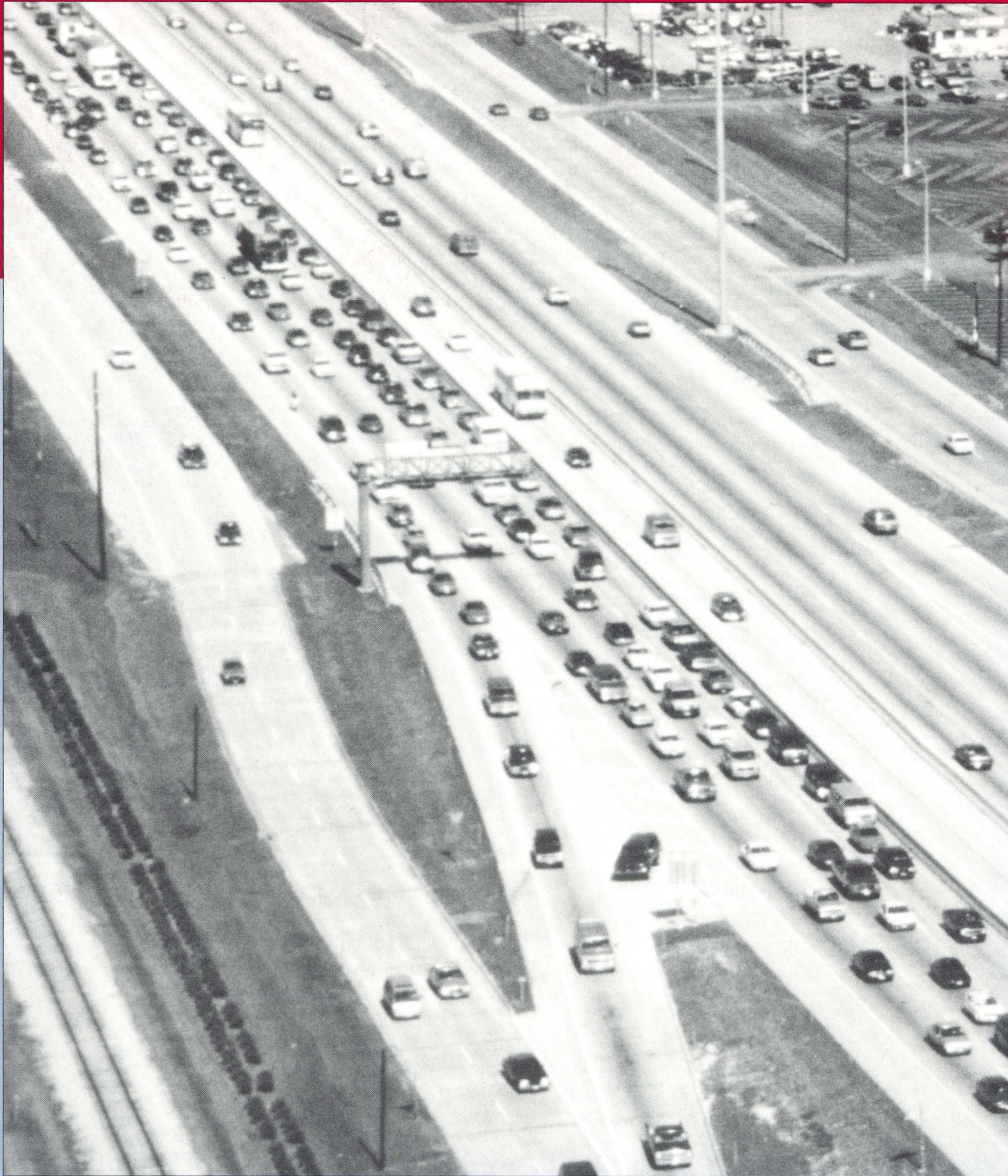


**THE HIGH-OCCUPANCY VEHICLE FACILITY SYSTEM  
HOUSTON, TEXAS**



***A Joint Project***



**Metropolitan Transit Authority  
of Harris County**



**Texas State Department of Highways and  
Public Transportation**

***Prepared by***

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The Texas A&M University System  
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***Sponsored by***

Metropolitan Transit Authority of  
Harris County and the Texas State  
Department of Highways and  
Public Transportation in coopera-  
tion with the U.S. Department of  
Transportation, Federal Highway  
Administration.

*A contraflow lane demonstration project was implemented on the North Freeway in 1979. This project borrowed a lane from off-peak direction traffic for use by buses and vans traveling in the peak direction. The demonstration was surprisingly successful and led to a large-scale commitment to HOV lanes in Houston.*



**T**he Houston high-occupancy vehicle (HOV) lanes represent the most extensive network of barrier-separated HOV lanes in the country. As of 1990, almost 47 miles of a planned 95.5-mile system were in operation. Designed and operated to provide preferential treatment for high-occupancy vehicles—buses, vanpools, and carpools—the HOV lane system represents one important approach for managing traffic congestion and mobility problems in Houston. The HOV lanes are primarily one lane, reversible, barrier-separated facilities and are located in the median of the freeway.

The development and operation of the priority HOV facilities have been the result of a joint effort between the Metropolitan Transit Authority of Harris County (METRO) and the Texas State Department of Highways and Public Transportation (SDHPT). These two agencies have utilized a variety of funding sources and have established a coordinated and flexible working relationship to develop and operate the HOV system.

Based on the results of an extensive evaluation of the HOV lanes, both METRO and the State Department of Highways and Public Transportation consider the facilities to be successful. This success has generated interest from numerous individuals and agencies across the country. As a result, this document has been prepared to provide an overview of the development and operation of the high-occupancy vehicle facility system. A series of photographs provide a physical description of the HOV facilities.

## When should HOV lanes be considered as an alternative?

This document describes HOV lanes that have been implemented on highly congested radial freeways in the fourth largest city in the United States. The data suggest that the Houston HOV lanes have produced beneficial impacts; however, these priority lanes are located in corridors in which they would be expected to be effective.

The Houston experience suggests that the following general conditions should exist before serious consideration is given to a high-occupancy vehicle lane alternative.

