

Managed Lanes Research in Texas

THIS FEATURE PRESENTS THE HIGHLIGHTS OF A MULTI-YEAR RESEARCH PROJECT SPONSORED BY THE TEXAS DEPARTMENT OF TRANSPORTATION AND CONDUCTED BY THE TEXAS TRANSPORTATION INSTITUTE TO INVESTIGATE THE COMPLEX AND INTERRELATED ISSUES SURROUNDING THE SAFE AND EFFICIENT OPERATION OF MANAGED LANES USING VARIOUS OPERATING STRATEGIES.

BY BEVERLY T. KUHN, PH.D., P.E. AND CARLOS A. LOPEZ, P.E.

INTRODUCTION

What once was known as “rush hour” now may last for up to six hours in the most congested cities in the United States. However, rising construction costs, land consumption, neighborhood impacts and environmental issues all must be considered when examining transportation alternatives, particularly on freeway systems. In many cases, these factors place practical limits on expansion projects.

There is a growing realization that simply adding more general purpose lanes to freeways is not always the answer for increasing mobility and travel efficiency. A viable and increasingly popular method for meeting urban mobility needs is the concept of managed lanes.

Managed lanes maintain free-flow travel speeds on designated lanes. Eligible user groups are allowed on these lanes through management strategies that include setting vehicle occupancy levels, pricing and vehicle types. These eligible user groups can vary by time of day or other factors, depending on the available capacity of the facility and the mobility needs of the community.

THE CHALLENGE

Like other transportation agencies around the United States, the Texas Department of Transportation (TxDOT) is looking to the managed lane operational approach to increase freeway efficiency and offer peak-period free-flow travel to certain user groups.

In a particular corridor, managed lanes might be used specifically for high-occupancy vehicles (HOV), commercial vehicles, toll-paying vehicles, transit, low-emitting vehicles, or a combination of these and other groups. Strategies might include time-of-day restrictions, vehicle-type restrictions, fee-based use, or incentives to rideshare.

Little is known about the complexities

of designing a practical, flexible, safe and efficient facility that may have multiple operating strategies throughout the course of a day, a week, a year, or beyond. How can the effectiveness of managed lanes be maximized through an entire day? How can travelers be encouraged to use the lanes when it would best benefit them? Who should use the lanes and when? How can different vehicle groups be permitted access to the lanes on a real-time basis without creating congestion? How should usage rules be communicated and how can it be made sure that travelers will follow them? What technologies could enhance the operation of managed lanes and the overall traffic flow of the entire freeway system? How can it be made sure that managed lanes are meeting mobility goals and objectives for a region or corridor?

BREAKING NEW GROUND

To answer these questions, TxDOT, in cooperation with the Federal Highway Administration (FHWA), initiated a multi-year research project in 2000. Led by a cross-disciplinary team of researchers from the Texas Transportation Institute (TTI) and assisted by Texas Southern University, “Operating Freeways with Managed Lanes” examines how best to optimize the performance of freeway managed lane facilities.

The numerous research tasks are designed to investigate all of the issues surrounding the use of managed lanes in an urban area. The key products to emerge from the research will be a decision matrix and a related comprehensive managed lanes handbook for TxDOT engineers.

The decision matrix correlates eligibility decisions with realistic considerations and constraints for a managed lane facility. Using the decision matrix as a framework, the handbook contains all of the research in a usable format, providing a clear, concise and step-wise approach to

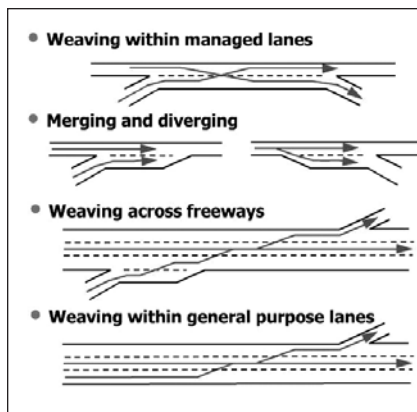


Figure 1. Complex managed lane weaving.

planning, designing and operating a managed lane facility and adapting that facility to meet the changing mobility needs of a region over time. It focuses on critical managed lane issues and project research results but also refers users to other pertinent documents that provide additional detailed information on various aspects of managed lanes.

