'
3	Restrictive	660'	440'	1320'	2640'	2640'
4	Non-Restrictive	660'	440'			2640'
GENERALLY DEVELOPED						
5	Restrictive	440'	245'	660'	2640'/1320'	2640'/1320'
6	Non-Restrictive	440'	245'			1320'
7	Both Median Types	125'		330'	660'	1320'

In June 1993, the FDOT District IV Office which comprises of Broward, Palm Beach, Martin, St. Lucie and Indian River Counties assigned roadway classifications for the purposes of access management to all state maintained roadways. Although one of the primary intent behind access classification was to protect public safety, the accident history along these corridors was only one of fourteen(14) criteria used to assign the access classification. The fourteen(14) Qualitative and Quantitative criteria used in the access classification include:

Qualitative

1. Existing and future functional classification
2. Presence of planned improvements
3. Development density
4. Type of Drainage/edge treatment
5. Existing and future land uses
6. Local street network/frontage roads
7. Potential for access restriction/new median

Quantitative

8. Number of through lanes
9. Posted Speed limit
10. Existing and future traffic volumes
11. Accident history
12. Driveway density
13. Median opening density
14. Signal spacing

STUDY PURPOSE

The primary purpose behind this study is to compare the accident statistics between different classes of roadways to test the significance of difference in accident experience.

STUDY PROCEDURE

Majority of arterial roadways in District IV are assigned either Class 3, 4, 5, 6, or 7 access classification. Therefore, the following six(6) segments of state roadways in Broward County are selected to compare the accident history (1996 through 1998) between segments of same roadways that are continuous and being assigned Class 3 versus Class 5.

Study Segment Characteristics

Roadway Segment	FROM	TO	Length	Class	Signals/mi.	Medians/ mi.	Connections/ mi.
1. State Road 5	Dania Canal Bridge - BMP 0.000	State Road 84 - EMP 2.547	2.547	3	1.2	2.4	12.2
(US 1)	State Road 84 - BMP 8.286	Broward Blvd. - EMP 10.330	2.044	5	1.5	8.3	68.5
2. State Road 7	Orange Drive - BMP 6.467	I 595 - EMP 7.782	1.315	3	1.5	3.8	16.0
(US 441)	Stirling Road - BMP 5.090	Orange Drive - EMP 6.467	1.377	5	2.2	8.0	50.8
3. State Road 7	Coral Gate Drive - BMP 20.438	P.B. County Line - EMP	4.153	3	1.0	3.6	9.8
(US 441)	McNab Road Bridge - BMP	Coral Gate Drive - EMP	4.240	5	2.8	10.1	53.8
4. State Road 816	University Dr. - BMP 0.000	N.W. 56th Avenue - EMP 1.847	1.847	3	2.7	8.1	28.2
(Oakland Pk. Bld)	N.W. 56th Avenue - BMP 1.847	US 441 - EMP 3.329	1.482	5	5.4	7.4	27.0
5. State Road 84	East of S.R. 7 - BMP 16.080	S.W. 15th Ave. - EMP 18.177	2.097	3	1.0	3.8	29.1
(SE 24th Street)	S.W. 15th Ave. - BMP 18.177	Miami Road - EMP 19.776	1.599	5	3.8	8.8	75.7
6. State Road 817	Dade County Line - BMP 0.000	S.W. 6th St. - EMP 9.825	9.825	3	2.1	7.7	22.2
(University Dr.)	S.W. 6th St. - BMP 9.825	Sample Road - EMP 21.003	11.178	5	3.0	7.7	31.8

The Florida Department of Transportation prioritize roadway segments for safety purposes based on a methodology that uses both the accident frequency and accident rates, referred to as Safety Ratio.

$$\text{Safety Ratio} = \frac{\text{Actual Accident Rate}}{\text{Critical Accident Rate}}$$

The Actual Accident Rate is a function of a segment length times the annual number of vehicles in relation to the number of accidents. The Critical Accident rate is a function of segment length, traffic volume, and the average accident rate for the category of roadway being tested. Therefore, segments of roadways with different cross sections cannot be objectively compared. The test segments being continuous lend to similar cross sections and eliminate the potential for discrepancies.

Crash Data (95,96,97) Summary

Roadway Segment	1995 Crash Statistics							1996 Crash Statistics							1997 Crash Statistics						
	Safety	**Crash**	**ADT**	**RE**	**ANG**	**LT**	**RT**	**Safety**	**Crash**	**ADT**	**RE**	**ANG**	**LT**	**RT**	**Safety**	**Crash**	**ADT**	**RE**	**ANG**	**LT**	**RT**
1. State Road 5	0.196	39	50,731	15	8	5	1	0.188	35	53,286	11	10	8	0	0.231	51	53,108	25	10	1	0
(US 1)	0.806	132	54,500	56	17	11	2	1.030	163	54,500	62	25	17	9	0.814	150	56,060	71	23	22	2
2. State Road 7	0.271	29	46,517	11	4	5	0	0.225	24	47,250	12	2	1	0	0.283	34	49,074	17	3	0	2
(US 441)	1.133	93	46,000	34	17	19	6	1.004	77	46,000	30	12	16	2	1.271	102	45,324	45	21	11	1
3. State Road 7	0.413	104	40,000	49	21	17	1	0.321	79	40,044	40	11	7	0	0.281	80	40,938	40	7	11	4
(US 441)	1.971	450	39,027	188	65	76	8	1.483	323	37,907	134	60	51	10	0.891	230	42,495	124	37	21	2
4. State Road 816	0.482	66	45,500	28	14	7	3	0.636	85	45,500	25	17	14	1	0.496	74	45,000	32	12	14	0
(Oakland Pk. Bld)	1.708	199	47,219	109	34	12	7	1.635	185	46,938	113	20	8	6	1.423	180	46,500	104	21	13	2
5. State Road 84	0.488	64	49,977	17	18	0	2	0.373	57	50,263	10	13	4	3	0.707	73	34,616	19	19	3	2
(SE 24th Street)	0.514	59	44271	14	19	10	0	0.507	59	44,514	16	21	8	1	0.732	67	29,119	17	18	14	0
6. State Road 817	0.958	683	51,947	330	114	100	19	0.983	703	53,592	371	87	119	14	1.099	886	53,063	466	126	116	32
(University Dr.)	1.154	860	47880	429	140	106	27	1.010	761	49,793	390	135	86	18	0.871	752	50,141	363	100	84	38

Study Segments - Access Class 3 & 5

Roadway Segment	FROM	TO	Exception	Length	Class
1 SR 5 (US 1)	0.000/DANIA CANAL BRIDGE	2.357/SR 84-SE 24 STREET		2.357	3
	8.381/SR 84-SE 24 STREET	10.235/SR 842-BROWARD BLVD		1.854	5
2. SR 7 (US 441)	6.656/ORANGE DRIVE-SW 45	7.582/SR 862-I 595		0.926	3
	5.184/SR 848-STIRLING ROAD	6.372/ORANGE DRIVE-SW 45		1.188	5
3. SR 7 (US 441)	20.600/CORAL GATE DRIVE-NW	24.402/PALM BEACH COUNTY		3.802	3
	16.297/McNAB-CYPRESSCREEK	20.316/CORAL GATE DRIVE-NW		4.019	5
4. SR 816 (Oakl Pk.Bld)	0.189/SR 817-UNIVERSITY	1.657/INVERRARY BLVD-NW 56		1.468	3
	1.941/INVERRARY BLVD-NW 56	3.234/SR 7		1.293	5
5. SR 84 (SE 24thSt.)	16.269/E OF SR 7	17.987/SW 15 AVENUE		1.718	3
	18.271/SW 15 AVENUE	19.681/MIAMI ROAD	19.272-19.462/RR XING	1.220	5*
6. SR 817 (Univ. Dr.)	0.189/DADE COUNTY LINE-	9.649/SW 6 STREET		9.460	3
	9.932/SW 6 STREET	20.908/SR 834-SAMPLE ROAD		10.976	5
7. SR 820 (Pines Blvd.)	0.189/SR 25-US 27	11.297/SR 817-UNIVERSITY		11.108	3
	11.580/SR 817-UNIVERSITY	13.902/SR 7-N 60 AVE		2.322	5
8. SR 814 (Atlan. Blvd.)	0.189/SR 7-US 441	2.293/SR 849-NW 31AVE		2.104	3
	3.322/SR 849-NW 31AVE	7.775/SR A1A-N OCEAN	4.774/EB EXIT TO SB SR 9-I 95	3.909	5*
9. SR 834 (Sample Rd.)	0.189/SR 817-UNIVERSITY	7.427/WB ENT FROM SB SR 9-I		7.235	3
	8.032/EB ENT FROM SR 9-I 95	9.396/SR 5-US 1		1.364	5
10. SR 842 (Browd Blvd.)	0.189/SR 817-UNIVERSITY	2.950/SR 7		2.761	3
	3.234/SR 7	7.071/SR 5-US 1	4.992/EB EXIT TO SR 9-I 95,	3.441	5*
11. SR 848 (Stirling Rd.)	0.189/SR 817-UNIVERSITY	2.466/SR 7-N 60 AVE		2.277	3
	2.750/SR 7-N 60 AVE	6.631/SR 5-US 1	5.132-5.322/RR XING, 5.437 I-95	3.691	5*
12. SR 870 (Comrcl Bld)	0.189/SR 817-UNIVERSITY	6.059/SR 845-POWERLINE		5.870	3
	6.342/SR 845-POWERLINE	9.798/SR A1A-OCEAN-NE 50	6.303/WB ENT FROM SB SR 9-I 95	2.970	5*

Crash Data Analysis Summary for Class 3 & 5 Study Segments (1996, 1997, & 1998 Data)

Roadway Segment	Acce. Class	Safety Ratio			Crash Frequency				ADT			THREE YEAR AVERAGES				Crash Rate (acc./ mvm.)
		1996	1997	1998	1996	1997	1998	TOTA	1996	1997	1998	RE	ANG	LT	RT	
1. SR 5 (US 1)	3	**0.157**	**0.191**	**0.233**	**27**	**39**	**45**	**111**	52,111	51,756	56,700	40	16	13	0	0.80
	5	**0.811**	**0.691**	**0.694**	**114**	**116**	**106**	**336**	52,917	56,030	54,311	151	55	32	6	3.04
2. SR 7 (US 441)	3	**0.274**	**0.306**	**0.355**	**20**	**27**	**27**	**74**	45,000	49,000	42,500	43	6	4	0	1.60
	5	**0.809**	**0.710**	**1.017**	**53**	**49**	**59**	**161**	45,000	46,092	43,102	73	30	15	3	2.77
3. SR 7 (US 441)	3	**0.326**	**0.286**	**0.319**	**74**	**74**	**93**	**241**	40,000	40,331	47,425	114	23	35	7	1.36
	5	**1.396**	**0.842**	**0.720**	**307**	**207**	**203**	**717**	41,627	42,895	43,272	337	124	87	19	3.82
4. SR 816 (Oakl Pk.Bld)	3	**0.309**	**0.360**	**0.345**	**37**	**44**	**43**	**124**	50,500	45,000	47,500	38	16	29	3	1.62
	5	**1.382**	**1.466**	**1.626**	**148**	**160**	**181**	**489**	50,500	45,000	47,500	300	50	31	9	7.25
5. SR 84 (SE 24th St.)	3	**0.365**	**0.609**	**0.515**	**31**	**50**	**43**	**124**	29,000	28,000	32,000	33	30	4	9	2.22
	5*	**0.892**	**0.911**	**0.839**	**47**	**61**	**52**	**160**	22,563	30,187	27,489	34	52	34	0	4.48
6. SR 817 (Univ Dr.)	3	**1.067**	**1.108**	**0.991**	**679**	**863**	**748**	**2290**	49,191	53,127	53,055	1188	327	319	71	4.27
	5	**1.009**	**0.838**	**0.807**	**727**	**720**	**685**	**2132**	48,382	50,803	51,692	1059	325	240	75	3.53
7. SR 820 (Pines Blvd.)	3	**0.707**	**0.909**	**1.035**	**366**	**582**	**692**	**1640**	37,727	42,807	49,553	963	148	185	39	3.11
	5	**0.889**	**1.042**	**1.110**	**104**	**162**	**160**	**426**	31,115	37,500	35,500	179	71	63	11	4.83
8. SR 814 (Atlan Blvd.)	3	**0.622**	**0.487**	**0.407**	**95**	**93**	**71**	**259**	46,500	52,000	48,500	115	52	20	1	2.29
	5*	**0.983**	**1.084**	**0.961**	**329**	**321**	**284**	**934**	51,174	44,304	44,208	447	170	83	17	4.69
9. SR 834 (Sample Rd.)	3	**1.048**	**0.640**	**0.691**	**442**	**388**	**418**	**1248**	43,515	56,201	57,073	685	191	132	15	3.01
	5	**0.941**	**1.068**	**1.113**	**83**	**86**	**96**	**265**	38,235	29,953	33,500	94	65	48	3	5.23
10. SR 842 (Browd Blvd.)	3	**0.376**	**0.369**	**0.373**	**69**	**75**	**75**	**219**	43,493	42,567	43,253	72	55	37	2	1.68
	5*	**0.877**	**0.991**	**0.937**	**374**	**312**	**291**	**977**	54,803	55,267	54,395	374	179	116	19	4.73
11. SR 848 (Stirling Rd.)	3	**0.582**	**0.660**	**0.669**	**78**	**95**	**90**	**263**	37,000	35,026	33,456	84	54	45	7	3.00
	5*	**0.448**	**0.438**	**0.386**	**110**	**96**	**87**	**293**	41,317	36,092	37,263	104	69	43	13	1.90
12. SR 870 (Comer. Bld)	3	**1.149**	**0.991**	**0.837**	**479**	**508**	**439**	**1426**	51,019	55,480	58,589	684	235	167	40	4.03
	5*	**0.937**	**0.915**	**0.903**	**247**	**261**	**255**	**763**	53,323	58,484	57,816	335	113	116	18	4.15

TOTALS	3		5931		4059	68%	1153	19%	990	17%	194	3%	
	5		6169		3487	57%	1303	21%	908	15%	193	3%	

Study Segments - Access Class 6 & 7

Roadway Segment	*FROM*	*TO*	*Exception*	*Length*	*Class*
1. SR A1A	*4.136/SR 822-SHERIDAN STREET*	*5.331/CAMBRIDGE STREET-BEACH*		*1.195*	*6*
	2.449/VIRGINIA STREET	*4.041/SR 822-SHERIDAN STREET*	*2.372/WB SR 820-TO-2.725/EB SR 820*	*1.231*	*7**
2. SR A1A	*0.812/EISENHOWER BLVD-OCEAN*	*2.267/HARBOR DRIVE*		*1.455*	*6*
	2.361/HARBOR DRIVE	*2.917/LAS OLAS BLVD*	*2.593-TO-2.696 ONE WAY TURN*	*0.453*	*7**
3. SR A1A	*7.332/WASHINGTON AVE*	*8.422/SE 15 STREET-McNAB ROAD*		*1.090*	*6*
	6.704/HIBISCUS AVE	*7.238/WASHINGTON AVE*		*0.534*	*7*
4. SR A1A	*8.516/SE 15 STREET-McNAB ROAD*	*15.113/SE 10 STREET*		*6.597*	*6*
	15.207/SE 10 STREET	*16.279/PALM BEACH CO LINE*		*1.072*	*7*
5. SR 811 (Wilton Dr.)	*2.386/SR 816-OAKLAND PARK BLVD*	*4.916/CYPRESS CREEK ROAD*		*2.530*	*6*
	0.047/SR 838-SUNRISE BLVD	*2.292/SR 816-OAKLAND PARK BLVD*		*2.245*	*7*

Crash Data Analysis Summary for Access Class 6 & 7 Study Segments (1996, 1997, & 1998 Data)

Roadway Segment	Acce. Class	Safety Ratio			Crash Frequency				ADT			THREE YEAR AVERAGES				Crash Rate (acc./ mvm.)
		1996	1997	1998	1996	1997	1998	TOT	1996	1997	1998	RE	ANG	LT	RT	
1. SR A1A	6	0.644	0.219	0.383	10	4	6	20	9,100	11,500	9,700	7	2	4	0	1.51
	7*	0.583	0.681	0.730	22	27	29	78	20,200	21,500	21,543	17	20	15	2	2.74
2. SR A1A	6	0.790	1.164	0.845	50	70	53	173	37,500	34,000	35,000	74	18	12	2	3.06
	7*	0.705	0.409	0.640	10	5	8	23	24,000	19,857	20,429	13	3	1	0	2.16
3. SR A1A	6	0.384	0.264	0.328	12	10	13	35	20,500	23,260	22,000	12	6	3	2	1.34
	7	0.916	0.678	0.741	16	13	15	44	20,594	21,746	20,880	13	5	3	0	3.57
4. SR A1A	6	1.088	1.052	0.670	81	84	54	219	12,626	13,826	11,751	77	20	40	1	2.38
	7	1.064	0.849	0.459	15	14	7	36	8,920	11,207	10,457	11	3	5	2	3.01
5. SR 811 (Wilton Dr.)	6	2.147	2.247	1.753	136	137	117	390	22,429	21,053	22,932	154	72	70	11	6.36

	7	1.002	1.225	1.959	64	65	107	236	25,000	19,500	19,700	55		61		40		6		4.49
TOTAL	6				837							324	39%	118	14%	129	15%	16	2%	
	7				417							109	26%	92	22%	64	15%	10	2%	

Class 3 vs Class 5 Accident Types - Difference Between Two Proportions Test

Crash Type	Access Class 3	Access Class 5	p	z	SIGNIFICANT (95% Confidence)
Rear End	68%	57%	0.6236	12.4854	YES
Angle	19%	21%	0.2030	2.7343	YES
Left Turn	17%	15%	0.1569	3.0242	YES
Right Turn	3%	3%	0.0320	0.0000	NO

Class 6 vs Class 7 Accident Types - Difference Between Two Proportions Test

Crash Type	Access Class 6	Access Class 7	p	z	SIGNIFICANT (95% Confidence)
Rear End	39%	26%	0.3453	4.5615	YES
Angle	14%	22%	0.1675	3.5745	YES
Left Turn	15%	15%	0.1539	0.0000	NO
Right Turn	2%	2%	0.0207	0.0000	NO

The Wilcoxon Two Sample Test is used to test the significance between Class 3 and Class 5 roadway segment Safety Ratios. The test proved that the Class 5 roadway segment Safety Ratios are significantly higher than the Class 3 roadway segment Safety Ratios. The level of significant is over 99%. Similarly the Accident Rates between the two classes of roadway segment groups are tested using the Wilcoxon Two Sample Test and found to have similar results. The level of significance for the Accident Rate comparison is over 98%.

The proportion of accident types between the two classes of roadways are also tested using the Difference between Two Proportion Test and found to have no significant difference.

Therefore it can be concluded that Access Management is a good Safety Management tool.

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Traffic Safety vs Access Management

Traffic Safety vs Access Management

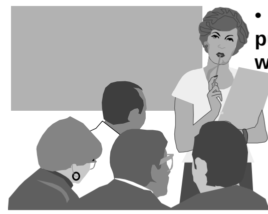
Raj Shanmugam, P.E. - URS Consultants

Jan Thakkar, P.E. - FDOT D4 Access Management

URS

FDOT Access Standards and Intent

- Administrative Rule 14-97: "Standards Rule" adopted February 1991.



