TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA/TX-92/27+484-14F		

4. Title and Subtitle	5. Report Date
An Assessment of Carpool Utilization of the Katy High-Occupancy Vehicle Lane and the Characteristics of Houston's HOV Lane Users and Nonusers	October 1991
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Diane L. Bullard	Research Report 484-14F
9. Performing Organization Name and Address	10. Work Unit No.
Texas Transportation Institute The Texas A&M University System College Station, Texas 77843-3135	11. Contract or Grant No. Study 2-10-85-484
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Texas Department of Transportation Transportation Planning Division P.O. Box 5051 Austin, Texas 78763	Final: September 1984 - August 1991
	14. Sponsoring Agency Code

15. Supplementary Notes

Research performed in cooperation with DOT, FHWA. Research Study Title: An Evaluation of the Impact of Permitting Carpools to Use the Katy Transitway

16. Abstract

In an effort to address the congestion problem and improve mobility levels within the Houston metropolitan area, the Metropolitan Transit Authority of Harris County and the Texas Department of Transportation have joined together to develop an extensive system of high-occupancy vehicle lanes within the medians of the existing freeway network. Phase I of the first completed HOV lane opened on the Katy Freeway (I-10W) in October 1984. Initially, only authorized buses and vanpools were designated as eligible users of the HOV lane. To encourage increased vehicular utilization of the facility, carpools were allowed to use the HOV lane on a test basis beginning in April 1985. Texas Transportation Institute (TTI) is currently monitoring the impacts associated with permitting carpools to use the HOV lane. In addition, TTI is also engaged in an assessment of public attitudes concerning the HOV lanes being developed in Houston. This assessment is being accomplished through the periodic distribution of survey questionnaires to both HOV lane users and nonusers. This report documents data collected in the Katy Freeway corridor in October 1990, 66 months or 5.5 years after carpool utilization of the Katy HOV Lane began. The 1990 data are compared to similar data collected before carpool utilization was permitted (March 1985) and after carpool utilization was permitted (April 1986, October 1987, October 1988 and October 1989). These comparisons address numerous concerns and provide an indication of the effectiveness of allowing carpools onto the Katy HOV Lane. Also included in this report are summaries of survey data collected along the Katy, North, Northwest and Gulf Freeway/HOV Lane corridors from April 1985 through October 1990. The primary intent of these surveys was to: 1) determine perceptions of HOV lane utilization; 2) identify why commuters have chosen their present travel mode; and 3) assess attitudes and impacts pertaining to the HOV lanes. Demographic data and data concerning general travel characteristics were also collected.

17. Key Words	18. Distribution Statement
High-Occupancy Vehicle Lanes, Transitways, Busways, Authorized Vehicle Lanes, Priority Treatment, Carpools, Vanpools, Transit	No restrictions; this report is available from: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161

19. Security Classif. (of the report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	207	

Form DOT F 1700.7 (8-69)

AN ASSESSMENT OF CARPOOL UTILIZATION OF THE KATY HIGH-OCCUPANCY VEHICLE LANE AND THE CHARACTERISTICS OF HOUSTON'S HOV LANE USERS AND NONUSERS

Research Report 484-14F

by

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An Evaluation of the Impact of Permitting Carpools to Use the Katy Transitway

Research Study 2-10-85-484

Sponsored by the
Metropolitan Transit Authority of Harris County
and the
Texas Department of Transportation
in Cooperation with the
U.S. Department of Transportation, Federal Highway Administration

Texas Transportation Institute
The Texas A&M University System
College Station, Texas 77843-3135

October 1991

METRIC (SI*) CONVERSION FACTORS

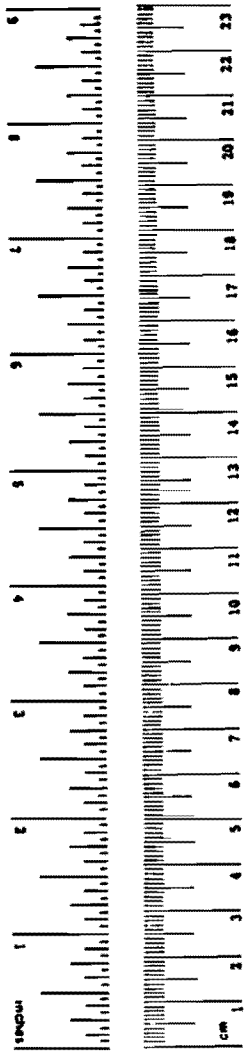
APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	2.54	millimetres	mm
ft	feet	0.3048	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km
AREA				
in^2	square inches	645.2	millimetres squared	mm^2
ft^2	square feet	0.0929	metres squared	m^2
yd^2	square yards	0.836	metres squared	m^2
mi^2	square miles	2.59	kilometres squared	km^2
ac	acres	0.395	hectares	ha
MASS (weight)				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
VOLUME				
fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft^3	cubic feet	0.0328	metres cubed	m^3
yd^3	cubic yards	0.0765	metres cubed	m^3

NOTE: Volumes greater than 1000 L shall be shown in m^3.

TEMPERATURE (exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
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m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi
AREA				
mm^2	millimetres squared	0.0016	square inches	in^2
m^2	metres squared	10.764	square feet	ft^2
km^2	kilometres squared	0.39	square miles	mi^2
ha	hectores (10 000 m^2)	2.53	acres	ac
MASS (weight)				
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams (1 000 kg)	1.103	short tons	T
VOLUME				
mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m^3	metres cubed	35.315	cubic feet	ft^3
m^3	metres cubed	1.308	cubic yards	yd^3

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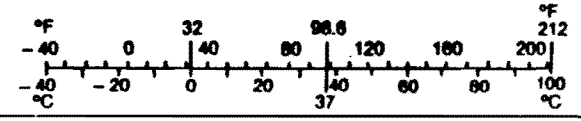

These factors conform to the requirement of FHWA Order 5190.1A.

* SI is the symbol for the International System of Measurements

ABSTRACT

In an effort to address the congestion problem and improve mobility levels within the Houston metropolitan area, the Metropolitan Transit Authority of Harris County and the Texas Department of Transportation have joined together to develop an extensive system of high-occupancy vehicle lanes within the medians of the existing freeway network. Phase I of the first completed HOV lane opened on the Katy Freeway (I-10W) in October 1984. Initially, only authorized buses and vanpools were designated as eligible users of the HOV lane. To encourage increased vehicular utilization of the facility, carpools were allowed to use the HOV lane on a test basis beginning in April 1985. Texas Transportation Institute (TTI) is currently monitoring the impacts associated with permitting carpools to use the HOV lane. In addition, TTI is also engaged in an assessment of public attitudes concerning the HOV lanes being developed in Houston. This assessment is being accomplished through the periodic distribution of survey questionnaires to both HOV lane users and nonusers. This report documents data collected in the Katy Freeway corridor in October 1990, 66 months or 5.5 years after carpool utilization of the Katy HOV Lane began. The 1990 data are compared to similar data collected before carpool utilization was permitted (March 1985) and after carpool utilization was permitted (April 1986, October 1987, October 1988 and October 1989). These comparisons address numerous concerns and provide an indication of the effectiveness of allowing carpools onto the Katy HOV Lane. Also included in this report are summaries of survey data collected along the Katy, North, Northwest and Gulf Freeway/HOV Lane corridors from April 1985 through October 1990. The primary intent of these surveys was to: 1) determine perceptions of HOV lane utilization; 2) identify why commuters have chosen their present travel mode; and 3) assess attitudes and impacts pertaining to the HOV lanes. Demographic data and data concerning general travel characteristics were also collected.

Key Words: High-Occupancy Vehicle Lanes, Transitways, Busways, Authorized Vehicle Lanes, Priority Treatment, Carpools, Vanpools, Transit, HOV Lane User Survey

IMPLEMENTATION STATEMENT

In October 1984, the first completed high-occupancy vehicle (HOV) lane was opened on the Katy Freeway (I-10) in west Houston. In November 1984, the I-45 North Freeway contraflow lane was converted to a permanent, barrier-separated HOV lane within the median of the North Freeway; in 1988, additional HOV facilities were opened on the Northwest (US 290) and Gulf (I-45) Freeways. Since these are the first such facilities to operate in Texas, many of the operating procedures and approaches are being developed through experience. A key issue that is being addressed is the types of vehicles that will be permitted to access the HOV lanes.

Texas Transportation Institute (TTI) is currently monitoring the impacts associated with permitting carpools to utilize the HOV lanes. In addition, TTI is also engaged in the assessment of public attitudes concerning these facilities. This assessment is being undertaken to assist the Metropolitan Transit Authority of Harris County and the Texas Department of Transportation in the implementation and operation of future HOV lane improvements.

DISCLAIMER

The contents of this report reflect the views of the author who is responsible for the opinions, findings and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Metropolitan Transit Authority of Harris County, the Texas Department of Transportation, or the Federal Highway Administration. This report does not constitute a standard, specification or regulation and is not intended for construction, bidding or permit purposes.

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SUMMARY

Within the Houston metropolitan area, a major effort is currently underway to develop an extensive system of high-occupancy vehicle (HOV) lanes in the medians of the existing freeway network. Sometimes referred to locally as transitways, the implementation of these facilities is a joint venture between the Metropolitan Transit Authority of Harris County (METRO) and the Texas Department of Transportation (TxDOT). As of October 1990, approximately 46 miles of barrier-protected HOV lanes in four freeway corridors were in operation.

Since their inception, one of the major operating issues regarding the HOV lanes has been the designation of eligible user groups. When the first HOV lane opened in October 1984 on the Katy Freeway, its use was limited to authorized buses and 8+ vanpools. To encourage increased vehicular utilization of the facility, authorized 4+ carpools were allowed onto the lane in April 1985. Approximately 6 months later, authorized 3+ carpools were allowed to use the HOV lane. In August 1986, the occupancy requirement for eligible vehicles was lowered to 2 persons, and all authorization requirements were eliminated. By the fall of 1988, a.m. peak hour vehicle volumes on the HOV lane were approaching (or exceeding) capacity and were beginning to have a negative effect on the operation of the facility. As a result, in October 1988, the minimum occupancy requirement was raised to 3 persons between the hours of 6:45 a.m. and 8:15 a.m.; 2-person carpools were still permitted on the lane during all other operating hours. In May 1990, the 3+ occupancy restriction was modified to include the hours between 6:45 a.m. and 8:00 a.m.

Because the Katy was the first of several HOV facilities being developed in Houston and the first to permit carpool use, a special study was sponsored by both METRO and TxDOT to evaluate the impacts associated with allowing carpools to use the HOV lane. As part of this

evaluation, major data collection efforts have been undertaken on several occasions. Included in each data collection effort were both traffic operations data collection activities designed to measure the effects of carpool usage on HOV lane/freeway operations and survey data collection efforts designed to assess public attitudes concerning the HOV lane.

In addition to the carpool traffic operations and survey efforts performed in the Katy corridor, surveys in the North, Northwest and Gulf HOV Lane corridors were also undertaken. These surveys were designed to complement other research efforts by collecting pertinent information on HOV lane user and nonuser characteristics, travel patterns and attitudes toward the HOV lanes.

This report presents the results of an evaluation of the effects of allowing carpools to use the Katy HOV Lane and the results of HOV lane user and nonuser surveys. Data in the report cover the time period from April 1985 through October 1990.

Trends in HOV Lane Utilization

In October 1990, over 9,700 persons used the Katy HOV Lane during the a.m. peak period; over 10,700 persons used the lane during the p.m. peak period. Almost 25,000 persons were transported on the HOV lane daily; 65% of these persons were moved in carpools. Of those carpoolers, approximately 12% have been attracted from other HOV lane modes (buses or vans). Carpools comprise approximately 96% of the vehicles using the HOV lane.

In October 1990, 957 vehicles used the HOV lane during the a.m. peak hour; 1,333 vehicles traveled the facility during the p.m. peak hour. The p.m. peak hour value is very close to the capacity of the Katy HOV Lane, which is estimated to be approximately 1,500 vehicle per hour. Allowing carpools to use the lane has increased the frequency of HOV lane vehicle breakdowns; over 95% of the disabled vehicles on the HOV lane are carpools.

Criteria for Judging the Success of the Carpool Experiment

Prior to allowing carpools onto the HOV lane, both METRO and TxDOT agreed upon a set of criteria to be used in evaluating the success of the carpool experiment. Each criterion is addressed in this report. Table 6 in the report outlines the criteria and the basis for that evaluation. Each criterion can be rated as "highly successful," "successful," "unsuccessful," or "highly unsuccessful." In the overall evaluation, the individual criterion are weighted, and a numerical value is assigned; "highly successful" is considered to be a 4, with "highly unsuccessful" considered to be a 1. Thus, a 2.5 overall rating would represent a neutral evaluation, midway between "successful" and "unsuccessful."

Data that permit analyses of the success of the carpool experiment have been collected on 6 separate occasions between April 1986 and October 1990. As carpool volumes have fluctuated on the HOV lane, so has the degree of success of the carpool experiment. In April 1986, the experiment was rated a 2.63 (between "successful" and "unsuccessful"); in April 1987 and October 1987, the experiment was rated a 3.2 and 3.3, respectively (between "successful" and "highly successful"). By October 1989, the experiment was rated a 3.0 ("successful") and by October 1990, it was rated a 3.2 (between "successful" and "highly successful"). The data for these 6 analyses are summarized in Table S-1. More detailed data for the October 1990 analyses are shown in Table S-2.

The October 1988 42-month "after carpools" evaluation showed that the past success of the carpool experiment had increased HOV lane travel times, thereby reducing the overall success of the facility. This travel time increase was a result of the vehicular volumes approaching or exceeding the capacity of the lane, thereby reducing the travel speeds and trip reliability. The October 1989 54-month evaluation showed that implementing the 3+ carpool occupancy requirement during a portion of the a.m. peak period had lowered the volume of vehicles using the facility. This, in turn, resulted in improved HOV lane travel speeds and trip reliability. Results of the October 1990 66-month evaluation show that carpool volumes have increased over 1989 volumes but not to the point of adversely affecting the operation of the facility. Consequently, the overall effectiveness of the carpool experiment has also improved.

Table S-1.
Overall Evaluation of the Katy HOV Lane Carpool Experiment, 66 Months After Carpools Were Allowed onto the HOV Lane

Criterion	Relative Weighting	Conclusion Pertaining to Experiment	Relevant Data
1. Change in Person Movement on the HOV Lane Directly Attributable to Carpooling	25%	"Highly Successful"	Carpools move 55% of total a.m. peak period person movement and 65% of the total daily person movement.
2. Nonuser Perception of Katy HOV Lane Utilization	30%	"Unsuccessful"	Less than 50% of the nonusers feel the HOV lane is sufficiently utilized.
3. Change in Travel Time on the HOV Lane	20%	"Highly Successful"	Average HOV lane speeds have increased by 1 mph.
4. Change in Delay to Mixed-Flow Traffic	15%	"Highly Successful"	Mixed-flow speeds have increased slightly.
5. Increase in Frequency of HOV Lane Breakdowns	5%	"Highly Unsuccessful"	Approximately 95% of HOV lane vehicle breakdowns are carpools. Approximately 10 breakdowns occur per week.
6. Increase in Authorization and Enforcement Costs	5%	"Successful"	Marginal increase in costs due to carpools has not been substantial.
TOTAL	100%	"Successful"	

Table S-2.
Overall Evaluation of the Katy HOV Lane Carpool Experiment, 1985-1990

Criterion	Relative Weighting	Conclusion Pertaining to Experiment					
		Apr 1986	Apr 1987	Oct 1987	Oct 1988	Oct 1989	Oct 1990
1. Change in Person Movement on the HOV Lane Directly Attributable to Carpooling	25%	2.5	4	4	4	4	4
2. Nonuser Perception of Katy HOV Lane Utilization	30%	1	2	3	3	2	2
3. Change in Travel Time on the HOV Lane	20%	4	4	3	1	3	4
4. Change in Delay to Mixed-Flow Traffic	15%	4	4	4	4	4	4
5. Increase in Frequency of HOV Lane Breakdowns	5%	3	1	1	1	1	1
6. Increase in Authorization and Enforcement Costs	5%	3	3	3	3	3	3
TOTAL	100%	2.63	3.20	3.30	2.90	3.00	3.20

Scoring:
1 = "Highly Unsuccessful"
2 = "Unsuccessful"
3 = "Successful"
4 = "Highly Successful"

Because of the success of allowing carpools on the Katy HOV Lane, the decision was made to allow 2+ carpools on the Gulf and Northwest HOV Lanes when they became operational in May 1988 and August 1988, respectively. Carpools were also allowed on the North HOV Lane beginning in June 1990.

Surveys of HOV Lane Users and Nonusers

HOV lane user and nonuser surveys have been performed on six occasions in the Katy Freeway corridor since 1985. HOV lane user and nonuser surveys have also been performed on several occasions in the North, Northwest and Gulf Freeway corridors in recent years. Some of the more important data from these surveys (that which relate to trip destination, choice of commuting mode and perceptions and attitudes concerning the HOV lanes) are summarized on the following pages.

Trip Destinations

As indicated in Table S-3, the vast majority of the a.m. peak period HOV lane bus trips are destined to downtown Houston. This is not surprising since essentially all bus service in the HOV lane corridors is oriented toward serving trips to the downtown area. In addition, more than three-fourths of the North and Gulf HOV Lane carpoolers and vanpoolers are also destined to the downtown area. Again, these relatively high percentages are not surprising as both the North and Gulf HOV Lanes terminate in the downtown area.

By contrast, the location and configuration of both the Katy and the Northwest HOV Lanes permit convenient access to/from the Post Oak-Galleria area, Greenway Plaza, the Texas Medical Center and other locations without having to travel through the downtown area first. Consequently, 47% of the Katy HOV Lane poolers and 60% of the Northwest HOV Lane poolers are destined to locations other than downtown Houston. In addition, 69% to 83% of the

motorists traveling the Katy, North, Northwest and Gulf Freeway mainlanes are destined to locations other than downtown Houston.

Table S-3.
Trip Destinations of Katy, North, Northwest and Gulf Freeway Corridor Commuters, 1985-1990

A.M. Trip Destination	Katy Corridor					
	1985	1986	1987	1988	1989	1990
HOV Lane Bus Users	(n=357)	(n=575)	(n=632)	(n=776)	(n=641)	(n=671)
Downtown	96%	95%	94%	97%	94%	93%
Galleria	—	0%	1%	0%	2%	2%
Greenway Plaza	0%	0%	1%	0%	0%	1%
Texas Medical Center	1%	1%	1%	1%	1%	1%
Other	3%	4%	3%	2%	3%	3%
HOV Lane Carpoolers/Vanpoolers	(n=95)	(n=123)	(n=597)	(n=404)	(n=567)	(n=708)
Downtown	57%	55%	39%	42%	39%	53%
Galleria	12%	14%	22%	19%	20%	13%
Greenway Plaza	6%	2%	6%	3%	5%	5%
Texas Medical Center	4%	5%	5%	5%	5%	6%
Other	21%	24%	28%	31%	31%	23%
Freeway Motorists	(n=302)	(n=728)	(n=1418)	(n=1056)	(n=1126)	(n=186)
Downtown	38%	33%	23%	30%	28%	26%
Galleria	24%	10%	13%	12%	13%	14%
Greenway Plaza	8%	4%	5%	4%	4%	3%
Texas Medical Center	9%	3%	3%	4%	4%	4%
Other	21%	50%	56%	50%	51%	53%

A.M. Trip Destinations	North Corridor		Northwest Corridor			Gulf Corridor	
	1986	1990	1988	1989	1990	1988	1989
HOV Lane Bus Users	(n=1252)	(n=988)	—	(n=215)	(n=293)	—	(n=464)
Downtown	94%	91%	—	97%	95%	—	86%
Galleria	1%	0%	—	—	2%	—	1%
Greenway Plaza	2%	0%	—	—	0%	—	0%
Texas Medical Center	1%	6%	—	2%	1%	—	5%
Other	2%	3%	—	1%	2%	—	8%
HOV Lane Carpoolers/Vanpoolers	(n=199)[1]	(n=189)	(n=268)	(n=250)	(n=235)	(n=123)	(n=122)
Downtown	61%	76%	38%	41%	40%	81%	78%
Galleria	7%	3%	26%	22%	28%	9%	6%
Greenway Plaza	8%	2%	4%	4%	5%	3%	1%
Texas Medical Center	4%	7%	4%	2%	6%	—	4%
Other	20%	12%	28%	31%	21%	7%	11%
Freeway Motorists	(n=421)	(n=648)	—	(n=1118)	(n=727)	—	(n=648)
Downtown	31%	31%	—	17%	17%	—	28%
Galleria	7%	9%	—	19%	19%	—	9%
Greenway Plaza	4%	4%	—	4%	6%	—	5%
Texas Medical Center	4%	7%	—	4%	3%	—	9%
Other	54%	49%	—	56%	55%	—	49%

[1] *Includes responses from vanpoolers only; carpools were not allowed on the HOV lane at the time of this survey.*

Mode Choice Considerations

Previous Mode of Travel

One of the primary reasons for developing HOV facilities is to influence mode choice decisions. By offering an attractive alternative to traveling in heavily congested freeway mainlanes, it is hoped that the HOV lanes will: 1) encourage drivers of single-occupant vehicles on the freeway to switch to a higher-occupancy vehicle on the HOV lane; and 2) encourage commuters making new trips in the corridor to choose an HOV mode. In looking at the previous travel modes of the HOV lane users, significant percentages reported that they either drove alone or did not make the trip prior to using the HOV lane (Table S-4).

A review of the most current survey data from each corridor shows that in the Katy Freeway corridor, 36% of the HOV lane bus users and 57% of the carpoolers and vanpoolers previously drove alone. An additional 32% of the bus riders and 4% of the carpoolers and vanpoolers did not make the trip prior to using the HOV lane.

In the North Freeway corridor, 39% of the HOV lane bus users and 42% of the carpoolers and vanpoolers drove alone prior to using a high-occupancy vehicle. In addition, 28% of the bus trips were new trips made on the HOV lane. Similar trends were also observed in the other two freeway corridors. A total of 67% of the bus users and 57% of the carpoolers/vanpoolers using the Northwest HOV Lane either previously drove alone or didn't make the trip prior to using the HOV lane; and 56% of the bus riders and 45% of the poolers on the Gulf HOV Lane previously drove alone or didn't make the trip.