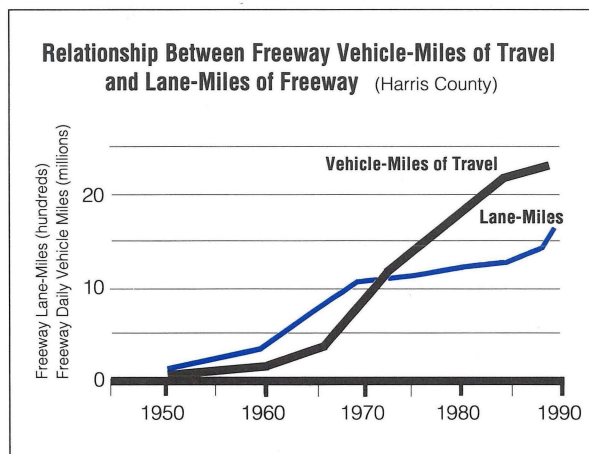
**1. General Support Should Exist from the Agencies Involved and the Public.**

**2. Intense, Recurring Congestion Must Exist on the Freeway General-Purpose Mainlanes.**

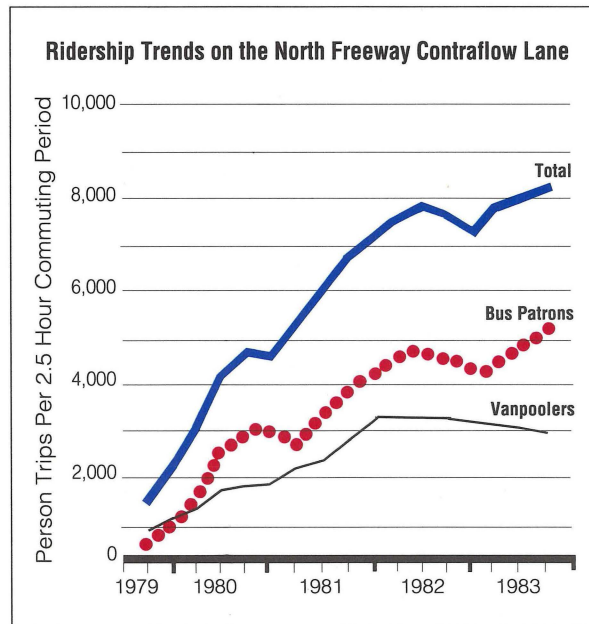
- Average daily traffic on the freeway should be at least 15,000 to 20,000 vehicles per lane.

- During the peak hour, average speeds on the freeway mainlanes during non-incident conditions should be less than 30 mph and, relative to using the freeway general-purpose lanes, the HOV lanes should offer a travel time savings during the peak hour of at least 5 to 7 minutes.

**Figure 1.** During the 1970s, travel increased much more rapidly than did the supply of roadway facilities. Houston changed from a city with excellent mobility to a congested urban area.



**Figure 2.** The surprisingly high use of the contraflow lane demonstrated that high-occupancy vehicle facilities had application in auto-oriented Texas cities such as Houston.



**P**rior to 1970, Houstonians generally enjoyed excellent mobility; new roadway construction had kept pace with the growth in travel demand. However, beginning with the migration to the Sunbelt in the early 1970s, congestion began to increase noticeably, with travel increasing much more rapidly than did the construction of new highway facilities (Figure 1). By the end of the 1970s, Houston had changed from a city with excellent mobility to a highly congested city. Furthermore, projections called for continued increases in travel demand.

To address these problems, improve transit and make better use of existing facilities, in the early 1970s the City of Houston and the Texas Highway Department considered a variety of approaches for operating the urban freeway system. A recognition had developed that, based on physical, environmental and economic constraints, it was neither possible nor desirable to continue to provide enough streets and highways to serve all travel demands at an average of 1.2 persons per vehicle. Consequently, increasing the number of persons per vehicle by providing priority treatments for high-occupancy vehicles was one of the approaches considered.

### The High-Occupancy Vehicle Facility Concept

High-occupancy vehicle (HOV) facilities are intended to help maximize person movement on a roadway by increasing the average number of persons per vehicle. This is accomplished by altering the manner in which a roadway is designed and/or operated in order to

### **3. The Travel Patterns on the Freeway Should be Conducive to Being Served by Rideshare—Either Bus or Carpool.**

- A significant volume of peak-period trips (perhaps more than 6,000 home-based work trips during the peak hour) on the freeway should be destined to major activity centers. Of these trips, at least 65% to 75% should be longer than 5 miles in length.

### **4. The HOV Lane Design Should Allow for Safe, Efficient, and Enforceable Operation.**

If all of these conditions are met, an HOV lane warrants consideration. However, it should be realized that, in many corridors, the HOV lane may be neither a preferred nor a viable option. In corridors where HOV facilities can be used effectively, their implementation can provide one additional tool to help maintain mobility; in all likelihood, that implementation will not eliminate the need to also pursue other actions intended to address the congestion problem.

provide travel time advantages—both a travel time savings and a more predictable travel time—to users of high-occupancy vehicles. These travel time advantages then serve as incentives for commuters to choose to ride a bus, vanpool, or carpool. One intent of HOV facilities is to provide a safe, cost-effective travel alternative that a significant volume of commuters will find attractive. Bus transit operations are also enhanced. Higher bus operating speeds, greater schedule adherence, higher bus productivity, and safer operations help make these improvements attractive to the transit operator.

By the early 1970s, the potential effectiveness of this concept had been demonstrated in several U.S. cities. Successful barrier-separated freeway HOV projects were in operation on the Shirley Highway in northern Virginia and on the San Bernardino Freeway in Los Angeles. Both projects showed that a single HOV lane could move 6,000 to 10,000 persons in an hour. It was apparent that, in at least some highly congested corridors, the HOV concept worked.

## **The North Freeway Contraflow Lane Demonstration**

The continued increase in congestion levels and the successful experience with HOV facilities elsewhere in the United States led to a decision by the City of Houston and the Texas Highway Department to test the HOV concept in Houston. Accordingly, they developed and operated a 9-mile contraflow lane on the North Freeway (I-45); this contraflow lane, which opened in August 1979, reserved the inside

freeway lane in the off-peak direction for exclusive use by buses and vans traveling in the peak direction. The lane was implemented as a joint City of Houston and Texas Highway Department project using federal, state, and local funding sources.