- The purpose is to "….protect public safety and general welfare,….."

FDOT Access Management - Arterial Classifications & Standards

CLASS	MEDIANS	CONNECTION		MEDIAN OPENING		SIGNAL
		> 45 mph	< 45 mph	Directional	Full	
GENERALLY DEVELOPING OR UNDEVELOPED AREAS						
2	Restrictive w/ Service Roads	1320'	660'	1320'	2640'	2640'
3	Restrictive	660'	440'	1320'	2640'	2640'
4	Non-Restrictive	660'	440'			2640'
GENERALLY DEVELOPED						
5	Restrictive	440'	245'	660'	2640'/1320'	2640'/1320'
6	Non-Restrictive	440'	245'			1320'
7	Both Median Types	125'		330'	660'	1320'

Qualitative

1. Existing and future functional classification
2. Presence of planned improvements
3. Development density
4. Type of Drainage/edge treatment
5. Existing and future land uses
6. Local street network/frontage roads
7. Potential for access restriction/new median

Quantitative

8. Number of through lanes
9. Posted Speed limit
10. Existing and future traffic volumes
11. Accident history
12. Driveway density
13. Median opening density
14. Signal spacing

Study Purpose

To determine if a correlation exist between Access Classification and Traffic Safety.

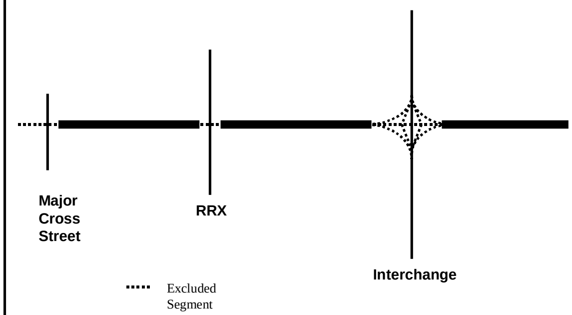
Study Segments - Access Class 3 & 5

Roadway Segment	From	T0	Length	Class
1 SR 5 (US 1)	0.000/DANIA CANAL BRIDGE	2.357/SR 84-SE 24 STREET	2.357	3
	8.381/SR 84-SE 24 STREET	10.235/SR 842-BROWARD BLVD	1.854	5
2. SR 7(US 441)	6.656/ORANGE DRIVE-SW 45 STREET	7.582/SR 862-I 595	0.926	3
	5.184/SR 848-STIRLING ROAD	6.372/ORANGE DRIVE-SW 45 STREET	1.188	5
3. SR 7 (US 441)	20.600/CORAL GATE DRIVE-NW 31 ST	24.402/PALM BEACH COUNTY LINE	3.802	3
	16.297/McNAB-CYPRESS CREEK BRIDGE20.316/CORAL GATE DRIVE-	20.316/CORAL GATE DRIVE-NW 31 ST	4.019	5
4. SR 816 (Oakl Pk.Bld)	0.189/SR 817-UNIVERSITY DRIVE	1.657/INVERRARY BLVD-NW 56 AVE	1.468	3
	1.941/INVERRARY BLVD-NW 56 AVE	3.234/SR 7	1.293	5
5. SR 84 (SE 24th St.)	16.269/E OF SR 7	17.987/SW 15 AVENUE	1.718	3
	18.271/SW 15 AVENUE	19.681/MIAMI ROAD	1.220	5*
6. SR 817 (Univ. Dr.)	0.189/DADE COUNTY LINE-NW215-TPK ENT	9.649/SW 6 STREET	9.460	3
	9.932/SW 6 STREET	20.908/SR 834-SAMPLE ROAD	10.976	5
7. SR 820(Pines Blvd.)	0.189/SR 25-US 27	11.297/SR 817-UNIVERSITY DRIVE	11.108	3
	11.580/SR 817-UNIVERSITY DRIVE	13.902/SR 7-N 60 AVE	2.322	5
8. SR 814(Atlan. Blvd.)	0.189/SR 7-US 441	2.293/SR 849-NW 31AVE	2.104	3
	3.322/SR 849-NW 31AVE	7.775/SR A1A-N OCEAN	3.909	5*
9. SR 834(Sample Rd.)	0.189/SR 817-UNIVERSITY DRIVE	7.427/WB ENT FROM SB SR 9-I 95	7.235	3
	8.032/EB ENT FROM SR 9-I 95	9.396/SR 5-US 1	1.364	5
10. SR 842 (Browd Blvd.)	0.189/SR 817-UNIVERSITY DRIVE	2.950/SR 7	2.761	3
	3.234/SR 7	7.071/SR 5-US 1	3.441	5*
11. SR 848 (Stirling Rd.)	0.189/SR 817-UNIVERSITY DRIVE	2.466/SR 7-N 60 AVE	2.277	3
	2.750/SR 7-N 60 AVE	6.631/SR 5-US 1	3.691	5*
12. SR 870 (Comrcl Bld)	0.189/SR 817-UNIVERSITY DRIVE	6.059/SR 845-POWERLINE ROAD	5.870	3
	6.342/SR 845-POWERLINE ROAD	9.798/SR A1A-OCEAN-NE 50	2.970	5*

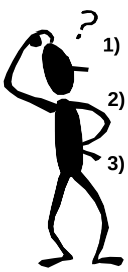
Study Segments - Access Class 6 & 7

Roadway	FROM	TO	Length	Class
1. SR A1A	***4.136/SR 822-SHERIDAN STREET***	***5.331/CAMBRIDGE STREET-BEACH PARK RD***	1.195	6
	2.449/VIRGINIA STREET	***4.041/SR 822-SHERIDAN STREET***	1.231	7*
2. SR A1A	***0.812/EISENHOWERBLVD-OCEAN WORLD***	***2.267/HARBOR DRIVE***	1.455	6
	2.361/HARBOR DRIVE	***2.917/LAS OLAS BLVD***	0.453	7*
3. SR A1A	***7.332/WASHINGTON AVE***	***8.422/SE 15 STREET-McNAB ROAD***	1.090	6
	6.704/HIBISCUS AVE	***7.238/WASHINGTON AVE***	0.534	7
4. SR A1A	8.516/SE 15 STREET-McNAB ROAD	15.113/SE 10 STREET	6.597	6
	15.207/SE 10 STREET	***16.279/PALM BEACH CO LINE***	1.072	7
5. SR 811 (Wilton Dr.)	2.386/SR 816-OAKLAND PARK BLVD	4.916/CYPRESS CREEK ROAD	2.530	6
	0.047/SR 838-SUNRISE BLVD	2.292/SR 816-OAKLAND PARK BLVD	2.245	7

Typical Study Segment



Methods of Comparison

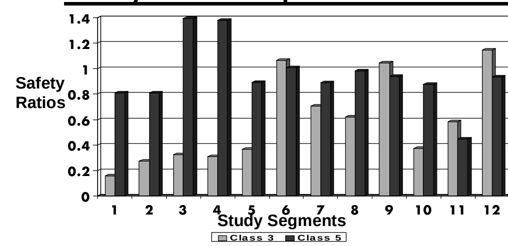


1) Accident Frequency

2) Accident Rate - MVM

3) Safety Ratio = Actual Accident Rate / Critical Accident Rate

Safety Ratio Comparison - 1996 Data



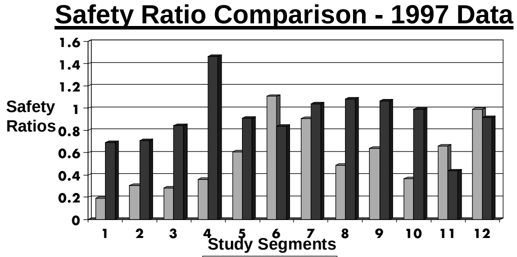
Wilcoxon's Two Sample Test

w1 = 111 w2= 189 u1= 33 u2= 111

U(0.001) =20 - Accept H, U(0.01) = 31 - Accept H, U(0.025) =37 - Reject H, U(0.05) = 42 - Reject H

Class 3 Roadways have a lower Safety Ratio than Class 5 Roadways *(97.5% significant)*

Safety Ratio Comparison - 1997 Data



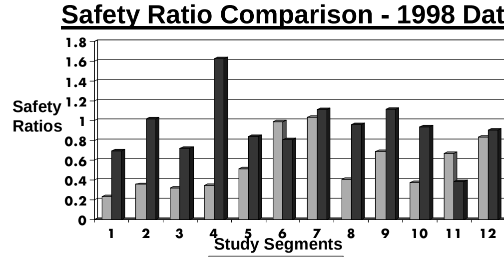
Wilcoxon's Two Sample Test

w1 = 106 w2= 194 u1= 28 u2= 116

U(0.001) = 20 - Accept H, U(0.01) =31 - Reject H, U(0.025) = 37 - Reject H, U(0.05) = 42 - Reject H

Class 3 Roadways have a lower Safety Ratio than Class 5 Roadways *(99.0% significant)*

Safety Ratio Comparison - 1998 Data



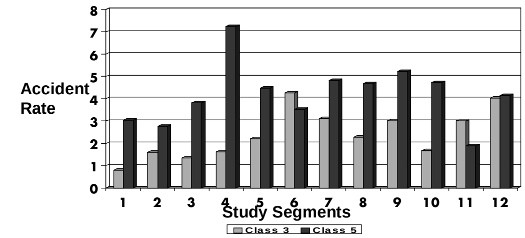
Wilcoxon's Two Sample Test

w1 = 103 w2= 197 u1= 25 u2= 119

U(0.001) = 20 - Accept H, U(0.01) =31 - Reject H, U(0.025) = 37 - Reject H, U(0.05) = 42 - Reject H

Class 3 Roadways have a lower Safety Ratio than Class 5 Roadways *(99.0% significant)*

Accident Rate Comparison (#Acc./MVM)



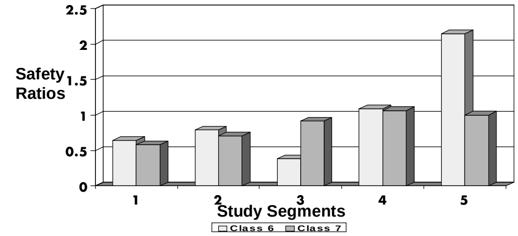
Wilcoxon's Two Sample Test

w1 = 98 w2= 202 u1= 20 u2= 124

U(0.001) = 20 - Accept H, U(0.01) =31 - Reject H, U(0.025) = 37 - Reject H, U(0.05) = 42 - Reject H

***Class 3 Roadways have a lower Crash Rates than Class 5 Roadways** (99.9% significant)*

Safety Ratio Comparison - 1996 Data

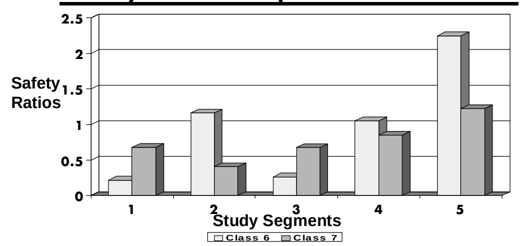


Wilcoxon's Two Sample Test

w1 = 28 w2= 27 u1= 13 u2= 12 U(0.5) = 12 - Reject H

***Class 7 Roadways have a lower Safety Ratio than Class 6 Roadways** (50.0% significant)*

Safety Ratio Comparison - 1997 Data

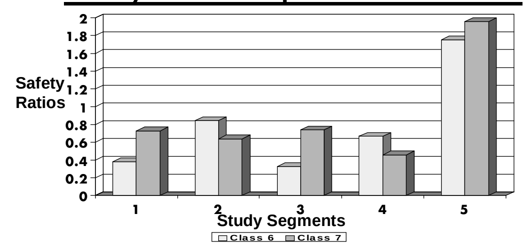


Wilcoxon's Two Sample Test

w1 = 27 w2= 28 u1= 12 u2= 13 U(0.5) = 12 - Reject H

***Class 6 Roadways have a lower Safety Ratio than Class 7 Roadways** (50.0% significant)*

Safety Ratio Comparison - 1998 Data

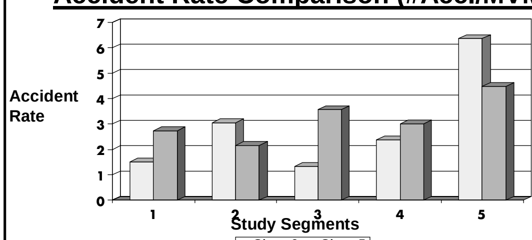


Wilcoxon's Two Sample Test

w1 = 25 w2= 30 u1= 10 u2= 15 U(0.345) = 10 - Reject H

***Class 6 Roadways have a lower Safety Ratio than Class 7 Roadways** (65.5% significant)*

Accident Rate Comparison (#Acc./MVM)



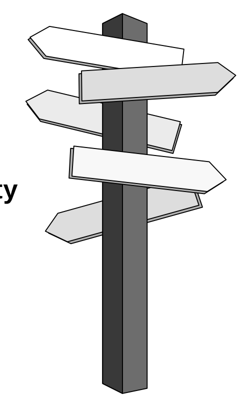
Wilcoxon's Two Sample Test

w1 = 24 w2= 31 u1= 9 u2= 16 U(0.274) = 9 - Reject H

***Class 6 Roadways have a lower Crash Rates than Class 7 Roadways** (72.6% significant)*

Conclusion

- **Stricter Access Control leads to better Traffic Safety**



What is Next?

- Quantify Benefits

STATISTICAL RELATIONSHIP BETWEEN VEHICULAR CRASHES AND HIGHWAY ACCESS

INTRODUCTION

The Minnesota Department of Transportation has undertaken a variety of new initiatives in an attempt to improve traffic operations and safety on the States 12,000-mile Trunk Highway System. One of the initiatives authorized by the legislature involves developing a process and a set of guidelines to take a more proactive approach to managing access from abutting properties.

In order to inform the legislature of the potential impacts of access management, Mn/DOT has studied the legal issues associated with property rights and local land development regulations. In addition, Mn/DOT retained the services of BRW, Inc. to assist with conducting a traffic safety study to help determine to what extent a case can be made for suggesting that access management is a public safety issue.

Mn/DOT was aware of the potential safety implications of access management as a result of previous research. However interesting this data appeared to be, Mn/DOT did not consider the information conclusive because the reports either did not actually document access density, did not consider different roadway types or the data was based on a very small sample size.

Mn/DOT placed a very high priority on having this study produce credible results with a very high level of statistical reliability. However, during the initial phase of the study it was determined that the data collection efforts associated with a analysis of the entire State Highway system was beyond Mn/DOT's time frame and budget. Therefore the study focused on first identifying and then analyzing a random and statistically representative sample of roadways.

The key steps in the study process are listed below and then described in more detail in the following sections:

- Data Collection
- Document and Analyze Access and Crash Statistics
- Analyze Relationship with Traffic and Roadway Characteristics
- Review Minnesota and Iowa Case Studies
- Conduct Statistical Tests
- Calculate Expected Benefits vs. Costs

In summary, the purpose of this project is to provide a comparison to the results of previous access management research conducted elsewhere and then based on comprehensive analysis of Minnesota access and crash statistics, determine if access management is a legitimate public safety issue.

DATA COLLECTION

Category Selection

The first step in developing this project was to determine the different roadway classifications that would be analyzed for the effect of access on the crash rate. The Minnesota Department of Transportation categorizes its roadways based on five parameters, including, roadway environment (rural, suburban, or urban), roadway design (conventional, expressway, or freeway), number of through lanes, type of median treatment (none or median), type of left turn treatment (none, paint, and physical). Breaking this down, there are 162 possible description combinations for a roadway in the State of Minnesota. Although many of these combinations are not used this was still too large a number of roadway types to analyze and some sort of consolidation was necessary.

The important factor in consolidating the different types of roadways was to come up with a manageable number of homogenous roadway categories that isolate the effects of access characteristics. As a result, eleven different roadway categories were selected for analysis. These roadway categories are listed in Table 1 along with a short definition of the category and an alpha descriptor. The alpha descriptor shown for each category in this table will be used in the rest of this document as an abbreviation for the category definition.

TABLE 1
ROADWAY CATEGORIES

NO.	DESCRIPTION	ABBREVIATION
1	2-Lane Rural Conventional/No Left Turn Lanes	RC2NLT
2	2-Lane Rural Conventional/With Left Turn Lanes	RC2LT
3	4-Lane Rural Conventional	RC4
4	6+Lane Rural Conventional	RC6
5	4-Lane Rural Expressway	RE4
6	2-Lane Urban Conventional/No Left Turn Lanes	UC2NLT
7	2-Lane Urban Conventional/With Left Turn Lanes	UC2LT
8	4-Lane Urban Conventional/No Left Turn Lanes	UC4NLT
9	4-Lane Urban Conventional/With Left Turn Lanes	UC4LT
10	6+Lane Urban Conventional	UC6
11	4-Lane Urban Expressway	UE4

Segment Selection

The definitive study of Mn/DOT’s road system would have involved sampling all 4,645 segments and 10,868 miles of conventional roads and expressways in the state. However, this magnitude of data collection was considered beyond the scope of the project and therefore it was determined that a statistically reliable randomly selected sample was sufficient for this project. A preliminary investigation suggested that a minimum total of 500 crashes in each category and a minimum of 25 segments should provide statistically reliable results.

Using the criteria described above a sampling percentage of the total number of segments in each category was determined. This percentage combined with a randomly generated seed applied to the total population of each roadway category then determined the segments that were to be sampled. Table 2 shows the size of the study sample and the statewide population for each of the roadway categories. This table shows that the sample set includes 432 segments and 766 miles of roadway.

TABLE 2
STUDY SAMPLE

	STATEWIDE POPULATION		STUDY SAMPLE	
CATEGORY	SEGMENTS	MILES	SEGMENTS	MILES
RC2NLT	2,710	9,020	120	412
RC2LT	14	20	14	20
RC4	79	142	36	68
RC6	7	7	7	7
RE4	202	577	25	80
UC2NLT	1,166	702	58	38
UC2LT	28	20	20	14
UC4NLT	130	83	48	29
UC4LT	112	83	42	33
UC6	28	26	17	14
TOTAL	4,645	10,868	432	766

Access Data Collection

The most labor intensive and time consuming piece of data to collect was the number of access points in each segment. This information was obtained through viewing the video logs the Minnesota Department of Transportation keeps for all its state highways. The data collection involved scrolling through 766 miles of state highway in order to account for approximately 9500 access points.

The access points were broken down into five different types of access including, public streets, commercial driveways, residential driveways, field entrances and other accesses (access points that could not be identified). The convention that was used for determining the number of accesses involved simply counting the number of intersecting legs with the main roadway. Therefore a T-intersection with the main roadway would constitute one access point and a 4-leg intersection with the main roadway would constitute two access points. It should be noted that the counting of accesses was not affected by whether or not the access point had full access (i.e. open median) or partial access (i.e. closed median).

This counting convention was selected after checking with other researchers at the Federal Highway Administration and Iowa State University. It was determined that this counting convention was consistent with the methodology in other similar research studies.

Crash Data Collection

The crash data used in the analysis of the sample segments was obtained from the Minnesota Statewide Crash Database. The collected data accounted for 13,700 crashes on all the sample segments between the years of 1994 and 1996 and included, total number of crashes, crash rate, total number of crashes for each level of severity (Fatal, Personal Injury A, B, and C, and Property Damage) and categorization of crashes by type of crash.