A major concern of permitting carpools (particularly 2-person carpools) to use the HOV lanes was that they would simply attract riders from buses or vans, thereby moving no more people, but requiring many more vehicles. Such does not appear to be the case; however, recent data show that only 6% of the Gulf HOV Lane carpoolers, 8% of the Northwest HOV Lane

Table S-4.
Previous Travel Mode of Katy, North, Northwest and Gulf Freeway Corridor Commuters, 1985-1990

Previous Travel Mode	Katy Corridor					
	1985	1986	1987	1988	1989	1990
HOV Lane Bus Users	(n=355)	(n=573)	(n=630)	(n=771)	(n=631)	(n=665)
Drove alone	24%	35%	34%	38%	37%	36%
Carpool	5%	5%	9%	9%	10%	10%
Vanpool	4%	6%	2%	4%	4%	3%
Bus	54%	34%	33%	21%	20%	19%
Didn't make trip	12%	18%	21%	28%	29%	32%
Other	1%	2%	1%	0%	0%	0%
HOV Lane Carpoolers/Vanpoolers	(n=549)	(n=624)	(n=588)	(n=391)	(n=552)	(n=699)
Drove alone	36%	39%	50%	45%	51%	57%
Carpool	22%	17%	29%	33%	26%	27%
Vanpool	12%	9%	3%	3%	4%	3%
Bus	13%	13%	9%	7%	8%	9%
Didn't make trip	17%	22%	9%	12%	11%	4%
Freeway Motorists[1]	(n=445)	(n=738)	(n=1424)	(n=1053)	(n=1122)	(n=192)
Drove alone	88%	90%	85%	91%	89%	92%
Carpool	8%	6%	12%	8%	9%	5%
Vanpool	1%	1%	0%	0%	0%	—
Other	3%	3%	3%	1%	2%	3%

Previous Travel Mode	North Corridor		Northwest Corridor			Gulf Corridor	
	1986	1990	1988	1989	1990	1988	1989
HOV Lane Bus Users	(n=1240)	(n=979)	—	(n=214)	(n=289)	—	(n=457)
Drove alone	35%	39%	—	46%	46%	—	38%
Carpool	10%	9%	—	9%	6%	—	8%
Vanpool	7%	8%	—	3%	3%	—	6%
Bus	22%	15%	—	21%	24%	—	30%
Didn't make trip	25%	28%	—	18%	21%	—	18%
Other	1%	1%	—	3%	—	—	0%
HOV Lane Carpoolers/Vanpoolers	(n=1622)[2]	(n=178)	(n=239)	(n=242)	(n=225)	(n=97)	(n=117)
Drove alone	30%	42%	34%	43%	53%	28%	40%
Carpool	21%	39%	60%	45%	34%	53%	44%
Vanpool	12%	3%	1%	3%	1%	6%	7%
Bus	14%	15%	4%	4%	8%	5%	4%
Didn't make trip	23%	1%	1%	5%	4%	8%	5%
Freeway Motorists[1]	(n=423)	(n=644)	—	(n=1130)	(n=727)	—	(n=651)
Drove alone	87%	87%	—	85%	87%	—	88%
Carpool	8%	9%	—	13%	9%	—	9%
Vanpool	1%	0%	—	0%	0%	—	0%
Other	4%	4%	—	2%	4%	—	3%

[1] *For the motorists, this is the current mode they normally use.*
[2] *Includes responses from vanpoolers only; carpools were not allowed on the HOV lane at the time of this survey.*

carpoolers, and 9% of the Katy HOV Lane carpoolers formerly used vans or buses on the HOV lanes.

On the North HOV Lane (which opened to carpools in June 1990), 15% of the carpoolers surveyed in 1990 reported they rode a bus prior to carpooling on the HOV lane. This response is consistent with the previous survey conducted in 1986 in which 14% of the vanpoolers stated they had previously commuted by bus prior to vanpooling on the HOV lane. Thus, opening the North HOV Lane to carpools has not greatly increased the number of commuters attracted from other HOV lane modes.

Impact of the HOV Lanes on Mode Choice

From all appearances, the Katy, North, Northwest and Gulf HOV Lanes have had a definite effect on mode choice. While sizable percentages of the HOV lane users indicated that they would be using their current mode even if there were no HOV facilities, more than 30% of the Katy HOV Lane bus users and more than 40% of the carpoolers/vanpoolers said they would *not* (Table S-5).

On the North HOV Lane, 37% of the bus users and 40% of the carpoolers and vanpoolers stated they would not be using their current mode if not for the HOV lane. In addition, 35% of the Northwest HOV Lane bus riders and 39% of the carpoolers and vanpoolers on that lane would not be using their current mode of not for that HOV lane and at least 20% of the Gulf HOV Lane users would not be riding in buses, carpools, or vanpools if not for that facility. Accordingly, it follows that the HOV lanes can be credited with encouraging individuals to switch travel modes.

Table S-5.
Use of Current Mode by HOV Lane Users if HOV Lane Had Not Opened, 1985-1990

Use Current Mode if No HOV Lane	Katy Corridor						
	1985	1986	1987	1988	1989	1990	
HOV Lane Bus Users	(n=356)	(n=575)	(n=629)	(n=773)	(n=641)	(n=670)	
Yes	69%	43%	52%	35%	32%	35%	
No	15%	26%	20%	33%	36%	31%	
Not sure	16%	31%	28%	32%	32%	34%	
HOV Lane Carpoolers/Vanpoolers	(n=551)	(n=633)	(n=588)	(n=398)	(n=559)	(n=702)	
Yes	84%	68%	50%	54%	42%	37%	
No	8%	16%	37%	35%	42%	43%	
Not sure	8%	16%	13%	11%	16%	20%	

Use Current Mode if No HOV Lane	North Corridor		Northwest Corridor			Gulf Corridor	
	1986	1990	1988	1989	1990	1988	1989
HOV Lane Bus Users	(n=1247)	(n=981)	—	(n=215)	(n=291)	—	(n=457)
Yes	23%	33%	—	41%	41%	—	56%
No	41%	37%	—	39%	35%	—	22%
Not sure	36%	30%	—	20%	24%	—	22%
HOV Lane Carpoolers/Vanpoolers	(n=1632)[1]	(n=185)	(n=255)	(n=247)	(n=237)	(n=122)	(n=120)
Yes	43%	48%	70%	52%	45%	75%	68%
No	27%	40%	21%	30%	39%	14%	20%
Not sure	30%	12%	9%	18%	16%	11%	12%

[1] *Includes responses from vanpoolers only; carpools were not allowed on the HOV lane at the time of this survey.*

Perceived HOV Lane Travel Time Savings

One of the primary reasons for implementing the system of HOV lanes is to offer riders of high-occupancy vehicles a travel time advantage and travel time reliability over traveling in the regular freeway lanes. HOV lane users generally do perceive a travel time savings as a result of being able to use a priority lane (Table S-6).

In the Katy and Northwest HOV Lane corridors, the median perceived travel time savings reported by users is 18 minutes in the a.m. and 18 to 20 minutes in the p.m. Median travel time savings perceived by North HOV Lane users is in the range of 15 to 17 minutes in the a.m. and

20 minutes in the p.m.; median travel time savings perceived by Gulf HOV Lane users is somewhat less (10 to 12 minutes in the a.m. and 15 minutes in the p.m.).

Table S-6.
Perceived HOV Lane Travel Time Savings, 1985-1990

Travel Time Savings	Katy Corridor					
	1985	1986	1987	1988	1989	1990
Perceived HOV Lane Travel Time Savings (minutes)						
HOV Lane Bus Users	(n=328)	(n=530)	(n=590)	(n=726)	(n=588)	(n=693)
a.m. (median)	9	15	15	20	20	18
p.m. (median)	13	20	15	20	20	20
HOV Lane Carpoolers/Vanpoolers	(n=505)	(n=588)	(n=592)	(n=394)	(n=565)	(n=639)
a.m. (median)	8	10	20	20	20	20
p.m. (median)	12	17	20	22	20	20
Actual HOV Lane Travel Time Savings (minutes)						
a.m. (6:00-9:30 a.m.)	6.8	3.0	4.4	5.1	7.9	9.4
p.m. (3:30-7:00 p.m.)	5.5	4.0	1.0	2.7	1.1	6.0

Travel Time Savings	North Corridor		Northwest Corridor			Gulf Corridor	
	1986	1990	1988	1989	1990	1988	1989
Perceived HOV Lane Travel Time Savings (minutes)							
HOV Lane Bus Users	(n=1147)	(n=924)	—	(n=185)	(n=280)	—	(n=386)
a.m. (median)	20	15	—	15	18	—	10
p.m. (median)	25	20	—	15	18	—	15
HOV Lane Carpoolers/Vanpoolers	(n=1595)	(n=184)	(n=256)	(n=245)	(n=235)	(n=121)	(n=121)
a.m. (median)	20	17	15	15	20	15	12
p.m. (median)	30	20	15	15	20	15	15
Actual HOV Lane Travel Time Savings (minutes)							
a.m. (6:00-9:30 a.m.)	4.2	3.3	3.1	-4.6	2.4	3.3	3.1
p.m. (3:30-7:00 p.m.)	8.0	0.1	1.3	-5.7	1.8	7.7	-3.1

[1] *Includes responses from vanpoolers only; carpools were not allowed on the HOV lane at the time of this survey.*

Motorists' Attitudes Concerning the HOV Lanes

In both the Katy and North HOV Lane corridors, as utilization of the HOV lanes has increased with time, so has the acceptance of the facilities by freeway motorists (Table S-7);

Table S-7.
Motorists' Attitudes Concerning the HOV Lanes, 1985-1990

Measure of Effectiveness	Katy Freeway						
	1985[1]	1986[2]	4/1987[3]	10/1987[3]	1988[4]	1989[4]	1990[5]
Sufficient Number of Vehicles Utilizing HOV Lane?	(n=451)	(n=742)	(n=948)	(n=1420)	(n=1052)	(n=1123)	(n=192)
Yes	3%	3%	36%	44%	31%	30%	37%
No	90%	92%	55%	42%	55%	53%	45%
Not sure	7%	5%	9%	14%	14%	17%	18%
HOV Lane Vehicle Volumes (A.M. Peak Period)[6]	138	256	2,412	2,854	2,032	2,186	2,635
Sufficient Number of Persons Utilizing HOV Lane?	(n=451)	(n=741)	(n=950)	(n=1426)	(n=1051)	(n=1126)	—
Yes	4%	4%	30%	36%	24%	26%	—
No	85%	86%	58%	46%	58%	54%	—
Not sure	11%	10%	12%	18%	18%	20%	—
HOV Lane Persons Moved (A.M. Peak Period)[6]	2,456	3,156	7,769	8,599	7,210	7,801	9,717
Is the HOV Lane a Good Transportation Improvement?	(n=441)	(n=733)	(n=949)	(n=1423)	(n=1045)	(n=1110)	(n=193)
Yes	41%	36%	56%	64%	64%	66%	71%
No	35%	43%	29%	20%	22%	20%	16%
Not sure	24%	21%	15%	16%	14%	14%	13%

Measure of Effectiveness	North Freeway		Northwest Freeway		Gulf Freeway
	1986[1]	1990[5]	1989[5]	1990[5]	1989[5]
Sufficient Number of Vehicles Utilizing HOV Lane?	(n=418)	(n=641)	(n=1109)	(n=727)	(n=643)
Yes	26%	36%	22%	37%	21%
No	56%	40%	58%	45%	61%
Not sure	18%	24%	20%	18%	18%
HOV Lane Vehicle Volumes (A.M. Peak Period)[6]	393	1,595	1,463	2,099	1,139
Sufficient Number of Persons Utilizing HOV Lane?	(n=422)	(n=645)	(n=1121)	(n=730)	(n=652)
Yes	23%	32%	19%	29%	21%
No	57%	40%	57%	47%	55%
Not sure	20%	28%	24%	24%	24%
HOV Lane Persons Moved (A.M.Peak Period)[6]	6,647	8,512	4,098	5,737	3,956
Is the HOV Lane a Good Transportation Improvement?	(n=417)	(n=647)	(n=1109)	(n=731)	(n=647)
Yes	62%	81%	71%	75%	63%
No	20%	9%	13%	11%	21%
Not sure	18%	10%	16%	14%	16%

[1] *Authorized buses and vanpools (before carpools were allowed).*
[2] *Authorized buses, vanpools and 3+ carpools.*
[3] *2+ vehicles, no authorization.*
[4] *3+ vehicles, no authorization between 6:45 a.m. and 8:15 a.m., 2+ vehicles, no authorization at all other times.*
[5] *3+ vehicles, no authorization between 6:45 a.m. and 8:00 a.m., 2+ vehicles, no authorization at all other times.*
[6] *Source: TTI Research Report 484-12 and TTI HOV Lane vehicle volume and occupancy counts.*

more than one-third of the motorists currently operating in the freeway mainlanes (non HOV lane users) feel there is sufficient vehicular utilization of these HOV lanes to justify the projects. Furthermore, 71% of the Katy Freeway motorists and 81% of the North Freeway motorists feel the HOV lanes in these corridors are good transportation improvements. *These represent the highest percentages of favorable responses received to date regarding this issue.* Thus, it appears that permitting carpools to utilize the Katy and North HOV Lanes has had positive effects on both the actual and perceived utilization of these facilities.

High percentages of motorists traveling the Northwest Freeway also look favorably on the HOV lane; 37% of those surveyed in 1990 felt there was sufficient vehicular utilization of the facility and 75% stated the HOV lane is a good transportation improvement. In the Gulf Freeway corridor, although a smaller percentage (about one-fifth) of the freeway motorists feel there is sufficient utilization of the HOV lane to justify the project, 63% nevertheless feel the facility is a good transportation improvement. (Note: Carpools have been permitted on the Northwest and Gulf HOV Lanes since these facilities opened in 1988.)

CHAPTER 1
INTRODUCTION

In an attempt to address a serious traffic congestion problem and provide improved mobility within the Houston metropolitan area, a variety of measures are currently being undertaken. One such measure is the implementation of an extensive system of high-occupancy vehicle (HOV) lanes in the medians of the existing freeway network. The system of HOV lanes being developed in Houston is a joint project between the Metropolitan Transit Authority of Harris County (METRO) and the Texas Department of Transportation (TxDOT). Approximately 96 miles of HOV lanes will ultimately be constructed on six of the city's freeways. By the end of 1990, just over 46 miles of HOV lanes on four separate freeways were operational (Figure 1). These lanes are typically located in the median of the freeway, are approximately 20 feet wide, are one-lane reversible, and are separated from the mixed-flow traffic lanes by concrete median barriers.

The intent of the Houston HOV lane system is to move more people through congested travel corridors in fewer vehicles. This is being accomplished by offering riders of high-occupancy vehicles access to special, limited access lanes designed to provide both a travel time advantage and travel time reliability over traveling in the regular freeway lanes.

Fundamental to the success of Houston's HOV lane project is the types of vehicles being permitted to use the special lanes. Based on the highly successful operation of the I-45 North Freeway contraflow lane in north Houston, only authorized buses and 8+ vanpools (truly high-occupancy vehicles) were initially envisioned to be eligible users of the HOV lane system.

Consequently, when the first HOV lane opened in October 1984 on the Katy Freeway, its use was also limited to authorized buses and 8+ vanpools. However, under this operating strategy, fewer than 150 vehicles per peak period traveled the HOV lane during its initial months

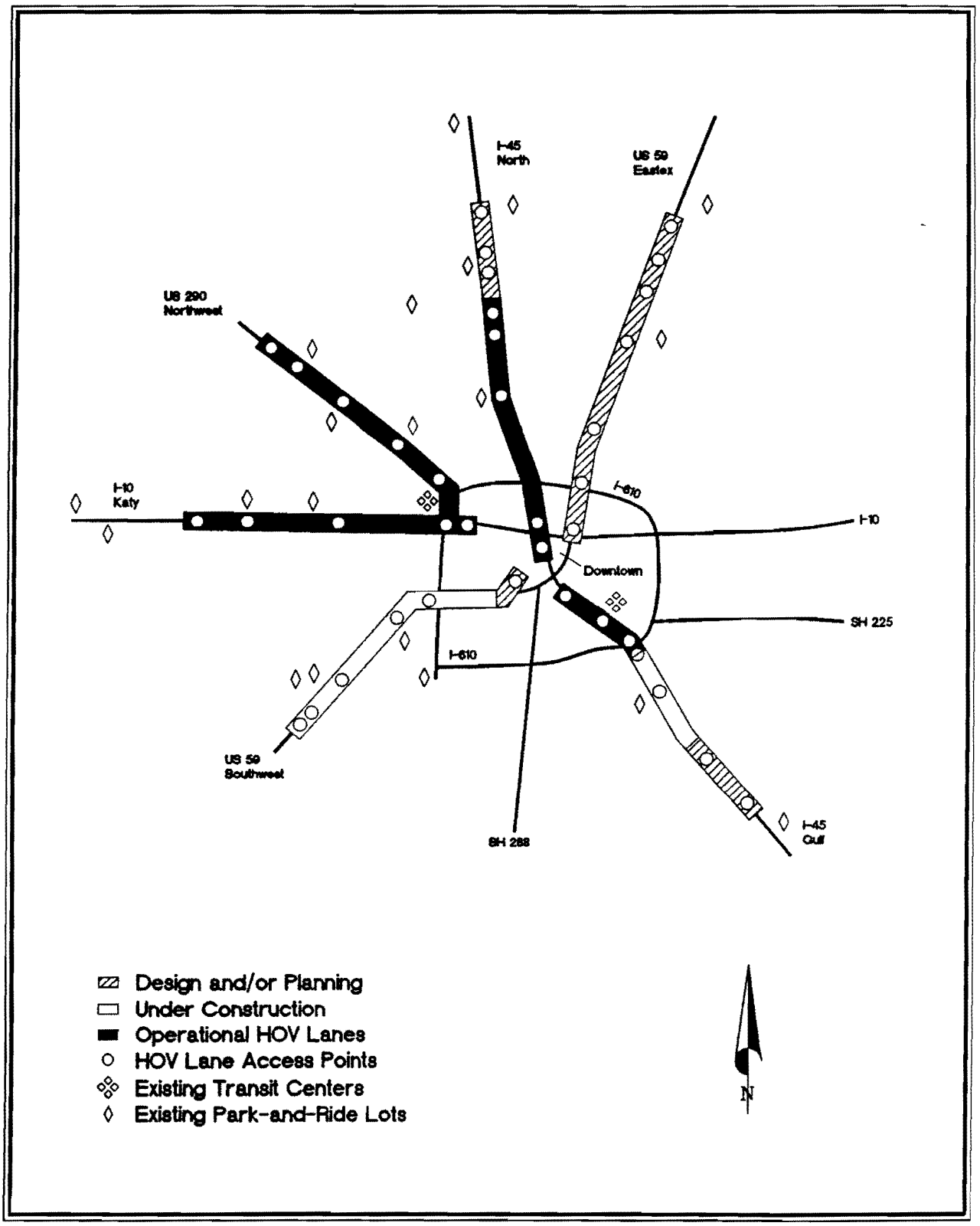


Figure 1. Status of the Houston HOV Lane Development, October 1990

of operation, giving the facility the appearance of being underutilized. To encourage increased vehicular utilization, authorized 4+ carpools were allowed to begin using the lane on a test basis beginning April 1, 1985. Although permitting carpools represented a means of increasing the volume of vehicles operating on the HOV lane, a number of operational concerns were associated with such an action. For example:

- Permitting carpools might simply attract commuters away from buses or vans, thereby moving no more people but requiring many more vehicles;

- The introduction of carpools might result in vehicle volumes that exceed the capacity of the HOV lane, thereby adversely affecting the level-of-service that is so essential to successful HOV lane operation;

- If carpool volumes were restricted sufficiently to maintain a high level-of-service on the HOV lane, the increase in the number of vehicles using the facility might not be great enough to change the perception that the lane is underutilized;

- Increased carpool volumes might result in an increase in vehicle breakdowns, thereby reducing the travel time reliability attribute of the HOV lane; and

- Other safety related concerns might develop.

Because the Katy was the first of several HOV facilities being implemented in Houston, and the first to permit carpool use, a special study was sponsored by both METRO and TxDOT to evaluate the impacts associated with allowing carpools to use the HOV lane. As part of this evaluation, major data collection efforts have been undertaken on several occasions. The first data collection effort was conducted in March 1985 *before* carpools were allowed to use the HOV lane. Data were also collected on five separate occasions *after* the introduction of carpools onto the HOV lane. Included in each data collection effort were both traffic operations data collection activities designed to measure the impacts of carpool usage on HOV lane/freeway

operations and survey data collection efforts designed to assess public attitudes concerning the HOV lane.

In addition to the carpool traffic operations data collection and survey efforts being performed periodically on the Katy HOV Lane, surveys in the North, Northwest, and Gulf HOV Lane corridors were also undertaken. These surveys were designed to complement other research efforts by collecting pertinent information on HOV lane user and nonuser characteristics, travel patterns and attitudes toward the HOV lanes.

In the North Freeway corridor, the North HOV Lane replaced the North Freeway contraflow lane in November 1984. As was the case on the Katy, when the North HOV Lane opened, its usage was restricted to authorized buses and 8+ vanpools (these were also the same operating restrictions as were present during the operation of the contraflow lane). Due to freeway and additional HOV lane construction within the corridor, however, carpools were not allowed on the North HOV Lane until June 1990.

Following three years of successful operation of the Katy HOV Lane with carpools, METRO and TxDOT agreed to permit carpools on the Gulf and Northwest HOV Lanes when they became operational in May 1988 and August 1988, respectively.

Previous Research Reports

A number of TTI research reports have addressed carpool utilization of the Katy HOV Lane and characteristics of HOV lane users and nonusers (1-17). This report is the fourteenth and final research report prepared as part of this study. In this report, the information collected has been combined and evaluated to identify the effects of the presence of carpools on the operation of the Katy HOV Lane and Katy Freeway, 66 months (5.5 years) after carpools were first allowed onto the lane. This report also contains summaries of survey data collected in the Katy, North, Northwest and Gulf HOV Lane corridors. This study addresses the period from October 29, 1984 through October 19, 1990. No attempt is made in this report to include all

the relevant material presented in the previous reports. Some pertinent data from previous reports are used in this report to draw conclusions concerning the impacts of allowing carpools onto the Katy HOV Lane.