The North Freeway contraflow lane, an Urban Mass Transportation Administration demonstration project, was successful beyond all expectations. Although it operated for only 2.5 hours during each peak period and was utilized only by authorized buses and vans, the contraflow lane moved over 8,000 persons during each peak period (Figure 2). The facility attracted transit riders who had autos available for the trip. Large vanpool programs developed.

It became evident that, under certain conditions (see Inset A), a significant unserved demand for high-speed, high-quality transit existed in some Houston corridors. The success of this relatively modest contraflow project brought about a large-scale commitment in Houston to the HOV concept. As a result, since 1979, the Houston area has seen continuous development of barrier-separated high-occupancy vehicle projects, or transitways as they are sometimes called locally.

The institutional arrangements for the design, construction, and operation of the Houston HOV facilities are unique. From conception through operation, the HOV program has been a joint venture of METRO and SDHPT. This is different from what has generally occurred elsewhere in the nation, where an HOV project has usually been the result of an initiative by a single agency. Moreover, "transit" and "highway" agencies in some major cities occasionally have been at odds rather than continually engaging in numerous joint efforts to improve mobility.

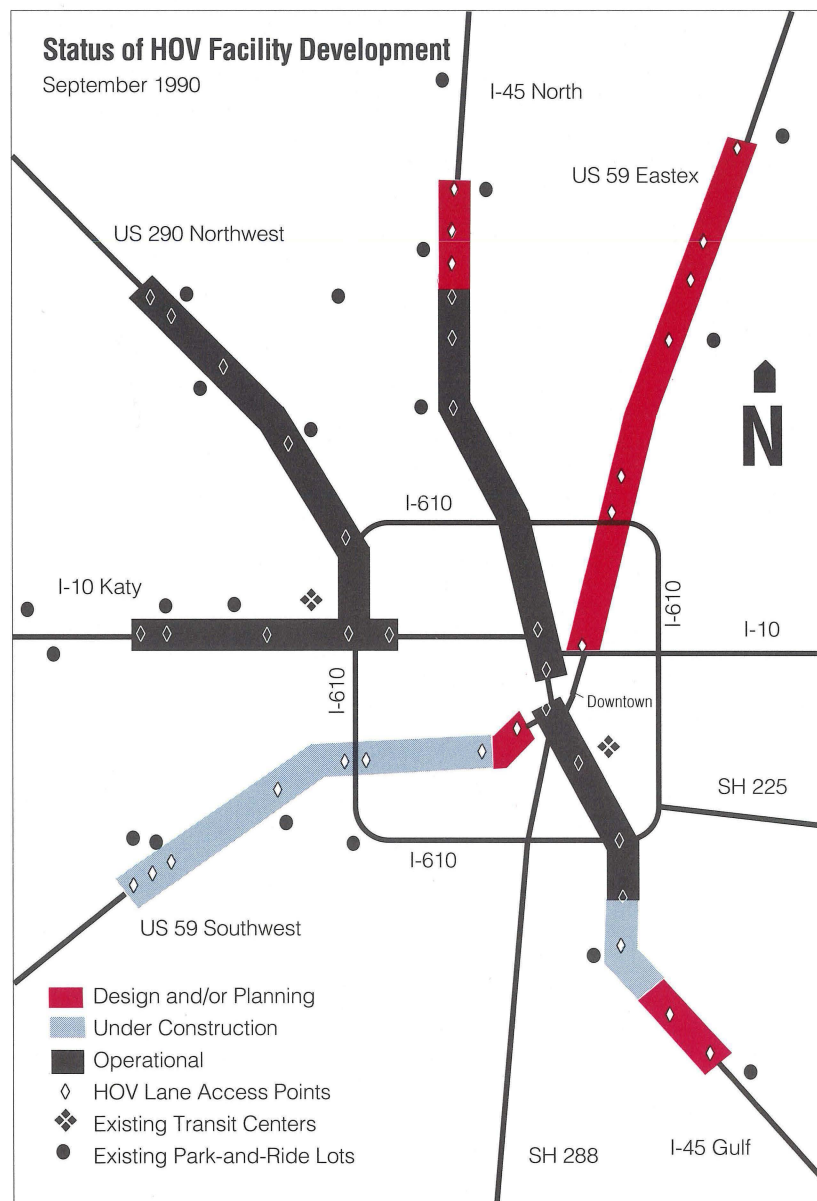
This cooperative METRO-SDHPT relationship operates on both formal and infor-

mal levels. Formal contractual agreements identify the legal, financial, and operational responsibilities of each agency. Equally important, however, are the informal arrangements at the staff level that have helped cut red tape, more effectively pursue available funding sources, and provide oversight and coordination of plan preparation.

The details of each agency's role in developing the HOV facilities are complicated. In general, METRO has initiated activity on a segment of a given HOV lane and has borne a larger share of the cost, often utilizing some federal transit funds. SDHPT frequently handles the plan preparation effort and acts as the contracting agency, since

most HOV lanes are built as part of freeway reconstruction projects. SDHPT usually handles construction supervision and provides personnel for inspection and engineering. Once a segment is opened to high-occupancy vehicle traffic, METRO is responsible for daily operation and enforcement, while both METRO and SDHPT share responsibility for maintenance. Operational management is handled by a METRO/State team.

There have been exceptions to this approach. For example, the Gulf Freeway HOV lane was initiated by SDHPT and funded mostly with highway monies. Also, when circumstances dictated, METRO has handled



## The Houston HOV Facility System

The Metropolitan Transit Authority and the Texas State Department of Highways and Public Transportation are committed to the development of a 95.5-mile HOV lane system in Houston. Ultimately, high-occupancy vehicle lanes will be provided on six of the radial freeways (Figure 3). As of 1990, priority facilities were in operation in four corridors, accounting for a total of almost 47 miles of barrier-separated HOV lanes. The remainder of the system is either under construction or in design, and the entire system should be operational by the year 2000. Selected characteristics of the HOV lanes are shown in Table 1. The projects have been cooperative multi-agency efforts, and this has been a key reason why the HOV facilities in Houston have been implemented in a timely and coordinated manner (see Inset B).