Segment Data

The segment characteristics for each sample segment were obtained from the Minnesota Roadlog Database. The following segment characteristics were obtained for each individual segment sampled:

- Segment Length (miles)
- Segment ADT (Average Volume across segment from 1994-1996)
- Segment VMT (Vehicle Miles Traveled from 1994-1996)
- Speed Limit
- Segment Environment (Rural, Suburban, Urban)
- Segment Design (Conventional, Expressway, Freeway)
- Number of Through Lanes
- Median Treatment (none or median)
- Left Turn Treatment (none, painted, physical)

TECHNICAL ANALYSIS

The focus of the technical analysis was to document the crash statistics as a function of access density for each segment in each roadway category, identify any observed trends in the data and then to provide an initial assessment of the relationship between access density and crash rate.

Roadway Access Statistics

The statistic used throughout this project to describe the level of access on a segment of roadway is access density. Access density is simply the average number of accesses per mile. It was computed by taking the total number of accesses in each segment that was sampled and dividing by the length of the segment.

It was determined that the average access density for all rural categories is approximately 8 accesses per mile and the average access density for all urban categories is approximately 28 accesses per mile. The data also shows that for similar types of roadway categories the urban category always has a higher average access density than the rural category.

The data also shows that residential driveways (38%) are the most prevalent types of access in rural areas followed by public roads (28%). Public roads (40%) are the most prevalent types of access in urban areas followed by commercial driveways (34%). This data suggests that the greatest opportunities to manage access involve public streets and residential driveways in rural areas and public streets and commercial driveways in urban areas.

Crash Statistics

The statistic used throughout this project to describe the level of crashes on a segment of roadway is the crash rate. Crash rate is simply the number of crashes per million vehicle miles traveled. The number of vehicle miles traveled is calculated from the segment ADT, the segment length, and the period of time over which the crashes were observed.

The average crash rates for the sample segments were first compared with the statewide average crash rates by roadway category. This analysis found that the crash rates for the sample segments are very similar to the crash rates of the statewide population. The data also shows that urban roadways have significantly higher crash rates than rural segments with similar design features.

Additional analysis of the crash data found that there are significantly more single vehicle crashes on rural roadways than on urban roadways and that the percentage of fatal crashes on rural roadways is three times the percentage on urban roadways.

Roadway Access/Crash Rate Relationship

As stated in the introduction, previous research suggests a positive relationship between access density and crash rate. Theoretical reasoning that suggests an increase in crash rate as access density increases supports this premise. This reasoning is based on the belief that turning vehicles and the conflicts caused by these turning vehicles is a major cause of crashes. In addition, this line of reasoning also suggests that with more access points, the number of possible conflict points increase and as a result the crash rate would be expected to increase as well.

The crash rate/roadway access relationship is documented in Table 3 for each of the eleven roadway categories, as a function of the different levels of access density.

This data shows that in almost every category there is a strong positive observed relationship (increasing crash rate as access density increases) between access density and the crash rate. This relationship doesn’t always appear between the different access density groups but it does always exist between the highest and lowest levels of access. Another interesting relationship was noticed when the average access density for each category was compared to these figures. In most cases the access density groups with crash rates lower than the category average also had access densities that were lower than the category average. The reverse was also true as most access density groups with crash rates higher than the category average had access densities higher than the category average.

TABLE 3
SAMPLE SEGMENT CRASH RATES AS A FUNCTION OF ACCESS DENSITY

RURAL ROAD	ACCESS DENSITY (ACCESSES PER MILE)				STATEWIDE AVG. CRASH RATE
CATEGORY	0-5	5-10	10-15	+15	
RC2NLT	0.8	1.0	1.3	1.3	1.1
RC2LT			1.8	2.1	1.9
RC4	0.9	1.1		2.8	1.2
RC6		4.4		2.8	3.4
RE4	0.6		0.8		0.8
URBAN ROAD					
CATEGORY	0-10	10-30	30-50	+50	
UC2NLT	1.7	2.6	4.9	6.0	3.2
UC2LT	3.0	3.0	5.3	5.2	4.3
UC4NLT	2.2	3.3	4.7	7.4	5.3
UC4LT	2.6	4.5	5.6	10.4	4.6
UC6	3.6	4.7	8.7	4.2	6.5
UE4	1.6	2.4		6.0	2.0

Additional technical analysis was also conducted to see if the observed relationship between access density and crash rates could be the result of other variables, such as traffic volume, traffic speed, or related to the type of access (public street, commercial driveway, etc.). To test the effect of traffic volume, crash data was tabulated by traffic volume category. The results of this effort found crash rates to be consistent across each of the volume categories and this suggests that traffic volume does not effect the access density/crash relationship.

In an effort to understand the effect of traffic speed, crash data was tabulated by traffic speed category. Only data for urban roadways was analyzed because there was no variance of speed limits on rural roadways, all of the rural segments had 55 mile per hour limits. The results of this effort shows a strong negative observed relationship between speed limit and crash rate, the crash rate decreased as the speed limit increased.

Analysis was also conducted to determine if the type of access had any effect on crash rates. This analysis consisted of plotting crash rates as a function of the density of particular types of access. The results suggest that in rural areas, the positive observed relationship between access density and crash rate does not appear to be a function of any particular type of access. However, in urban areas it does appear that the observed relationship between access density and crash rate is primarily a function of public street and commercial driveway access.

The results of the technical analysis suggest that a strong positive relationship (crash rate increases with increasing access density) was observed between access density and crash rate.

CASE STUDIES

The technical analyses documented in the previous section focused on the observed relationship between access density and crashes along a sample of Minnesota roadways. This section approaches the safety issues associated with access management from a second perspective, actual before/after case studies for three projects in Minnesota and eight projects in Iowa. The case studies consisted of documenting the following project related information:

- General project description
- Before and after traffic volumes
- Before and after crash frequency
- Before and after crash rates
- Before and after access density (where data was available)
- Results

Minnesota Case Studies

The three roadways included in the Minnesota Case Studies included TH 49 (Rice Street), TH 3 (Robert Street) and TH 61 (Vermillion Street). All of the roadways are in suburbs surrounding the St. Paul-Minneapolis metropolitan area and all were experiencing significant safety problems. These roadways are classified as urban arterials with 30 or 35 mile per hour speed limits and daily traffic volumes ranging from 15,000 to 25,000 vehicles per day. Prior to the implementation of the reconstruction projects, each of the roadways had significantly higher than expected crash frequencies (more than 100 crashes per year) and crash rates (between 6 and 13 crashes per million vehicle miles).

The Minnesota projects, overall, were designed to address the safety deficiencies by reducing conflicts along each of the roadways. These projects include conversion of a two and four-lane undivided roadway to a three-lane road, conversion of a four-lane to a five-lane, and the addition of raised medians with protected turning bays to a four-lane undivided roadway. As a result of these projects, crash frequency and crash rates were reduced by an average of more than 40 percent.

Iowa Case Studies

The Iowa Case Studies were documented in a research report prepared by the Center for Transportation Research and Education at Iowa State University, as part of the Iowa Access Management Awareness Project. The Iowa Department of Transportation, Iowa Highway Research Board and the Federal Highway Administration funded this research project.

The eight roadways in the Iowa Case Studies are located in either the Des Moines metropolitan area or in regional centers around the state. All of the roadways are classified as urban arterials with lower speeds and daily traffic volumes in the range of 15,000 to 29,000 vehicles per day. Each of the roadways is also experiencing high crash frequencies and crash rates (between 5 and 9 crashes per million vehicle miles). The Iowa projects were designed to address the identified safety deficiencies by providing systems of left turn lanes, frontage roads and reducing the number of commercial driveways.

The results of the research from the Iowa Access Management Awareness Project showed that these access management projects had a significant, positive impact in terms of traffic safety. The average reduction in the density of access was approximately 20 percent and the reduction in annual crash rates was approximately 40 percent.

Summary

The crash reductions resulting from all but one of these eleven access management projects are significant at a 95% confidence interval. The only case study where the resulting crash rate reduction was not statistically significant is the Spencer (US 71) case study in Iowa. It is interesting to note that this case had the smallest crash reduction and the highest density of access after reconstruction.

STATISTICAL ANALYSIS

Statistical analysis of the data was a key component of this project to ensure the validity and reliability of the results about the relationship between access density and crashes. Consideration of statistical issues began with the initial random selection process of roadway segments. A randomly generated seed determined which segments would be sampled. This random selection process makes it likely that the samples are representative of the roadways in the state. This increases the probability of producing statistically reliable results.

Following the documentation of the crash rates for each of the roadway categories and the identification of an apparent access density-crash rate relationship, the data was subjected to a series of statistical tests. Within a roadway category, different segments may have different crash rates for a number of different reasons. Conclusions one may reach from a statistical analysis about the access density – crash rate relationship may be suspect unless other effects are found to be unimportant. Therefore, tests were performed to address these concerns.

One reason different sites may have different crash rates could be the dependency of the crash rate on traffic volume. A simple test of the correlation between ADT and Access Density was performed to address this concern. Low correlations were found for nine out of the eleven roadway categories. This indicated that the crash rates were not dependent on traffic volumes.

Another reason why segments within a category may have different crash rates could be because of unobserved differences among the segments. Therefore, a test was performed to check the variability of the observed crash rates within each of the roadway categories. The results indicated that the crash rates varied more than what would be expected (were overdispersed), thus posing problems for statistically reliable results. As a result, specialized statistical analysis was under taken to address the concern of the variability of the crash rates. This analysis would produce statistically reliable results for judging if crash rates tend to increase as access density increases, despite the variability found in the data. The results of this testing showed that, in five out of the six roadway categories that had large enough sample sizes, the crash rate tends to increase as the access density increases (a significant access effect was found).

Confidence intervals (90%) were also reconstructed for the six out of eleven roadway categories that had large sample sizes to produce statistically reliable results. This analysis found that five out of six categories showed a statistically significant difference in crash rates between the lowest access density range and the highest.

Table 4 presents a summary of the access density – crash rate relationship for each roadway category. A positive relationship was observed between access density and the crash rate (crash rate appears to increase as the access density increases) for ten of the eleven segments. Five out of six roadway types with a sufficient sample size to draw statistical conclusions were found to have a statistically significant access effect.

TABLE 4
SUMMARY OF ACCESS DENSITY – CRASH RATE RELATIONSHIP

Roadway Categories	Observed Positive Access/Crash Relationship	Adequate Sample Size for Statistical Analysis	Statistically Significant Access Effect
RC2NLT	✓	✓	✓
RC2LT	✓		
RC4	✓	✓	✓
RC6			
RE4	✓		
UC2NLT	✓	✓	
UC4NLT	✓	✓	✓
UC6	✓		
UC2LT	✓		
UC4LT	✓	✓	✓
UE4	✓	✓	✓

The statistical tests performed show that on a majority of roadway types with a sufficient sample size, there is a statistically significant tendency for sites with higher access densities to have higher crash rates in both urban and rural areas.

BENEFIT-COST ANALYSIS

An analysis was conducted in order to estimate the potential benefits (based solely on crash reduction) that could be realized from the implementation of access management projects.

Benefit-cost analysis looks at the benefits generated by a project and compares them to the cost incurred by the project over a certain analysis period. A project is generally considered economically feasible if the benefits are greater than the costs, producing a benefit-cost ratio greater than one. Typically, the benefits (cost savings) associated with transportation improvement projects may include delay savings, crash cost savings, operating cost savings, routine maintenance cost savings and environmental benefits. This study utilized only the benefits from crash reduction.

The benefits due to crash reduction were determined by first calculating the number of crashes per mile for each category of roadway and then applying an average crash cost using the statewide distribution of crash severity and crash cost values used by Mn/DOT (Property Damage Only = $2,700, Personal Injury = $30,500, Fatality = $500,000). The average annual crash cost per year per mile was then calculated for each category. Finally, values for a range of crash reduction varying from 10 to 80 percent were calculated for each roadway category.

The costs presented for managing access represent initial capital investments annualized over 20 years with a discount rate of 5 percent. Operations and maintenance costs are not included. A range of investment levels and crash reductions were used because it is not possible to determine at this time either the exact cost of an access management project or the exact reduction in crashes that would likely occur due to the level of investment in access management. However, the range of crash reductions (10 to 80 percent) and per mile costs ($100,000 to $2,000,000 per mile) should be sufficient to cover most rural and urban scenarios.

The key conclusion of this analysis is that for many of the assumed combinations of crash reduction and cost per mile for managing access, the benefits outweigh the costs. Crash reduction benefit-cost ratios over 1.0 exist in every roadway category. However, greater benefits for similar levels of investment accrue from crash reduction on urban roadways than or rural roadways:

- If a $500,000 investment was expected to result in a 40 percent reduction in crashes, (the average crash reduction as determined by the case studies), the crash reduction benefit-cost ratios range from 0.18 for a 2-lane rural conventional roadway with no left turn lanes to 3.25 for a 4-lane urban expressway.
- If a $250,000 investment was expected to result in a 40 percent reduction in crashes, the crash reduction benefit-cost ratios range from 0.37 for a 2-lane rural conventional roadway with no left turn lanes to 6.50 for a 4-lane urban expressway.

The results of this analysis have the potential to be used as a guide for assessing the cost effectiveness of different access management projects.

CONCLUSIONS

The previously published safety research has suggested a link between access and crash rates. However, this research either did not actually document access density, did not account for known differences in crash characteristics between various roadway types or the data was based on very small samples. In addition, none of the research used either access or crash statistics from Minnesota.

In order to address these potential deficiencies and to provide an analysis of local crash data, this study was completed, using a representative random sample of segments from Minnesota's State Trunk Highway System. The characteristics of the study sample included 432 roadway segments, 765 miles of roadway (out of a statewide population of approximately 11,000 miles), 9,545 access points and 13,700 crashes (over the three-year period 1994-1996). The roadway segments were then divided into eleven roadway segment categories (five rural and six urban) in order to isolate the potential relationship between crash rates and access density.

Based on the results of the technical analysis, it can be concluded that there is an observed positive relationship between access density and crash rates in ten of the eleven highway categories (i.e., higher levels of access density resulted in higher crash rates). Only the 6-lane category does not show this correlation and this may be due to the small number of segments in this category. Additional analysis of the crash data in each of the roadway categories revealed that in all cases, roadway segments with the highest crash rates have high levels of access density and segments with the lowest crash rates have low levels of access density.

A comprehensive package of statistical testing was performed. The results of this testing indicate that there were sufficient sample sizes in six of the eleven roadway categories to reach statistically reliable conclusions and there was a statistically significant access effect in five of the six categories. The statistical testing also suggests that the differences in crash rates are not related to either traffic volumes or traffic speed.

A Benefit Cost analysis was completed for each of the eleven roadway categories. The results are based on a range of estimated project costs and crash reductions and indicate that positive outcomes (a B/C ratio greater than 1) are possible in every category. However, the data also suggest that urban projects would likely result in greater crash reductions and therefore, greater benefits.

Crash data was analyzed from two different perspectives; a comparison of crash rates on a random sample of the State's Highway System and a Before/After comparison of crash rates from eleven case studies. The results from each approach suggest a strong and statistically sound relationship between levels of accessibility and crash rates.

The final conclusion addresses the key question identified in the Introduction. IS ACCESS MANAGEMENT A LEGITIMATE PUBLIC SAFETY ISSUE? Crash data was analyzed from two different perspectives; a comparison of crash rates on a random sample of the State's Highway System and a Before/After comparison of crash rates from case studies in both Minnesota and Iowa. The results from each approach suggest a strong and statistically sound relationship between levels of accessibility and crash rates. Therefore, the results of the various analyses suggest that yes; access management is a legitimate public safety issue.

References

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3. Preston, H. Crash and Safety Fundamentals. Unpublished Handout for University of Minnesota T2 Traffic Engineering Workshop, 1998

Acknowledgements

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MOVING FORWARD 19/22

Median Construction Project

Other 19/22. SALEM FIELD TRIP

Moderator: Peter Fernandez, City of Salem Public Works

MOVING FORWARD 20/21

Mock Administrative Hearing

Paper

20/21. Mock Administrative Hearing

Moderator: Rindy Lasus, New Jersey Dept. of Law & Public Safety

Hearing Office Panel, ODOT Section

Dwight Apple, Deputy Chief Hearing Officer

Maurice Russell, Administrative Law Judge

Ron Benckendorf, Administrative Law Judge

Lynne Wehrlie, Administrative Law Judge

Dale Hormann, Oregon Department of Justice

Del Huntington, Oregon DOT

Tuesday, August 15, 2000 3:00 PM – 4:30 PM

Track 3 - Workshop

ACCESS MANAGEMENT PRESENTATION
Script

ALJ- TO AUDIENCE:

This presentation is based on portions lifted from a transcript of a hearing that was conducted in Oregon within the past two years, suitably modified of course, to avoid identification of the parties, and to fit in the time allowed. Actually, a hearing like this could take several days. The transcript for the hearing this presentation is based on, runs 275 pages, instead of 19 for this script. We have left the meat of the agency's testimony in the record, though, so you can tell what kind of issues come up in hearings like this.

I am Lynne Wehrlie the Administrative Law Judge in this case. Skip Russell (nods) is the agency's attorney. Dale Hormann will represent the Petitioner (property owner) Dwight Apple. Our witnesses are Del Huntington ODOT Manager of the Access Management Unit and Ron Benckendorf, will be the Department Witness.

When the presentation is over, we will ask for a show of hands to see what you think the outcome should be. We will then tell you what actually happened, and open discussion.

ALJ: Okay, we're on the record. My name is Lynne Wehrlie, Administrative Law Judge assigned to this case. This is a hearing on the matter of the Notice of Intent to Cancel a Highway Approach Road Permit issued by the Oregon Department to Transportation on October 10, 1999, to Dwight Apple, owner. The notice was issued pursuant to Oregon Revised Statutes Section 374.305 et seq, advising Mr. Apple that the Department of Transportation proposes to cancel the Highway Approach Road Permits located at HIGHWAY 26, Mile Point 27.31 and Mile Point 27.34, in Sandy, Multnomah County, Oregon. The Notice of Intent to Cancel the Permit was issued as noted on October 10, 1999 by District Manager Ronald Benckendorf and advises the owner, Dwight Apple, that he has a right to request a hearing in this matter. Mr. Apple, Petitioner, here, requested a hearing in this case, and all activity by the Department regarding this matter was stayed pending my order.

This hearing involves ODOT Case Number am235-2 for Dwight Apple, owner of the property adjacent to Highway 26 at MP 27.31 and MP 27.34.

Prior to the opening of the record in this case, the issues presented in this case and the procedures to be followed were discussed. This matter is being tape recorded. The tape will constitute the official record of these proceedings, together with the exhibits and submissions by the participants.

It should be noted that I have marked certain items in the file as Exhibits as follows:

Exhibit 1 is a notice to the parties of their rights under ORS Chapter 183.413, the Oregon Administrative Procedures Act.

Exhibit 2 is a copy of the Notice of Intent to Cancel Highway Approach Road Permit;

Exhibit 3 is a notice of today's hearing.

Exhibit 4 is a revised Environmental Assessment Review, dated July 3, 1998.

Okay, so far we have identified 4 exhibits that are basically foundation as to the procedural status of this case. Counsel, have your respective clients had a chance to review exhibits 1 through 4?

P-Counsel: Yes your Honor.
State-Counsel: Yes your honor.