Organization of this Report

Following this introductory chapter, Chapter 2 describes trends in utilization of the Katy HOV Lane. Chapter 3 delineates the criteria used in evaluating the "success" of the HOV lane carpool experiment and addresses each criterion individually. Methodologies used for the surveys of HOV lane users and nonusers in the Katy, North, Northwest and Gulf Freeway corridors are outlined in Chapter 4; results of the various surveys are summarized in Chapters 5 through 7. Study conclusions are presented in Chapter 8.

CHAPTER 2
KATY HOV LANE UTILIZATION

The Katy HOV Lane began initial operation on October 29, 1984. Since that date, the lane has experienced a number of modifications in its geometrics and operations. Significant modifications include those which have affected the HOV lane length, the types of vehicles permitted to use the facility, and hours of operation. Table 1 outlines the historical development of the HOV lane.

Background on the Katy HOV Lane Carpool Utilization

Only authorized buses and 8+ passenger vanpools were allowed to use the Katy HOV Lane during the first 5 months of operation (October 1984 through March 1985). In order to become authorized, vehicles had to have:

- Certified drivers;
- Valid Texas vehicle inspection stickers no more than six months old;
- The minimum state insurance coverage;
- Passed a visual inspection of the vehicle by METRO; and
- Driver(s) with some familiarity with the HOV lane geometrics before actually driving in the lane.

Once these requirements were satisfied, the vehicles were issued authorization decals to be displayed on the front and rear windshields. Only vehicles which displayed the special authorization permits were permitted access to the HOV lane by METRO transit police.

Table 1.
Katy HOV Lane Milestone Dates
(October 1984 - October 1990)

Date	Operational Length	Vehicles and Occupancy Requirement to Use HOV Lane	Operating Hours
10/29/84	HOV lane opened from Post Oak to Gessner (4.7 miles)	Authorized buses and 8+ vanpools	M-F: 5:45 a.m. - 9:30 a.m. inbound; 3:30 p.m. - 7:00 p.m. outbound
4/1/85	Same	Authorized buses, vanpools and 4+ carpools; 4+ for authorization and use	Same
5/2/85	HOV lane extended from Gessner to West Belt (total length - 6.4 miles)	Same	Same
7/29/85	Same	Authorized buses, vanpools and 4+ carpools; 4+ for authorization and 3+ for use	Same
11/4/85[1]	Same	Authorized buses, vanpools and 3+ carpools; 3+ for authorization and use	Same
8/11/86	Same	All 2+ vehicles; no authorization requirements	M-F: 5:45 a.m. - 11:00 a.m. inbound; 2:00 p.m. - 7:00 p.m. outbound
6/29/87	HOV lane extended from West Belt to SH 6 (total length - 11.5 miles)	Same	M-F: 5:45 a.m. - 11:00 a.m. inbound; 2:00 p.m. - 8:00 p.m. outbound
7/25/88	Same	Same	M-F: 4:00 a.m. - 1:00 p.m. inbound; 2:00 p.m. - 10:00 p.m. outbound
10/17/88	Same	All 3+ vehicles, no authorization between 6:45 a.m. and 8:15 a.m. weekdays; 2+ vehicles all other operating hours	Same
10/1/89	Same	Same	M-F: 4:00 a.m. - 1:00 p.m. inbound; 2:00 p.m. - 10:00 p.m. outbound Sat: 4:00 a.m. - 10:00 p.m. outbound Sun: 4:00 a.m. - 10:00 p.m. inbound
1/9/90	HOV lane extended from Post Oak to Washington (total length - 12.33 miles)	Same	Same
5/23/90	Same	All 3+ vehicles, no authorization between 6:45 a.m. and 8:00 a.m. weekdays; 2+ vehicles all other operating hours	Same

[1] *Official date of 3+ authorization; actual 3+ authorization began in 9/85.*

Access locations: Post Oak - flyover ramp (used from 10/29/84 to present).
Gessner - intermediate slip ramp (used from 10/29/84 to present).
West Belt - terminal slip ramp (used from 5/2/85 to 6/29/87).
Addicks Park-and-Ride - elevated "T" ramp (used from 6/29/87 to present).
SH 6 - terminal slip ramp (used from 6/29/87 to present).
Washington - terminal slip ramp (used from 1/9/90 to present).

Although this operating strategy offered the potential to move large numbers of persons, it did not result in moving large numbers of vehicles, and the public developed the perception that the HOV lane was underutilized. In an effort to address this perception problem, METRO and TxDOT agreed to permit carpools to use the HOV lane on a trial basis. Beginning April 1, 1985, authorized automobiles carrying four or more persons could access the lane. The authorization procedures for carpools were identical to those described previously for vanpools. If an authorized carpool had fewer than four persons on any given day due to a carpool member's work schedule, travel, illness or vacation, it was not permitted onto the HOV lane that day. This carpool definition was structured to ensure maximum passenger occupancy of vehicles traveling on the lane. Another factor contributing to the 4+ occupancy requirement was a concern that a 3+ designation could possible generate a sufficient vehicular volume to exceed the capacity of the HOV lane, creating unacceptable operating conditions.

During the first month the Katy HOV Lane was open to carpools, approximately 30 carpools became authorized to use the facility. However, of these 30, an average of only 5 carpools actually used the lane during a typical peak period. Although the number of carpools observed using the HOV lane doubled between April and July 1985, the absolute demand levels remained extremely low. Consequently, effective July 29, 1985, carpools with a minimum of three passengers were permitted access to the HOV lane; four or more registered passengers were still required to obtain authorization, however. Less than a month after the carpool occupancy requirement requirements were reduced, only nine more carpool trips were being made on the HOV lane each day.

As a result, a decision was made to reduce the minimum authorization requirement from four persons to three persons. Officially, the authorization of 3+ carpools was not to commence until November 4, 1985. However, as early as September 1985, 3+ carpools were being authorized by METRO and permitted on the HOV lane. Even with the 3+ designation, however, peak-hour carpool volumes remained less than 100 vehicles per hour and the perception of underutilization remained. Consequently, in August 1986, the minimum passenger requirement for eligible vehicles was lowered to 2 persons, and all authorization requirements

were eliminated. Following this change, there was an immediate increase in carpool volumes. Carpool volumes continued to climb in 1987 and 1988.

By the fall of 1988, traffic volumes on the HOV lane during the a.m. peak hour (7:00 a.m. - 8:00 a.m.) increased to levels exceeding 1,500 vehicles per hour, normally assumed to be the capacity of the facility. This dramatic increase was beginning to have a negative effect on the facility's a.m. inbound operation (lower travel speeds, increased travel times and unreliable travel times). To relieve this peak-hour congestion, the minimum carpool occupancy requirement was raised from 2 to 3 persons between 6:45 a.m. and 8:15 a.m. effective October 17, 1988; 2-person carpools were still permitted on the facility in the mornings *before* 6:45 a.m. or *after* 8:15 a.m. and during the entire p.m. operating period. On May 23, 1990, the morning 3+ occupancy requirement was modified to include the hours between 6:45 a.m. and 8:00 a.m.

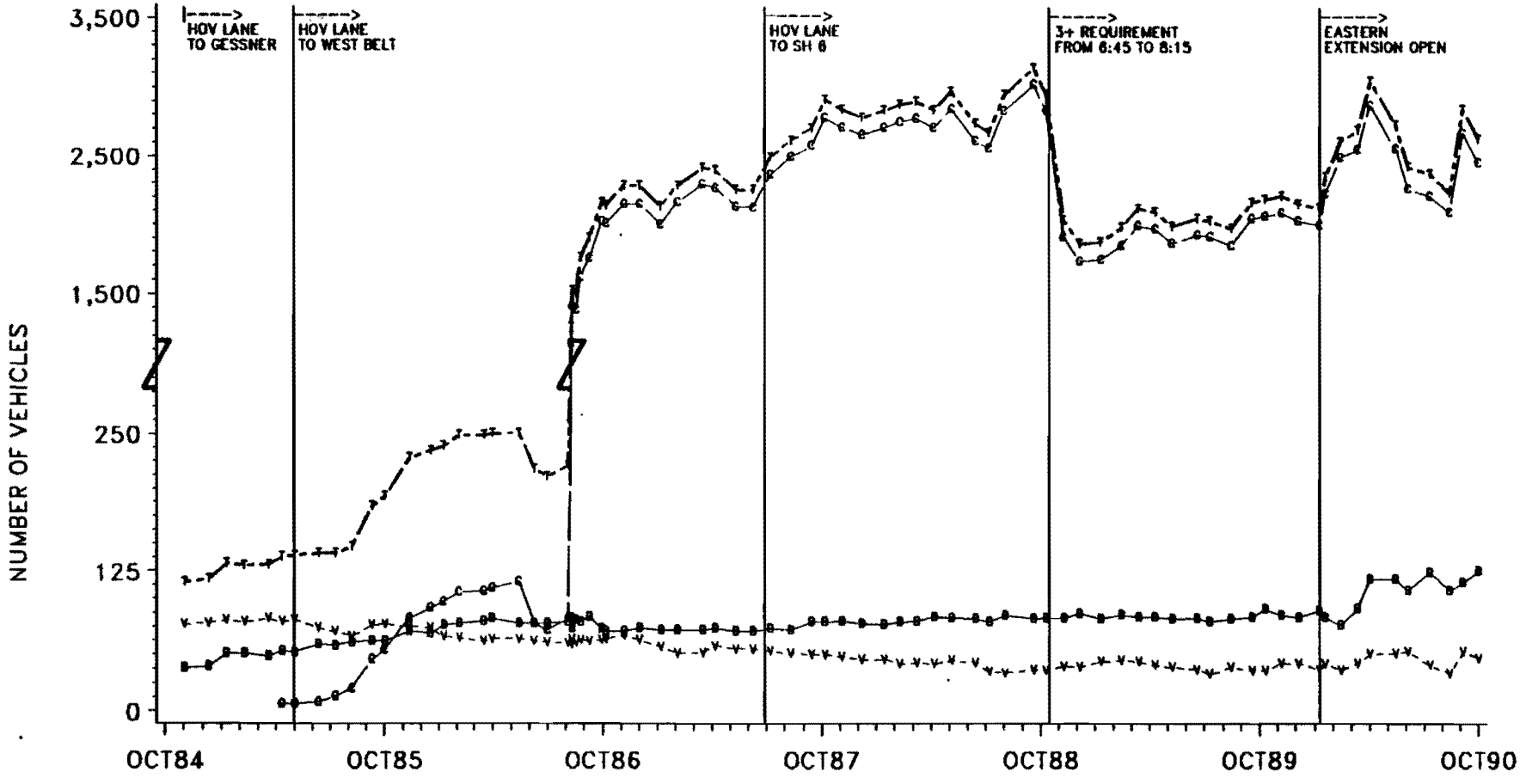
Trends in Katy HOV Lane Utilization

Trends in average peak-period utilization of the Katy HOV Lane are illustrated in Figures 2 through 5. In October 1990, on a daily basis (approximately two years after the a.m. 3+ carpool restriction was implemented):

- Buses accounted for 3% of the vehicles using the HOV lane and moved 32% of the people (buses had moved 26% of the people in October 1988 just before the 3+ restriction was implemented);

- Vanpools represented 1% of the vehicles on the HOV lane and carried 3% of the people (unchanged from October 1988); and

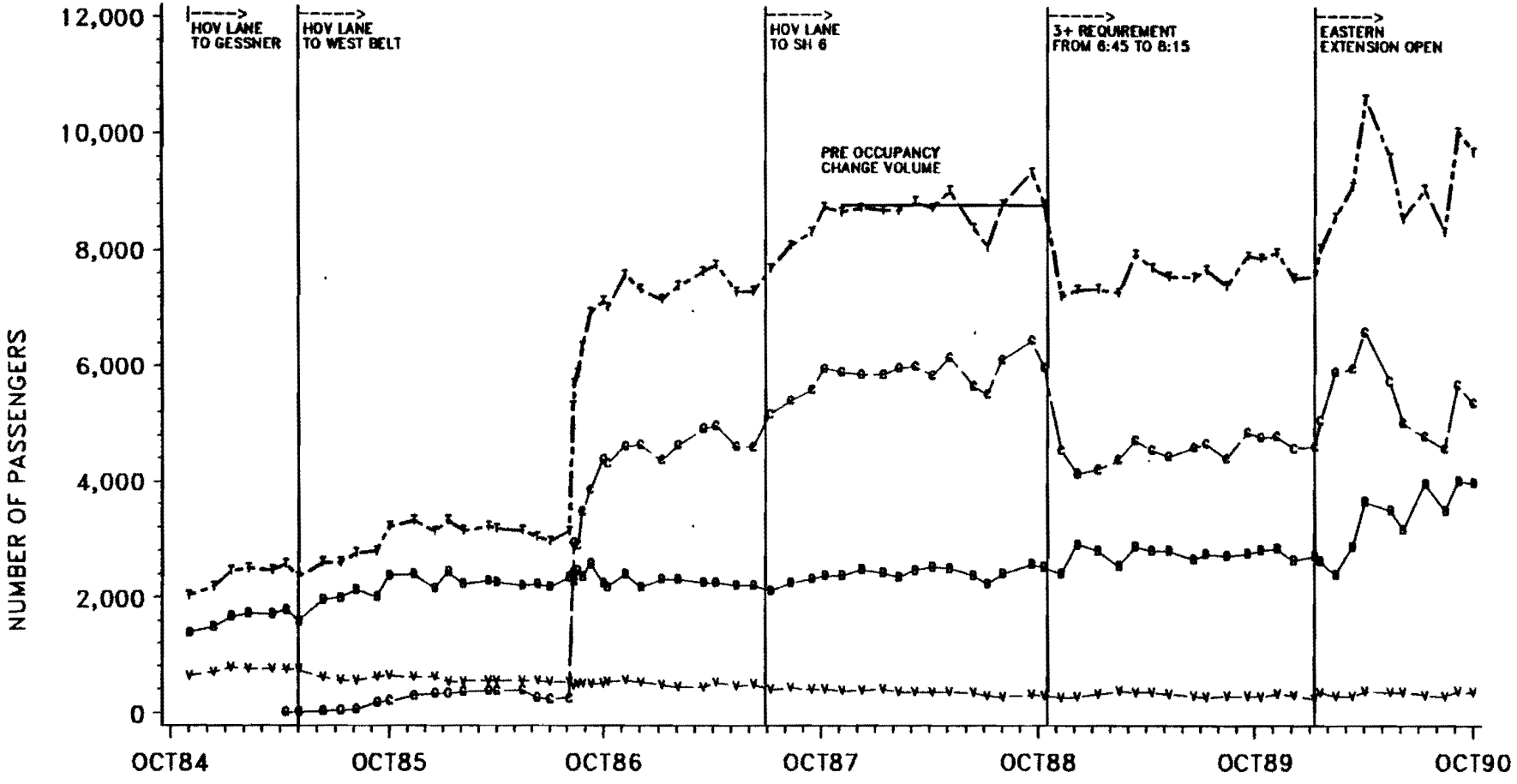
- Carpools comprised 96% of the total HOV lane vehicles and moved 65% of the people (down from 71% in October 1988).



KATY HOV LANE PHASE 1, POST OAK TO GESSNER (4.7 MI.), OPENED OCTOBER 29, 1984
HOV LANE EXTENSION FROM GESSNER TO WEST BELT (1.7 MI.) OPENED MAY 2, 1985
OFF-PEAK, UNAUTHORIZED & 2+ CARPOOL OPERATION BEGAN AUGUST 11, 1986
HOV LANE EXTENSION FROM WEST BELT TO SH 6 (5.0 MI.) OPENED JUNE 29,1987
3+ CARPOOL REQUIREMENT FROM 6:45 TO 8:15 A.M. IMPLEMENTED OCTOBER 17, 1988 (MODIFIED TO 6:45 TO 8:00 A.M. MAY 23, 1990)
HOV LANE EASTERN EXTENSION (1.17 MI.) OPENED JANUARY 9, 1990
PEAK PERIOD IS 6:00 - 9:30 A.M.
DATA COLLECTED BETWEEN GESSNER AND POST OAK
SOURCE : TEXAS TRANSPORTATION INSTITUTE

LEGEND : T = TOTAL HOV VEHICLES
B = TOTAL BUSES
V = TOTAL VANPOOLS
C = TOTAL CARPOOLS

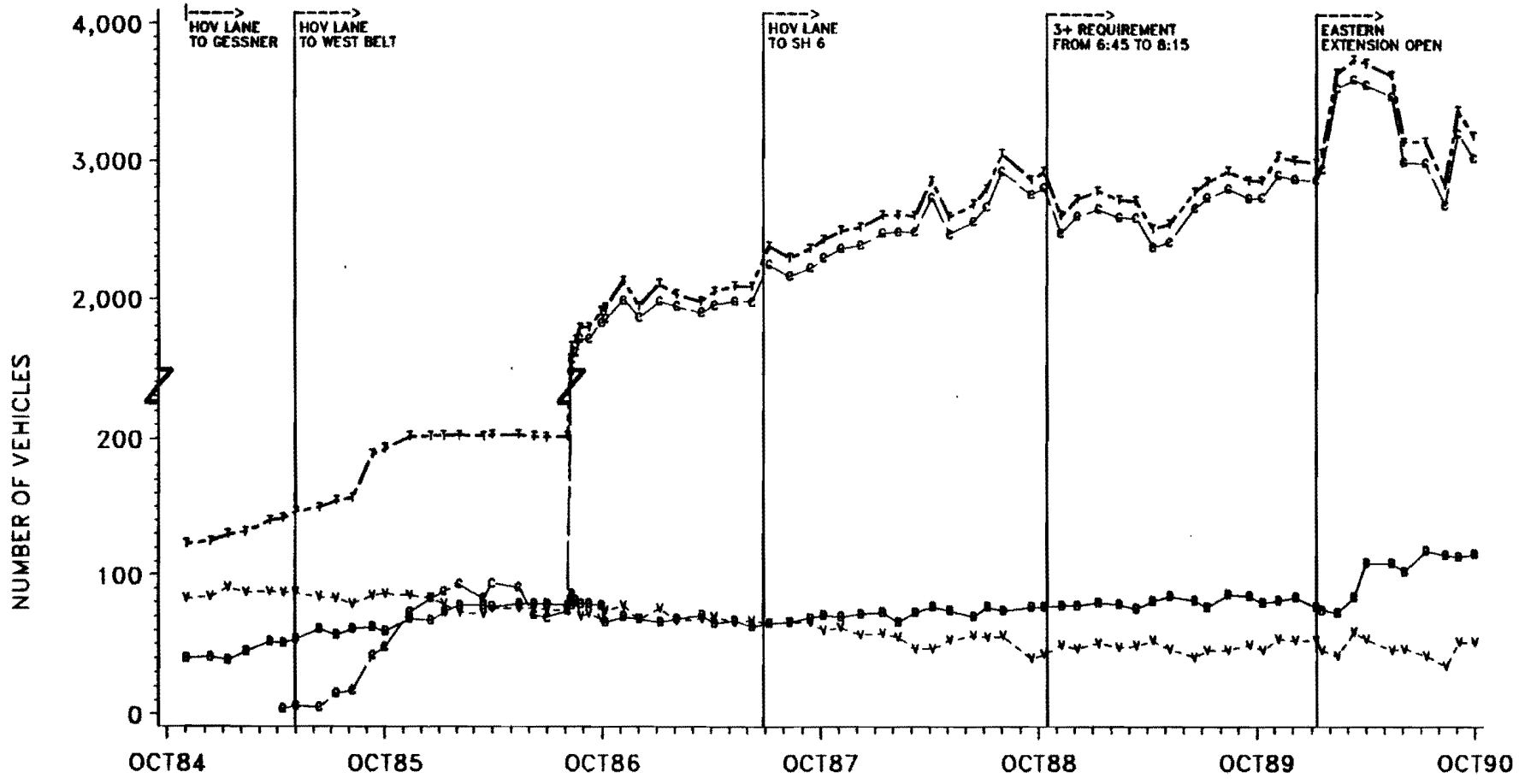
Figure 2. A.M. Peak Period Katy HOV Lane Vehicle Utilization



KATY HOV LANE PHASE 1, POST OAK TO GESSNER (4.7 MI.), OPENED OCTOBER 29, 1984
HOV LANE EXTENSION FROM GESSNER TO WEST BELT (1.7 MI.) OPENED MAY 2, 1985
OFF-PEAK, UNAUTHORIZED & 2+ CARPOOL OPERATION BEGAN AUGUST 11, 1986
HOV LANE EXTENSION FROM WEST BELT TO SH 6 (3.0 MI.) OPENED JUNE 29,1987
3+ CARPOOL REQUIREMENT FROM 6:45 TO 8:15 A.M. IMPLEMENTED OCTOBER 17, 1988 (MODIFIED TO 6:45 TO 8:00 A.M. MAY 23, 1990)
HOV LANE EASTERN EXTENSION (1.17 MI.) OPENED JANUARY 9, 1990
PEAK PERIOD IS 6:00 – 9:30 A.M.
DATA COLLECTED BETWEEN GESSNER AND POST OAK
SOURCE : TEXAS TRANSPORTATION INSTITUTE