**Figure 3**  
Houston is developing a 95.5-mile HOV lane system that will operate on six radial freeways. Nearly 47 miles of that system are currently in operation.

plan preparation and acted as the contracting agency. Throughout the process, both agencies have exhibited a willingness to explore alternatives to usual practice.

Replacing the City of Houston's Office of Public Transportation, METRO came into existence in January 1979, the first Houston area regional transit agency supported by a local one-percent sales tax. In the public transportation field, SDHPT is not much older. In 1975, the Texas Legislature gave the long-standing Texas Highway Department responsibility for public transportation at the state level and renamed the agency. However, the interagency cooperation which has been the hallmark of the

METRO-SDHPT joint venture predates these agencies. An outcome of a 1975 study by the City and the State was the proposal for implementing an experimental contraflow lane.

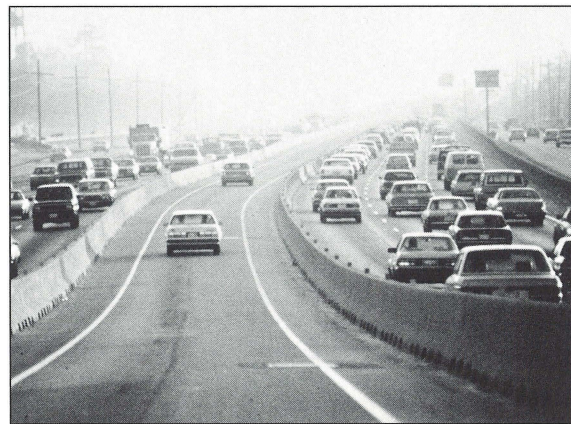
The North Freeway contraflow lane opened in 1979 and, by 1981, had amply demonstrated how successful an HOV lane could be in Houston. Because the METRO transit plan depended heavily on HOV facilities, and because the contraflow lane's useful life was limited, METRO and SDHPT began to plan for its replacement with a permanent HOV lane. The first segment of this lane opened in 1984. It was designed, constructed, maintained, and operated un-

der a contractual agreement similar to that described previously. Since then, the same basic approach has been used for nearly all HOV lane development, although maintenance and operation of all priority lanes are now covered by a single "master" agreement.

The joint METRO-SDHPT venture was born out of necessity. Early in its tenure, METRO had access to funds and possessed operational capability, but it lacked experience in complex highway-type construction projects. The SDHPT had experience but was short of funds. Individually, neither agency could have developed today's HOV system. Together, they have.

## Physical Description

While some two-direction HOV facilities are being developed, the typical Houston HOV lane is located in the freeway median, is approximately 20-feet wide, is reversible, and is separated from the general-purpose freeway mainlanes by concrete median barriers. In certain locations, high-occupancy vehicle lane implementation was accomplished by narrowing freeway mainlane and inside shoulder widths.



*The "typical" Houston HOV lane is approximately 20 feet wide, is reversible, is located in the median of a freeway, and is separated from the freeway general-purpose lanes by concrete median barriers. The HOV lanes currently in operation have been constructed for approximately \$5 million per mile.*

**TABLE 1**

### Status of the HOV Lane System

September 1990

HOV Facility	Date First Phase Opened	Miles in Operation	Final System Mileage
Katy (I-10)	October 1984	13.0	13.0
North (I-45)	November 1984 <sup>1</sup>	13.5	19.7
Northwest (US 290)	August 1988	13.5	13.5
Gulf (I-45)	May 1988	6.5	15.5
Southwest (US 59)	Not Open in 1990	—	13.8
Eastex (US 59)	Not Open in 1990	—	20.0
<b>TOTAL</b>		<b>46.5</b>	<b>95.5</b>

<sup>1</sup>A contraflow lane was implemented on the North Freeway in August 1979. It was replaced with a barrier-separated reversible HOV lane in November 1984.

The Houston HOV facility program is a new approach for addressing mobility problems in Texas. While a good deal has been learned through the development and implementation of these projects, several issues continue to warrant attention.

### 1. Increase the Person-Movement on the High-Occupancy Vehicle Lanes.

- Attention will continue to be focused on implementing programs designed to encourage more persons to ride buses or carpools on the special lanes. If the design volumes of 7,000 to 10,000 persons per hour per HOV lane

are to be attained, it will be necessary to continue to increase the average vehicle occupancy on the priority lanes during at least the peak hour.

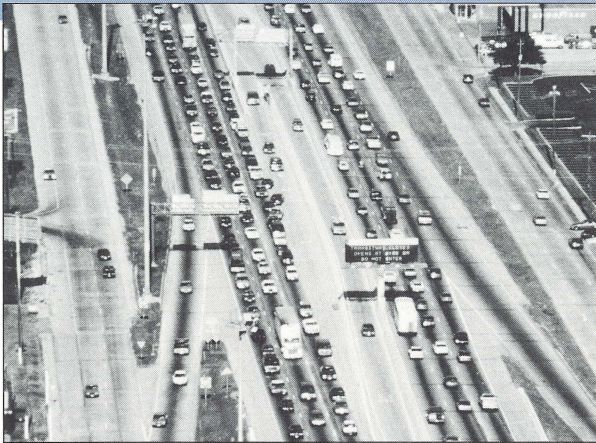
### 2. Operational and Enforcement Issues.

- During all operating periods, high and reliable operating speeds need to be maintained on the HOV lanes. Due to the high percentage of total demand that occurs in the peak hour, it will become increasingly desirable to take steps to assure that vehicle demand does not exceed capacity during the peak-hour without adversely impacting the demand that occurs outside of the peak hour.