ALJ: OKAY, I am prepared to receive into the record exhibits 1 through 4 at this time, unless either of you have any objections.

State-counsel: No objection.

P-Counsel: For the record, I object to Exhibit 2, to the extent it purports to establish the propriety of these proceedings, for the reason stated in my objection and request for dismissal.

ALJ: I'm not asking you to waive your objection to the propriety of these proceedings. We'll get to that in a minute, but subject to that general concern do you object to my receipt of Exhibit 2 for foundational purposes, with any other use of the document subject to my ruling on your Request for Dismissal?

P-Counsel: With that qualification, I do not object to receipt of Exhibit 2 into the record. I do object to Exhibit 4 as irrelevant and immaterial unless the state is able to establish a lawful basis for this hearing.

ALJ: I have marked those exhibits as foundation, to show how we have gotten procedurally where we are, today. On that basis I will receive these exhibits, since they are at least relevant to a determination whether this hearing is relevant. I will make note of your objection, however, and address it in the order in this case, as part of my disposition of your Objection and Request for Dismissal.

I also have a hearing memorandum from the Department. Any objections to that being received?

P-Counsel: the same objection I had to the other exhibits.

ALJ: We'll get to that in a minute, counsel. I'll tell you what, I will give you a continuing objection, and I'll fold my discussion of your objection into my discussion of your Request for Dismissal. That way you don't have to worry about waiving anything, and we can save time getting the record started. Okay?

P-Counsel: Well, I guess that's okay. But I reserve my right......

ALJ: If you have some other objection, counsel, to anything being considered, you can, of course raise that objection. My proposal only applies to objections for reasons that may be subsumed under your Objection to Hearing and Request for Dismissal. Anyone have any problem with that.

State-Counsel: If it will save time, I'm all for it.

ALJ: Okay. Now we've reserved 5 through 22 for Petitioner's exhibits. Isn't that right?

Both Counsel: Yes.

ALJ: So, I guess the next number in order would be 23. I'm marking the Department's Hearing Memorandum as Exhibit 23, and Petitioner's hearing memorandum as Exhibit 24. Subject to petitioner's continuing objection, I am going to receive Exhibit 23. Any objection to Exhibit 24.
State-Counsel: No objection.

ALJ: 23 and 24 are received. Next is Petitioner's hearing memorandum on the Objection to Hearing and Request to Dismiss. That would be 25. Objection?

State-counsel: none.

ALJ: 25 is received. Now we have the Department's response. That would be 26. Objection?

P-Counsel: Subject to my arguments on the Request, and my continuing objection, no.

ALJ: 26 is received on the conditions noted. So now we're done for the time being. Counsel, you had a motion:

P-Counsel: Motion to Dismiss. I think it's inappropriate to proceed any further than this motion until the State can establish its statutory basis for proceeding. There is no statutory basis for these proceedings. I will cite "SAIF Corporation v. Shipley, 326 Or 557, Supreme Court, 1998 for that proposition.

ALJ: Wait. Slow down. That cite again?

P-Counsel: 326 Or 557.

ALJ: Okay: What does a worker's compensation case have to do with ODOT?

P-Counsel: The Supreme Court held that an agency has only those powers that the legislature grants, and cannot exercise authority it doesn't have. Furthermore, pursuant to the Oregon Administrative Procedures Act, in ORS chapter 183, a hearing on a contested case can only happen when the agency has discretion to

suspend or revoke a right or a privilege of a person. Here, there is no statute giving the agency any discretion to suspend or revoke my client's right or privilege, as they are trying to do. Furthermore, the agency is required to give my client a Notice that refers to the particulars of the statutes and rules involved, and provides a plain and short statement of the matters to be asserted or charged. The notice in this case says, in paragraph three-and I quote: "ODOT proposes to cancel the approach road permit previously issued, a copy attached, pursuant to its authority under ORS 374.305 et seq. " That doesn't look like a "description in particularity" to me.

The "et seq" part would take you through the remaining 300 or so chapters of the Oregon Revised Statutes, if you wanted to carry it that far. But it really doesn't make any difference because none of those other statutes gives the Department the authority to hold this hearing, anyway. The state's counsel tries to boot-strap to ORS 326.205 in his memorandum. But that statute, though a general empowering statute, doesn't give him the authority for this. You can't-as a judge-under the statutory construction provisions of ORS 174.010 and .020 add to or take from a statute. You read what's there and apply what's there. Besides, the specific controls the general.

ALJ: Whoa, counsel, you lost me there for a minute. Are you arguing that the notice is inadequate or that the state doesn't have the authority to take the proposed action?

P-Counsel: Both, actually. We say the notice doesn't comply with the Administrative Procedures Act, and therefore must be dismissed, and that the statutes the state relies on do not give the state the authority to take the action proposed.

Besides, the state has impliedly admitted that my client has a property right to those approaches, by calling the permit and "approach road permit." ORS 374.310 says that an approach road permit can't be issued where there are no rights of access between the highway and the abutting real property. Since this permit is for an approach road, it means the department, by issuing the permit, recognized that the owner had a pre-existing property right of access. Nothing in any statute gives the hearings officer jurisdiction to hear a matter involving a property right of access, nor does the state have statutory authority to cancel a permit based on a private right of access. The only thing the state could have done was give a 30 day notice of non-compliance, and then they would have to show-which they can't- that they gave such a notice, and that what they propose to do is a repair or fix-not a removal.

There is no statutory authority of any kind for this proceeding. We object to proceeding from this point forward. I would ask that that objection be continuing, if you decide to go forward.

ALJ: Okay. Anything further?

P-Counsel: That's my objection.

ALJ: Counsel, any response?

State-Counsel: Your Honor, we are talking about permits to use state property, not a property right of access. There may be some situations where a property right to access a state highway exists, but that could only be where the appropriate state officer gave a deed or other conveyance that actually and expressly granted that

right. You can't acquire a private ownership right in state property by adverse possession, no matter how long you use the property, and no matter what informal expressions made by the state could imply an ownership. The Petitioner here has not provided any evidence of the type of written conveyance that would create an ownership interest in the approach. It is suggested that the use of the term "approach road permit" in describing the permit in this case is an admission that Petitioner has a property right in the access, but this is not legally the case. Just because some unidentified agent of the state uses the wrong term for a permit, doesn't convert the permit into a conveyance. It stays a permit.

Now, as a permit, it is basically a revocable permission to cross the state property constituting that stretch of ground on the right of way between the improved roadway and Petitioner's property line. By its nature it is cancelable, and, by administrative rule, it is indefinite, not permanent. This permit has been in force for around 18 years. That does not make it a grant in perpetuity.

In this case, the state's intention to close off these approaches has been known for some time. We have had several public hearings in this area to spread the word about the project, and, according to the records from those hearings, Petitioner showed up to those hearings arguing the same as they are today.

The Transportation Commission has been empowered and mandated to preserve the state's highway resources. It is doing that in this case by closing the approaches for reasons that will be discussed in the main argument on the case.
As to the statutory reference in the Notice of Action, I submit that the notice that was given to Petitioner was legally adequate. But, even if it isn't, the notice is still effective unless the Petitioner can show that he or she has somehow been prejudiced by the delay. In this case, Petitioner hasn't even attempted to make such a showing, and would be hard-pressed to do so, with the witnesses who have appeared today, and the ferocity of Petitioner's attack. They certainly haven't been deprived of a reasonable opportunity to prepare for the hearing.

Also, I would point out that one of these permits was for access to a grocery store. I understand that there hasn't been a grocery store at that location for some time. Since the permit is use-specific, and depends on an evaluation of the volume of use that is to be expected from the use of the underlying property, a change of use makes the permit invalid. The property owner has to apply for a new permit to allow the Department to decide whether it is safe to allow an approach given the anticipated volume of use of the approach. So, that approach has been automatically invalidated anyway.

ALJ: Okay, counsel a response?

P-Counsel: Well, ODOT may think it is all powerful, but it's still taking my clients' property when it cuts off those accesses, and recognized that when it called those accesses "approach road permits." That department simply does not have the power to take those accesses in these proceedings. The permits specifically note

that they can be abrogated by a "future legislative act" but don't say anything about administrative fiat. Since there is no future legislative act to authorize the taking, the state would have to act by condemnation, and compensate my clients for what they have lost.

ALJ: Okay, I'm going to take this motion under advisement and address it in my order in this case. So, we're now to the point of the merits in the case. Counsel? (nods to State-counsel).

State-counsel: First off, we have an exhibit that shows the current configuration of these approaches, and the proposed changes in the approach. We also have two exhibits showing design standards related to this project.

ALJ: Okay, those will be exhibits 27, 28 and 29. If you pass them, I'll mark them now. (marks and returns.) Counsel, (turning to P-Counsel) have you seen these?

P-Counsel: Yes, Your Honor, and I would object to them as irrelevant and immaterial for the same reasons I have previously stated.

ALJ: Well, subject to your continuing objection, sir, I will receive these exhibits conditionally, and address your objection in my order. You know, counsel, to save time I think I'm going to suggest that we assume that you will have the same objection to all the remaining exhibits submitted by the state, and that I will be addressing that objection in my order, so you don't have to raise the same objection to each one. You can figure you've made your record on that objection, and only have to object again if you have something different to say. Is that acceptable?

P-Counsel: I'm not sure. I wouldn't want to waive....

State-Counsel: Your Honor, I will stipulate that Petitioner's objections to relevance and materiality based on the state's lack of legislative authority to take the action proposed can apply to all the exhibits and can be addressed by the Officer in his order, without Petitioner's waiving any rights on appeal.

ALJ: He's made a stipulation that should cover the situation. Now, let's move on, shall we? Counsel?

P-Counsel: Hrmph! I need to speak with my client about this.

ALJ: Okay-we'll take a short recess.

RECESS

ALJ: Now, we're back on the record.
State-Counsel: The properties in question are those marked on Exhibit 28, circled in blue ink. The approaches as they are at present are circled in red on Exhibit 28. Now, on Exhibit 29, you can see that those approaches have been eliminated, but that there is a new approach on the other side of the property, going on to the Old Sandy Highway. Patrons of Petitioner's establishments can turn at Conifer Lane, drive a short block to the old Sandy Highway and make another right, and are at the new approach within 250 feet. I would add that the state has agreed to pay for construction of the new approach. We have also arranged with the county, that operates that road, for a county approach permit to be issued at the appropriate time.

The Department of Transportation has a highway project that's going through here that's going to end-if I'm not mistaken-about 2 miles north of this intersection. That's about here (points on exhibit). The Project runs south to a point off the end of this exhibit, near the intersection of this highway and NE 122nd Avenue. The highway is going from a 2 lane to a 4 lane facility throughout this section, with a raised median for substantially it's entire length. I would point out that the median is a closed issue that is not a proper subject for this case. The median will be installed regardless of what happens here, today. Because of that, if Petitioner gets what he says he wants, here, he will only have a connection to traffic from one direction.

At the intersection connected with this case, the Department has agreed to construct a left turn bay for southbound traffic to allow potential patrons of Petitioner's establishments to turn up Conifer Lane to reach the approach on the back. That is important, because if Petitioner kept the present approach and didn't get the new approach in back, none of the southbound traffic could reach Petitioner's establishments without going around several blocks and approaching again from the northbound side. So, both northbound and southbound traffic can turn onto Conifer Lane, go one short block, turn right again and reach Petitioner's premises. Petitioner can put a sign, here (points) to tell people where to turn to reach them, and that should do it.

This entire project is going to be constructed within the existing right of way. There will be no additional acquisition or condemnation of property.

So, what I am showing you is that there is a reasonable access to the property, so that the Petitioner is not cut off entirely if we close the direct access to the state highway. That is important because we believe that even if we show you that it is not in the interest of the motoring public to allow those approaches to continue, which is our main burden in these cases, we still have to convince you, under ORS 374.310, that reasonable access remains, because without reasonable access the statute does not allow us to exercise our authority to manage the approaches.

I will say that your decision here will have preclusive effect, that is, that if you decide that the state is authorized to take the action proposed, Petitioner cannot come in tomorrow with a new application for the same approach under the same conditions. That does not mean that if someone, including Petitioner, were to come in with a new application and a different circumstance, they could not be issued an approach road permit if they showed a change of conditions that demonstrated that such an approach was in the public interest.

ALJ: Anything more?

State-Counsel: No, that's about it.

ALJ: (turning to P-Counsel) Counsel, any response?

P-Counsel: This is a hearing to cancel two permits. The basis for canceling those permits doesn't exist in the statute. And whether there's another potential access is immaterial. We're here under the notice for 374.305 to 374.325. Nowhere in those statutes does it say that if you have other reasonable access the state can come in and cut off your main driveway. That's a condemnation issue. If they would like to go through a condemnation hearing, we would be happy to see them there. That's their only legal option to cancel these permits.

ALJ: anything more?

P-Counsel: No, that's enough.

ALJ: (turning to State-Counsel) Counsel:

You will see in our brief citations to cases where the courts have talked about what constitutes reasonable access. The Department of Transportation is trying to manage access state-wide. They have designed the project involved here to get more bang for the buck, if you will. The more approaches you have on a highway, the more conflicts you have, the more reduction you have in safety, and the less traffic-flow you end up with as a result. This stretch of highway has been a traffic safety corridor for almost 10 years. The reason for that designation is that it has a high accident rate, as you will hear from the witnesses. That high accident rate, in turn, is caused by increasing traffic levels, which have reached a point where the current road, with the number of approaches it has, can't handle the traffic well. This project will be increasing the width of the road to 4 lanes, and increasing the speed limit to 55 miles per hour, except around this intersection where, since there is a traffic signal planned there, the speed will slow to 50. These approaches are too close together, and too close to the intersection with Conifer Lane to allow traffic to flow through here safely at that speed. They have a general degrading effect on the ability of the highway to carry the expected flow. We are finding the same thing in a lot of places around the state, and we are doing what we can, such as this project, here, (gestures to charts) to remedy the problem.

Now, with that, I am prepared to call my first witness.

ALJ: Proceed.

State-Counsel: I would call Del Huntington.

ALJ: I'll swear him in. Sir, please raise your right hand. Do you solemnly swear or affirm that the testimony you are about to give in this case is the truth, the whole truth, and nothing but the truth?

Witness 1: I do.

ALJ: Please state your name for the record.

Witness 1: Del Huntington, that's H-U-N-T-I-N-G-T-O-N.

ALJ: Counsel, go ahead.

State-Counsel: Sir, please describe in general your work experience and present employment.

Witness 1: For more than 25 years I have been involved in the construction trades, as a contractor, surveyor, or engineer.. I was with the Highway Department in California for 10 years, before coming up here to work on highways for the State of Oregon 15 years ago. I am a professional surveyor. I serve on several national committees on the subject of access management. I chair a subcommittee of the

Transportation Research Board on preparing a national manual on access management that can be used by state, county and city governments throughout the country. I have been the leader of the Access Management Program for the State for the past 5 years.

S-Counsel: Have you brought with you material that will help in understanding your testimony?

Witness 1: Yessir. (hands over documents.)

S-Counsel: What's the next number? (hands to ALJ, and copy to P-Counsel)

ALJ: 30 (marks)

S-Counsel: Would you tell the hearings officer how the Department of Transportation and the Transportation Commission is looking at highway access?

P-Counsel: I would object to this as being irrelevant and immaterial to these permits. What the State's policy is is irrelevant. We're here on the two permits listed in the Notices.

ALJ: Your objection is noted for the record. Counsel, it seems to me that it's related to the continuous objection I allowed earlier. Can we keep focus? Obviously, if I rule against you I am going to need this information to decide the merits, unless we all want to haul our witnesses back hear in a month or so. (nodding to S Counsel) go ahead.

S-Counsel: You can answer the question, now.

Witness 1: Both nationally, and in the State of Oregon, States and local agencies are looking with renewed interest at the way the system of transportation operates for both efficiency and safety. One of the ways to do that is through access management, which can increase safety dramatically, and increase efficiency

without requiring, in some cases, the purchase of more right of way. In Oregon, there are a total of 84,920 miles of highway in the public system. Of that total, the State operates 7,484, or less than 10 percent. Yet on those few miles, we carry

about 60 percent of the total traffic per day in the state. According to data we've collected, we estimate that in 1995 we experienced about 10,000 crashes because of driveways and intersections. Because of expected increases in population, we think that will increase to 14,000 per year by 2015, unless we do something with the highways to prevent it. That works out to about 800 million dollars cost per year, figuring in a 2 percent inflation rate.

We know from national studies that there is a clear relationship between the number of approaches and intersections on a highway, and the number of crashes that highway will experience. That is because the approaches introduce conflicts in the traffic flow. There are more opportunities where crashes can occur. In high speed areas, meaning 45 miles per hour or more, when you increase access points, you increase the number of severe crashes.

We know that we are not going to see a huge increase in gas tax revenues, so we cannot expect to be able to build entirely new roads. So the way to manage the existing system to increase the capacity to handle traffic is to reduce the number of access points. That's why the Oregon Transportation Commission has taken a very serious look at access management, and how to implement better access

management policies to protect the safety and efficiency of the highway system the Commission manages.

S-Counsel: Okay, anything else.

Witness 1. No, that's the overview. I think you may have other witnesses who can go into greater detail.

S-Counsel: Thank you.

ALJ: (looking to P-Counsel) Any questions?

P-Counsel: Yes. (turns to Witness 1): Of those 10,000 crashes per year, isn't it true that none of those crashes, in the past 10 years, have occurred at either of these approach points?

Witness 1: I don't know the answer to that.

P-Counsel: You don't know?

Witness 1: No.

P-Counsel: So you don't know if even one penny of cost has been incurred through crashes because of either of these approach points?

Witness 1: No, I can't say.

P-Counsel: Now, your focus is safety and efficiency, right?

Witness 1: There are other spin-offs, but those are the primary benefits.

P-Counsel: But you do expect people to use the roads, don't you?

Witness 1: Well, yes.

P-Counsel: I mean, if you put 4-foot walls down both sides of the road, that would be better, and then if you walled off both ends, that would be perfect, from a safety point of view, wouldn't it?

Witness 1: No, that's not correct.

P-Counsel: Now these studies you have referred to, they are generalities, aren't they? They don't apply to specific situations on the ground?

Witness 1: Well, the science of travel and motorist behavior allows us to predict.....

P-Counsel: That's statistical. It doesn't apply to any particular stretch of road, to any particular car on any particular day. Right?

Witness 1: It is the summary of a lot of research.

P-Counsel: Again, that does not apply to a particular car on a particular day?

Witness 1. No. The fact is that if you slow to 10 miles per hour less than the through traffic speed, your chances of being in an accident increase by 90 times.

P-Counsel: Okay. ODOT expects to put a raised median on this road, doesn't it.

Witness 1: I believe so, yes.

P-Counsel: But if you put a center turning lane here, instead, wouldn't the traveling public expect drivers to pull into that lane to turn? Couldn't you do that instead of removing these approaches?

Witness 1: No. This is a high-speed corridor. We wouldn't use a continuous two-way left turn lane on a 55 mile an hour highway. There may be a painted median, but it is not for people to turn out of the travel lane. The kind of lane you are talking about would only be used in an urban environment, where the speeds are much slower.

P-Counsel: Now out of all the miles of highway you've talked about, what percentage of that is on Highway 26.

Witness 1: I don't know. You would have to ask another witness about that.

P-Counsel: You do not know.

Witness 1: I could not swear to an answer.

P-Counsel: That's all I have for this witness.