LEGEND : T = TOTAL HOV PASSENGERS
B = TOTAL BUS PASSENGERS
V = TOTAL VANPOOLERS
C = TOTAL CARPOOLERS

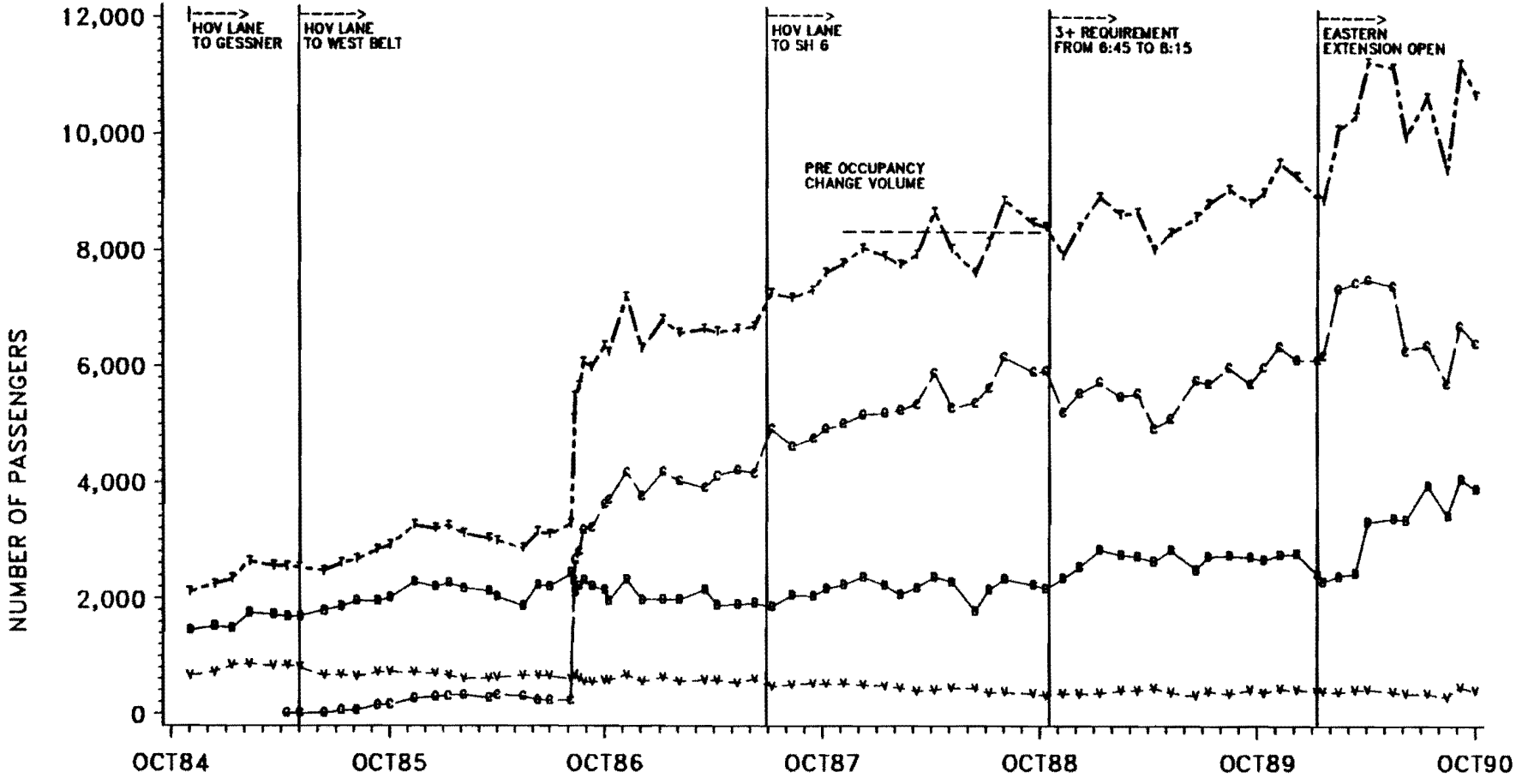
Figure 3. A.M. Peak Period Katy HOV Lane Person Movement



KATY HOV LANE PHASE 1, POST OAK TO GESSNER (4.7 MI.), OPENED OCTOBER 29, 1984
HOV LANE EXTENSION FROM GESSNER TO WEST BELT (1.7 MI.) OPENED MAY 2, 1985
OFF-PEAK, UNAUTHORIZED & 2+ CARPOOL OPERATION BEGAN AUGUST 11, 1986
HOV LANE EXTENSION FROM WEST BELT TO SH 6 (5.0 MI.) OPENED JUNE 29,1987
HOV LANE EASTERN EXTENSION (1.17 MI.) OPENED JANUARY 9, 1990
PEAK PERIOD IS 3:30 - 7:00 P.M.
DATA COLLECTED BETWEEN GESSNER AND POST OAK
SOURCE : TEXAS TRANSPORTATION INSTITUTE

LEGEND : T = TOTAL HOV VEHICLES
B = TOTAL BUSES
V = TOTAL VANPOOLS
C = TOTAL CARPOOLS

Figure 4. P.M. Peak Period Katy HOV Lane Vehicle Utilization



KATY HOV LANE PHASE 1, POST OAK TO GESSNER (4.7 MI.), OPENED OCTOBER 29, 1984
HOV LANE EXTENSION FROM GESSNER TO WEST BELT (1.7 MI.) OPENED MAY 2, 1985
OFF-PEAK, UNAUTHORIZED & 2+ CARPOOL OPERATION BEGAN AUGUST 11, 1986
HOV LANE EXTENSION FROM WEST BELT TO SH 6 (5.0 MI.) OPENED JUNE 29,1987
HOV LANE EASTERN EXTENSION (1.17 MI.) OPENED JANUARY 9, 1990
PEAK PERIOD IS 3:30 – 7:00 P.M.
DATA COLLECTED BETWEEN GESSNER AND POST OAK
SOURCE : TEXAS TRANSPORTATION INSTITUTE

LEGEND : T = TOTAL HOV PASSENGERS
B = TOTAL BUS PASSENGERS
V = TOTAL VANPOOLERS
C = TOTAL CARPOOLERS

Figure 5. P.M. Peak Period Katy HOV Lane Person Movement

Thus, carpools became (and have continued to remain) the dominant mode of HOV lane person movement since unauthorized 2+ vehicles were allowed to use the facility.

Data pertaining to daily HOV lane utilization by mode are summarized in Table 2. Since carpools were introduced to the HOV lane, bus passenger volumes have increased by 129% and vanpool passenger volumes have decreased by 52%. The vanpool decline appears to be more a function of the downturn in the Houston economy than it is the introduction of carpools; this conclusion is supported subsequently where the previous mode of travel is documented for HOV lane carpoolers.

Table 2.
Trends in Daily Utilization of the Katy HOV Lane

HOV Lane Vehicle Type	Volume							Percent Change	
	11/84[1]	3/85[2]	4/86[3]	10/87[4]	10/88[5]	10/89[6]	10/90	3/85 to 10/90	10/89 to 10/90
Buses									
Vehicles	78	100	160	156	166	171	242	+142%	+42%
Passengers	2,860	3,450	4,302	4,685	4,830	5,505	7,885	+129%	+43%
Vanpools									
Vehicles	160	170	140	112	79	82	99	-42%	+21%
Passengers	1,304	1,596	1,180	942	623	653	764	-52%	+17%
Carpools									
Vehicles	0	0	204	5,466	6,227	5,579	7,744	——	+39%
Passengers	0	0	706	11,716	13,042	12,393	16,300	——	+32%
Total									
Vehicles	238	270	504	5,734	6,472	5,832	8,085	+2894%	+39%
Passengers	4,164	5,046	6,188	17,343	18,495	18,551	24,949	+394%	+34%

[1] *First full month of HOV lane operation.*
[2] *Month before carpools were allowed onto the HOV lane.*
[3] *Data from 12-month evaluation report (TTI Research Report 484-3).*
[4] *Data from 30-month evaluation report (TTI Research Report 484-7).*
[5] *Data from 42-month evaluation report (TTI Research Report 484-11).*
[6] *Data from 54-month evaluation report (TTI Research Report 484-13).*
Source: Texas Transportation Institute counts.

An overall assessment of trend data in the Katy corridor is shown in Table 3. This table compares conditions in the corridor prior to implementation of the HOV lane (1984) with conditions in the corridor during 1987, 1988, 1989, 1990 and 1991. As noted in this table, the

HOV lane has been successful in increasing the total person throughput and average vehicle occupancy even with the a.m. 3+ occupancy restriction.

Table 3.
Comparison of Travel Conditions in the Katy Freeway Corridor Before and After HOV Lane Implementation, A.M. Peak Period, Peak Direction

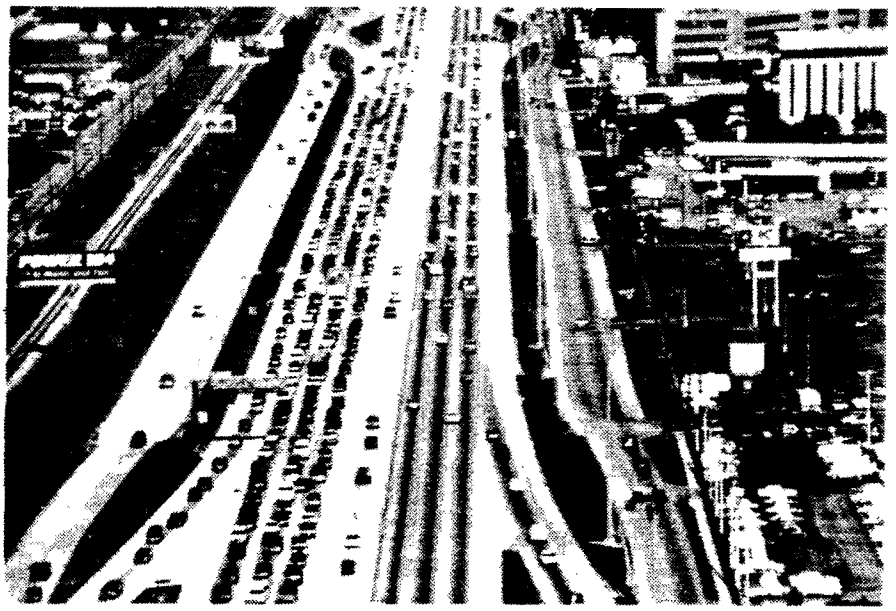
Type of Data	"Representative Value"				
	1981[1]	1987[2]	1988[3]	1989[4]	1990[5]
HOV Lane Data					
Person Movement					
Peak Hour	—	4,252	4,569	3,316	4,406
Peak Period	—	8,369	9,341	7,523	11,445
Total Daily	—	16,737	19,078	18,352	21,960
Vehicle Volumes					
Peak Hour	—	1,364	1,531	950	1,034
Peak Period	—	2,719	3,146	2,155	3,386
Accident Rate (Accidents/MVM)	—	0.96	1.06	1.12	1.37
Vehicle Breakdowns (VMT/Breakdown)	—	29,000	37,570	34,253	35,424
Violation Rate	—	1%	1%	14%	19%
Freeway Data					
Peak-Period Freeway Vehicle Volume	12,750	14,222	14,839	17,660	16,869
Peak-Period Freeway Person Volume	15,655	15,073	15,761	19,280	18,129
Peak-Period Freeway Vehicle Occupancy	1.23	1.06	1.06	1.11	1.05
Peak-Period Operating Speed in mph (West Belt to Wirt)	27	27	22	32	35
Accident Rate (Accidents/MVM)	1.34	1.34	1.22	1.34	1.28
Combined Freeway and HOV Lane Data					
Person Movement					
Peak Hour	5,100	9,183	8,566	9,446	10,175
Peak Period	15,655	23,442	25,102	26,803	29,574
Peak-Hour Vehicle Occupancy	1.26	2.55	1.60	1.46	1.56
Peak-Period Vehicle Occupancy	1.23	1.38	1.40	1.35	1.46
Peak-Period Carpool Vehicle Volume	1,570	3,300	3,541	2,968	3,376
Total Peak-Period Vehicle Volume	12,750	16,941	17,985	19,815	20,255
Transit Data					
Vehicles Parked in Park-and-Ride Lots	575	1,250	1,530	1,873	2,073
Peak-Period Bus Trips	32	90	82	84	124
Peak-Period Bus Passengers	900	2,400	2,585	2,645	4,057

[1] *Represents typical pre-HOV lane conditions.*
[2] *Represents typical HOV lane conditions during 2+ carpool operation.*
[3] *Represents typical HOV lane conditions prior to morning 3+ carpool restriction (September 1988).*
[4] *Represents typical HOV lane conditions approximately one year after morning 3+ carpool restriction.*
[5] *Represents typical HOV lane conditions approximately two years after morning 3+ carpool restriction.*
Note: The a.m. peak hour extends from 7:00 a.m. to 8:00 a.m.; the a.m. peak period extends from 6:00 a.m. to 9:30 a.m.
MVM = Million Vehicle Miles
VMT = Vehicle Miles Traveled
Source: Texas Transportation Institute data collection.

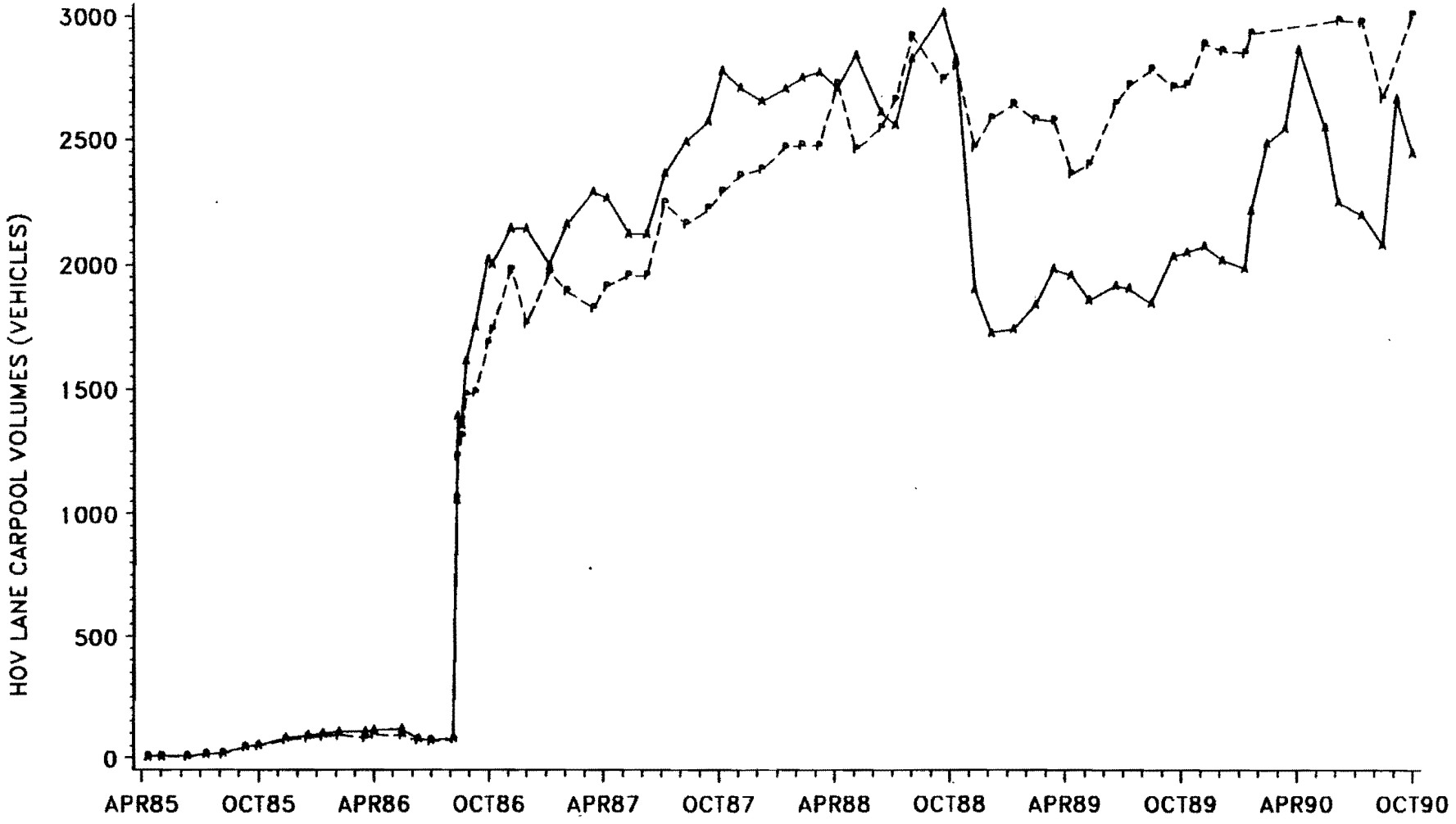
Trends in Carpool Utilization of the Katy HOV Lane and Selected Other HOV Projects

Trends in peak hour and peak period carpool utilization of the Katy HOV Lane are shown in Figures 6 and 7. As shown in these figures, carpool utilization of the Katy HOV Lane was extremely low between April 1985 and August 1986. However, once the carpool definition was modified to include all 2+ vehicles with no authorization, utilization skyrocketed. As to be expected, a.m. carpool utilization of the HOV lane dropped immediately following the implementation of the 3+ occupancy requirement between 6:45 a.m. and 8:15 a.m. (October 17, 1988). Afternoon carpool demand also declined somewhat when the 3+ occupancy requirement went into effect. This would suggest that some commuters (formerly traveling in 2-person carpools) were no longer carpooling since they could not use the HOV lane in both the morning and the afternoon. Other carpools appear to be using the HOV lane in the afternoons only, as evidenced by the comparatively high afternoon carpool demand.

As illustrated in Figure 8, since the time 2+ carpools were permitted to use the HOV lane, carpools have consistently represented approximately 95% of the total vehicular volume and between 50% and 70% of the total HOV lane person volume.



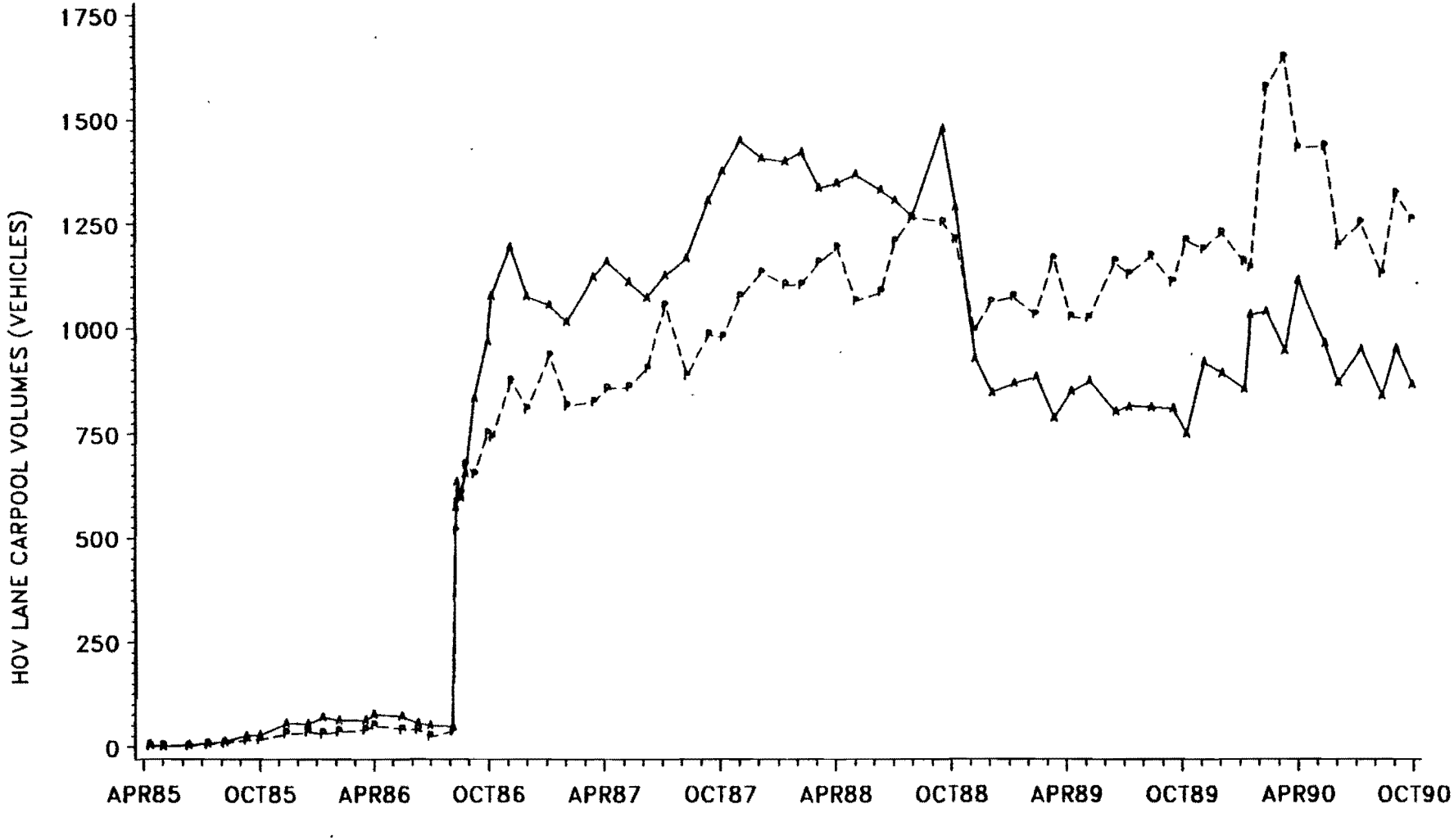
Katy HOV Lane, Houston



AUTHORIZED 4+ CARPOOLS ALLOWED ON HOV LANE, APRIL 1, 1985
AUTHORIZED 3+ CARPOOLS ALLOWED ON HOV LANE, SEPTEMBER, 1985
2+ CARPOOLS WITH NO AUTHORIZATION ALLOWED ON HOV LANE, AUGUST 1986
3+ CARPOOL REQUIREMENT FROM 6:45 :45 TO 8:15 A.M. IMPLEMENTED OCTOBER 17, 1988 (MODIFIED TO 6:45 TO 8:00 MAY 3, 1990)
DATA COLLECTED BETWEEN GESSNER AND POST OAK
PEAK PERIOD(S) ARE 6:00-9:30 A.M. & 3:30-7:00 P.M.
SOURCE : TEXAS TRANSPORTATION INSTITUTE