RECENT RESEARCH

The research effort to date has proven extremely timely for TxDOT. As researchers complete tasks, they provide TxDOT with specific findings so that project managers can use the findings in current projects. The following sections highlight some key research results developed over the past four years that have been well received by sponsors.

Managed Lanes Weaving

A primary consideration for a successful managed lanes project is access for users. Can intended users access the facility efficiently and safely? Weaving across general purpose lanes to access managed lanes may present a problem if the access is at-grade.

Typical weaving scenarios, as illustrated in Figure 1, may include weaving within managed lanes; merging and diverging at managed lane access points; weaving from a freeway entrance to a managed lane entrance or from a managed lane exit to a freeway exit; and intra-freeway vehicle stream separation of vehicles destined for managed lane access.

The research team developed recommended weaving distances to update typical design guidelines for managed lanes

Table 1. Weaving distances for managed lane cross-freeway maneuvers.

Design year volume level	Allow up to 10 mph main lane speed reduction for managed lanes weaving?	Intermediate ramp (between freeway entrance/exit and managed lane entrance/exit)?	Recommended minimum weaving distance per lane (feet)
Medium (level of service C or D)	Yes	No	500
		Yes	600
	No	No	700
		Yes	750
High (level of service E or F)	Yes	No	600
		Yes	650
	No	No	900
		Yes	950

* Note: The provided weaving distances are appropriate for freeway vehicle mixes with up to 10 percent heavy vehicles; higher percentages of heavy vehicles require increasing the per lane weaving distance. The value used should be based on engineering judgment, although a maximum of an additional 250 feet per lane is suggested.

Source: Venglar, S., D. Fenno, S. Goel and P. Schrader. *Managed Lanes—Traffic Modeling*. Report No. FHWA/TX-02/4160-4. Texas Transportation Institute, College Station, TX, USA, 2002.

(see Table 1). They also placed some conditions on these generic guidelines.¹ As shown in Table 1, minimum weaving distances are a function of main lane design year volume levels; allowable speed reduction for those users accessing the managed lanes; and the presence of intermediate ramp(s) between the freeway entrance/exit and the managed lanes entrance/exit. As more of these factors impact the access design, more weaving distance needs to be provided for at-grade access to a managed lane facility.

It is important to remember that these distances are needed once drivers already have determined whether they are candidates for the managed lane facility. Providing drivers with sufficient information early enough to make that determination is discussed later in this feature.

In addition, these transition distances provide enough warning so that main lane speeds are not significantly impacted by weaving vehicles trying to access the managed lane facility. If shorter transition distances were used, main lane and weaving vehicle speeds would be reduced.

Direct Connect Ramps for Managed Lanes

Another factor to consider when designing managed lane facilities is the

effect of ramp spacing on freeway operations and managed lane access. When should a direct ramp between the managed lanes and a generator or surface street system be considered? Grade-separated or direct access ramps are desirable because they provide dedicated access where high vehicle volumes might exist or where additional time savings and operational efficiencies can be gained.

Direct access ramps usually are found with exclusive managed lanes, but they may be used with any type of lane. They may be used at the start, the end, or at intermediate locations along a managed lane facility. They can be the most efficient means of managing conflicting movements at locations where there is substantial congestion and facilitating enforcement.

Table 2 provides general threshold values developed by the research team for considering a direct connect ramp for a managed lane facility.² Under moderate volume freeway conditions (such as level of service C or D), a maximum weaving volume of 450 vehicles per hour is recommended between any given freeway entrance and the next downstream managed lane entrance, or for any given managed lane exit and the next downstream freeway exit.

Table 2. Maximum weaving volumes for direct access consideration.

Freeway volume	Maximum weaving volume (before considering direct managed lanes access ramps)
Moderate (level of service C or D)	450 vehicles per hour
High (level of service E or F)	350 vehicles per hour

Source: Fitzpatrick, K., M. Brewer and S. Venglar. *Managed Lane Ramp and Roadway Design Issues*. Report No. FHWA/TX-03/4160-10. Texas Transportation Institute, College Station, TX, USA, 2003.

Under high volume freeway conditions, this number drops to 350 vehicles per hour. In corridors where weaving volumes for managed lanes exceed these values, it is recommended that direct access be provided from park and ride or transit facilities to the managed lanes.