ALJ: Okay. Anything else from anyone from this witness?

P-Counsel: No
S-Counsel: No

ALJ: You can step down. You can leave if you want, or stay and watch . It's up to you.

Witness 1: Thank you , Your Honor.

ALJ: (turning to S-Counsel): Any more witnesses?

S-Counsel: Yes. Call Ron Benckendorf.

Witness 2: Right here. Where shall I sit?

ALJ: That's fine. (pointing). Please raise your right hand. (witness raises hand) Do you solemnly swear or affirm that the testimony you are about to give in this case is the truth, the whole truth, and nothing but the truth?

Witness 2: I do.

ALJ: Please state your first name for the record:

Witness 2: Ron Benckendorf, that's B-E-N-C-K-E-N-D-O-R-F.

ALJ: Thank you. Counsel?

S-Counsel: Could you state your present occupation, please?

Witness 2: I am currently the District Manager for District 1, of the Oregon Department of Transportation.

S-Counsel: Did you have any material that you brought here to testify from?

Witness 2: I have this (hands packet of documents to S-Counsel)

S-Counsel: (turning to ALJ) Should these be marked as 31?

ALJ: Yes. But did you intend to offer 30 into evidence?

S-Counsel: Oh, you're right. I offer Exhibit 30 to be received into the record.

P-Counsel: I object.

ALJ: On what grounds, besides that contained in your continuing objection?

P-Counsel: These documents are hearsay, and are also cumulative.

ALJ: Overruled. I will consider your continuing objection to these exhibits for discussion in my order. As far as this specific objection is concerned, hearsay is generally admissible in these proceedings unless you can think of some more specific objection.

P-Counsel: No, I just oppose consideration of hearsay in these proceedings, as they prevent me from cross-examining the state's witnesses.

ALJ: Be that as it may, that type of objection goes to weight, rather than admissibility, and goes more properly in final argument.

P-Counsel: I disagree with that. I....

ALJ: Counsel, I have ruled. Exhibit 30 is received. There will be no more discussion. Your prerogative is to appeal the decision.

P-Counsel: I certainly shall.

ALJ: Fine. Proceed.

S-counsel: Okay, now I've marked this as exhibit 31. Please refer to it if you need to. Now, what are your duties as District Manager?

Witness 2: I am responsible for maintenance and operations in the two counties, Multnomah and Clackamas County.

S-Counsel: If I want to construct an approach road to a state highway, would I have to go through you?

Witness 2: That's correct. The Oregon Administrative Rules assign the responsibility for approach road permitting to the Region Manager or his/her designee, and that's me. I then assign subordinates to exercise it in particular cases for the most part.

S-Counsel: So could you go into the background of this highway—this project, a little bit?

Witness 2: In Oregon there are four main classes of highway: Interstate Highways, highways having statewide importance, highways having regional importance, and highways having district importance. Highway 26, the highway involved here, has been classified by the Department as a region-level highway, meaning that it serves functions beyond the district level. It doesn't just move traffic between the two cities, it also serves the entire river basin, and provides a main route for trips to Eastern Oregon across the Cascades. It was established as a safety corridor about 10 years ago, because it has an accident rate well above the statewide average. Many of the crashes that have occurred on this highway involved vehicles making turning movements, such as rearend crashes, or so-called angle crashes from the rear. The number of approach points is very high, and every approach point creates a conflict point, in this case, where the speed differential between people entering and leaving the highway, and the through traveler, driving at 55 miles per hour, is great. This creates a very dangerous situation.

This particular section of highway has the highest number of fatal crashes at intersections in the region.

S-Counsel: And where are the intersections you are talking about, in relation to the approaches at issue here?

Witness 2: The worst one is about 1/2 mile south of that location, although all the intersections along the highway have higher than average accident rates.

S-Counsel: Go ahead.

Witness 2: From NE 122nd, to a point about a mile south of these approaches, the highway has 4 through lanes and a continuous two-way left-turn lane, all at posted speeds of 35 or 40 miles per hour. At the end of that stretch the highway narrows to two lanes, and increases to 45 miles per hour, which continues past the area where these approaches are located. Because of development throughout the region, traffic counts have increased dramatically, and are expected to reach a point fairly soon where a 2-lane highway will fail completely to accommodate the traffic flow. In 1995, that stretch of highway showed an average daily traffic of 13,000. That's projected to more than double to nearly 27,000 by 2017. The Department has graded this highway as grade D on a scale where grade A is free flowing traffic without interaction, and grade F is complete gridlock. The Transportation Commission assigned an expected service-level for this highway of grade C. It's already below that, and will get worse unless something changes. We do not expect the population of this part of the state to drop, or even slow down its increase in the near future. The only other possible change is to reconfigure the highway to increase the volume of traffic it can carry. That's what this project is intended to accomplish, and access management is an important tool in that effort. As Mr. Huntington said, national studies have shown convincingly that access points onto the highway produce conflict points and increase the danger of crashes, as well as reducing the flow of traffic for efficient use of the highway.

S-Counsel: Could you elaborate on what you mean by "conflicts?"

Witness 2: The easiest way to do that is to compare this highway with Interstate 84. On the interstate, you get on, and you go, without worrying about anyone stopping in front of you to make a turn, or turning onto the highway at a speed much slower than the through traffic flow. There are very few places, relatively speaking, to get on, and those are at or nearly at the speed of through traffic. That makes it a very easy facility to drive on, and permits it to handle high loads of traffic at high speeds. When you compare that to a facility like this one, where there are many access points, people stopping to make left turns, and everything else, there are many many more conflicts to deal with, and driving is much more difficult.

S-Counsel: I just have to pay more attention?

Witness 2: Well, yes, you have to be much more aware, and you have to stop or slow down much more often.

S-Counsel: Now can you accomplish all that you want to accomplish within the current right-of-way.

Witness 2: That's one of the goals, anyway, to avoid taking people's property. Right of way takings on a project of this magnitude are difficult. They impact people's homes, etceteras, and the more we can avoid that, the happier our customers are. It makes a project much easier to develop and to build, so that is a major goal, to minimize right-of-way takings. You can't eliminate them altogether, but you really do want to minimize them if you can.

S-Counsel: Have you experienced problems such as you've described here in the past?

Witness 2: Yes. 10 years ago, or so, we built several facilities where we were not very aggressive in access management. People built along them, adding new approaches to the highway, as the population of the whole area grew. Almost from the beginning we started having crashes along them. In some cases, we are now going back and building a whole new facility at great cost to the public because that road simply will not carry the traffic people are putting on it now.

S-Counsel: And when you do that, you have to condemn people's property, and worry about other socio-economic and environmental impacts?

Witness 2. Exactly. They're expensive, and very disruptive of people's lives. We understand how difficult this kind of thing can be, although if we let it go, the fix would just be that much worse.

S-Counsel: Did you get public input before you finalized the plans for this project?

Witness 2: Oh, yes. We've been having public meetings since well before I came here, to receive comments on the proposals. The design has changed a great deal, since then, some of it in response to comments from the Petitioner in this case.

S-Counsel: Oh?

Witness 2: We met Mr. Apple several times to discuss this particular access issue, and have tried to find a solution that is acceptable to all parties. For example, as has been mentioned, we intend to run a raised median down the center of the project. After meeting with Petitioner, here, we agreed to put a break in the median so that southbound traffic can turn left at the intersection, here, to get to Petitioner's establishment from the cross-street.

In addition, we hired a consulting firm out of Portland to do an analysis of the impacts of the access management aspects of this project. They concluded that there would be little if any impact on Petitioner's business, among others. People who intend to patronize their businesses know where they are and come here planning to go to them. So, it was their feeling that the changes in the approach would still leave them a reasonable access.

Basically, we have eliminated 25 of the 43 existing approaches, and we feel that when the project is done we will have a facility that will operate much more efficiently, and last a long time, and serve the public well.

S-Counsel: So, is it your opinion that these approach permits need to be canceled in the public interest?

Witness 2: Yes.

S-Counsel: How long have you been aware of this property?

Witness 2: At least 5 years.

S-Counsel: Now, one of the approach permits is for a grocery store, is it not?

Witness 2: Yes, that's the one at milepost 27.31.

S-Counsel: Have you ever seen a grocery store in either of the buildings on this property?

Witness 2: No grocery store has operated on this property at least since I have been here, for the last 5 years.

S-Counsel: One of the drawings you produced as part of Exhibit 31 shows a projected entry to the property from Conifer street, is that right?

Witness 2: Yes, but that is property in a different ownerhsip that is not a part of this hearing. To get to the property, people could turn east on Conifer, then south on Old Sandy Highway, and the approach would come off the county road, about 200 feet in from the intersection.

S-Counsel: Did your consultants consider the impact on Petitioner's operations of moving the approach to that point?

Witness 2: Yes.

P-Counsel: Objection. Irrelevant. Hearsay.

ALJ: You've already made your record on the irrelevancy objection. I'll rule on that in my order. And I've already noted that hearsay is admissible. You want to make an offer of proof why this particular hearsay is unreliable?

P-Counsel: I have no way of testing it to determine what information they used to reach their conclusion. They could have been reading tea-leaves for all I know.

ALJ: Your objection is duly noted. I overrule it, as to admissibility, but I'll consider it in evaluating the weight to give this report. Go ahead counsel.

S-Counsel: What did your consultants conclude?

Witness 2: They compared this situation with similar changes in access of similar businesses in other areas of the country, and concluded that the change would not have a significant effect on the business conducted there. Depending on which direction you're coming from, the total change in distance people have to travel to reach the business from its current configuration is about 500 feet—less if you're approaching from the North. It is just not that difficult to reach. Besides, we couldn't leave both the approaches here, under current design standards.

S-Counsel: Meaning—

Witness 2: These two approaches are much too close together. The current design standards for regional highways is 990 feet between approaches. In this case, because we are signalizing this intersection, the speed limit will drop to 50 miles per hour 1/4 mile before the intersection in both directions. The design standard for distance between approaches at 50 miles per hour is 560 feet. That is still a lot more than the distances here. These approaches are only around 150 feet apart, and both of them are less than 560 feet from the intersection. Much too short a distance especially given that they both go into the same parking lot.

S-Counsel: Okay. That's all I have.

ALJ: You want to offer 31?

S-Counsel: Yes.

ALJ: (pause) 31 is received. Counsel, any questions?

P-Counsel: May I have a short recess to talk with my client?

ALJ: Of course. We're in recess. (turns off the tape recorder).

P-Counsel: Are you aware of any crashes that have occurred near these approaches points?

Witness 2: Just one, where a motorist lost control and slid into a ditch.

P-Counsel: That wouldn't have anything to do with these approaches, would it?

Witness 2: I don't know. Depends on why the driver lost control.

P-Counsel: Has the accident rate dropped on this section of highway since it was designated a safety corridor, with a reduced speed limit?

Witness 2: Yes.

P-Counsel: In fact, it is now below the state-wide average isn't it?

Witness 2: Marginally so, perhaps, yes, but----

P-Counsel: You can expand on that for your own counsel, later. Right now it's my time. Isn't it true that the accident rate is below average for this road?

Witness 2. Yes.

P-Counsel: Now, you expect traffic count to reach almost 27,000 by the year 2017, is that right?

Witness 2: Yes.

P-Counsel: And how did you reach that conclusion?

Witness 2: There are models used to project these things?

P-Counsel: And models are rarely accurate, are they?

Witness 2: There are varying degrees of accuracy, depending on the model.

P-Counsel: So what we're really talking about is a wild-ass guess, aren't we?

Witness 2: Wait a minute, that's ----

P-Counsel: There are a lot of places with traffic counts more than 24,000 without raised medians, right..

Witness 2: Yes, but----

P-Counsel: Right?

Witness 2: Yes.

P-Counsel: Now there are others on this stretch of road that got to keep their approaches, didn't they.

Witness 2: A few.

P-Counsel: Like the Jacobs?

Witness 2: Yes. And as to that----

P-Counsel: Please elaborate on your own time.

Mr. Benckendorf, the real reason you're taking the approaches here and not in some of the other locations is because there's not enough people to complain, the politically disempowered are here, and it's something you can do and get away with?

Witness 2: No. The reason we're doing this is because we're investing 8.3 million tax dollars and it needs to be done right the first time.

P-Counsel: I have no further questions.

S-Counsel: You were cut off by counsel regarding the Jacobs. What were you going to say?

Witness 2: Mr. and Mrs. Jacobs had no reasonable alternative access. We allowed them an approach on the highway because they would otherwise have been land-locked. There are a few approaches like that out of the 43 originally on the highway that we have left. But those, like Petitioner in this case, that had reasonable alternative access were removed because they would not experience any serious loss because of the removal.

S-Counsel: Was there anything else?

Witness 2: Yes. In most of the cases where traffic counts were 24,000 and had no raised medians, the area was urban, and the speed limits down around 35 miles per hour or so. This is a safety corridor, so right now the speed limit is 45 miles per hour at this location. But it is a regional highway. A 45-mile an hour speed limit, and a D level of service are unacceptable. We need to improve this highway so we can increase the speed limit to levels more in keeping with its role in regional transportation. We are not going to allow traffic to be tangled up throughout the region to allow this one landowner two approaches he doesn't really need, anyway.

S-Counsel: Nothing further from this witness.

ALJ: Anything further at this point?
S-Counsel: Nothing for now.
ALJ: (looks at P-Counsel): Counsel?
P-Counsel: Yes. I would ask that Dwight Apple be sworn.
ALJ: Mr. Apple, please raise your right hand. Do you promise on penalty of perjury to tell the truth?
D. APPLE: I do.
ALJ: Please state your full name.
D. APPLE: Dwight Apple, as in the fruit.
P-Counsel: Mr. Apple, I hand you a document. (Turns to ALJ) What number is this?
ALJ: Let's see. We're at 5 in the numbers reserved for Petitioner, now?
S-Counsel: I think so, yes.
P-Counsel (writes on document) I hand you a document marked Exhibit 5, and ask if you recognize it.
D. APPLE: Yes. That's the deed that Grace Harding gave to Charles Wilson, in 1944. It's the deed to the property I bought from Charles Wilson in the 60s.
P-Counsel: Your honor, Exhibit 5 is a Warranty Deed, dated January 3, 1944, that is in the chain of title to this property, from one previous owner to her successor, my client's predecessor in title. You will note that it states a grant of access to the highway. Since this deed predates the

legislation under which ODOT claims to have the authority to regulate approach roads, it creates a property right that the state may not take without compensation.

ALJ: (To S-Counsel) Any objection?

S-Counsel: I don't see the relevance of a grant from one private party to another. That can't bind the state on the use of its own property, I wouldn't think.

ALJ: Well, I think I'll receive it, and we'll see where the argument goes from there. It is useful to the inquiry at hand, since it shows that the approaches were in existance before 1951, when the first legislation was enacted.

ALJ turns to audience:

OKAY: that concludes the evidence we will present, today. Counsel? (turns to S-Counsel):
S-Counsel: (faces audience) In the rest of the state's case, we would put on additional evidence showing that there is a safety issue, and that there is reasonable alternative access. We would also present the economic analysis showing that the property owner would not suffer significant economic harm from this change, and any way that even if there were such harm, the state still has the authority to take its action.
P-Counsel: From this point, we would continue to hammer on the question whether this is a taking of a property right. We would also put on evidence that Petitioner would experience substantial economic hardship from the state's action.

ALJ: You have gotten the outline of the case.
Any questions?

TIME FOR QUESTIONS.

Now, before we wrap up:
How many out there would uphold the cancellation of the permits?

How many would let the Petitioner keep one? Both?

How many think the ALJ should grant the Motion to Dismiss, based on the problems with the notice?

How many would deny the Motion?

Who, out there, would have handled the entire thing differently?

We are now ready to present the decision in the case. Under Oregon process, the ALJ normally does not state a decision at the hearing. Instead, the decision is mailed some time after the record closes. (sits, picks up a paper and reads)

"The motion to dismiss for inproper notice is denied. Petitioner appeared at this hearing, and had a full opportunity to argue the issues and present evidence. There is no evidence that Petitioner was prejudiced in any way by the features of the notice submitted.

The cancellation of the two approach permits is upheld. Petitioner has not shown a property interest in the permits that would limit the State's authority to manage access to its highways. The deed does not bind the state regarding disposition of its own property, and the state cannot be bound by the passage of time except in specific circumstances that do not apply here."

The floor is now open for questions and discussion.

23 Access Management Challenges

Paper
Other

23A. Livable Communities

Moderator: Del Huntington, Oregon DOT

Mike Burrill, Burrill Resources, Inc.

Bill Lennertz, Lennertz, Cole & Associates

Gary Sokolow, Florida DOT

Dane Ismart, Louis Berger & Associates

Paper
Slides

23B. 10 Top Things You Hear At A Public Hearing and How To Respond

David Gwynn, TEI Engineers & Planners

Wednesday, August 16, 2000 – 8:00 AM – 9:30 AM

The list of questions in each of your areas is lengthy. Please select the major questions that address what you want to cover in the 10 minutes allowed for each panelist. Also consider how you can work the questions you don't address in your 10-minute talk into your five-minute Q&A or the 30 minutes of dialogue.

Please review the list of questions for other panel members to ensure continuity and avoid duplication.

Del Huntington: Introduction of panel members.

Sam Imperati: Designing the convening, roles, responsibilities, and procedures for the process.

- How was the assessment made? Within the agency? With other stakeholders?
- What did you learn from the assessment that helped in planning and organizing the process?
- What, if any, preparation or orientation to consensus decision making did the participants have?
- What about ground rules? Were there any especially important provisions? Any you would have added in hindsight?
- What role did information lay in the process? How was information used?
- How would you describe the stages of this process?
- What were the difficult issues? How were they managed?
- What were the options for addressing the issues developed by the group?
- What mechanisms were set up to keep constituencies informed and provide their feedback as the process proceeded?
- What kinds of linkages were created to the formal decision-making process?

Craig Greenleaf: Selecting and convening the process and implementing the committee's product.

- What led to the ODOT selecting a collaborative process?
- What was the agency's mandate?
- Why did you think this process could be of assistance?
- What were you hoping to get out of a consensus process?
- Was the agency leadership supportive?
- What would you say to other state departments of transportation about the key features of a consensus process?
- What do you see as the advantages of this kind of process? The disadvantages?
- What did the process deliver? Did it meet your expectations? What were the highlights?
- How did you prepare for the process?
- What kinds of resources were needed to conduct the process?

- What kinds of linkages needed to be created between these informal processes and the formal decision making processes?
- What has been done to lay the groundwork for implementing the outcome of the decision?

Mark Whitlow: Participation of "big box" developers - the reasons and motives.

- What led you to participate in the process?
- How did you prepare? What kind of help, if any, do you think would be useful when preparing future endeavors like this?
- How did you communicate with your constituency during the process?
- What did the process deliver from your perspective? Did it meet your expectations? What were the highlights?
- How will you play a role in the adoption and implementation of the agreement?

Lynn Peterson: Negotiating your interest and not selling out.

- What led you to participate in the process?
- How did you prepare? What kind of help, if any, do you think would be useful in preparing future endeavors like this?
- How did you keep up communications with your constituency during the process?
- What did the process deliver from your perspective? Did it meet your expectations? What were the highlights?
- How will you play a role in the adoption and implementation of the agreement?

Dialogue: Thirty minute dialogue with the audience to address their questions.