LEGEND : A = A.M. PEAK PERIOD
P = P.M. PEAK PERIOD

Figure 6. Peak Period Katy HOV Lane Carpool Utilization



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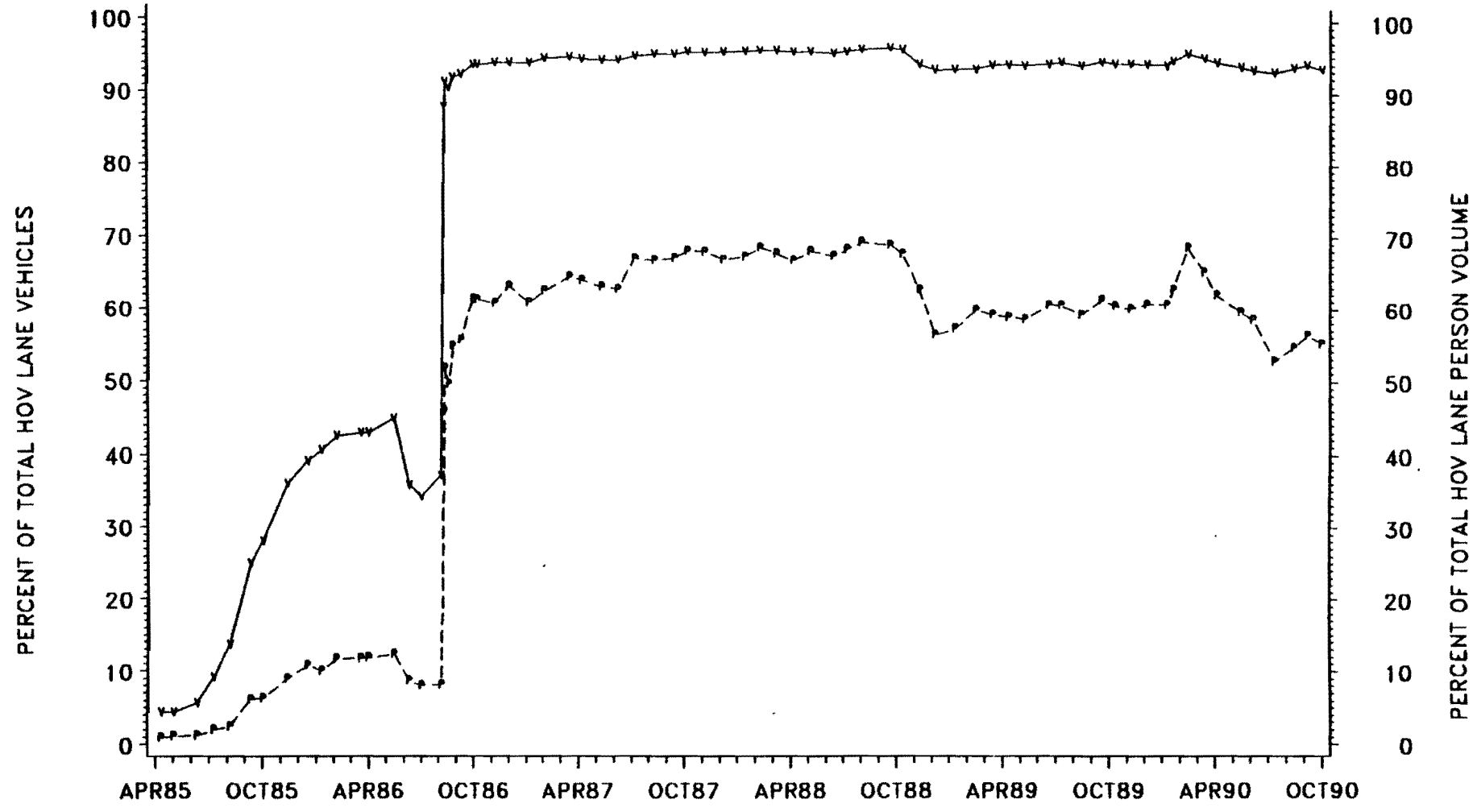
DATA COLLECTED BETWEEN GESSNER AND POST OAK
SOURCE : TEXAS TRANSPORTATION INSTITUTE

LEGEND : A = A.M. PEAK HOUR
P = P.M. PEAK HOUR

Figure 7. Peak Hour Katy HOV Lane Carpool Utilization



KATY HOV LANE PHASE 1, POST OAK TO GESSNER (4.7 MI.), OPENED OCTOBER 29, 1984
HOV LANE EXTENSION FROM GESSNER TO WEST BELT (1.7 MI.) OPENED MAY 2, 1985
OFF-PEAK, UNAUTHORIZED & 2+ CARPOOL OPERATION BEGAN AUGUST 11, 1986
HOV LANE EXTENSION FROM WEST BELT TO SH 8 (5.0 MI.) OPENED JUNE 29,1987
3+ CARPOOL REQUIREMENT FROM 6:45 TO 8:15 A.M. IMPLEMENTED OCTOBER 17, 1988 (MODIFIED TO 6:45 TO 9:00 MAY 3, 1990)
DATA COLLECTED BETWEEN GESSNER AND POST OAK 8:00 TO 9:30 A.M.
SOURCE : TEXAS TRANSPORTATION INSTITUTE

LEGEND : V = TOTAL VEHICLES
P = TOTAL PERSONS

Figure 8. Katy HOV Lane Carpools as a Percent of Total HOV Lane Travel, A.M. Peak Period

Peak-Hour Carpool Volumes

A.M. peak-hour carpool volumes for selected freeway HOV lanes in the United States are presented in Table 4. Typically, the highest utilization of an HOV facility will occur during the a.m. peak hour. Such is not the case on the Katy HOV Lane, however, due to the a.m. 3+ occupancy restriction. Therefore, for comparative purposes, p.m. peak-hour carpool volumes on the Katy HOV Lane are also included in Table 4. As to be expected, the p.m. peak-hour carpool vehicle volume is 42% higher than the a.m. peak-hour volume. The Katy HOV Lane, at approximately 1,300 carpools during the p.m. peak hour, is presently one of the better used single-lane facilities.

The high peak-hour volumes experienced on some HOV lanes have made it necessary to determine an appropriate capacity level. A consensus of the agencies involved in operating freeway HOV lanes is that the capacity of these lanes is somewhere in the range of 1,000 to 1,500 vehicles per hour per lane (TTI Research Report 484-3). As evaluated in TTI Research Report 484-6, it appears that 1,500 vehicles per hour is representative of the capacity of the Katy HOV Lane.

By the fall of 1988, a.m. peak-hour HOV lane volumes were approaching and sometimes exceeding 1,500 vehicles per hour, resulting in lower HOV lane travel speeds, increased travel times and unreliable travel times. Consequently, the morning 3+ occupancy requirement was implemented, and vehicular demand has been reduced to a level below capacity. Detailed analyses of the impacts of this change are presented in TTI Research Reports 1146-1 and 1146-2.

Increase in Carpooling Due to HOV Lane Implementation

Typically, allowing carpools to use an HOV facility results in an increase in the total volume of carpools in the freeway corridor. Following the introduction of 2+ carpools, this has also occurred in the Katy Freeway corridor.

Table 4.
A.M. Peak-Hour HOV Lane Carpool Ridership and Vehicle Volumes for Selected U.S. HOV Facilities

HOV Facility	Number of Lanes	Carpool Definition	A.M. Peak Hour Carpools			
			Vehicles[1]	As a % of Total HOV Vehicles	Persons	As a % of Total HOV Person Trips
Exclusive Facilities, Freeway Right-of-Way						
Houston, TX						
Katy (I-10W) - a.m.	1	2+/3+[2]	895[3]	94%	2,242[3]	51%
Katy (I-10W) - p.m.	1	2+	1,273[3]	95%	2,724[3]	57%
North (I-45N)	1	2+	765	92%	1,859	42%
Northwest (US 290)	1	2+	1,127	98%	2,334	74%
Gulf (I-45S)	1	2+	713	97%	1,537	67%
Los Angeles, CA						
San Bernardino Freeway	1	3+	1,374	95%	4,352	61%
Minneapolis, MN						
I-394	1	2+	430	97%	942	67%
Pittsburgh, PA						
I-279	2	3+	147	92%	498	51%
San Diego, CA						
I-15	2	2+	1,259	99%	2,818	88%
Washington, D.C.						
I-395	2	3+	2,314	93%	9,483	63%
I-66	2	3+	618	98%	2,278	85%
Concurrent Flow Facilities						
Los Angeles/Orange Co., CA						
Rt. 55 Commuter Lane	1	2+	1,295	99%	2,687	98%
I-405 Commuter Lane	1	2+	1,625	99%	3,705	97%
Rt. 91 Commuter Lane	1	2+	1,294	100%	3,112	100%
Miami, FL						
I-95	1	2+	1,300	99%	2,460	86%
San Francisco, CA						
US 101	1	2+	678	92%	1,490	43%
Seattle, WA						
I-90	1	3+	127	79%	229	15%
SR 520	1	3+	210	79%	498	14%
I-5	1	2+/3+[4]	466	88%	1,105	30%
I-405	1	2+	193	99%	435	96%
Wash., D.C./Northern VA						
I-95	1	3+	1,242	97%	5,336	81%

[1] *Includes autos in HOV lane in violation of HOV occupancy requirements.*
[2] *3+ between 6:45 a.m. and 8:00 a.m. weekdays; 2+ during all other operating hours.*
[3] *October 1990 data.*
[4] *Different segments of the I-5 HOV Lane have different occupancy requirements.*
Source: TTI data collection, TTI Research Report 925-1, "A Description of High-Occupancy Vehicle Facilities in North America."

Extensive carpool data have been collected in the Katy corridor since 1983. Some of these data are summarized in Figures 9 and 10. It appears that, particularly since carpools were allowed onto the HOV lane, the increase in carpooling has been substantial.

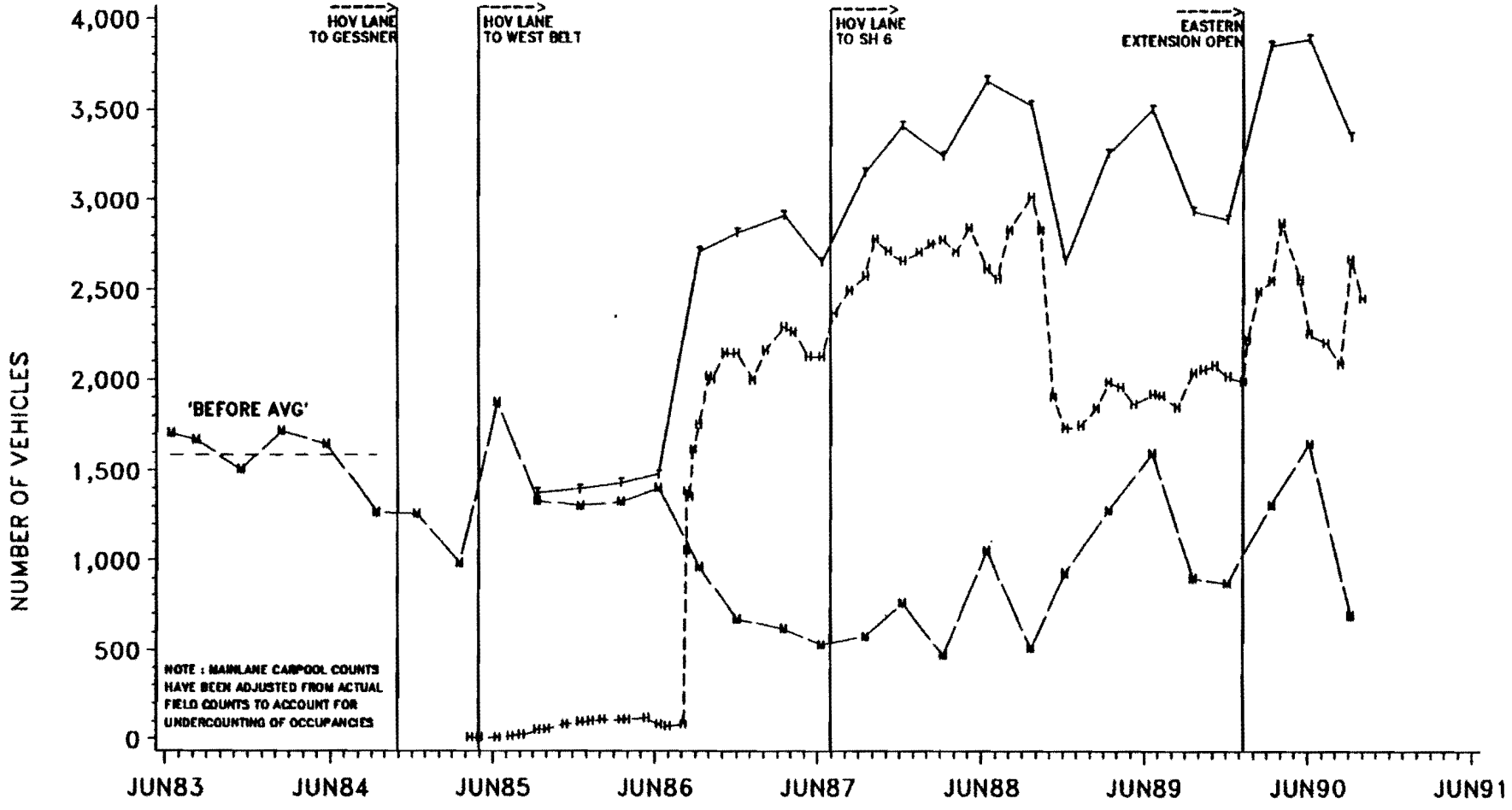
As shown in below, two years after implementation of the 3+ occupancy restriction during a portion of the morning peak period, carpooling in the Katy Freeway corridor in the a.m. peak period has increased 115% since the inception of the HOV lane.

Table 5.
Estimated Increase in Carpool Volumes Due to Implementation of Katy HOV Lane

Katy Freeway Corridor (1983-1990)	Carpool Volume Before HOV Lane	Carpool Volume After HOV Lane[1]	Percent Change
A.M. Peak Period (6:00-9:30 a.m.)	1,570	3,376[2]	+115%

[1] *Freeway plus HOV lane carpool volume.*
[2] *3+ vehicles between 6:45 a.m and 8:00 a.m.; 2+ vehicles during all other operating hours.*

Surveys were conducted in March 1987, October 1987, November 1988, October 1989 and October 1990 to determine the origin of carpools using the HOV lane. These analyses are summarized in Figure 12. The survey data suggest that relatively few carpools now using the HOV lane were existing carpools that diverted to the HOV lane from parallel routes. Even fewer carpoolers were formerly bus riders or vanpoolers on the HOV lane. In fact, it appears that perhaps as many as 62% of the carpools currently using the HOV lane are "new" carpools formed largely due to the implementation of the HOV lane ("new" carpools being represented by the sum of previous mode being either "drove alone" or "did not make trip prior to carpooling on the HOV lane").



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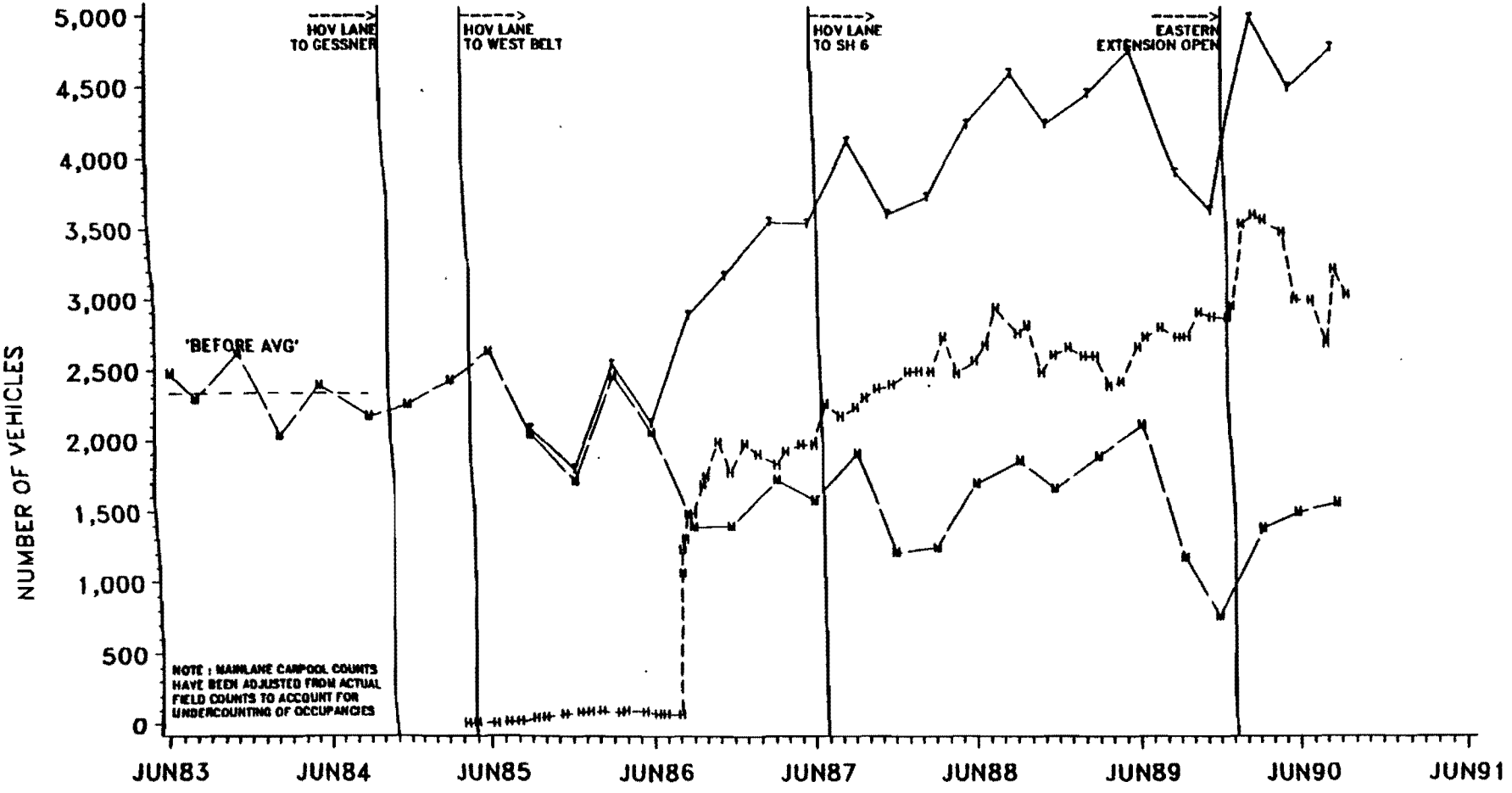
PEAK PERIOD IS 6:00 - 9:30 AM
SOURCE : TEXAS TRANSPORTATION INSTITUTE

LEGEND : T = TOTAL 2+ CARPOOLS
H = TOTAL HOV LANE 2+ CARPOOLS
M = TOTAL MAINLANE 2+ CARPOOLS

Figure 9. Increases in Carpooling in the A.M. Peak Period



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PEAK PERIOD IS 3:30 - 7:00 PM
SOURCE : TEXAS TRANSPORTATION INSTITUTE

LEGEND : T = TOTAL 2+ CARPOOLS
H = TOTAL HOV LANE 2+ CARPOOLS
M = TOTAL MAINLANE 2+ CARPOOLS

Figure 10. Increases in Carpooling in the P.M. Peak Period

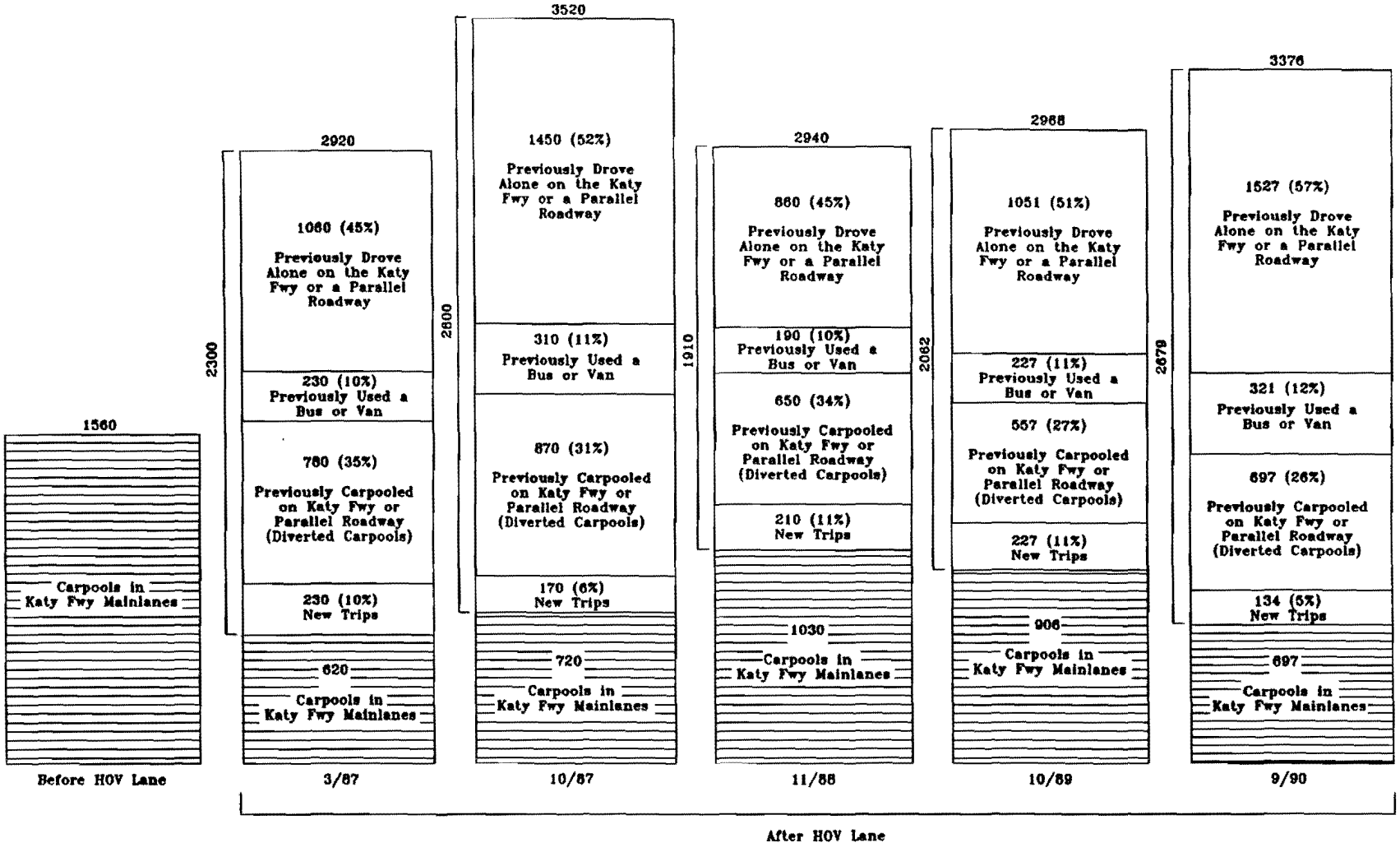


Figure 11. A.M. Peak Period Carpool Volumes (Freeway + HOV Lane) Before and After Katy HOV Lane

CHAPTER 3
CRITERIA FOR EVALUATING THE SUCCESS OF THE HOV LANE CARPOOL EXPERIMENT

Carpool utilization of the Katy HOV Lane was initiated as an experiment which would be evaluated periodically to determine whether or not the project was being successful. Prior to allowing carpools on the HOV lane, METRO and TxDOT identified the general criteria that would be used to evaluate the success of the carpool experiment. Those criteria, as developed and presented in TTI Research Report 484-1, are repeated in Table 6. Throughout the duration of the experiment, data collection efforts in the Katy corridor have been oriented to obtain information to quantify the criteria shown in Table 6. The criteria, and the relative performance of the Katy HOV Lane carpool experiment with regard to the criteria, are addressed individually in subsequent sections of this chapter. Included in this presentation are relevant data from:

- The 12-month "after carpools" evaluation conducted in April 1986 (when HOV lane use was limited to authorized buses, vanpools and 3+ carpools);
- The 30-month "after carpools" evaluation conducted in October 1987 (when the HOV lane was open to all 2+ vehicles with no authorization);
- The 42-month "after carpools" evaluation conducted in October 1988 (just prior to implementing the 3+ carpool occupancy requirement from 6:45-8:15 a.m.);
- The 54-month "after carpools" evaluation conducted in October 1989 (approximately one year after the a.m. 3+ carpool passenger requirement went into effect); and
- The 66-month "after carpools" evaluation conducted in October 1990 (approximately two years after the a.m. 3+ carpool passenger requirement went into effect).