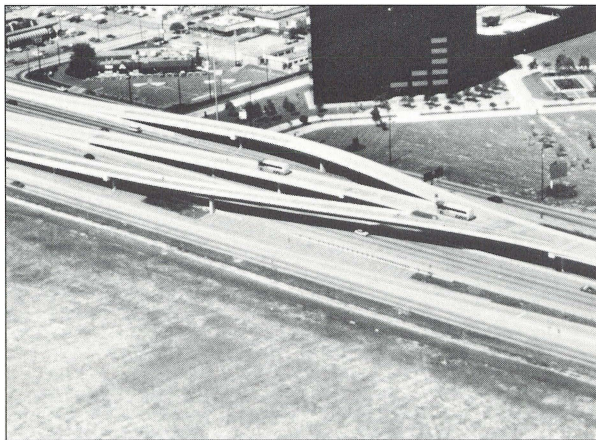
- Effective enforcement is a key to successful operation. Adequate resources must continually be devoted to enforcement, and innovative enforcement strategies warrant serious consideration.

### 3. Potential Use of the HOV Facilities as Laboratories for Testing Various Intelligent Vehicle and Highway System (IVHS) Related Concepts.

*At some locations, access/egress to the HOV lanes is provided from the inside freeway lane via slip ramps. While this access is relatively inexpensive to provide, depending on the location these ramps can contribute to freeway congestion.*



*Most of the access to the HOV lanes is provided by grade-separated ramps. These ramps eliminate the potential for interference with freeway traffic and also provide additional travel time savings for high-occupancy vehicles.*



## Access

Access to the median high-occupancy vehicle lanes is provided in a variety of manners. At some locations, "slip ramps" are used to provide access to, and egress from, the inside freeway lane. However, for operational purposes, most access to the HOV lanes is by grade-separated interchanges of various designs; the high-occupancy vehicle lane becomes elevated in the freeway median, and ramps go over the freeway lanes to connect with streets or transit support facilities such as park-and-ride lots. These grade-separated ramps eliminate interference with freeway mainlane operation, improve safety, provide additional travel time savings for users of high-occupancy vehicles, and offer effective locations for use by enforcement personnel.



## Houston HOV Facilities Compared to Other Fixed-Guideway Projects

In recent years, a variety of major transit projects have been implemented in the United States. A comparison of cost and ridership information indicates that the Houston HOV facilities represent a relatively inexpensive approach for increasing person-movement capacity during peak commuting periods. In comparison, the rail projects are generally moving more total daily passengers.

**Comparison of Fixed-Guideway Transit Improvements, 1990**

City and Transit Improvement		Length (miles)	Capital Cost Per Mile <sup>1</sup>	Average Weekday Person Trips	Maximum Ridership Peak Hour, Peak Direction
Houston HOV Lanes <sup>2</sup>	Gulf	6.5	\$ 4.2	9,000	2,600
	Katy	13.0	\$ 3.0	25,500	4,900
	North	13.5	\$ 4.9	18,300	4,700
	Northwest	13.5	\$ 6.7	10,600	3,500
	Average	11.6	\$ 4.7	15,900	3,900
Light Rail Transit	Portland	15.1	\$14.1	22,000	2,200
	Sacramento	18.3	\$ 9.6	21,000	2,500
	San Diego (San Ysidro Line)	15.9	\$ 7.3	31,900	2,300
	San Jose	10.0	\$18.8	9,400	500
	Average	14.8	\$12.4	21,100	1,900

<sup>1</sup>Construction year dollars. HOV costs do not include cost of buses. <sup>2</sup>Ridership volumes include buses and carpools.

Source: Texas Transportation Institute and respective transit agencies.

### Operations

The HOV lanes operate inbound toward the downtown on weekdays from 4 a.m. to 1 p.m. and outbound from 2 p.m. to 10 p.m. The priority lanes are closed from 1 p.m. to 2 p.m. to reverse the direction of operation and are also closed from 10 p.m. to 4 a.m. On weekends, the high-occupancy vehicle lanes operate outbound on Saturdays (4 a.m. to 10 p.m.) and inbound on Sundays (4 a.m. to 10 p.m.). Average speeds on the priority lanes are in excess of 50 mph.

The types of vehicles allowed to use the HOV lanes, as well as the required number of persons per vehicle, have changed on several occasions. As of 1990, with one exception, vehicles with 2 or more persons (2+) are allowed to use all of the HOV lanes during all operating hours. The exception to this operating rule is the Katy Freeway HOV lane, where usage is restricted to vehicles with 3 or more occupants on weekdays between 6:45 a.m. and 8:00 a.m. For this facility, occupancy requirements were increased from 2+ to 3+ in October 1988 to reduce the a.m. peak-hour vehicle congestion and delay that were occurring on the HOV lane as a result of increasing carpool volumes. This increase in the occupancy requirement restored the high speeds and reliable trip times that are so important to HOV lane success.

Operation and enforcement of the high-occupancy vehicle lanes, while performed by METRO, is coordinated through a team of the implementing agencies that meets on a regular basis. This group continually reviews the operating procedures to identify means of enhancing performance and

safety (see Inset C). METRO has enforcement personnel and operating crews assigned to the priority lanes, and the cost for daily operation and enforcement is approximately \$250,000 per HOV lane per year. Major maintenance, such as pavement and barrier repair, is performed by the State Department of Highways and Public Transportation.

### Estimated Capital Cost

The estimated cost of the entire 95.5-mile HOV facility system is \$830 million, or approximately \$8.7 million per mile. Included in this value is the cost of most of the major support facilities such as bus transfer centers and park-and-ride lots. However, the initial 47 miles of HOV lane now being operated were built at an average cost of less than \$5 million per mile (see Inset D). In general, costs are reduced by locating the priority lanes in available highway rights-of-way and by constructing these lanes in conjunction with major highway projects.

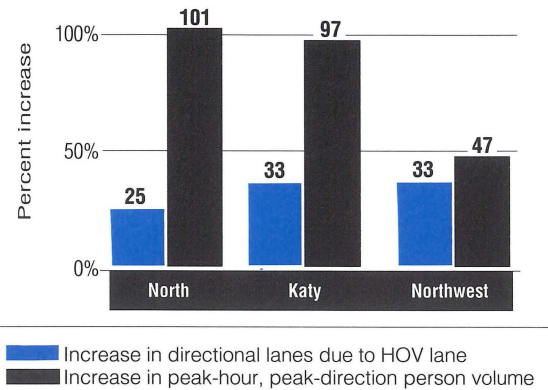
Funding for the HOV system has come from a combination of federal, state, and local highway funds, and transit funds. About 80% of total funding has been transit related; with the exception of some ramps and support facilities, the HOV facility system has been constructed in state owned rights-of-way.