Access Management Process Abstract
Fourth National Conference on Access Management
Portland Oregon
August 13 – 16 2000

Over the past several years the importance and prominence of access management as an issue and as a management tool have risen. The Oregon Department of Transportation (ODOT) is spending increasing time and energy to provide a sound forum for the resolution of some of the major issues and conflicts surrounding access management.

Along with the external dissention regarding access management decisions, there are internal philosophical differences and misunderstandings around how ODOT can best address access management decisions.

To address this issue in a pro-active manner, ODOT initiated a collaborative negotiated rule-making process to advise the department on how to implement its access management policies. To assist with this effort, the ODOT Director appointed an Access Management Advisory Committee (AMAC) consisting of representatives from 16 interest groups all with diverse opinions regarding access management. The interest groups represented are: cities and counties; developers; citizen interests; business; property owners; land use and economic development agencies; freight representatives; retailer and big box developers; alternative modes of transportation; environmental; and safety. Although ODOT is not a voting member of AMAC, the process allows the department to make substantive language suggestions on relevant decision points.

In addition, ODOT has convened an internal Access Management Advisory Group (AMAG). AMAG representation includes ODOT's senior management involved in the access management program. The charge of this committee is to develop draft rule language and to review and comment on recommendations developed by the AMAC. AMAG is an advisory committee to the Department's Deputy Director of the Transportation Development Division and ODOT's AMAC representative.

The collaborative process is designed to improve communication, obtain public input, and explore balanced, practical solutions to the implementation of access management policies.

A single text process is being used to draft recommendations for Administrative Rules. Single text process is a discussion model, which provides an opportunity for many parties to draft a single document, or discussion draft that reflects their interests. The discussion draft being developed by the committee reflects the consensus or majority recommendations of the members. The process allows committee members to evaluate an existing draft and propose changes to satisfy the concerns of AMAC members.

The collaborative process between ODOT and its stakeholders will be completed in May 1999. This process is helping to restore the credibility and lack of trust that exists between ODOT and some of its stakeholders that occurs because access management is such an emotional issue. In addition, the process provides the department with useful tools for implementing its access management policies. The process is expected to create Administrative Rules, a revised Highway Design Manual, and/or a Desk Manual — all of which will be used to implement ODOT's access management policies as defined in the department's 1999 Oregon Highway Plan.

PUBLIC INFORMATION MEETINGS FOR ACCESS MANAGEMENT PROJECTS

THE DISTRICT FIVE EXPERIENCE PRESENTATION OUTLINE

David W. Gwynn, Jr., P.E.
TEI Engineers & Planners

The main focus of this presentation will be to discuss several items which were learned during the past few years in District Five in regards to Median Opening Modifications and the conveyance of the proposed changes to the general public. District Five has taken a very active role in promoting public involvement in the access management decision making process.

Over the fast four years I have been working with Mr. Jim Wood and the District Five Traffic Operations staff on a project entitled "District-wide Median Evaluation and Public Involvement." There were several objectives of the project:

1. To study several recently completed projects which significantly changed the location and frequency of median openings. The study was geared to determine what, if any, traffic operations improvements were attained by implementation of the project.

2. To determine the opinions of several specific groups regarding these projects. These groups included the general motoring public, local business owners, and law enforcement agencies.

3. To develop handouts and audio-visual aids to convey the purpose of the Department's access management guidelines to the general public.

4. To prepare for and conduct public information meetings for access management projects on behalf of the Department.

I will briefly overview the first three objectives of the project and focus the majority of the presentation on the fourth objective.

Objective # 1 - Study of Recently Completed Projects

The study was performed on five projects in Winter Park, Daytona Beach, Merritt Island, and Casselberry. Each project included the installation of a much more restrictive median treatment. Some of the projects also included other capacity enhancements such as turn lanes, additional travel lanes, and signal upgrades. The studies showed that there were significant and quantifiable improvements as a result, at least in part, of the more restrictive median treatments.

These improvements include:

- Although the number of median openings decreased, and the amount of turning traffic increased at the remaining openings, the frequency of collisions at the remaining openings did not increase.
- Total number of collisions decreased.
- Average travel speeds increased.
- Side-street delay increased at some locations.
- Signalized intersections had to be looked at to see if existing timings could handle increased U-turn volumes.

Objective #2 - Surveys of Specific Groups

Usually the people who show up at public information meetings are not a good representation of the general public. For the most part, people will not attend the meeting unless they are worried that they will be adversely impacted and will not make public comment or fill out a comment card unless they are very concerned that they will be negatively impacted. Unfortunately, the general road users and non-affected business owners and residents are not willing to give up their limited time to attend these meetings. Therefore, we attempted to solicit these peoples input and opinions by using mail-out surveys, handouts along the roadways, and general discussions with business owners, law enforcement agencies, and local residents. The general results of the surveys are as follows:

Driver Surveys

- 800 mail back surveys were distributed and 23% were returned.
- 73% noted an origin or destination adjacent to the roadway section which was modified.
- 88% were familiar with the changes.
- 78% believed the roadway was safer as a result of the changes.
- 82% favored the changes.
- 57% did not feel inconvenienced having to make U-turns.
- U-turns were overwhelmingly not a major decision in selecting business patronage.

Business Owner Surveys

- 500 mail back surveys distributed. 0 46% returned.
- 86% had been in business at the same location prior to the change in median treatments.
- 64% had no impacts from the changes.
- 9 1 % made no changes to the way they did business.
- 59% had no problems with the changes.
- 57% reported an increase or stability in their business volumes.

Objective # 3 - Handouts and Audio-Visual Aids

One of the major objectives of the project was to develop materials which could be used as handouts and presentation materials for use at Public Information Meetings. These materials included the following:

- A fifteen minute professionally produced videotape entitled "Managing Our Highways." The video explains, in layman's terms, why the Department has adopted access management guidelines. The video goes into detail about the problems associated with poor access management as well as the benefits associated with good access management. The video has been well received by both technical people as well as the general public.

- A generic handout which summarizes the goals and objectives of the access management guidelines.

- Project specific handouts explaining the access management strategy being proposed for the affected roadway.

- Presentation boards prepared using aerial photography showing the proposed and existing access management. The aerial based boards have been very well received by the public as they can easily point out their property as well as show problems which they have concerns about. The aerials are also very useful to the technical staff as they can illustrate alternate routes, discuss the rationale behind various access management strategies, and understand the concerns of the public easier.

Objective # 4 - Conduct Public Information Meetings

Public Information Meetings have been conducted on numerous projects throughout District Five. David Gwynn and Jim Wood have conducted the majority of these meetings along with other FDOT and TEI staff. These meetings have been attended by as few as 5 to 10 people and as many as 900 people. The attendance at these meetings is highly dependent upon the level of controversy associated with the project as well as the effectiveness of publicizing the meeting. As was stated earlier, the majority of people who attend these meetings are there because they are worried about what FDOT is going to do to "their road and how it will impact them directly. It will be impossible to make everyone happy, because there will always be people who do not want change and will disagree with anything that will affect their access. However, there are certain lessons we have learned from conducting these meetings which can improve relations with the public and avoid valid criticism. These lessons will also allow us to better serve the public and avoid making mistakes which are caused by the use of incomplete information, inadequate analysis, ignorance of site specific conditions or events or a simple oversight. By avoiding these common mistakes, we can hopefully avoid being labeled as sloppy, arbitrary, or incompetent, all of which are instant credibility killers.

I have compiled a "Top Ten" list of the most common complaints heard from the public at Access Management Public Information Meetings. Along with these ten complaints I have included some strategies we have used to avoid these complaints as much as possible.

Complaint # 10 - I don't understand why you are doing this to me.

One thing I have discovered at these meetings is that many people take median opening closures very personally. Often the opening is referred to as "mine" or "ours." Although they are not implying that they physically own the openings, many feel as if they have a permanent right of access through them. In fact, many property owners may have at one time participated in the funding to build the opening. We have to be careful not to be defensive, and also hear the people out. They are directing their anger at us, but their true feelings are of fear and frustration. We have found the following strategies helpful - in handling these situations.

- Assure the person that a final decision has not been made and that you are interested in what they have to say. Often this will calm the person down.

- Listen to the person and ask sufficient questions to determine their real concern.

- Explain the reason that the median opening they are concerned about is being considered for closure or modification.

- Brief the person on alternate routes to and from their property/place of business.

Although you may not be able to make the person happy, at least you might be able to convince them that they are not being singled out and that a great deal of thought was put into the decisions which were made.

Complaint #9 - No one can show me how you came to your final decision.

This is a common complaint. Many times a member of the public will want to see what analysis was done to justify recommending a median opening for closure of modification. This includes traffic volumes, collision data, alternate routes, etc. The following items have proven invaluable in such situations:

- Ensure that someone has copies of all documentation prepared for the project. Additionally, a summary of the rationale behind how each median opening was analyzed should be readily available.

- Be prepared to show existing traffic volumes and collision data. Also be prepared to show how the traffic will be rerouted after construction.

- Offer to send the person copies of the traffic volume and collision data if they would like.

Complaint # 8 - The U-turns will cause a safety problem.

Many people, especially the elderly, believe that increasing the number of U-turns will increase collision frequency. In general this is not true, however the following items may help to address this complaint:

- Studies have shown that reducing the number of conflicts along a roadway results in a decrease in angle and left turn collisions. The amount of the reduction is highly dependent upon specific site conditions. However, in general the increase in U-turns will not increase the number of accidents at the location the U-turns will be rerouted through, and will significantly reduce the collision frequency at the openings being closed.

- Ensure that there are no problems associated with U-turns. This includes addressing the conflicts between U-turns and right turns from the side street, provisions for commercial and oversized vehicles, and any other site specific concerns.

- Review the existing collision data with the person. Often the median opening strategy is designed, at least in part, to eliminate high collision locations.

- Talk to local law enforcement agencies about any known safety problems. These folks work the accidents and often times are the most knowledgeable persons in regards to safety conditions. They may also be able to help you determine if you have all the accident data or if you are missing some.

Complaint # 7 - You will be impacting thousands of people!

Most people do not have a good idea of what 100 vehicles per hour looks like, as opposed to 1000 vehicles per hour. Unless they live or work right at the intersection, they only see traffic on the roadway once or twice a day. Therefore, it is important to illustrate to them the amount of traffic that will be affected based on actual traffic counts.

- Have traffic volumes ready to show the public. These traffic volumes should include the AM and PM peak hours, and preferably include the midday peak or other non-traditional site specific peaks if possible. This will allow the person to get a good handle on the actual amount of traffic being impacted.

- Follow the rerouted traffic through the network to ensure that the shift of traffic does not create more problems.

- Use other locations to provide a reference as to the amount of traffic being impacted. Usually the locations being closed or modified serve less traffic than those which will be left open.

Complaint # 6 - What about the new Wal-Mart?

Wal-Mart is used here as an example. But since they seem to be going up everywhere, and everyone knows when they are coming, it is a good example. We have to realize that for the most part, local business owners and residents know a lot more about their community than we do. However, we need to try and obtain as much information as possible prior to developing recommendations and presenting them to the public. It is quite embarrassing to present a plan and then be informed that a major development is coming soon and the plan did not consider it.

Some things that can be done are:

- Ensure that all local planning agencies are contacted to determine if any planned developments are known within the study area. If so, integrate this development into the Access Management Plan.

- Always investigate claims of future development. Many times an "impending development" is actually something which is anything but impending. Some people will claim that a development is approved and will be built soon when in fact there is no basis to the claim other than rumor.

- Try and encourage cross-access agreements. Sometimes property owners are willing to consider cross access agreements if it will enable them to get a median opening. This often is a "win-win" situation for the landowner, the FDOT, and the public.

Complaint # 5 - What about Trucks?

One of the legitimate concerns of local businesses is the ability of delivery vehicles to access their property. Many buildings are designed specifically to accommodate trucks entering from a specific access point. Others may require unusually large or wide vehicle access, sometimes only once a month or so. Rerouting trucks due to the modification of a median opening requires special analysis to ensure that you do not unreasonably restrict trucks from accessing a business.

- One of the most important things to do in this regard is to talk to the business owners along the road. This includes both businesses along the frontage of the road as well as those on the side-streets. You must think about how trucks would access the site for any proposed median plan.

- Then you must drive that route and look for any problems which a truck might have in maneuvering that route.

- Determine any internal circulation problems which may occur. Some may be easily addressed when others may require structural or other expensive modifications to the site. The objective is to try and accommodate the land owners existing business operations as much as possible.

- Be prepared to discuss how trucks will access all affected sites.

Complaint # 4 - A Fatal Flaw was not considered.

Sometimes a fatal flaw is not uncovered until too late. The flaw can take many forms. The key is to research as much as possible before laying out a plan. It is quite embarrassing to have a member of the public point out a fatal flaw which should have been known. A good example is not being aware of other road improvement projects in the study area which will need to be accommodated in the plan.

Some ways to attempt to avoid a fatal flaw are:

- Talk to all local agencies to see if there are any upcoming projects in the study area.

- Talk to local residents and business owners. They often can provide valuable information.

- Ask the question, "Is there anything I need to know before I start developing my plan?" when talking to agency staff and other involved parties.

Complaint # 3 - You really don't care what I have to say!

This is a very common complaint and can be credited to a combination of people's general distrust for the government, and perhaps past experience with FDOT and other agencies before the current emphasis on public involvement was established. Although many of these people will not believe anything you say, there are some things that can be used to help convince these people that we indeed do care what they have to say.

- The most important thing you can do is to let the person know that the median opening strategy is not final. Encourage them to make comments, both verbally and preferably in writing, for consideration by the Department staff.

- Listen well. Do not interrupt people. If someone becomes long winded, try and convince them to restate the problem and then let you respond. We want to avoid the impression that we already have our minds made up -- which is what many of them think.

- After the meeting, carefully review the input from the public and make changes as necessary. Make sure that each comment is thoroughly discussed and resolved.

- Send a personalized letter to each person who submitted a written comment. The letter should thank them for their input and also provide an explanation of the resolution of their comments. Although this is time consuming, it is received much better than a form letter.

- Do not argue with people. Explain the Department's position and guidelines, but don't allow yourself to get pulled into an argument. If the person is aggressive or offensive, thank him for his comments and tell them you must go help other people.

- Under no circumstances give the Median Opening Spacing distances included in 14-97 as the reason a median opening was placed where it was. These spacings should be portrayed as guidelines which are modified as necessary for specific site conditions. Strict adherence to the formal spacings will tend to reinforce some people's belief that the FDOT is either inflexible or already has their mind made up and is at the meeting merely as a formality..

Compliant # 2 - I wasn't notified of the meetings.

This is a common complaint, although not always a valid complaint. However, there are many things we can and need to do which will help provide notice to as many people as possible. Many people fear that the government is trying to "sneak something past them" by not notifying everyone.

- The media can be a useful tool. Most newspapers are receptive to running articles announcing the meetings. The articles for our meetings have ranged from one paragraph in the local section to front page articles, depending on the level of controversy associated with the project.

- Fliers for the meeting should be distributed in a number of ways. For very small projects, the fliers can be distributed to homes and businesses along the road and affected sidestreets. The fliers should clearly describe the time, date, location, and purpose of the meeting. This will ensure that all of the directly affected properties are notified.

- For larger projects, fliers should be mailed out in addition to handed out. The mail out should be to the entire affected area, while the hand delivered fliers should be distributed along the frontage of the road. This will help ensure that both property owners and tenants are notified. Many times, especially with commercial property, the property owner is not located at the site.

- Radio stations and television stations generally do not announce the meetings, but for highly controversial or very large projects they may be receptive to announcing or even covering the meeting.

- By a combination of field visits, review of aerials, and discussions with local agencies, try and determine any neighborhoods, major employers, or others who may be interested and/or impacted by the project. Sometimes these groups are not immediately identified. Then ensure that these groups are notified.

- Keep a list of the people who were mailed fliers. Check the name of anyone who states that they were not notified against the list and add their name if it is not on the list. Apologize to the person if they were overlooked and ensure them that they are now on the list.

<u>Complaint # I - You are going to put me out of business!</u>

This is by far the most common and passionate complaint. Most small business owners pour their life saving into their business. It is their source of income and security for the future. Therefore, they are very protective of their businesses and are afraid of anything which they view as a threat to the viability of their business. Although it is very difficult to persuade these folks that closing a median opening will not significantly impact their business, the following points could be used to try and calm their fears:

- Our surveys have shown that median opening modifications had little or no affect on the selections drivers make when doing business. Most drivers are willing to make U-turns to access a business that they have used in the past.

- The most heavily affected businesses are convenience-type stores (gas stations, fast food, etc.). However, the median changes do not impact the demand for these items. In fact, some businesses may actually be positively impacted in these cases. While the store may become slightly less attractive to some motorists, it win likely be more attractive to others.

- Many motorists avoid businesses where the access is perceived as unsafe. This often occurs along roadways with poor access management and numerous conflicts. Motorists may be more attracted to a sight with less conflicts at its access points.

- Our before and after surveys of business owners found that most business owners were not negatively impacted, and in fact, most said that it was not nearly as bad as they had thought it would be.

- Most motorists surveyed stated that they liked the median changes and that the changes did not change their shopping habits.

- Service industry offices (Doctors, Lawyers, Accountants, etc.) and specialty stores are not generally impacted as their patrons tend to have an allegiance with the owner or service provider.

These pointers to dealing with the ten most common complaints about access management should help us provide better service to our clients, the citizens of Florida.

24 Closing

Moderator: Del Huntington, Oregon DOT

Paper
Slides

24A. Dumb Access Management Tricks and How to Avoid Them

Gary Sokolow, Florida DOT

Other

24B. Access Jeopardy

Host: Dane Ismart, Louis Berger & Associates

The Challenge between Academia, Consultants and Government

Tribunal: *Bud Koepke S/K Transportation Consultants*
Vergil Stover, University of South Florida
Phil Demosthenes, Colorado DOT

Other

24C. Introduction of the New Access Management Committee Chair

Ron Giguere/Art Eisdorfer

Introduction of 5th National Access Management Conference in Austin, Texas

Eddie Schafie, Earth Technology Transportation Group

Paper

Attendee List

Abstract

Dumb Access Management Tricks, *and How to Avoid Them*

Note: *This paper contains personal observations. It is the author=s opinions and not necessarily the opinions of the Florida Department of Transportation.*

Access Management, as a practice, has been around for many years. From the start it held much promise for improving safety and operations. Over the years we have tried to institute good Access Management practices but we have learned some lessons along the way. We have learned how to do lots of things that have a positive impact, but we have also begun to learn that some of the access management techniques may have negative impacts when used inappropriately . This paper will show what we have learned about a few techniques which, if we don't use wisely, can be called, **"Dumb Access Management Tricks"**. We may make some of these mistakes when doing the following:

$ **Frontage roads**
$ **Over abundant right turn lanes**
$ **Continuous right turn lanes**
$ **Too narrow driveways**
$ **Trying to control left turns without a median**

This paper also gives strategies that can help you avoid some of the common mistakes in access management.