Table 6.
Criteria for Judging the Success of the Katy HOV Lane Carpool Experiment

Proposed Evaluation Factor	Relative Weighing	Resulting Impact
1. Change in person movement on the Katy HOV Lane directly attributable to carpooling.	25%	Highly Successful: Total HOV lane person movement increases by at least 20% due to carpooling. Successful: Person movement increases by between 5% and 20%. Unsuccessful: Person movement remains essentially unchanged (0% to 5% increase). Highly Unsuccessful: Person movement decreases.
2. Nonuser perception of Katy HOV Lane utilization.	30%	Highly Successful: At least 70% of nonusers respond that HOV lane is sufficiently utilized. Successful: Between 50% and 70% of nonusers respond that HOV lane is sufficiently utilized. Unsuccessful: Between 50% and 70% of nonusers respond that HOV lane is not sufficiently utilized. Highly Unsuccessful: More than 70% of nonusers respond that HOV lane is not sufficiently utilized.
3. Change in average travel time on the Katy HOV Lane.	20%	Highly Successful: No change. Successful: Average travel speed decreases by no more than 3 mph. Unsuccessful: Average travel speed decreases by between 3 mph and 6 mph. Highly Unsuccessful: Average travel speed decreases by more than 6 mph.
4. Change in person delay to mixed-flow traffic.	15%	Highly Successful: No change or a decrease in total delay. Successful: Delay increases by less than 5%. Unsuccessful: Delay increases by 5% to 10% Highly Unsuccessful: Delay increases by more than 10%.
5. Increase in frequency of breakdowns on the Katy HOV Lane.	5%	Highly Successful: None. Successful: Increases by less than 5%. Unsuccessful: Increases by between 5% and 15%. Highly Unsuccessful: Increases by more than 15%.
6. Increase in authorization and enforcement costs.	5%	Values developed by METRO. Authorization has been eliminated.

Note: In this table, Items 1, 3 and 4 indirectly address change in total corridor delay; Item 5 indirectly addresses trip reliability.

Change in Person Movement on the Katy HOV Lane

One of the main reasons for permitting carpools to use the Katy HOV Lane was to increase the volume of persons moved on the facility. As shown previously in Table 2, carpools are presently carrying the majority of persons on the HOV lane.

Carpool Component

The number and percent of persons moved on the HOV lane, by vehicle type, are presented in Table 7. As this table indicates, approximately 9,717 persons were moved on the HOV lane during the a.m. peak period in October 1990 (as compared to 3,196 persons being moved in April 1986); approximately 10,722 persons were moved during the p.m. peak period in October 1990 (as compared to 2,992 persons being moved in April 1986 during the same time period). Table 7 further shows that not only has the total person movement increased substantially over time, but the carpool component of total person movement has increased significantly over time (particularly since 2+ unauthorized carpools were allowed onto the HOV lane). As might be expected, the percentage of persons moved in HOV lane carpools in the mornings has dropped somewhat since the morning 3+ occupancy requirement went into effect.

At first glance, these data appear to indicate that, as of October 1990, allowing carpools onto the HOV lane has effectively increased person movement by 124% in the a.m. peak period and by 149% in the p.m. peak period. Such conclusions, however, do not take into consideration the fact that some of the carpoolers traveled in buses or vans on the HOV lane prior to carpooling. In fact, approximately 9% of the current carpoolers were attracted from other HOV lane modes (Table 8); these trips do not represent a net increase in person movement due to carpooling. Therefore, in October 1990, carpooling actually increased a.m. peak period person movement by about 112%, and p.m. peak period person movement by 120%. The average increase in person movement on the HOV lane is assumed to be approximately 116% for both the a.m. and p.m.

Table 7.
Person Movement on the Katy HOV Lane

Time Period	Bus		Vanpool		Carpool		Total
	Volume	Percent	Volume	Percent	Volume	Percent	
A.M. Eastbound							
Peak Hour							
April 1986	980	61%	377	23%	261	16%	1,618
April 1987	1,025	27%	256	7%	2,531	66%	3,812
October 1987	1,200	28%	195	4%	2,965	68%	4,360
October 1988	1,215	32%	240	6%	2,375	62%	3,830
October 1989	1,340	38%	163	5%	1,965	57%	3,468
October 1990	2,115	49%	220	5%	2,022	46%	4,357
Peak Period							
April 1986	2,270	71%	548	17%	378	12%	3,196
April 1987	2,300	30%	534	7%	4,960	63%	7,794
October 1987	2,405	27%	400	5%	5,956	68%	8,761
October 1988	2,540	29%	298	3%	5,961	68%	8,799
October 1989	2,820	36%	285	3%	4,808	61%	7,913
October 1990	3,985	41%	362	4%	5,370	55%	9,717
P.M. Westbound							
Peak Hour							
April 1986	670	56%	366	30%	166	14%	1,202
April 1987	1,065	35%	212	7%	1,804	58%	3,081
October 1987	1,175	34%	185	5%	2,083	61%	3,443
October 1988	1,195	31%	92	3%	2,543	66%	3,830
October 1989	1,430	35%	81	2%	2,613	63%	4,124
October 1990	2,065	43%	69	1%	2,656	56%	4,790
Peak Period							
April 1986	2,032	68%	632	21%	328	11%	2,992
April 1987	1,895	29%	596	9%	4,113	62%	6,604
October 1987	2,175	29%	521	7%	4,925	64%	7,621
October 1988	2,180	26%	325	4%	5,921	70%	8,426
October 1989	2,685	30%	368	4%	6,025	66%	9,078
October 1990	3,900	36%	402	4%	6,420	60%	10,722

Notes: April 1986 - authorized 3+ carpools were allowed to use the HOV lane.
April 1987, October 1987 and October 1988 - 2+ carpools with no authorization were allowed on the HOV lane.
October 1989 - HOV lane restricted to 3+ carpools (no authorization) between 6:45 a.m. and 8:15 a.m., 2+ carpools (no authorization) allowed at all other times.
October 1990 - HOV lane restricted to 3+ carpools (no authorization) between 6:45 a.m. and 8:00 a.m., 2+ carpools (no authorization) allowed at all other times.
Peak Periods - 6:00 a.m. to 9:30 a.m and 3:30 p.m. to 7:00 p.m.; Peak Hour - peak hour for vehicle volumes.

Table 8.
Prior Use of the Katy HOV Lane by Carpoolers

Did You Use the HOV Lane Before Carpooling	Carpool Survey Date						
	10/85	4/86	4/87	10/87	11/88	10/89	10/90
Yes, Bus	3%	7%	7%	8%	6%	8%	8%
Yes, Van	2%	7%	2%	1%	1%	2%	1%
No	95%	86%	91%	91%	93%	90%	91%

Conclusion Pertaining to First Evaluation Criterion

The increase in HOV lane person movement resulting from carpool utilization is the first criterion established for evaluating the success of the Katy HOV Lane carpool experiment (Table 6). Table 9 summarizes the application of the data to this criterion. As of October 1990, in terms of this evaluation criterion, the carpool experiment is judged to be "highly successful."

Table 9.
HOV Lane Person Movement Impacts of Carpooling,
Criterion for Assessing the Success of the Katy HOV Lane Carpool Experiment

Date of Evaluation	A.M. Peak Period Carpool Person Volume	Estimated % Increase in HOV Lane Person Movement	Rating of Criterion (See Table 6)
4/86	378	10%	"Successful"
4/87	4,960	135%	"Highly Successful"
10/87	5,956	150%	"Highly Successful"
10/88	5,961	180%	"Highly Successful"
10/89	4,808	135%	"Highly Successful"
10/90	5,370	111%	"Highly Successful"

Perception of HOV Lane Utilization

One of the primary reasons for allowing carpools on the Katy HOV Lane was to make the facility appear better utilized to the general public. Permitting carpools has significantly increased the volume of vehicles using the HOV lane. In fact, the number of vehicles using the HOV lane during the a.m. peak period has risen from 138 in March 1985 to 2,635 by October 1990. The effect of this increased volume of vehicles on the perception of HOV lane utilization has been noticeable; it is evident that a relationship does exist between vehicular utilization of the HOV lane and the perception that the lane is sufficiently utilized.

The perceptions of HOV lane utilization are based on TTI surveys of both HOV lane users and nonusers. These surveys were performed in March 1985, April 1986, October 1987, November 1988, October 1989 and October 1990.

As to be expected, there is a significant difference in the perception of HOV lane utilization between the HOV lane users and nonusers. As noted in Table 10, the majority of the HOV lane users (75% of the carpoolers/vanpoolers and 87% of the transit users) surveyed in October 1990 felt the facility is sufficiently utilized.

Table 10.
Perception of Katy HOV Lane Utilization by HOV Lane Users

Is HOV Lane Sufficiently Utilized?	Survey Date						
	3/85[1]	4/86[2]	4/87[3]	10/87[3]	11/88[4]	10/89[4]	10/90[5]
HOV Lane Transit Users							
Yes	49%	66%	—	77%	72%	85%	87%
No	33%	14%	—	7%	8%	5%	4%
Not sure	18%	20%	—	16%	20%	10%	9%
HOV Lane Vanpoolers							
Yes	30%	41%	—	—	47%	74%	—
No	51%	34%	—	—	27%	13%	—
Not sure	19%	25%	—	—	26%	13%	—
HOV Lane Carpoolers							
Yes	—	45%	82%	—	43%	77%	75%[6]
No	—	32%	9%	—	43%	14%	15%[6]
Not sure	—	23%	9%	—	14%	9%	10%[6]
HOV Lane A.M. Peak Period Vehicle Volume[7]	138	256	2,412	2,854	2,032	2,186	2,635

[1] *Authorized buses and vanpools (before carpools were allowed).*
[2] *Authorized buses, vanpools and 3+ carpools.*
[3] *2+ vehicles, no authorization.*
[4] *3+ vehicles, no authorization between 6:45 a.m. and 8:15 a.m.; 2+ vehicles, no authorization at all other times.*
[5] *3+ vehicles, no authorization between 6:45 a.m. and 8:00 a.m.; 2+ vehicles, no authorization at all other times.*
[6] *Includes responses from HOV lane vanpoolers.*
[7] *Vehicle volumes present on HOV lane during months surveys were performed.*

However, the majority of commuters traveling in the Katy Freeway general purpose lanes (persons who may not perceive they are directly benefitting from the HOV lane) did not agree; 45% of the freeway motorists surveyed in October 1990 felt the HOV lane was *not* sufficiently utilized (Table 11). Nevertheless, as HOV volumes have increased, so has the acceptance of the lane by freeway motorists; 71% of the freeway motorists now feel the HOV lane is a good transportation improvement (Table 11). *(Note: This is the highest percentage of favorable responses received to date regarding this issue.)*

Table 11.
Perception of Katy HOV Lane Utilization by Motorists in the General Freeway Lanes (Non HOV Lane Users)

Measure of Effectiveness	Survey Date						
	3/85[1]	4/86[2]	4/87[3]	10/87[3]	11/88[4]	10/89[4]	10/90[5]
Is HOV Lane Sufficiently Utilized?							
Yes	3%	3%	36%	44%	31%	30%	37%
No	90%	92%	55%	42%	55%	53%	45%
Not sure	7%	5%	9%	14%	14%	17%	18%
Is HOV Lane a Good Transportation Improvement?							
Yes	41%	36%	56%	63%	64%	66%	71%
No	35%	43%	29%	20%	22%	20%	16%
Not sure	24%	21%	15%	17%	14%	14%	13%
HOV Lane A.M. Peak Period Vehicle Volume[6]	138	256	2,412	2,854	2,032	2,186	2,635

[1] *Authorized buses and vanpools (before carpools were allowed).*
[2] *Authorized buses, vanpools and 3+ carpools.*
[3] *2+ vehicles, no authorization.*
[4] *3+ vehicles, no authorization between 6:45 a.m. and 8:15 a.m.; 2+ vehicles, no authorization at all other times.*
[5] *3+ vehicles, no authorization between 6:45 a.m. and 8:00 a.m.; 2+ vehicles, no authorization at all other times.*
[6] *Vehicle volumes present on HOV lane during months surveys were performed.*

Conclusion Pertaining to Second Evaluation Criterion

In evaluating the success the Katy HOV Lane carpool experiment, the nonuser perception of HOV lane utilization was the single most important criterion (Table 6). Table 12 summarizes the application of the nonuser perception findings to this criterion. As of October 1990, in terms of perceived HOV lane utilization, the experiment is judged to be "unsuccessful."

Table 12.
Perception of Katy HOV Lane Utilization,
Criterion for Assessing the Success of the Katy HOV Lane Carpool Experiment

Date of Evaluation	A.M. Peak Period HOV Lane Vehicle Volume	% of Motorists in General Purpose Lanes Who Feel HOV Lane is Sufficiently Utilized[1]	Rating of Criterion (See Table 6)
4/86	256	6%	"Highly Unsuccessful"
4/87	2,412	40%	"Unsuccessful"
10/87	2,854	51%	"Successful"
10/88	2,922	51%[2]	"Successful"
10/89	2,186	38%	"Unsuccessful"
10/90	2,635	46%	"Unsuccessful"

[1] *This represents the sum of those responding the HOV lane is sufficiently utilized plus one-half of those stating they were "not sure." See Table 11 for data breakdown.*
[2] *For this evaluation, the October 1987 survey responses were assumed to represent October 1988 conditions (before the a.m. 3+ carpool operating restriction went into effect).*

Change in Average Travel Time on the HOV Lane

While allowing carpools represented a means to increase the volume of vehicles operating on the HOV lane, a number of concerns were associated with such an action. For example, permitting carpools might result in vehicle volumes that exceed the capacity of the HOV lane, thereby adversely affecting operating speeds on the facility. Any decrease in HOV lane speed would reduce both the HOV lane travel time savings and the trip time reliability. This, in turn, would reduce the attractiveness of the HOV lane.

HOV Lane Average Travel Speeds

The average travel speed (space mean speed) was calculated for each bus using the Katy HOV Lane. Bus speeds were then used to estimate the HOV lane speeds of vanpools and carpools, as bus flow rates during peak periods were high; buses ran at average headways of two minutes. The average of peak period a.m. and p.m. travel speed of all buses using the HOV lane when no carpools were allowed is compared to the same average travel speeds in 1986, 1987, 1988, 1989 and 1990 when carpools were present (Table 13).

Table 13.
Average A.M. and P.M. Peak Period Travel Speed (mph) for Vehicles on the Katy HOV Lane

Vehicle Type	3/85[1]	5/86[2]	11/87[3]	10/88[3]	10/89[4]	10/90[5]
Bus	52	56	52	45	49	53
Van	56	57	NA	NA	NA	NA
Carpool	--	56	NA	NA	NA	NA

[1] *Authorized buses and vanpools (before carpools were allowed).*
[2] *Authorized buses, vanpools and 4+ carpools.*
[3] *2+ vehicles, no authorization.*
[4] *3+ vehicles, no authorization between 6:45 a.m. and 8:15 a.m.; 2+ vehicles at all other times.*
[5] *3+ vehicles, no authorization between 6:45 a.m. and 8:00 a.m.; 2+ vehicles at all other times.*
Notes: Speeds represent average of a.m. and p.m. peak period speeds based on travel time runs between SH 6 and the S.P.R.R. overpass (13.3 miles). HOV lane speeds for 4:00, 5:00 and 6:00 p.m. were measured in October 1988. NA = speed not available; bus speeds are assumed to estimate all HOV lane vehicle speeds.

The average travel speeds of vehicles traveling on the Katy HOV Lane in 1986 and 1987 were at "pre-carpool" base condition levels or higher. By October 1988, however, the average

recorded HOV lane travel speed of 45 mph was 7 mph less than the 52 mph "pre-carpool" base condition. This drop in peak hour travel speeds was one of the factors that led to the implementation of the 3+ carpool occupancy requirement between 6:45 a.m. and 8:15 a.m. in late October 1988. The drop in average travel speed was the result of vehicular volumes approaching, and sometimes exceeding, the capacity of the HOV lane and also from delay encountered at the lane's eastern terminus (at Post Oak). Once the 3+ operating restriction went into effect, however, vehicular volumes on the HOV lane declined and the average HOV lane travel speed subsequently improved; by October 1989, the average of a.m. and p.m. peak period travel speeds increased to 49 mph. Average travel speeds further improved following the opening of the eastern extension to the lane (which bypasses the Post Oak intersection). In fact, in October 1990, the average HOV lane travel speed of 53 mph was one mph higher than the "pre-carpool" base condition.

Conclusion Pertaining to Third Evaluation Criterion

The change in HOV lane operating speed is the third criterion developed for use in evaluating the success of the Katy HOV Lane carpool experiment (Table 6). As shown in Table 14 below, the October 1990 average travel speed (two years after the implementation of the 3+ a.m. operating restriction and 9 months following the opening of the eastern extension) is one mile per hour higher than the 1985 base condition speed. As a result, this criterion is rated "highly successful" for October 1990.

Table 14.
Change in Average Bus Travel Speed on the HOV Lane,
Criterion for Assessing the Success of the Katy HOV Lane Carpool Experiment

Date of Evaluation	Average HOV Lane Speed (mph)	Rating of Criterion (See Table 6)
3/85	52	Base Condition
5/86	56	"Highly Successful
11/87	52	"Highly Successful"
10/88	45	"Highly Unsuccessful"
10/89	49	"Successful"
10/90	53	"Highly Successful"

Mixed-Flow Traffic Lanes

It is possible that permitting carpools to use the Katy HOV Lane could have either a positive or a negative effect on speeds and operation in the Katy Freeway mixed-flow lanes. For example, if substantial carpool volumes use the HOV lane, freeway mainlane volumes could decrease, which might improve operations. Conversely, the location of some of the access/egress points to the HOV lane are not necessarily optimal; large volumes of vehicles entering or exiting the HOV lane (particularly at Gessner) could result in a deterioration of the level-of-service on the mainlanes.

Freeway Average Travel Speeds

In October 1990, travel time studies were conducted on the Katy Freeway mainlanes at 30-minute intervals between the SH 6 interchange an the Southern Pacific Railroad (S.P.R.R.) overpass east of Washington Avenue, a distance of approximately 13 miles. The results of these travel time studies were compared to similar studies performed in 1985, 1986, 1987, 1988 and 1989 using the study sections shown in Table 15.

Table 15.
Section Limits for Travel Time Runs on the Katy HOV Lane

Section Number A.M. Designation	Section Number P.M. Designation	Limits of Section
1	3	SH 6 to Gessner access ramps (6.4 miles)
2	2	Gessner access ramps to HOV lane eastern terminus at Post Oak (4.7 mi.)[1]
3	1	Post Oak to the S.P.R.R. overpass of I-10 Katy Freeway (2.2 mi.)[2]

[1] *In October 1990 (after HOV Lane Eastern Extension opened), section limits extended from Gessner access ramps to Post Oak flyover (4.63 mi.).*
[2] *In October 1990 (after HOV Lane Eastern Extension opened), section limits extended from Post Oak flyover to S.P.R.R. overpass (2.25 mi.).*

A.M. Peak Period

Eastbound floating car travel times were conducted over the 13-mile study length on the Katy Freeway, and the average speeds for the three study lengths were calculated. The results of these travel time runs are presented in Table 16. The travel speeds for each freeway section were then averaged for each time period. The 1990 data, presented in Figure 12 and Table 16, can be directly compared to previous travel speed data.