## Have the HOV Facilities Been Effective?

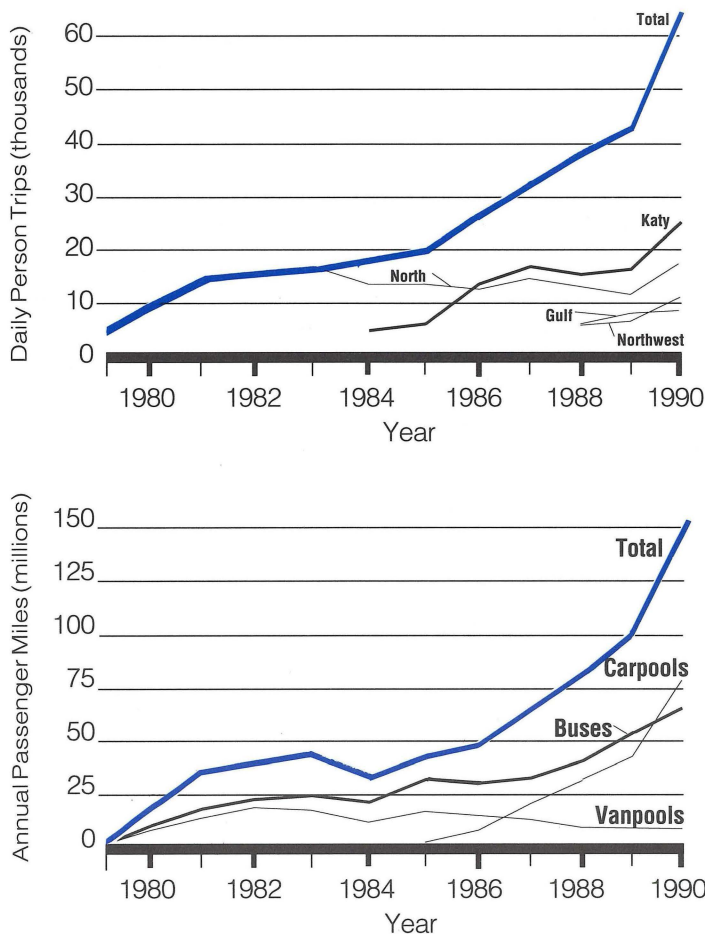
**B**ased on today's level of usage, the HOV lanes are an important aspect of peak-period mobility.

Implementation of the priority lanes has greatly increased person volumes carried during the congested peak periods. The percent increase in person volume is considerably greater than the percent increase in lanes.

Change in Lane Capacity and Person Volumes Due to HOV Lanes



### Trends in Utilization of the Houston HOV Lane System



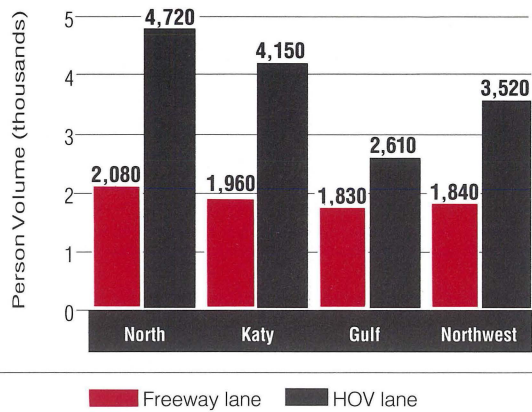
**Figure 4.** Over 63,000 daily person trips are served by the Houston HOV lanes.

### Trends in Utilization

Trends in daily person trips on the Houston HOV system are shown in Figure 4. As more lanes have opened and as carpool use of these lanes has become more common, use of the system has increased; in September 1990, over 63,000 weekday person trips were served on the high-occupancy vehicle lanes. Carpools and vanpools serve approximately 60% of the daily person trips, with the remainder being moved in buses. As long as the vehicular capacity of the HOV lanes is not exceeded, use of these priority lanes by carpools has certain advantages, including: 1) carpool volumes are moved at a relatively small marginal cost; and 2) carpools are able to effectively serve trip patterns, particularly suburb-to-suburb travel, that are sometimes difficult to serve with fixed-route bus service. The HOV lanes serve a relatively large volume of persons during the heavily-congested peak hours (see Inset D).

An extensive system of bus transfer centers, designated downtown bus lanes, carpool lots, and bus park-and-ride lots support the high-occupancy vehicle system and are critical to the success of the system. Several large park-and-ride lots, all generally having more than 1,000 spaces, serve each of the corridors. As of 1990, nearly 9,000 cars were parking in these lots each weekday. Without the HOV lanes, many of these vehicles would be utilizing street and parking capacity in downtown Houston and adding to congestion in that area. Also, a major bus transfer facility either currently exists or is planned in each HOV corridor (see Figure 3).

A.M. Peak-Hour, Peak-Direction Per Lane Person Volume on Houston Freeways and HOV Lanes



## Who Uses the HOV System?

Persons using the high-occupancy vehicle lanes are typically young, educated, white-collar commuters (Table 2). Transit riders are using the buses by choice; over 90% have an auto available for the trip. This extensive use of transit by choice riders represents a significant expansion of the transit market in Texas. Principal reasons given for using the HOV lanes include: 1) freeway too congested (22%); 2) saves time (18%); 3) time to relax (16%); and 4) reliable trip time (15%).

## The Effectiveness of the Houston HOV System

A primary reason for implementing the HOV facilities is to increase the average number of persons per vehicle on the freeways in a cost effective manner, and to accomplish this without unduly impacting the operation of the freeway general-purpose lanes. Desirably, these improvements will have public support. If these objectives are attained, related benefits, such as improved air quality and reduced fuel consumption, will also result. The HOV system has been in operation long enough to begin to see whether these objectives are being met. Data pertaining to HOV system effectiveness are included in Inset E.