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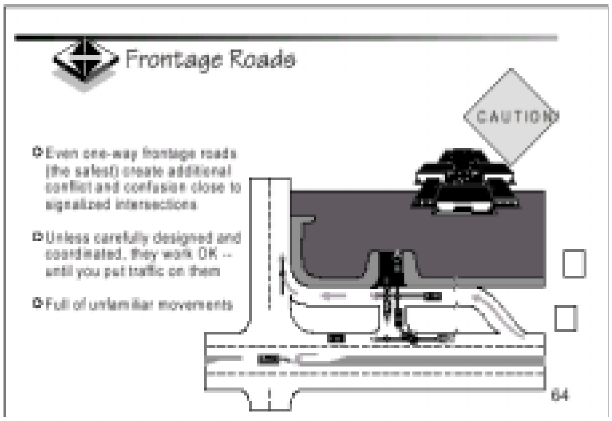
Dumb Access Management Tricks, and How to Avoid Them



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Access Management is the process that provides for and manages access to land development while preserving the flow of traffic on the surrounding roads. Access management also enhances safety, smoother operations, and roadway capacity. It involves the design and placement of driveways, medians, median openings, and provisions for turning movements and pedestrians.

Access Management, as a practice, has been around for many years. From the start it held much promise for improving safety and operations. Over the years we have tried to institute good Access Management practices but we have learned some lessons along the way. We have learned many actions have a positive impact, but we have also begun to learn that some of the access management techniques may have negative impacts when used inappropriately . This paper shows what we have learned about a few techniques which, if we do not use wisely, can be called, **"Dumb Access Management Tricks"**. We may make some of these mistakes when ding the following:

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This paper also gives strategies that can help you avoid some of the common mistakes in access management.

Frontage roads
When the idea of frontage roads along arterials was first introduced, much excitement was generated. This was a way many highway engineers believed would increase speed on the major road and still provide access to growing properties along the major corridors. Soon after the construction of many of these frontage roads, we saw problems. These problems arose where they were most worrisome, at the major intersections. When the frontage road reaches the major cross streets, its weakness becomes apparent. If the frontage road is one-way (the safest),

movements at that intersection become confusing. This is not only true of the driver at the frontage road's end, but for the driver just getting through the intersection. And what happens when both intersecting arterials have frontage roads? It is clear that the intersecting movements become confusing and inefficient, even when the frontage road is one-way.
Some planners and engineers believe these problems can be avoided by "flaring" the terminus of the frontage road 150' to 250'. This could help, (see below) but we usually do not have enough right of way to build this sort of design.

How to avoid this mistake
There are several ways that this mistake can be avoided.

Flaring at intersections As mentioned previously, the designer could prevent problems by "flaring" the terminus of the frontage roads. But, the standard 150' to 250' called for in the literature is often pretty "short" to get the frontage road drivers from infringing on the side street=s queue and functional area. Take a look at your own municipality=s driveway separation standards. You probably don=t even meat these simple standards for separation. Recognize that a frontage road intersection is not a simple driveway, it is a major connection.

If the designer is going to flare your frontage road, do enough analysis to assure the design and placement are done in a way to give drivers entering or leaving the major intersection, a chance to prepare for this important movement. Be especially wary of the drivers making right turn at an intersection, not knowing that there are other right turners in their path.

Limiting Turns - One way to retrofit frontage roads is to limit turns at the intersections, both on the main street and along the frontage roads. Right turns could be prohibited from the main arterial and left turns from the frontage road. Slip ramps would be provided to get the vehicle from one road to the other.

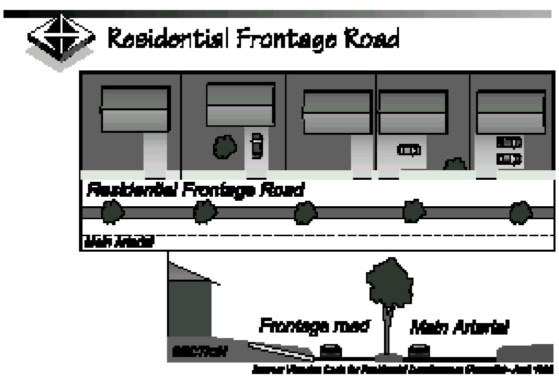
Service Roads - Many of the assumed benefits of frontage roads can be realized more simply with the use of what can be called Aservice roads@. They can take many forms, but they all serve the purpose of combining traffic from multiple developments and placing the access points in such a way to maximize safety and operations. They can take the form of a Abackage@ road, which goes behind corridor development, They can also be interconnected parking lots, and shared common collector roads serving multiple developments.

Backage roads - One way to assure reasonable separation for frontage roads is to build a "backage" road instead. These are usually located behind the businesses along a corridor. If they are suitably designed, they will serve commercial development on both sides. By placing this backage road behind the development, one automatically gets a large separation between the service road terminus and the major intersection.

Interconnected internal circulation - Requiring that neighboring developments (including residential) to connect parking and internal circulation areas is one of the best practices site planners can institute. These interconnections should be designed to operate like collector roads, but it is not always necessary to have them be more than informal connections between parking lots.

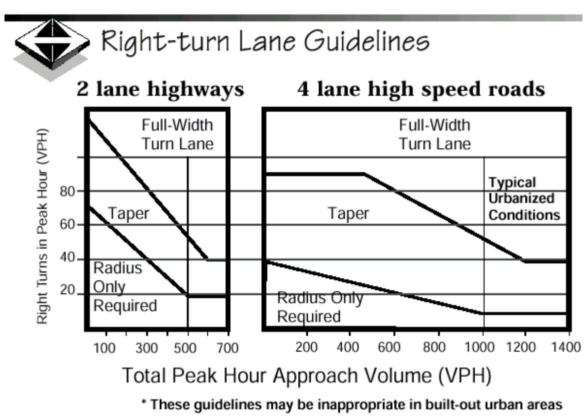
Shared public access - Another way to connect access to developments is the shared public access or collector road. During the development review process, land between developments are used to develop shared collector roads. They should be designed to public road standards and then given to the local government to be maintained. At first it may be just 2 developments served, but in time these short roadways can be the start of a complete system of supporting roadways.

Mid Block Frontage Roads are OK - Does this mean all frontage roads are bad? No, if they are mid-block, they can serve a good function. These mid-block frontage roads can serve residential, small office, and if adequately designed some medium sized commercial developments.



Overabundant right turn lanes

Right turn lanes at driveways have long been recognized as a good access management technique. However, national and Florida criteria for when they are needed have not been reviewed for many years until recently. Also, a cursory look at where they are built , and compare them to the next major road show that we are building right turn lanes in lower right turn volume conditions as compared to major intersections. Criteria developed primarily for high speed rural conditions (see NCHRP #279 Intersection Channelization Design Guide - Figures 4-22 and 4-23) have been incorrectly used to Aover-require@ exclusive right turn lanes in urban, lower speed conditions.



By building too many right turn lanes in urban locations we run the risk of some negative impacts. They are:

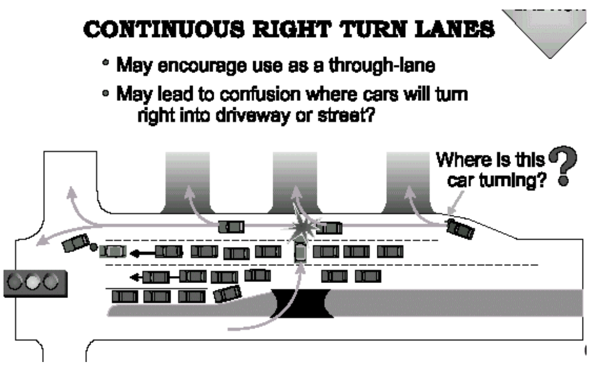
$ Pedestrians that have longer distances to cross streets

$	Drainage problems from too much impervious surface.
$	creating a wider road feel in our urban settings where we may be trying to create a more constrained roadway environment.
$	Roadway aesthetics and pedestrian environment is compromised

How to avoid mistakes
Florida DOT has recently undertaken the task of re-evaluating the requirements for right turn lanes. We had been previously been suggesting 40 right turns per hour as the criteria but we may now go as high as 110 along our typical urban multi-lane arterial.

Continuous right Turn Lanes
Continuous right turn lanes have caused a number of problems on our highways. They have all the problems associated with individual right turn lanes but also have some additional problems. Some drivers will use them as through lanes. Also, vehicles can get hit by vehicles traveling in them due to confusion of were they turn. Another problem happens behind busy signalized intersections where queues develop. A left turn into a property is allowed by "good Samaritans" to enter and then blind sided by a free flowing vehicle in the continuous right turn lane.

How to avoid this mistake



Break them up - One way to help situations where continuous right turn lanes exist is to "break them up". This can be done as simply as striping. Landscaping and Brick pavers can also be used for this purpose. The advantage of brick pavers is that the car can run over these and will not cause an accident, but it is a firm reminder that the driver is not in a through lane.

Acceleration lanes
Acceleration lanes serving major driveways has been a standard access management practice in the past. Over time though, these have been shown to do little more than add pavement that is not needed. Observations show that most right turn vehicles when offered the acceleration lane really use very little of it and immediately enter the through lanes. Fortunately, this practice has not been very popular recently.

Limiting commercial access on side streets where residential neighborhoods are
One inappropriate use of access control is limiting commercial driveways on certain residential streets. Many local governments prohibit commercial driveways on side streets to major arterials if those side streets eventually serve residential neighborhoods. The reason here is that absence of commercial driveways would discourage commercial traffic on the residential street.

There are a number of disadvantages to this practice, not the least of which is the inconvenience to those people living in the neighborhoods to use the commercial centers they are so close to. The effect of limiting access along the side street is to place greater conflicts along the major arterial and many of these conflicts are fairly close to the side street making trips to and from the neighborhoods more dangerous. Look at your local ordinances and see if this provision is in there. Providing access along a residential side street does not allow or require commercialization down that side street but provides safe and convenient access for both the neighbors and customers of the commercial areas along the major roads.

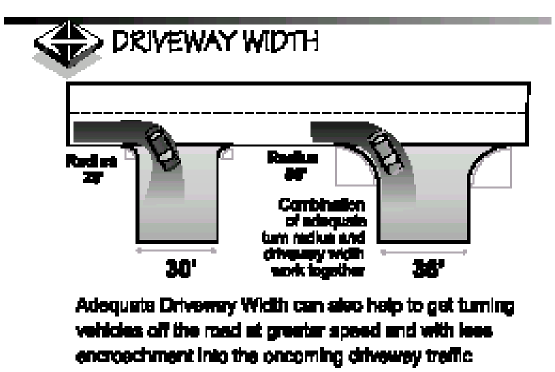
APork chop@ driveways where there are no medians

Another practice to be avoided is the use of driveway channelization to prevent left hand turns where there are no medians in place along the major roadway. These driveway channelization features often called Apork chops@ are a useful Amessage@ to the driver where medians are in place to prevent left hand turns. But, where these features are added, to try and prevent left hand turns by themselves, they are usually failures. Observations of many of these show very little compliance to their intended purpose. They, may in fact, prevent vehicles from quickly entering the driveway thereby causing more problems. If the traffic professional really wants to control left turns, the best way to do it is through the use of restrictive medians. Where median space is not available, the traffic engineer can consider flexible traffic posts in the main road to discourage left turns.

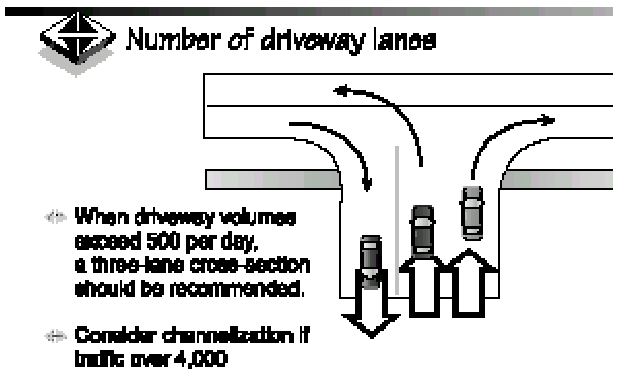
Too narrow driveways

Some local governments have tried to manage access by having very narrow driveway requirements. In the past, we allowed Awide open@ frontages where vehicles were allowed in and out along entire frontage of a property. These wide open frontages are a problem because of driver expectancy(not knowing where a vehicle will enter or exit). But a too narrow driveway will also cause problems due to vehicles slowing and stopping in the through lanes in order to turn right into the driveway

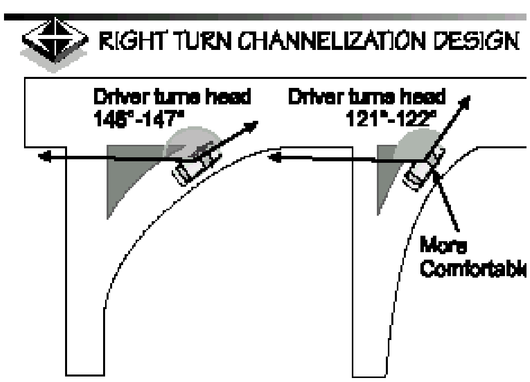
Narrow driveways may work with very low traffic (less than five vehicles per hour) but, wherever there is the probability of a vehicle leaving and entering at the same time, the driveway should be wide enough driveway for this maneuver. Safe and efficient driveway movements can be realized through the use of well designed driveways where exclusive right turn lanes (used appropriately) and the curb turning radius allows safe and efficient movement in and out of the driveway.



In addition to providing enough width and curb radius for vehicles turning in and out simultaneously, where there are over 500 vehicles per day expected to use this driveway, and left turns are allowed from it, the designer should provide for a separate left hand turn lane outbound, so the right turns do not get excessively backed up at the driveway.



Over channelization
Channelization at the driveway is usually desirable allowing different movements to have their own space and providing a visual cue of the appropriate direction and speed. But too much channelization can cause problems. If the channelization islands are too small, then they become hazards to vehicles and pedestrians. Over channelization can also happen when we treat arterials too much like freeways and we have entering traffic from a driveway or side street use an excessively channelized acceleration lane causing the drivers head to turn too much to the left uncomfortably to see the oncoming traffic. A slip ramp rather than acceleration ramp or lane might be more appropriate and is more comfortable to the driver of the entering vehicle.



Restricting right turn in-out driveways too much
If an arterial has restrictive medians and well placed median openings, it is possible to allow more driveways with right-in and right-out movements. There are some advantages to this. Not only is this a convenience to the driver, but if we over restrict the placement of right turn access drives, then these vehicles may get added to those left turn vehicles at the major driveways and side streets causing long queues, frustration, and pressure to perform unsafe maneuvers. For major commercial developments, if they have sufficient left turn controls through medians, tehr engineer should consider well placed and restricted right turn in and out driveways.

Obviously, there are many more Adumb tricks@, but almost all of them can be avoided by careful planning and sensitive retrofit activities in access management. Remember that the dumbest trick of all is not to institute access management because you will be missing some important safety and operational benefits.

TRB Access Management Committee Meeting

Paper Minutes of Meeting

Wednesday, August 16, 2000 – 1:00 – 3:00 PM

Agenda
Mid-Year Meeting of
TRB Committee A1D07, “Access Management”
Wednesday, August 16, 2000 - 1:00 p.m.
Lloyd Center DoubleTree Hotel, Portland, Oregon

Welcome and Introductory Remarks

Art Eisdorfer opened the meeting at 1:00 pm by welcoming 5 new committee members: Joe Bared, Federal Highway Administration, Bill Frawley, Texas Transportation Institute, Chris Huffman, Kansas Department of Transportation, and Donna Lewis, Mercer County, New Jersey. Outgoing Committee Chair Ron Giguere then reviewed the accomplishments of the committee during his tenure and the growth from a section to a full Committee. He thanked members for their hard work and formally passed the mantle of chairmanship to Arthur Eisdorfer, New Jersey Department of Transportation, who served as Committee Secretary during Ron’s tenure. Kristine Williams, Center for Urban Transportation Research, University of South Florida, was introduced as the new Committee Secretary.

As new Chair, Art Eisdorfer emphasized his continued commitment to the following goals:

1. Complete the comprehensive access management manual,
2. Continue to spread the word on access management, and
3. Continue to facilitate new research to advance the field.

Art Eisdorfer made a motion to approve the minutes from 2000 Annual Meeting. The motion was seconded and approved by the committee. The members and friends were asked to update the information on the rosters and other attendees were asked to sign the attendance list.

National Conferences and Meetings

Wrap up of 4th National Conference

Del Huntington and Linda Apple gave an overview of the Fourth National Conference in Portland, Oregon. About 235 participants attended the conference, with about 160 staying through the last day. About 39 states and the District of Columbia were represented by the participant list, as well as France. Phil suggested looking at who wasn’t represented for additional outreach activities. Session 15 on Roundabouts appeared to be the most popular Session. The Mock Trial was not well attended. Many participants commented positively on the field trips, with about 30 participants on the median field trips, and 50 on the bike trip. However, Linda Apple noted that they were logistically difficult. About 45 people attended Access Management 101, once again illustrating the demand for having a general workshop in concert with the conference. This year the registration fee was increased to cover production of the compendium. The objective was to pass on about $17,500, but it may be closer to $20,000.

Comments indicated that most people felt the conference fee was not too high in relation to the meals, quality of lodging, and other aspects of the conference

Lessons learned included the importance of not setting a July 1 cutoff for early registration, as this is the beginning of the new fiscal year for state agencies. Linda Apple indicated she would produce a report on the conference and lessons learned and forward that to Art and Kristine to distribute to members.

Frank Broen of Teach America is producing the Conference Compendium, which will be produced on CD-rom and is expected to be completed by the end of the year. Doug Landry requested that it be completed as early as possible and Frank offered to make early versions available. About 80-90% of papers have been received to date, but only a few presentations. Linda requested that presentations be included as well.

TRB 2001 Session

As has become a tradition, the best papers from the conference were selected for representation at the access management session at the 2001 TRB Annual Meeting. Best papers nominated included Tim Bevan on context sensitive design, Jerry Gluck's paper expanding on the analysis done in NCHRP 420 with new data; David Gwynn on public involvement, a presentation on roundabouts by Bruce Robinson of Kittelson & Assoc, and Kristi Sebastian from Wisconsin on succesful median modification projects. Frank Broen's "SAM I AM" Dr. Seuss style presentation was also well received. Art noted that offer letters would be sent to presenters and the session reserved with Jim Scott.

5th National Conference in Austin

Eddie Shafie was formally inducted as Chair of the Conference Subcommittee. He said the contract was signed by TRB with the conference hotel in January 2000. The Conference will be held at the Omni Hotel between June 23-26, 2002. The hotel can readily accommodate 250 people. Eddie distributed information on the hotel and the current rate projection is approximately $80 per night. Volunteers to chair session tracks will be requested at the TRB meeting in January.

Potential sites and dates for the 6th National Conference

Sites discussed for the 6th National Conference in 2004 included Kansas City, Missouri and Salt Lake City or Park City, Utah. Members discussed the value of getting broad geographic coverage. A vote was held and the majority (16) voted for Kansas City. Chris Huffman indicated he would explore KDOT's interest in hosting the conference and the possible locations, including the Country Club Plaza in downtown Kansas City. The committee agreed to hold its 2006 conference in Utah. UDOT needs to refine their recommendation for a location to propose.

Future Committee Meetings

The 2001 Annual Meeting will be the first meeting following the conference in Oregon. It was suggested that the next mid-year meeting of the Committee be held to coincide with the TRB A Group Division Meetings (Group One Council), which will be Vail or Breckenridge on July 11-15. After some discussion, Del Huntington suggested we coordinate our meeting with that of the

TRB group meeting. Phil Demosthenes motioned to approve, and it was seconded by Bud Koepke. There was no opposition. Art Eisdorfer indicated he would notify Jim Scott and begin making arrangements.