Legislation

It is critical that state or local jurisdictions are able to legally operate a roadway using a specific operational strategy for managed lanes. Is legislation a roadblock to the implementation of managed lanes? The operation of different types of managed lanes may be sufficiently different from typical freeway operations that changes in legislation and/or regulations may be required. Appropriate legislation should be in place at the federal and state levels to ensure their success and legality.

Researchers identified critical issues that may prevent jurisdictions from implementing managed lanes, including the following:³

- Enabling legislation: Laws need to allow agencies to establish and operate all types of managed lane facilities.
- Contractual agreements: Legislation is needed to make it easy for agencies to enter into contractual agreements for the design, operation and/or maintenance of transportation facilities with managed lanes.
- Managed lane violation: Operating authorities need to be able to issue citations for managed lane violations. One single law that addresses the violation of any managed lane facility in operation in a state could help ensure the statewide implementation of managed lane strategies.

- Operational changes: Agencies need the authority to make operational changes to a managed lane facility, if necessary, to better meet the goals and objectives of the region and maximize its benefits.
- Enforcement: Legislation needs to address managed lane enforcement, including automated enforcement.

TTI research regarding legislative issues was critical in securing recent changes in Texas statutes during the 2003 regular session of the 78th Texas Legislature. The research was used to draft statutes that provide TxDOT and other operational agencies with a complete arsenal of options to design and operate managed lanes under a variety of control scenarios.⁴ Specifically, three bills—Texas House Bill 3588, Texas Senate Bill 514 and Texas House Bill 1208—address managed lanes, in that they:

- define exclusive lanes;
- allow exclusive lanes on roadways included in the Trans Texas Corridor;
- allow the Texas Transportation Commission to designate exclusive lanes and lane restrictions;
- give Texas counties the authority to create lane restrictions within their jurisdictions and designate exclusive lanes and lane restrictions; and
- correct identified problems with the current statute allowing municipalities to designate lane restrictions.

All of these provisions are contingent upon TxDOT approval. Currently, Houston, TX; Austin, TX; and San Antonio, TX, are implementing or expanding truck lane restrictions as a result of this legislation.

Marketing Managed Lanes

Public acceptance plays a critical role in the success of any project. How can sufficient public support be gained? Marketing a new product or concept can be challenging. Effective marketing campaigns must consider the goals of the project and tailor the message to meet those goals. Several different techniques can be used to communicate with the public, depending on the message that is to be delivered and the objectives of the project.

Likewise, a message may be tailored to particular audiences. It is important to correctly define the audience. Audiences will depend on the nature or scope of the project and may change through the different phases of the project. The research team identified the following issues as critical to success when considering a managed lane project:⁵

- Public involvement must include a comprehensive public education component that describes the concept and includes all aspects of the project, such as goals, objectives, operations and revenue use.
- All interested parties should be involved in the decision-making process. Efforts should be made to contact known stakeholders as well as non-traditional stakeholders who may have a vested interest in a project.
- A project champion who can be a spokesperson in the education process must be identified.
- Key messages to be communicated to the general public include the issue of providing a choice to travelers; managed lanes as one tool for addressing congestion; the idea that managed lanes maximize available capacity; system operations; the handling of enforcement; the use of any revenue; and overall transportation funding information.

The research team developed two concept marketing brochures intended to provide TxDOT's statewide perspective on managed lanes, as shown in Figure 2. One is tailored to editorial staff, transportation reporters and others in the media.⁶ The second is intended for policy-makers in Texas.⁷ These user-friendly brochures, which can be adapted to any state or juris-