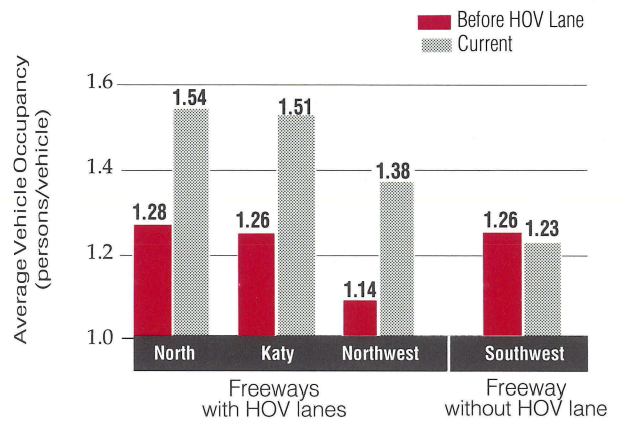
TABLE 2

Selected Characteristics of HOV Lane Users

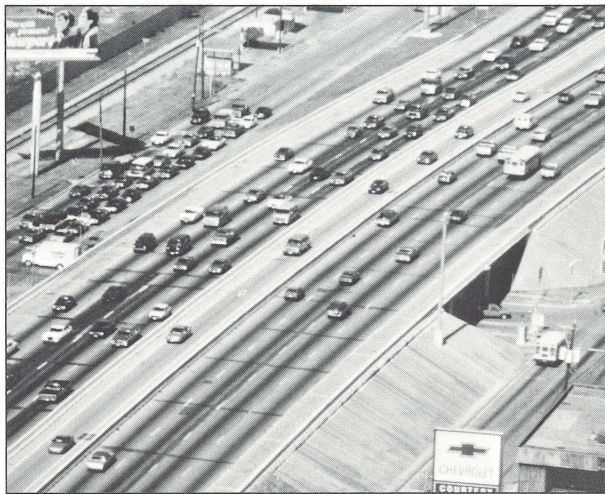
Characteristic	Transit Patrons	Carpoolers
<b>A.M. Trip Destination</b>		
Downtown	93%	53%
3 Major Suburban Activity Centers	4%	23%
Other	3%	24%
<b>Trip Purpose (% Work)</b>		
	98%	92%
<b>Age, Years (50th Percentile)</b>		
	34	37
<b>Sex</b>		
Male	41%	50%
Female	59%	50%
<b>Occupation</b>		
Professional	42%	45%
Managerial	17%	19%
Clerical	32%	20%
<b>Previous Mode of Travel</b>		
Drove Alone	41%	45%
Carpool or Vanpool	16%	43%
Bus	23%	5%
New Trip	20%	7%

The preferential high-occupancy vehicle improvements have resulted in significant increases in average vehicle occupancy, 2+ carpools, and bus ridership. Similar increases have not been experienced on a freeway without a HOV lane.

A.M. Peak-Hour, Peak-Direction Average Vehicle Occupancy



Of the 63,000 daily person trips served on the HOV lanes, about 60% are served in carpools and vanpools. Carpool trips are accommodated at a relatively low marginal cost and are an effective means of accommodating the suburb-to-suburb trips that can be difficult to serve with fixed-route transit.



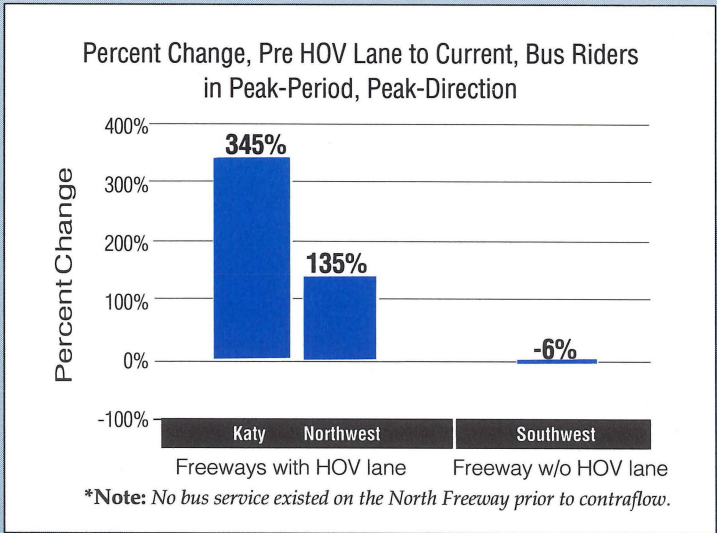
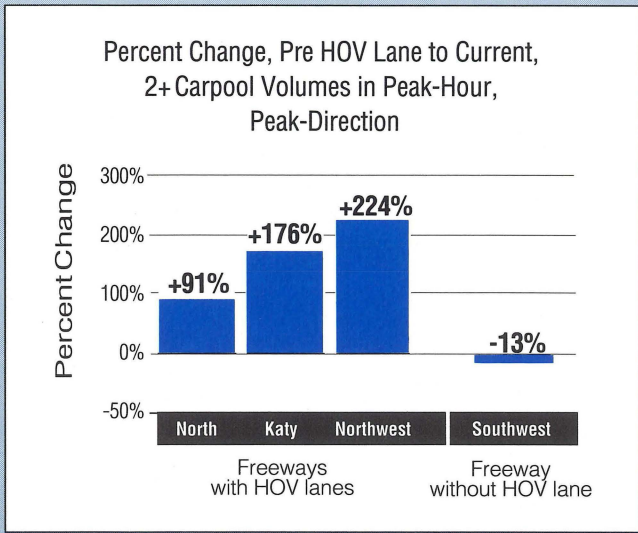
A large system of support facilities, such as bus transfer centers and park-and-ride lots, complements the HOV lanes. Many of these have direct, grade-separated ramps that provide access to the priority HOV lanes.