Relevant Conferences and Meetings
Jerry Schutz mentioned that the Small and Medium Size Communities Conference will be held September 28 to 30, 2000 in Little Rock, Arkansas. The American Planning Association conference that will be held in March 2001? in New Orleans. An access management session has been proposed by Kristine Williams. Similar sessions have been accepted for the past three APA National APA Conferences. The Eighth Conference on the Application of Transportation Planning Methods will be held in Corpus Christi, Texas 22-26 April 2001 and abstracts are being sought. Send abstracts to Eddie Shafie who is hoping to put together a session on access management. SAASHTO will be holding a meeting in Ashville, NC in 2001 and has contacted Kristine Williams to put together an access management session. Kathy Facer of FHWA will follow up with Kristine on this. ITE will be held in Chicago next summer and abstracts are due soon.

Access Management Manual
Kristine Williams reiterated the schedule presented by Ron Giguere in the plenary session for production of the manual, which calls for the full draft manual to be presented and reviewed at TRB and the final draft to be sent to TRB for publication in March. The manual has been largely drafted, except for the chapter on permitting which will be distributed in early fall for review by the subcommittee chairs. Extensive editing work is anticipated in the fall to meet this schedule. Comments on materials submitted for review prior to the Portland Conference must be submitted to CUTR by August 31. The objective is for TRB to publish the manual in July or August of 2001 so that it coincides with the mid-year meetings. Contracting delays have resulted in extension of the schedule about a year beyond that which was originally anticipated. These delays were largely due to fiscal year budgeting issues of FDOT and FHWA, and some of the funding has still not been received by CUTR. CUTR will continue to make every effort to meet this schedule.

Research
Jerry Gluck noted that he had completed Research Results Digest, Number 247, in May 2000. The Digest presents the results of Jerry's analysis of the Minnesota database on access related crashes. Jerry evaluated the data using methods from NCHRP Report 420 and results were relatively consistent.

Pat Hawley discussed three new problem statements that have been submitted. The problem statement from last year entitled, "Safety of U-turns" was approved, funded, a consultant has been selected and work is underway. On May 24, 2000, NJDOT submitted the first stage research problem statement "Economic Impacts of Access Management Treatments on Business, A Research Synthesis, " to NCHRP. This would be a synthesis of current practice, as opposed to an NCHRP Research Project.

Phil Demosthenes submitted two other problem statements on May 31, 2000. These address 1) Development of Right-Turn Deceleration Lane Warrant and Design Criteria and 2) Estimating the National Frequency and Costs of Access Related Crashes. The statement on warrants for right turn deceleration lanes finished out of the running in the last NCHRP selection process. The decision was made to reshape it and resubmit it in May.

One paper was submitted for the 2001 annual TRB meeting and it was decided that the paper should be reviewed by members of the committee and Bill McShane. The committee discussed future efforts to coordinate with a new program area in FHWA related to research and development. Phil Demosthenes was thanked for all his hard work in facilitating research in access management and was formally inducted as Chair of the Research Subcommittee.

Outreach

Chair of the Outreach Subcommittee, Bud Koepke, indicated that outreach activity since the January meeting in Washington, DC could have been better. This year the NHI short course "Access Management Location and Design" was conducted eight times and included seven different states. It was presented twice in Michigan. Since 1994, the NHI Course has been presented 42 times. This amounts to about 1300 class participants from states, counties, cities and FHWA. Several of the programs also included some private consultants. The course conducted in Missouri this year was the third course there in a little over a year. The course notes have been updated and sent to NHI to be used in future offerings. Anyone that would like more information on having a course in your state should contact Bud Koepke or Vergil Stover. There have been several requested for individual copies of the FHWA video tape "Access Management Overview" and the "Access Management Library CD", which has been very well accepted.

Bud noted that access management is becoming more and more prominent in other organizations. A separate chapter on access management was included in the 1999 Edition of the "ITE Transportation Engineering Handbook." Access management will have a greater presence in the next AASHTO "Green Book," and several NCHRP projects deal directly with access management. Two of these projects were presented during the Portland conference. In addition, the access management manual should be a best seller when it is published. These activities are important, however Bud encouraged members to do more and asked anyone at the meeting with additional information, to contact the subcommittee.

Bud thanked the Committee for his term as Chair and indicated he was stepping down. John Taber was inducted as new chair of the outreach subcommittee.

Access Management Website

Frank Broen noted that the website offers a benefit of a discussion group medium and asked whether we should use Delphi (Gary's site). Members discussed the Delphi website created by Gary Sokolow to serve as a resource and chat room on access management. Gary noted the difficulty in keeping the site updated. Ali Eghtedari from Multnomah County volunteered to establish an E-mail listserve discussion group on access management. Frank Broen received a small grant to update the FHWA access management website and Ron Giguere suggested that Ali coordinate with Frank on the website activities.

Frank noted that he will push the Delphi site on the website. The conference program and proceedings will also be placed on the website in PDF format. Art suggested that we make some Powerpoint presentations on access management available on the website for others to use and members agreed. Ron Giguere suggested maintaining an up to date calendar of events on website and requested such from the outreach subcommittee. The calendar could be interactive and the committee would get a password to make changes. Art recommended that one member be asked to do this.

Future Subcommittee Structure

Art Eisdorfer presented a proposal for the future subcommittee structure. Five subcommittees were recommended. The structure and responsibilities are as follows.

<u>Access Management Manual Subcommittee</u>
Responsibilities would be to address comments received on the manual, maintain the manual website, address revisions to the manual as new information is developed and organize the information in the manual. Vergil Stover indicated that interpreting content should not be a function of the subcommittee as the manual is not intended to be that prescriptive. The chair will be selected at TRB in January 2001. Until that time, the current subcommittee chairs will serve as oversight for the manual.

<u>Conference Subcommittee</u>
Responsibilities include planning and implementing national conferences. Also, Art recommended that this group play a larger role in the annual and mid year meetings, not just the conference. As noted above, Eddie Shafie will chair this subcommittee.

<u>Research Subcommittee</u>
Responsibilities include increasing solicitation of papers, developing and maintaining a list of problem statements and their status, participating in the development of the Highway Safety Manual, and participating in SHRP2 and suggesting research topics to be funded. TRB suggests that the Committee solicit papers more actively. The year after conference we have trouble generating papers. As noted above, Phil Demosthenes will chair this subcommittee.

<u>Strategic Plan Subcommittee</u>
TRB wants us to align our activities with their strategic plan and, given the importance, this effort should be a subcommittee. Responsibilities include developing a strategic plan for the Committee that is aligned with the TRB Strategic Plan, identifying access management projects to be undertaken by 2005, 2010, and 2020, and identifying FHWA incentives to implement access management, particularly as part of new construction. This subcommittee could also take over activities related to the paper on access management in the new millennium that was prepared by Ron Giguere. Ron Giguere was asked to Chair this subcommittee and accepted.

Outreach Subcommittee

The primary responsibility of this subcommittee is to get the word out on access management and establish formal liaisons with other TRB Committees (Geometric Design A2A02, Operational Effects and Geometric Design, Transportation and Land Development A1D02, Statewide Multimodal Transportation Planning A1D01) and professional organizations (ITE, AASHTO, APA, NARC, ASCE, etc). Herb Levinson emphasized the importance of getting more outreach to the broader engineering community doing impact studies and working with developers. Dane Ismart suggested we expand our international emphasis and reach out to other nations, international membership, what's happening in other countries and so forth. The strategic plan might consider an international symposium. Current international participants found out about it on the web. Dane strongly says we need to be proactive and find out who in various countries is doing access management or interested and extend an invitation. Then an international symposium could work. Art asked everyone to send international contacts and e-mail addresses to Kristine. Jerry Gluck says TRB is a good time to identify international participants also. As noted above, John Taber is the new Chair of this subcommittee.

New and Other Business

Art noted that he had circulated the Federal Notice of Proposed Rulemaking for Planning, www.nara.gov/fedreg/public.html, May 25, 2000 issue (Vol 65, No. 102). Kristine had provided comments to the docket related to including access management in relevant sections, and Art asked others to submit theirs to him quickly so he could coordinate a response.

Adjournment of General Meeting

Art thanked everyone for attending and the meeting was adjourned at 3:00 pm.

Executive Session

The Executive Session was not held. Instead, the subcommittee chairs met and discussed the access management manual.

4th Nat'l Access Management Conf. - Registration List

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McSwain	Richard	Oregon DOT	455 Airport Rd. SE	Salem	OR	973-105395	503-986-2649	richard.f.mcswain@odot.state.or.us
Meena	Joel	Wyoming DOT	5300 Bishop Blvd	Cheyenne	WY	82009-3340	(307)777-4374	JMEENA@state.wy.us
Mehta	Jamsheed	Metro Area Planning Dept.	455 N Main	Wichita	Kansas	67202	(316)268-4421	Mehta_J@ci.wichita.ks.us
Meyers	Tony	City of Lenexa	12350 N. 87th St. Pkwy	Lenexa	KS	66215-2882	913-477-7732	tmeyers@ci.lenexa.ks.us
Miller	John S.	Virginia Transp. Research Cncl	530 Edgemont Road	Charlottesville	VA	22903	(804)293-1999	millerjs@vdot.state.va.us
Miller	Edward J.	Oregon DOT	5440 SW Westgate Dr.	Portland	OR	97221-2414	(503) 229-6542	edward.j.miller@odot.state.or.us
Mills	James A.	Florida DOT	605 Suwannee Street, MS-32	Tallahassee	FL	32399-0450	850-414-4318	jim.mills@dot.state.fl.us
Molitor	Edward L.	Lower Rio Grande Valley Dev.	311 N. 15th	McAllen	Texas	78504	956-682-3481	emolitor@lrgvdc.org
Moore	Wanda Gale	Richmond Reg. Plng Dist. Comm.	2104 W. Laburnum Ave., Suite 101	Richmond	Virginia	23227	(804)278-6108	wmoore@richmondregional.org
Morgan	Philip E.	Missouri DOT	1590 Woodlake Drive	Chesterfield	MO	63017-5712	314-340-4221	morgapl@mail.modot.state.mo.us
Nale	Harlan	Oregon DOT	555 13th Street NE, Suite 2	Salem	OR	97301-4178	503-986-4112	larlan.l.nale@state.or.us
Narusiewicz	Sherry	Minnesota DOT	1500 W Co. Rd. B-2	Roseville	MN	55113	651-582-1400	sherry.narusiewicz@dot.state.mn.us
Nemariam	Haregu	Oregon DOT	3500 NW Stewart Pkwy, #161	Roseburg	OR		(541)957-3512	haregu.nemariam@odot.state.or.us
Nepstad	Jon	Fehr &Peers Associates	64 E. 6400 South, #330	Murray	Utah	84107	801-533-9249	j.nepstad@feharandpeers.com
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Nims	Donald	Clark Patterson Assoc.	186 N. Water St.	Rochester	NY	14604	716-454-7600	dnims@clarkpatterson.com
Nohr	Ronald	Wisconsin DOT	4802 Sheboygan Ave.	Madison	WI	53707	608-266-2186	ronald.nohr@dot.state.wi.us

Last Name	First Name	Agency	Address	City	St/Prov	Postal Code	Telephone	EMail
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Ouadah	Zoubir	WILLDAN	9275 Sky Park Ct. #110	San Diego	CA	92123	858-467-6950	zouadah@willdan.com
Pacheco	Daniel F.	FHWA	2520 West, 4700 South, Suite 9A	Salt Lake City	UT	84118-1847	801-963-0078, ext.	dan.pacheco@fhwa.dot.gov
Parsonson	Peter S.	Parsonson & Associates, Inc.	105 Mark Trail NW	Atlanta	GA	30328	(404) 966-2244	peter.parsonson@ce.gatech.edu
Patte	Lionel	French Ministry of Transportation	46 Avenue A. Briand	Bagneux	Hauts-de-S	92 225	0033-4611-3133	lionel.patte@setra.fr
Perez	Richard	City of Federal Way	33530 1st Way S	Federal Way	WA	98003	(253)661-4133	
Plazak	David	Center for Transp. Research & Educ.	2901 S. Loop Dr., Ste 3100	Ames	IA	50010	515-296-0814	dplazak@iastate.edu
Poole	Kate	Oregon DOT	555 13th Street NE	Salem	OR	97301-4178	503-986-6397	kathleen.m.poole@odot.state.or.us
Preston	Howard	Howard R. Green Co.	1326 Energy Park Dr.	St. Paul	MN	55108	651-644-4389	www.hrgreen.com
Radovic	Mark	Gannett Fleming	Staon Bus. Park, Ste A, 4701 Mt. Hope Dr.	Baltimore	MD	21215	410-585-1460, x302	mradovic@gfnet.com
Radvansky	Glenda	City of Albany, OR	PO Box 490	Albany	OR	97321	541-917-7627	gradvansky@ci.albany.or.us
Raign	Stephen	Delaware Dept. of Transportation	PO Box 778	Dover	DE	19903	302-760-2139	
Reaveley	Clyde J.	Utah DOT	Utah DOT, 4501 S. 2700 W.	Salt Lake City	UT	84119	801-965-4045	jreavele@dot.state.ut.us
Reavis	Kathleen	City of Fort Collins	210 E. Olive	Fort Collins	CO	80522-0580	970-224-6140	kreavis@ci.fort-collins.co.us
Reese	Shawn	Cheyenne Area Transp. Plng.	2101 O'Neil	Cheyenne	WY	82001	307-637-6271	sreese@cheyennecity.org
Reiff	Thomas	City of Fort Collins	210 East Olive	Fort Collins	CO	80522-0580	970-416-2040	treiff@ci.fort-collins.co.us
Reynolds	Nancy	Oregon DOT	455 Airport Rd. SE, Bldg. B	Salem	OR	97301-5395	(503) 986-2836	nancy.j.reynolds@odot.state.or.us
Reynolds	Dick	Oregon DOT	555 13th Street NE	Salem	OR	97301-4178	503-986-4222	richard.d.reynolds@odot.state.or.us
Richter	Raymond	Delaware DOT	PO Box 778, 800 Bay Road	Dover	DE	19901	302-760-2213	rrichter@mail.dot.stae.de.us
Roberts	Shirley	Oregon DOT	200 Antelope Rd	White City	OR	97504	(541) 774-6399	shirley.j.roberts@odot.state.or.us
Roberts	Tim	City of Colorado Springs	PO Box 1575 M.C. 440	Colorado Springs	CO	80901-1575	(719)385-5908	troberts@ci.colospgs.co.us
Robinson	Bruce	Kittelson & Associates, Inc.	610 SW Alden, Ste 700	Portland	OR	97205	503-228-5230	brobinson@kittelson.com
Russell	Maurice	Oregon Hearings Officer Panel	1905 Lqana Ave., NE	Salem	OR	97314	503-945-7962	maurice.l.russell@state.or.us
Safavian	Seyed	Washington DOT	401 Second Ave. S., Ste 300	Seattle	WA	98104-2887	206-464-6038	safavis@wsdot.wa.gov

Last Name	First Name	Agency	Address	City	St/Prov	Postal Code	Telephone	EMail
Sangouard	Jean-Marc	French Ministry of Transportation	46 Avenue A. Briand	Bagneux	Hauts-de-S	92 225	0033-4611-3396	jean-marc.sangouard@setra.fr
Sartnurak	Somkeart	City of Corvallis	PO Box 1085	Corvallis	OR	97339	541-766-6731, ext.	
Scheib Jr.	Daniel	Maryland St. Highway Admin.	707 North Calvert St.	Baltimore	MD	21202	410-545-5652	dscheib@sha.state.md.us
Schulz	James	Becher-Hoppe Assoc., Inc.	330 Fouth Street, P.O. Box 8000	Wausau	WI	54402-8000	(715)845-8000	jschulz@bhassoc.com
Schutz	Jerry	Washington DOT	PO Box 330310	Seattle	WA	98133-9710	(206)440-4727	schutzj@wsdot.wa.gov
Sebastian	Kristi	Wisconsin DOT	PO Box 798	Waukesha	WI	53187-0798	(262)548-8719	kristi.sebastian@dot.state.wi.us
Shafie	Eddie	Earth Tech. Inc.	811 Barton Springs Dr., Suite 400	Austin	TX	78704-1164	512-479-1601	eddie_shafie@earthtech.com
Shambaugh	Jack	Arizona DOT	206 S. 17th Ave., MD 310B	Phoenix	AZ	85007	602-712-8141	jshambaugh@dot.state.az.us
Shanmugam	Rajendran	URS	6100 NW 33 Ave., Suite 155	Fort Lauderdale	FL	33309	954-739-1881	Aaj_Shanmugam@URSCorp.com
Sherman	Bob	Oregon DOT	Mill Creek Bldg., 555 13th St. NE	Salem	OR	97301-4178	503-986-4226	robert.l.sherman@odot.state.or.us
Simms	Kenneth D.	Mesa County	Box 20,000	Grand Junction	CO	81502-5093	970-244-1830	Ksimms@co.mesa.co.us
Simms	Ken	Mesa County	PO Box 20000-5014	Grand Junction	CO	81502-5014		
Simpson	Tom	Washington DOT	PO Box 330310	Seattle	WA	98133-9710	(206)440-4715	simpsot@wsdot.wa.gov
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Sokolow	Gary	Florida DOT	605 Suwannee St.	Tallahassee	FL	32399	850-414-4912	gary.sokolow@dot.state.fl.us
Soler	Dan	Ramsey County Public Works	3377 North Rice St.	Shoreview	MN	55126	651-482-5209	dan.soler@co.ramsey.mn.us
Sparks	Lee	Oregon DOT	3500 Stewart Parkway	Roseburg	OR	97470	541-957-3538	lee.e.sparks@odot.state.or.us
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Stephenson	Bob	Ontario Canada, Ministry of Transp.	1st Fl, Atrium Tower, Bldg. D, 1201 Wilson Ave.	Downsview	Ontario	M3M 1J8	416-235-5388	
Stoneman	Darla	Oregon DOT	555 13 th Street NE, Suite 2	Salem	OR	97301-4178	(503)986-4372	darla.s.stoneman@state.or.us
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Trooien	Dave	Minnesota DOT	PO Box 768	Willmar	MN	56201	320-231-5497	dave.trooien@dot.state.mn.us
Tucker	Bill M.	Texas DOT	PO Box 294029	Kerrville	TX	78029-4029	830-257-8444	btucker@mailgw.dot.state.tx.us
Turberville, PE	Clark D.	Florida DOT	3400 W. Commercial Blvd.	Fort Lauderdale	FL	93309-3421	954-777-4377	clark.tuberville@dot.state.fl.us
Ulberg	Ivan	Montana DOT	2710 Prospect Ave.	Helena	MT	59620	406-444-9458	iulberg@state.mt.us
Upchurch	James	North Carolina DOT	P.O. Box 25210	Raleigh	NC	27611-5201	(919)733-4705	
Upton	Dorthy	Oregon DOT	555 13th Street NE, Suite 2	Salem	OR	97301-4178	503-986-4106	
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Warncke	Julie	Oregon DOT	455 Airport Rd., SE, Bldg. B	Salem	OR	97301-5395	503-986-5751	julie.h.warncke@odot.state.or.us
Wegmann	Frederick	Univ. of Tennessee, Dept. of Civil	113 Perkin Hall	Knoxville	TN	37996-2010	865-974-7706	fwegmann@utu.edu
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