Table 16.
A.M. Average Speeds (mph) on the Eastbound Katy Freeway Mainlanes

Time	3/85	11/87	10/88	10/89	10/90
Section 1 - A.M.					
6:00	54	56	61	58	52
6:30	32	33	28	36	32
7:00	22	24	24	23	18
7:30	18	22	17	18	23
8:00	32	37	19	18	58
8:30	37	48	44	34	52
9:00	--	50	59	60	56
Section 2 - A.M.					
6:00	55	56	59	54	55
6:30	39	34	37	42	46
7:00	28	26	26	30	23
7:30	21	22	21	27	22
8:00	26	28	23	35	27
8:30	28	31	29	37	51
9:00	--	50	36	54	37
Section 3 - A.M.					
6:00	55	55	59	57	53
6:30	36	55	54	59	59
7:00	27	55	56	59	57
7:30	21	55	57	58	57
8:00	32	55	55	55	58
8:30	35	57	57	61	61
9:00	--	55	59	60	57
Total Length - A.M.					
6:00	55	56	60	57	54
6:30	36	36	33	40	39
7:00	27	28	28	28	22
7:30	21	24	20	23	26
8:00	32	34	23	25	42
8:30	35	40	38	38	53
9:00	--	50	48	58	48

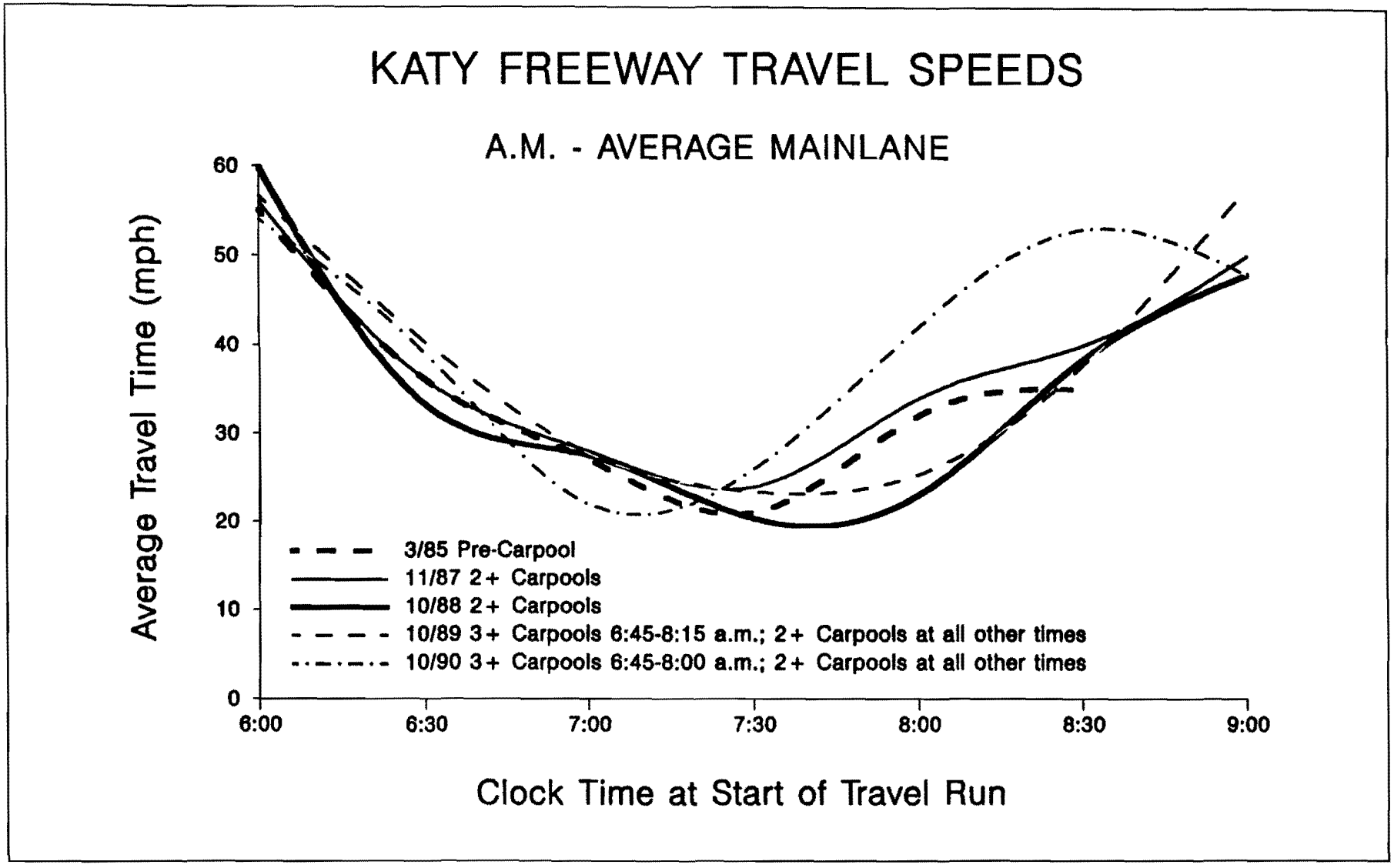


Figure 12. Katy Freeway Average Mainlane Travel Speeds, A.M. Eastbound, SH 6 to S.P.R.R. Overpass

The travel time profile shown in Figure 12 indicates that 1990 freeway travel speeds between 6:00 a.m. and 9:00 a.m. have generally improved since 1985.

Average travel time and average speeds for freeway and HOV lane traffic are shown for both two- and three-hour periods in Table 17. These values represent travel times over the entire study length from SH 6 to the S.P.R.R. overpass. In general, average travel times for both the Katy HOV Lane and the Katy Freeway traffic are lower in 1990 and average speeds for both are higher in 1990 than in 1985.

Table 17.
Eastbound A.M. Travel Times and Average Speeds,
Katy Freeway Mainlanes and HOV Lane

Time Period	Average Travel Time (minutes)					% Change 85-90
	3/85	11/87	10/88	10/89	10/90	
3-Hour Period, 6:00-9:00 a.m.						
Non HOV Lane Traffic	26.5	22.0	26.9	25.2	22.8	-14%
HOV Lane Traffic	21.2	16.6	19.0	17.0	14.4	-32%
2-Hour Period, 6:30-8:30 a.m.						
Non HOV Lane Traffic	30.6	26.4	31.8	29.0	26.7	-13%
HOV Lane Traffic	23.5	17.4	20.9	17.5	14.2	-40%
Time Period	**Average Speed (mph)**					**% Change 85-90**
	3/85	11/87	10/88	10/89	10/90	
3-Hour Period, 6:00-9:00 a.m.						
Non HOV Lane Traffic	30	36	30	32	35	+17%
HOV Lane Traffic	37	48	42	48	55	+49%
2-Hour Period, 6:30-8:30 a.m.						
Non HOV Lane Traffic	26	30	25	28	30	+15%
HOV Lane Traffic	34	46	38	46	56	+65%

Note: Travel times and speeds for freeway and HOV lane are from SH 6 to S.P.R.R. Overpass.

P.M. Peak Period

The westbound Katy Freeway speeds are presented by section in Table 18 and compared to the previous years' studies in Table 19. Average travel speeds for 1990 are compared to 1985, 1986, 1987, 1988 and 1989 conditions in Figure 13.

Table 18.
P.M. Average Speeds (mph) on the Westbound Katy Freeway Mainlanes

Time	3/85	11/87	10/88	10/89	10/90
Section 1 - P.M.					
3:00	55	–	–	62	–
3:30	57	–	55	58	56
4:00	55	60	57	29	56
4:30	54	56	38	47	57
5:00	46	54	54	61	44
5:30	49	51	46	49	37
6:00	50	55	55	45	55
6:30	–	57	55	58	–
7:00	–	59	–	61	–
Section 2 - P.M.					
3:00	66	–	–	59	–
3:30	54	–	55	57	53
4:00	60	44	42	33	38
4:30	34	46	34	29	48
5:00	24	34	30	25	23
5:30	19	25	24	21	15
6:00	32	31	28	26	27
6:30	–	38	38	37	–
7:00	–	49	–	44	–
Section 3 - P.M.					
3:00	61	–	–	59	–
3:30	52	–	59	56	56
4:00	56	52	59	58	55
4:30	41	55	53	53	55
5:00	32	54	52	53	37
5:30	27	37	52	42	50
6:00	42	32	56	55	55
6:30	–	37	59	58	–
7:00	–	56	–	59	–
Total Length - P.M.					
3:00	61	–	–	60	–
3:30	52	–	57	57	55
4:00	56	52	51	40	48
4:30	41	52	42	40	53
5:00	32	45	41	38	30
5:30	27	35	36	31	26
6:00	42	38	42	38	40
6:30	–	44	49	47	–
7:00	–	55	–	53	–

Table 19.
Westbound P.M. Travel Times and Average Speeds,
Katy Freeway Mainlanes and HOV Lane

Time Period	Average Travel Time (minutes)					% Change 85-90
	3/85	11/87	10/88	10/89	10/90	
3-Hour Period, 4:00-7:00 p.m.						
Non HOV Lane Traffic	21.3	18.0	18.7	21.6	18.1	-15%
HOV Lane Traffic	16.3	17.3	17.3	16.2	14.3	-12%
2-Hour Period, 5:00-7:00 p.m.						
Non HOV Lane Traffic	24.7	19.3	19.4	21.2	25.7	+4%
HOV Lane Traffic	16.6	17.5	18.0	16.4	14.5	-13%
Time Period	**Average Speed (mph)**					**% Change 85-90**
	3/85	11/87	10/88	10/89	10/90	
3-Hour Period, 4:00-7:00 p.m.						
Non HOV Lane Traffic	37	44	43	38	44	+19%
HOV Lane Traffic	49	46	46	50	56	+14%
2-Hour Period, 5:00-7:00 p.m.						
Non HOV Lane Traffic	32	41	41	38	31	-3%
HOV Lane Traffic	48	45	44	49	55	+15%

Note: Travel times and speeds for freeway and HOV lane are from S.P.R.R. Overpass to SH 6.

Freeway Mainlane Volumes

Volume counts (from loop detectors installed in the Katy Freeway mainlanes at the Silber overpass and at the Gessner overpass) were taken in 1985, 1987, 1988 and 1989. No volume counts were available for 1990 as the loop detectors had been removed for a pavement overlay project.

The ADT, a.m. peak hour and peak period, and p.m. peak hour and peak period counts for 1985 through 1989 are shown in Table 20. In general, eastbound traffic volumes observed at the Silber overpass decreased from 1988 levels, while traffic volumes at the Gessner overpass increased.

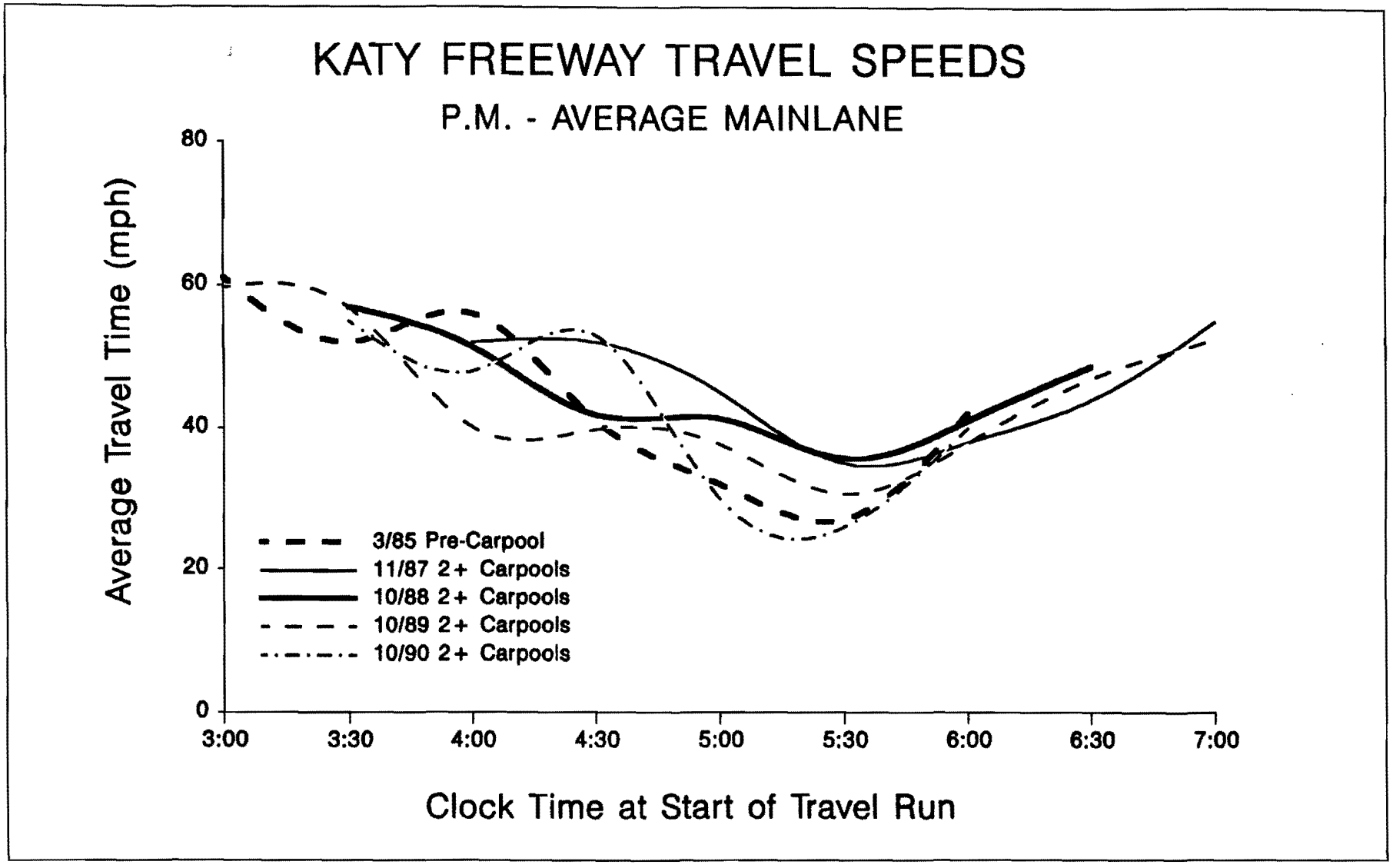


Figure 13. Katy Freeway Average Mainlane Travel Speeds, P.M. Westbound, S.P.R.R. Overpass to SH 6

Table 20.
Traffic Volumes, Katy Freeway Mainlanes

Eastbound Direction Location and Time	3/85	8/86	10/87	10/88[1]	10/89	% Change 88-89
Silber Overpass - 4 Lanes						
ADT	90,325	89,507	87,730	92,588	87,857	-5.1%
6:30-9:30 a.m.	20,589	19,445	20,783	21,270	20,295	-4.6%
3:30-6:30 p.m.	16,406	16,296	16,662	17,722	16,848	-4.9%
Peak Hour	7,295	7,113	7,200	7,425	7,163	-3.5%
Gessner Overpass - 3 Lanes						
ADT	70,069	69,250	64,064	71,647	73,186	+2.1%
6:30-9:30 a.m.	15,263	15,528	13,448	13,771	13,697	-0.5%
3:30-6:30 p.m.	13,547	12,717	12,972	14,734	15,340	+4.1%
Peak Hour	5,526	5,523	5,127	5,444	5,485	+0.8%
Westbound Direction Location and Time	**3/85**	**8/86**	**10/87**	**10/88**	**10/89**	**% Change 88-89**
Silber Overpass - 4 Lanes						
ADT	86,978	87,622	85,690	89,787		—
6:30-9:30 a.m.	14,395	13,864	13,973	14,868	*Data not*	—
3:30-6:30 p.m.	17,539	17,692	18,535	18,211	*available.*[2]	—
Peak Hour	6,368	6,278	6,426	6,497		—
Gessner Overpass - 3 Lanes						
ADT	70,919	69,965	69,147	75,199	78,255	+4.1%
6:30-9:30 a.m.	12,130	11,432	11,375	12,476	12,654	+1.4%
3:30-6:30 p.m.	14,270	12,835	16,911	17,322	17,278	-0.3%
Peak Hour	4,985	4,933	5,886	6,041	5,923	-2.0%

[1] *Volume represents average of Tuesday through Thursday.*
[2] *Data not available - loop detectors not accessible because of construction.*
Notes: Peak Hour - Eastbound direction for a.m. period, westbound direction for p.m. period.
Katy Freeway mainlane traffic volume data for 1990 not available - loop detectors on Katy Freeway removed during pavement overlay project.

Travel Time Savings

Desirably, the HOV lane will result in travel time savings for both the HOV users and the freeway users. HOV users can reduce travel time by utilizing the HOV lane to avoid congestion delays in the freeway mainlanes. When commuters change travel modes and begin using the HOV lane, the number of vehicles on the freeway may be reduced, which could then result in a travel time savings for freeway users as well. Travel time saved by HOV lane traffic is calculated by comparing the freeway mainlane travel time to the HOV lane travel time at the same time period and determining the number of vehicles and persons using the HOV lane during the same time period. The number of vehicles, by type and occupancy rate, were

determined from independent surveys taken at the same time as the travel times. Eastbound direction travel time savings are presented in Tables 21 and 22.

Table 21.
Eastbound A.M. Travel Time Savings for Katy HOV Lane Traffic, SH 6 to Gessner Entrance, October 1990

Time of Day	Average Travel Time		Time Saved by HOV Lane (minutes)	HOV Lane Volumes				Travel Time Saved (person minutes)
	Non HOV Lane (minutes)	HOV Lane (minutes)		Buses	Vans	Carpools	Persons	
6:00 a.m.	7.3	7.2	0.1	3	5	125	379	38
6:30 a.m.	12.1	6.6	5.5	9	9	522	1,450	7,975
7:00 a.m.	21.5	7.2	14.3	10	1	195	786	11,240
7:30 a.m.	17.1	6.7	10.4	14	5	142	827	8,601
8:00 a.m.	6.6	6.7	-0.1	4	1	184	546	-55
8:30 a.m.	7.4	7.1	0.3	5	3	83	408	122
3 Hour Total, 6:00-9:00 a.m.			6.4	45	24	1,251	4,396	27,921
2 Hour Total, 6:30-8:30 a.m.			7.7	37	16	1,043	3,609	27,761

Table 22.
Eastbound A.M. Travel Time Savings for Katy HOV Lane Traffic, Gessner Entrance to S.P.R.R. Overpass, October 1990

Time of Day	Average Travel Time		Time Saved by HOV Lane (minutes)	HOV Lane Volumes				Travel Time Saved (person minutes)
	Non HOV Lane (minutes)	HOV Lane (minutes)		Buses	Vans	Carpools	Persons	
6:00 a.m.	7.6	7.4	0.2	11	9	148	739	148
6:30 a.m.	8.4	7.1	1.3	16	3	487	1,552	2,018
7:00 a.m.	14.7	7.6	7.1	32	14	456	2,088	14,825
7:30 a.m.	15.2	6.9	8.3	30	13	420	2,269	18,833
8:00 a.m.	12.5	7.8	4.7	20	3	449	1,638	7,699
8:30 a.m.	7.7	8.4	-0.7	10	2	319	900	-630
3 Hour Total, 6:00-9:00 a.m.			4.7	119	44	2,279	9,186	42,893
2 Hour Total, 6:30-8:30 a.m.			5.7	98	33	1,812	7,547	43,375

Total Time Saved = 27,921 + 42,893 = 70,814 Person Minutes (6:00-9:00 a.m.).
Total Time Saved = 27,761 + 43,375 = 71,136 Person Minutes (6:30-8:30 a.m.).

In Table 21, the eastbound direction from SH 6 to the Gessner access ramp is analyzed. During all time periods except one, the travel time for the HOV lane traffic is less than or equal to the freeway travel time, and the results are positive savings. In fact, travel time savings between 7:00 and 7:30 a.m. averaged 14 minutes.

In Table 22, for the section from Gessner to the S.P.R.R. overpass, travel time savings are also generally positive; the late morning data (8:30 a.m. to 9:00 a.m.) indicate that HOV lane users lose 0.7 minutes. This small time loss may be due to lighter mainlane traffic volumes at the end of the peak periods. Thus, the travel time savings are negative during that period. However, the fact that commuters use the HOV lane during this period indicates that the trip time reliability can offset a small loss in travel time savings.

The total time saved by HOV lane users is determined from figures in Tables 21 and 22 and shown in Table 23. During the morning peak period, the total time saved by HOV lanes users was over 71,000 person-minutes (over 1,180 person-hours).

Table 23.
Total Travel Time Savings for Eastbound Katy HOV Lane Traffic

Time of Day	5/85	11/87	10/88	10/89	10/90
Time Saved by HOV Lane (minutes)[1]					
6:00 a.m.	-1.2	-0.9	-1.7	-2.1	0.3
6:30 a.m.	4.0	3.1	3.7	1.9	6.4
7:00 a.m.	9.4	4.8	8.9	5.4	12.5
7:30 a.m.	11.4	6.1	6.6	9.8	12.1
8:00 a.m.	7.8	4.8	6.0	10.0	4.7
8:30 a.m.	3.7	2.3	4.2	1.8	-0.6
3 Hour Total, 6:00-9:00 a.m.	6.8	4.4	5.9	5.2	7.7
2 Hour Total, 6:30-8:30 a.m.	8.0	4.8	6.5	6.3	9.4
HOV Lane Person Volume					
6:00 a.m.	242	387	391	573	739
6:30 a.m.	532	1,540	1,703	1,781	1,552
7:00 a.m.	646	2,346	2,127	1,687	2,088
7:30 a.m.	384	2,320	1,922	1,590	2,269
8:00 a.m.	426	1,198	1,540	1,046	1,638
8:30 a.m.	150	600	706	891	900
3 Hour Total, 6:00-9:00 a.m.	2,380	8,391	8,389	7,568	9,186
2 Hour Total, 6:30-8:30 a.m.	1,988	7,404	7,292	6,104	7,547
Travel Time Saved (person-minutes)					
6:00 a.m.	-299	-361	-660	-1,203	186
6:30 a.m.	2,123	4,840	6,367	3,334	9,993
7:00 a.m.	6,061	11,157	19,005	9,176	26,065
7:30 a.m.	4,372	14,057	12,732	15,570	27,434
8:00 a.m.	3,329	5,735	9,204	10,441	7,644
8:30 a.m.	558	1,400	2,964	1,568	-508
3 Hour Total, 6:00-9:00 a.m.	16,144	36,828	49,612	39,284	70,814
2 Hour Total, 6:30-8:30 a.m.	15,885	35,789	47,308	38,521	71,136

[1] *Time saved by HOV lane (minutes) was calculated, and rounded to tenths, by dividing "person-minutes" by "person volume."*

Table 23 also provides similar data for 1985, 1987, 1988 and 1989. Table 23 shows that the total travel time saved continued to increase with from 1985 through 1988, but decreased in 1989. The decrease in 1989 is due to fewer persons being moved on the HOV lane in the mornings after the 3+ carpool restriction went into effect. By 1990, however, the total travel time saved was up by more than 80% from 1989 levels. This dramatic increase was due to the opening of the eastern extension to the HOV lane (which bypasses the Post Oak intersection) and increased person volumes on the facility. Similar calculations for the afternoon peak period are presented in Tables 24 and 25 below.

Table 24.
Westbound P.M. Travel Time Savings for Katy HOV Lane Traffic, S.P.R.R. Overpass to Gessner Exit, October 1990

Time of Day	Average Travel Time		Time Saved by HOV Lane (minutes)	HOV Lane Volumes				Travel Time Saved (person minutes)
	Non HOV Lane (minutes)	HOV Lane (minutes)		Buses	Vans	Carpools	Persons	
4:00 p.m.	9.7	7.2	2.5	12	19	332	1,308	3,270
4:30 p.m.	8.3	7.6	0.7	18	14	524	1,875	1,313
5:00 p.m.	15.2	7.4	7.8	24	3	639	2,239	17,464
5:30 p.m.	22.7	9.5	13.2	36	5	626	2,551	33,673
6:00 p.m.	12.7	7.4	5.3	13	2	439	1,384	7,335
6:30 p.m.	—	7.2	—	9	1	251	727	—
3 Hour Total, 4:00-7:00 p.m.			6.3	112	44	2,811	10,084	63,055
2 Hour Total, 5:00-7:00 p.m.			8.5	82	11	1,955	6,901	58,472

Table 25.
Westbound P.M. Travel Time Savings for Katy HOV Lane Traffic, Gessner Exit to SH 6, October 1990

Time of Day	Average Travel Time		Time Saved by HOV Lane (minutes)	HOV Lane Volumes				Travel Time Saved (person minutes)
	Non HOV Lane (minutes)	HOV Lane (minutes)		Buses	Vans	Carpools	Persons	
4:00 p.m.	6.9	6.3	0.6	3	8	227	650	390
4:30 p.m.	7.0	6.6	0.4	5	8	251	771	308
5:00 p.m.	10.5	6.6	3.9	10	2	338	1,069	4,169
5:30 p.m.	7.8	6.5	1.3	11	2	262	942	1,225
6:00 p.m.	7.0	6.7	0.3	12	1	243	900	270
6:30 p.m.	—	6.8	—	8	3	227	711	—
3 Hour Total, 4:00-7:00 p.m.			1.3	49	24	1,548	5,043	6,362
2 Hour Total, 5:00-7:00 p.m.			1.6	41	8	1,070	3,622	5,664

Total Time Saved = 63,055 + 6,362 = 69,417 Person Minutes (4:00-7:00 p.m.).
Total Time Saved = 58,472 + 5,664 = 64,136 Person Minutes (5:00-7:00 p.m.).