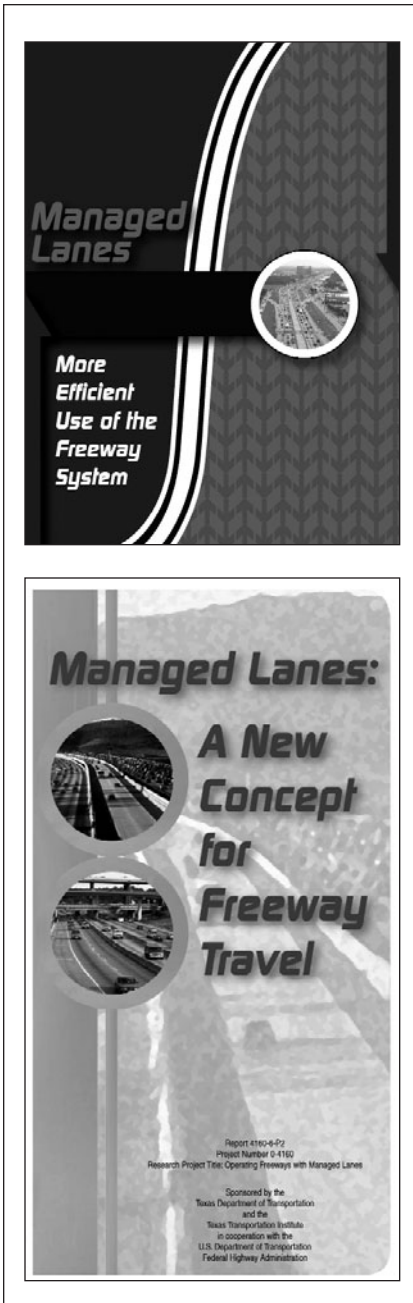


Figure 2. Concept marketing brochures.

diction, have been distributed widely across the state and have been popular and useful to both audiences.

Traveler Information and Traffic Control

With managed lanes offering additional choices to users, the related information that must be processed can be complicated. Do users have enough information to identify their choices and make appropriate decisions? These choices can vary by time of day or in response to changing traffic conditions

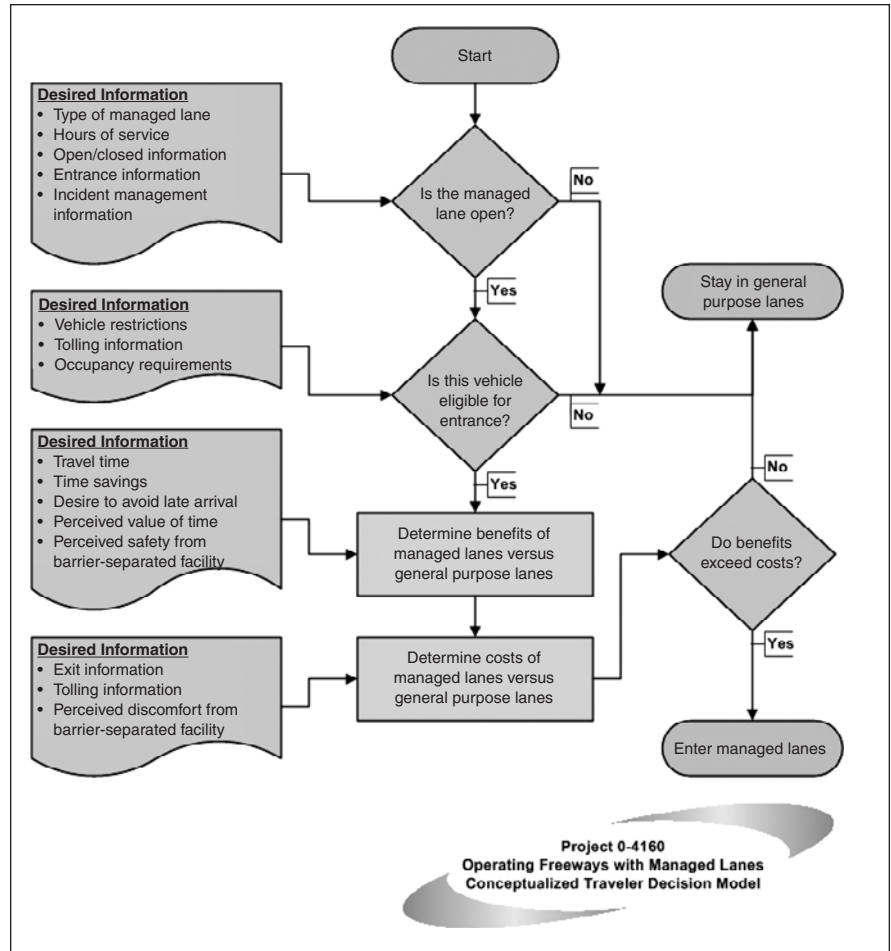


Figure 3. Conceptualized traveler decision model. Source: Schrock, S., G. Ullman, A. Williams and S. Chrysler. Identification of Traveler Information and Decision-Making Needs for Managed Lane Users. Report No. FHWA/TX-04/0-4160-13. Texas Transportation Institute, College Station, TX, USA, 2004.

on either managed lanes or other general purpose lanes in a corridor or region.