### Have the High-Occupancy Vehicle Lanes Increased Person Movement?

High-occupancy vehicle lanes are intended to increase the volume of persons moved on the roadway during peak periods. For this to happen, the number of persons per vehicle needs to increase, and it has. In comparison to pre HOV lane conditions, average peak-hour vehicle occupancy has increased by approximately 20% on the freeways with HOV lanes. During peak periods, the average occupancies on the Houston freeways that have HOV facilities are the highest in the state. Over the corresponding time period, vehicle occupancy on a Houston freeway without an HOV lane declined.

Vehicle occupancy increased because more persons have formed carpools and/or chosen to ride a bus. In comparison to pre HOV lane conditions, the volume of peak-hour 2+ carpools on the roadways with HOV facilities has generally more than doubled; even greater increases have been realized in bus ridership. And again, these types of changes have not been experienced on freeways without HOV lanes.



### Are the High-Occupancy Vehicle Lanes Cost Effective?

To compete for limited highway and transit funds, it is important that these facilities be cost effective. As a rule of thumb, if average daily usage on a Houston HOV lane over the life of the project exceeds 10,000 to 12,000 person trips, the project is cost effective. The average Houston HOV facility already meets this mark, with only the incomplete Gulf Freeway HOV lane falling slightly below this level. Because usage should continue to increase over time, it appears that the Houston high-occupancy vehicle system will be a highly cost effective transportation improvement.

### Have the HOV Lanes Impacted Freeway Mainlane Operations?




Due to its design, the high-occupancy vehicle facility system operates somewhat independently of the freeway system. Thus, impacts on the freeway mainlanes and on parallel routes have been minimal. Although the HOV lanes move several thousand persons in the peak hour, significant changes in freeway and parallel route congestion have not occurred. Like most transit improvements, the HOV system is more beneficial in reducing the rate of growth in congestion rather than in reducing existing levels of congestion.

### Do the HOV Facilities Have Public Support?

The Houston high-occupancy vehicle program represents a significant long-term capital investment. Policy level support for the HOV concept from both highway and transit interests has existed since the success of the contraflow lane demonstration project. The projects have also enjoyed acceptance from the general public, with surveys of motorists using the highly congested freeway mainlanes demonstrating support for the high-occupancy vehicle lane program. When these motorists are asked if the HOV lanes being developed in Houston are good transportation improvements, their responses are: yes, 67%; no, 18%; and not sure, 15%. Although concern continues to be expressed by some individuals regarding perceived underutilization of the high-occupancy vehicle lanes and the perceived benefits that might occur from opening those lanes to all traffic, HOV projects continue to move forward with support from the involved parties.

Analyses of the Katy Freeway comparing the current cross section (3 directional general-purpose lanes and a reversible HOV lane) with alternative cross sections that offer only general-purpose lanes indicate that, at today's level of demand, the HOV alternative provides both energy and air quality benefits.

### Legend

-  3 directional freeway lanes plus 1 HOV lane
-  4 directional freeway lanes without HOV lane
-  3 directional freeway lanes without HOV lane
- HC** Hydrocarbons
- CO** Carbon Monoxide
- NO** Nitrous Oxide

Source: FREQ Computer Simulation by Texas Transportation Institute

## What Are the Energy and Air Quality Impacts?

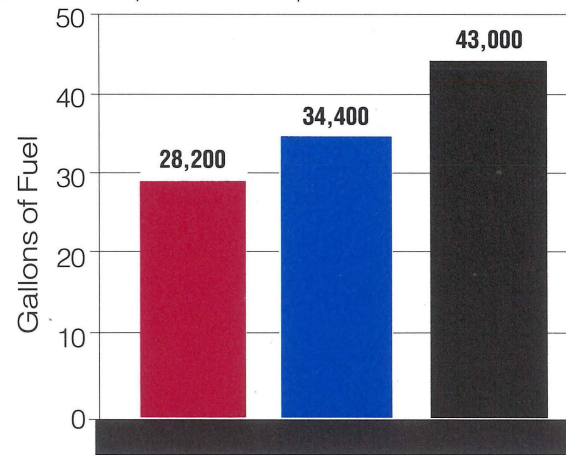
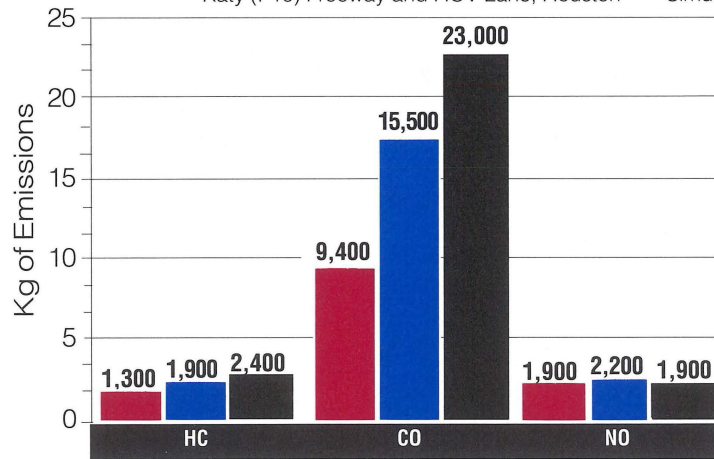
The Houston high-occupancy vehicle lanes have been successful in increasing the average number of persons per vehicle, and the result is positive in terms of both air quality and energy consumption. At the demand levels currently being served, the HOV facility improvement provides favorable impacts when compared to either the alternative of taking no action (building nothing) or to the alternative of only adding more general-purpose, mixed-flow traffic lanes.

## Conclusions

In Houston, high-occupancy vehicle facilities are a part of the regional plan to improve mobility by upgrading transit as well as the street and highway system. Although only half of the planned HOV system is complete, current use indicates these facilities can successfully play their part in improving mobility. In Houston, implementation of the coordinated multi-modal transportation program actually resulted in a 9% decrease in congestion levels between 1984 and 1988.

## Estimated Impacts of HOV Improvements on Air Quality and Energy Consumption

Katy (I-10) Freeway and HOV Lane, Houston • Simulation (6 a.m. to noon) of alternative improvements



## Additional HOV Facility Information

Additional information on the Houston HOV Facility System may be obtained from the following individuals.

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