The extent to which travelers can and will accommodate operational flexibility hinges on getting the right information to travelers—at the right time and in the right format—so that they can make effective decisions pertaining to their trip.

To aid in the development of managed lane facilities, researchers developed a conceptualized decision model, as shown in Figure 3.⁸ This model incorporates the information a driver needs to correctly answer each of the questions required in the process of deciding whether a managed lane facility is a better choice than general purpose lanes.

It also takes into account not only the specifics of the managed lane facility and traffic conditions, but the qualitative specifics of the individual driver. All of this information is processed in the

mind of the driver in real time or just prior to the trip.

The traveler decision model is related to the issue of driver familiarity. A general classification of drivers who might reasonably be confronted with the decision of whether to enter a managed lane facility includes unfamiliar drivers, semi-familiar drivers and very familiar drivers. The entire driving population would fill the continuum between the extremes of completely unfamiliar drivers and completely familiar drivers. Figure 4 illustrates the concept that familiarity with managed lane facilities reduces the amount of information needed by a driver during a trip.

Determination of who the target audience really is (familiar, semi-familiar, or unfamiliar drivers) can help determine how much information must be presented within the managed lane corridor

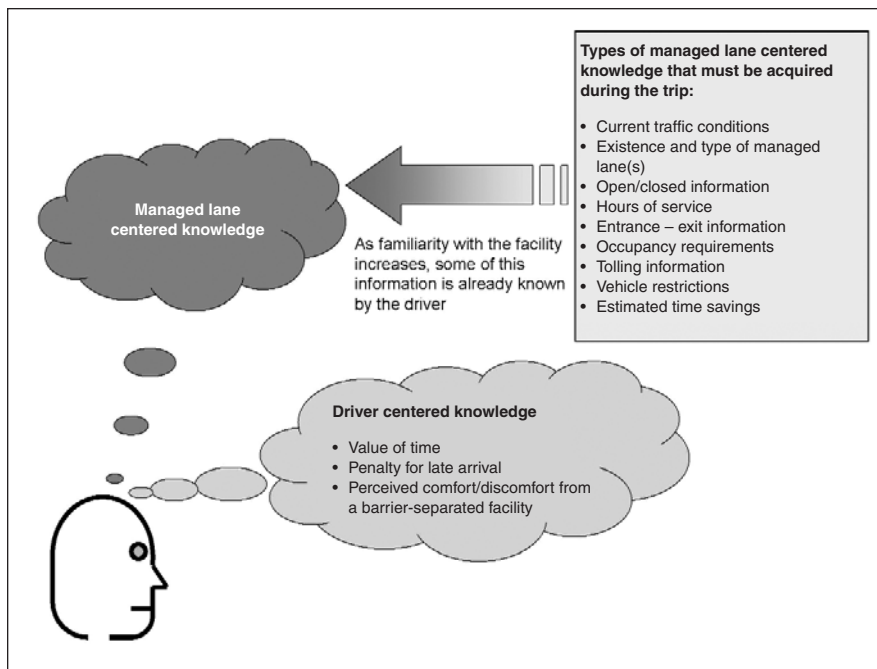


Figure 4. Driver information needs. Source: Schrock, S., G. Ullman, A. Williams and S. Chrysler. *Identification of Traveler Information and Decision-Making Needs for Managed Lane Users.* Report No. FHWA/TX-04/0-4160-13. Texas Transportation Institute, College Station, TX, USA, 2004.

regarding managed lanes. This step must take place early in the design process so that designers can make rational decisions about what levels of information need to be presented.

Additionally, if the target audience can be defined specifically (such as toll users who have electronic transponders), other options for information dissemination become available, such as direct mailings.

FINAL REMARKS

This feature highlights research findings from the past four years of work. The research team has a Web site that serves as a growing resource for managed lane information and interaction. In addition to links to projects across the United States, the Web site contains a quarterly newsletter, project reports and products, as they become available. Researchers also maintain an electronic distribution list for communicating with those interested in managed lane projects.

For more information on the emerging research results on this project or to join the distribution list, contact Beverly Kuhn; 979-862-3558 or b-kuhn@tamu.edu or Ginger Goodin; 512-467-0946 or g-goodin@tamu.edu or visit the project Web site at managed-lanes.tamu.edu.

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