The data in these tables indicate that significant improvements in the time saved by HOV lane has also occurred in the afternoon. As shown in Table 26, the total time saved by HOV lane users during the afternoon peak in 1990 was over 69,000 person-minutes (as compared to 40,000 person-minutes in 1989 -- about a 72% increase).

Table 26.
Total Travel Time Savings for Westbound Katy HOV Lane Traffic

Time of Day	5/85	11/87	10/88[1]	10/89	10/90
Time Saved by HOV Lane (minutes)[2]					
3:30 p.m.	-0.9	-0.9	—	—	—
4:00 p.m.	-0.1	-0.9	-0.3	3.9	2.8
4:30 p.m.	5.5	-1.8	6.4	3.9	0.9
5:00 p.m.	10.3	-0.5	-0.1	5.1	9.7
5:30 p.m.	12.2	3.1	-0.7	6.2	13.7
6:00 p.m.	2.0	4.5	4.3	4.7	5.5
6:30 p.m.	—	—	2.6	1.7	—
3 Hour Total, 4:00-7:00 p.m.	5.5	1.0	1.9	4.8	6.9
2 Hour Total, 5:00-7:00 p.m.	7.0	2.2	1.1	5.0	8.0
HOV Lane Person Volume					
3:30 p.m.	278	407	———	———	———
4:00 p.m.	412	1,024	1,011	1,107	1,308
4:30 p.m.	654	1,435	1,566	1,580	1,875
5:00 p.m.	496	1,632	1,907	1,981	2,239
5:30 p.m.	364	1,909	1,844	2,143	2,551
6:00 p.m.	180	898	1,023	1,109	1,384
6:30 p.m.	—	———	563	611	727
3 Hour Total, 4:00-7:00 p.m.	2,384	7,380	7,914	8,531	10,084
2 Hour Total, 5:00-7:00 p.m.	1,926	4,921	5,337	5,844	8,049
Travel Time Saved (person-minutes)					
3:30 p.m.	-246	-366	———	———	———
4:00 p.m.	-30	-937	-142	4,649	3,660
4:30 p.m.	3,576	-2,646	4,829	6,255	1,621
5:00 p.m.	5,110	-831	-48	10,008	21,633
5:30 p.m.	4,436	5,880	-838	13,257	34,898
6:00 p.m.	366	4,363	3,499	5,188	7,605
6:30 p.m.	———	———	930	1,056	———
3 Hour Total, 4:00-7:00 p.m.	13,212	7,044	8,230	40,413	69,417
2 Hour Total, 5:00-7:00 p.m.	13,488	10,627	3,543	29,509	64,136

[1] *The 4:00, 5:00 and 6:00 p.m. HOV lane travel times were measured in November 1988, as October 1988 travel times were not available for these time periods.*

[2] *Time saved by HOV lane (minutes) was calculated, and rounded to tenths, by dividing "person-minutes" by "person volume."*

The change in travel time for freeway users is also a concern. A comparison of freeway mainlane travel times in 1990 was made with similar data for 1985. Tables 27 and 28 use the travel time saved, freeway occupancy rate from Table 3 (1.05 persons per vehicle), and the volume count at Gessner (assumed as an average flow rate for the 13 miles) to calculate the

vehicle-minutes of travel time saved. Tables 27 and 28 indicate that there are significant travel time savings for freeway users particularly during the morning peak period. The average of the a.m. and p.m. travel time savings for freeway users is used as the fourth criterion for evaluating the success of the Katy HOV Lane carpool experiment.

Table 27.
Eastbound A.M. Travel Time Savings for Katy Freeway Mainlane (Non HOV Lane) Traffic, SH 6 to S.P.R.R. Overpass, October 1990

Time of Day	Non HOV Lane 1985 (minutes)	Non HOV Lane 1990 (minutes)	Time Saved 1985-1990 (minutes)	Vehicle Volume at Bunker Hill (vehicles)	Total Time Saved (person-minutes)
6:00 a.m.	13.8	14.9	-1.1	2,321	-2,732
6:30 a.m.	21.5	20.5	1.0	2,471	2,644
7:00 a.m.	30.2	36.1	-5.9	2,156	-13,611
7:30 a.m.	38.2	31.3	6.9	2,221	16,398
8:00 a.m.	32.7	19.1	13.6	2,254	32,800
8:30 a.m.	24.4	15.1	9.3	2,866	28,520
3 Hour Total, 6:00-9:00 a.m.			4.5	14,289	64,019
2 Hour Total, 6:30-8:30 a.m.			4.1	9,497	38,231

Table 28.
Westbound P.M. Travel Time Savings for Katy Freeway Mainlane (Non HOV Lane) Traffic, S.P.R.R. Overpass to SH 6, October 1990

Time of Day	Non HOV Lane 1985 (minutes)	Non HOV Lane 1990 (minutes)	Time Saved 1985-1990 (minutes)	Vehicle Volume at Bunker Hill (vehicles)	Total Time Saved (person-minutes)
4:00 p.m.	14.5	16.6	-2.1	2,658	-5,973
4:30 p.m.	19.6	15.2	4.4	2,555	12,029
5:00 p.m.	27.2	26.6	0.6	2,180	1,400
5:30 p.m.	30.3	30.6	-0.3	2,131	-684
6:00 p.m.	23.2	19.8	3.4	2,599	9,455
6:30 p.m.	—	—	—	—	—
3 Hour Total, 4:00-7:00 p.m.			1.3	12,123	16,227
2 Hour Total, 5:00-7:00 p.m.			1.5	6,910	10,171

Conclusion Pertaining to Fourth Evaluation Criterion

Changes in freeway speeds and travel times are the fourth criterion for evaluating the success of the Katy HOV Lane carpool experiment (Table 6). Table 29 indicates the results of

the evaluation of the mixed-flow lanes. In terms of this evaluation factor or measure of effectiveness, the carpool experiment is considered "highly successful" in that freeway speeds have actually improved. It is recognized that factors other than the HOV lane may have had a major impact on the fact that freeway speeds have improved.

Table 29.
Change in Person Delay to Mixed-Flow Traffic,
Criterion for Assessing the Success of the Katy HOV Lane Carpool Experiment

Date of Evaluation	Total Travel Time Saved (person-minutes)		Rating of Criterion (See Table 6)[1]
	a.m.	p.m.	
9/86	19,485	23,102	"Highly Successful"
11/87	55,623	66,245	"Highly Successful"
10/88	-395	59,737	"Highly Successful"
10/89	22,557	16,848	"Highly Successful"
10/90	64,019	16,227	"Highly Successful"

[1] *Based on average of a.m. and p.m. total travel time saved.*

HOV Lane Vehicle Breakdown Data

One of the concerns associated with permitting carpools to use the Katy HOV Lane has been that such an action would result in an increase in the frequency of vehicle breakdowns; if those breakdowns blocked the lane, HOV lane trip reliability would be adversely affected.

METRO operating data was obtained and analyzed for the period from October 29, 1984 through October 19, 1990. These data are summarized in Table 30.

Since carpools represent 96% of the vehicles, allowing carpools to use the HOV lane has greatly increased the number of vehicle breakdowns that occur. Carpools have represented 95% of all disabled vehicles on the HOV lane since the time 2+ carpools began using the facility. The carpool breakdown rate between May 1990 and October 1990 (approximately 1 per 33,000 vehicle-miles of travel) is actually less than that which would exist if only buses used the facility (a breakdown rate of approximately 1 per 22,000 vehicle-miles of travel).

Table 30.
Vehicle Breakdown Rates, Katy High-Occupancy Vehicle Lane

Vehicle Group	10/29/84 to 10/19/90[1]	4/1/85 to 10/19/90[2]	8/11/86 to 10/19/90[3]	10/17/88 to 10/19/90[4]	5/23/90 to 10/19/90[5]
Number of Disabled Vehicles					
Buses	96	93	57	33	9
Vans	14	14	9	1	1
Carpools	1,357	1,356	1,339	731	194
Total	1,467	1,463	1,405	765	204
Disabled Vehicles per Week	4.72	5.08	6.47	7.36	9.71
Number of Towed Vehicles					
Buses	26	26	18	9	4
Vans	7	7	6	0	0
Carpools	873	872	863	366	129
Total	906	905	887	375	133
Vehicle Miles of Travel (VMT)					
Buses	1,748,167	1,704,461	1,438,374	809,679	202,150
Vans	1,303,561	1,222,373	910,338	425,686	88,011
Carpools	48,958,324	48,958,324	48,629,340	26,632,228	6,374,481
Total	52,010,052	51,885,158	50,978,052	27,867,593	6,664,642
VMT per Disabled Vehicle					
VMT/Disabled Bus	18,210	18,328	25,235	24,536	22,461
VMT/Disabled Van	93,112	87,312	101,149	425,686	88,011
VMT/Disabled Carpool	36,078	36,105	36,318	36,433	32,858
VMT/Disabled Vehicle, Total	35,453	35,465	36,283	66,638	32,670
VMT per Towed Vehicle					
VMT/Towed Bus	67,237	65,556	79,910	89,964	50,538
VMT/Towed Van	186,223	174,625	151,723	——	——
VMT/Towed Carpool	56,081	56,145	56,349	72,766	49,415
VMT/Towed Vehicle, Total	57,406	57,332	57,472	74,314	50,110

[1] *Operating period from inception of the HOV lane.*
[2] *Operating period from when 4+ authorized carpools were allowed onto the HOV lane.*
[3] *Operating period from when unauthorized 2+ vehicles were allowed onto the HOV lane.*
[4] *Operating period from when use of the HOV lane was restricted to 3+ vehicles between 6:45 a.m. and 8:15 a.m.*
[5] *Operating period since use of the HOV lane was restricted to 3+ vehicles between 6:45 a.m. and 8:00 a.m.*
Note: Towed vehicles are a subset of disabled vehicles.

Conclusion Pertaining to Fifth Evaluation Criterion

An increase in the frequency of vehicle breakdowns on the Katy HOV Lane was the fifth evaluation criterion. The criterion was evaluated as follows: "highly successful," no increase; "successful," less than a 5% increase; "unsuccessful," increase by 5% to 15%; "highly unsuccessful," increase by over 15%.

The data suggest that the total breakdowns have increased substantially due to carpool utilization of the HOV lane; this equates to "highly unsuccessful." Even though carpool breakdowns generally do not physically block the lane, their frequency (roughly 10 per week) does create reliability concerns and requires frequent use of the METRO emergency crews. As a result, the findings for this criterion appear warranted.

Authorization and Enforcement Costs

The decision to allow carpools on the Katy HOV Lane could have increased costs for both enforcement and vehicle authorization. However, in August 1986, all authorization requirements were eliminated on the HOV lane. As a result, authorization costs were also eliminated and, at this time, are no longer an issue.

Increase in Enforcement Costs

Currently, METRO does not have permanent enforcement stations on the Katy HOV Lane. The officers assigned to the lanes use a roving patrol or stationary enforcement mode as the situation dictates. At present, there is a minimum of one METRO police officer assigned to the Katy HOV Lane (typically a motorcycle patrolman stationed at the Eastern Extension) which does not represent an increase or decrease in enforcement costs. The introduction of carpools to the Katy HOV Lane has resulted in an increase in traffic violations and vehicle breakdowns; however, operating costs have not been significantly affected at this time.

Conclusion Pertaining to Sixth Evaluation Criterion

Experience has shown that, at least to date, the HOV lane can be operated without authorization; thus, authorization costs have been eliminated. It appears that the marginal effect on enforcement due to HOV lane utilization has been minimal. In regard to this criterion, the

Katy HOV Lane carpool experiment is judged to be "successful." This is the same conclusion found in the 30-, 42- and 54-month "after carpools" evaluations (TTI Research Reports 484-7, 484-11, and 484-12).

Conclusions

The evaluation of the individual criterion for the 66-month "after carpools" evaluation is summarized in Table 31. Based on that observation, as of October 1990, the Katy HOV Lane carpool experiment is judged to be "successful." If numerical values are assigned to the possible outcomes (with "highly successful" = 4' "successful" = 3; "unsuccessful" = 2; and "highly unsuccessful" = 1), the weighted value for the carpool experiment is 3. The criteria related to HOV lane person movement, HOV lane travel time and mixed-flow traffic delay were rated as "highly successful" and the criterion related to enforcement costs was rated as "successful." The criteria rated as "unsuccessful" or "highly unsuccessful" included nonuser perception of HOV lane utilization and HOV lane vehicle breakdowns.

Table 31.
Overall Evaluation of the Katy HOV Lane Carpool Experiment, 66 Months After Carpools Were Allowed onto the HOV Lane

Criterion	Relative Weighting	Conclusion Pertaining to Experiment	Relevant Data
1. Change in Person Movement on the HOV Lane Directly Attributable to Carpooling	25%	"Highly Successful"	Carpools move 55% of total a.m. peak period person movement and 65% of the total daily person movement.
2. Nonuser Perception of Katy HOV Lane Utilization	30%	"Unsuccessful"	Less than 50% of the nonusers feel the HOV lane is sufficiently utilized.
3. Change in Travel Time on the HOV Lane	20%	"Highly Successful"	Average HOV lane speeds have increased by 1 mph.
4. Change in Delay to Mixed-Flow Traffic	15%	"Highly Successful"	Mixed-flow speeds have increased slightly.
5. Increase in Frequency of HOV Lane Breakdowns	5%	"Highly Unsuccessful"	Approximately 95% of HOV lane vehicle breakdowns are carpools. Approximately 10 breakdowns occur per week.
6. Increase in Authorization and Enforcement Costs	5%	"Successful"	Marginal increase in costs due to carpools has not been substantial.
TOTAL	100%	"Successful"	

Since the introduction of carpools, the Katy HOV Lane has maintained at least a minimal level of success (defined as a rating greater than 2.5). Since the introduction of the 2+ vehicle occupancy requirement with no authorization procedures, the HOV lane has maintained a rating at or near the "successful" level (3.0±). The trends in HOV lane success are shown in Table 32.

Table 32.
Overall Evaluation of the Katy HOV Lane Carpool Experiment, 1985-1990

Criterion	Relative Weighting	Conclusion Pertaining to Experiment					
		Apr 1986	Apr 1987	Oct 1987	Oct 1988	Oct 1989	Oct 1990
1. Change in Person Movement on the HOV Lane Directly Attributable to Carpooling	25%	2.5	4	4	4	4	4
2. Nonuser Perception of Katy HOV Lane Utilization	30%	1	2	3	3	2	2
3. Change in Travel Time on the HOV Lane	20%	4	4	3	1	3	4
4. Change in Delay to Mixed-Flow Traffic	15%	4	4	4	4	4	4
5. Increase in Frequency of HOV Lane Breakdowns	5%	3	1	1	1	1	1
6. Increase in Authorization and Enforcement Costs	5%	3	3	3	3	3	3
TOTAL	100%	2.63	3.20	3.30	2.90	3.00	3.20

Scoring:
1 = "Highly Unsuccessful"
2 = "Unsuccessful"
3 = "Successful"
4 = "Highly Successful"

CHAPTER 4
SURVEYS OF HOV LANE USERS AND NONUSERS

As part of the carpool evaluation, considerable survey data have been collected in the Katy HOV Lane corridor. Similar data were also collected for Houston's other three operating HOV lanes. Specifically, the surveys of HOV lane users and nonusers included:

- Transit riders traveling on the Katy, North, Northwest and Gulf HOV Lanes;
- Carpoolers and vanpoolers using the Katy, North, Northwest and Gulf HOV Lanes; and
- Motorists on the Katy, North, Northwest and Gulf Freeways *not* using the HOV lanes.

The primary intent of these surveys was to: 1) determine perceptions of the level of HOV lane utilization; 2) identify why individuals have chosen their present travel mode; and 3) assess attitudes and impacts pertaining to the HOV lanes. Demographic data and data concerning general travel characteristics were also collected as part of the major survey efforts.

All survey efforts were performed by TTI personnel. Comprehensive Katy HOV Lane survey efforts were undertaken on six separate occasions between March 1985 and October 1990. In addition, a special carpool survey was undertaken in October 1985 and special carpool and motorist surveys were performed in April 1987. Comprehensive survey efforts were also undertaken on two occasions in the North and Gulf HOV Lane corridors and on three occasions in the Northwest HOV Lane corridor. A chronological listing of survey activities relative to the opening dates and operating restrictions of each HOV lane is outlined on the following page.

MAJOR SURVEY ACTIVITIES

Katy HOV Lane User and Nonuser Surveys

March 1985 - 5 months after the opening of the HOV lane and 1 month before carpools were allowed on the facility.

April 1986 - 18 months after the HOV lane operation began; 1 year after carpools were introduced; approximately 7 months after the carpool passenger requirement was lowered to 3 persons.

October 1987 - Approximately 3 years after the HOV lane opened; 2.5 years after carpools were introduced; 14 months after unauthorized 2+ carpools were permitted.

November 1988 - Approximately 4 years after the HOV lane began operation; 3.5 years after carpools were introduced; 2 years after unauthorized 2+ carpools were permitted; 3 weeks after the carpool occupancy requirement was raised from 2 to 3 persons between the hours of 6:45 a.m. and 8:15 a.m.

October 1989 - Approximately 5 years after the HOV lane opened; 4.5 years following the introduction of carpools; 3 years after unauthorized 2+ carpools were allowed; 1 year after the passenger requirement for carpools was increased from 2 to 3 persons between the hours of 6:45 a.m. and 8:15 a.m.

October 1990 - Approximately 6 years after the HOV lane became operational; 5.5 years after carpools were introduced; 4 years after unauthorized 2+ carpools were allowed; 2 years after a.m. 3+ carpool occupancy requirement was implemented. *(Note: The hours of the 3+ operating restriction were modified to 6:45 a.m. - 8:00 a.m. in May 1990.)*

(Note: A special carpool survey was also undertaken in October 1985, and special carpool and motorist surveys were performed in April 1987.)

North HOV Lane User and Nonuser Surveys

January 1986 - 16 months after the North HOV Lane replaced the North Freeway Contraflow Lane.

October 1990 - Approximately 6 years after the North HOV Lane replaced the North Freeway Contraflow Lane; about 4 months after unauthorized 2+ carpools were introduced.

Northwest HOV Lane User and Nonuser Surveys

November 1988 - 3 months after the HOV lane opened (HOV lane carpool/vanpool surveys only).

October 1989 - 14 months after the HOV lane opened.

October 1990 - Just over 2 years after the HOV lane opened.

Gulf HOV Lane User and Nonuser Surveys

November 1988 - 6 months after the HOV lane opened (HOV lane carpool/vanpool surveys only).

October 1989 - Approximately 1.5 years after the HOV lane had opened.

Survey Methodologies

HOV Lane User Surveys

Bus Mode

On-board transit user surveys were conducted on all METRO bus routes using the Katy, North, Northwest and Gulf HOV Lanes during the a.m. peak operating period. For each route, the objective was to survey 100% of the passengers on approximately 30% of the bus runs. TTI staff were present on all buses surveyed to distribute and collect the surveys. Survey response rates by route are summarized in Tables 33 and 34. An example survey instrument used is included in the Appendix.

Carpool and Vanpool Modes

For the 1985 and 1986 surveys, vanpools and carpools were surveyed during the p.m. operating period. All vehicles were stopped at the entrances to the HOV lanes by METRO police. TTI staff distributed surveys to all carpools and vanpools on the Katy HOV Lane and to all vanpools using the North HOV Lane. One survey was given to the driver, and a different survey was given to each passenger. The driver survey requested more detailed data than did the passenger survey. Postage-paid return envelopes were included with the surveys, and the respondents were requested to return the completed questionnaire to TTI by mail.

For the 1987 Katy HOV Lane survey, however, it became necessary to modify the survey procedures. Vehicle volumes on the Katy HOV Lane during the p.m. peak were approaching 2,000 vehicles. Hence, for safety and operational reasons, it was no longer possible to distribute surveys by stopping vehicles as they entered the HOV lane. Instead, license plate numbers of carpools and vanpools traveling inbound on the HOV lane during the a.m. operating period were recorded by TTI Staff. TxDOT Division of Motor Vehicles license plate files were accessed to obtain addresses.

Table 33.
On-Board Transit User Survey Distribution,
Katy HOV Lane Bus Routes

Katy HOV Lane Bus Routes	Surveys Distributed	Surveys Completed	Response Rate
March 1985			
Katy-Mason Park-and-Ride	81	73	90%
Addicks Park-and-Ride	96	94	98%
West Belt Park-and-Ride	55	55	100%
Memorial Express	137	136	99%
Total	369	358	97%
April 1986			
Kingsland (formerly Katy-Mason) Park-and-Ride	106	104	98%
Addicks Park-and-Ride	219	211	96%
West Belt Park-and-Ride	100	99	99%
Memorial Express	169	167	99%
Total	594	581	98%
October 1987			
Kingsland Park-and-Ride	101	101	100%
Addicks Park-and-Ride	204	193	95%
West Belt Park-and-Ride	56	55	98%
Memorial Express	175	173	99%
Wilcrest Express	112	112	100%
Total	648	634	98%
October 1988			
Kingsland Park-and-Ride	111	105	95%
Addicks Park-and-Ride	363	341	94%
West Belt Park-and-Ride	86	79	92%
Memorial Express	171	166	97%
Wilcrest Express	89	86	97%
Total	820	777	95%
October 1989			
Katy-Fry Park-and-Ride	25	25	100%
Kingsland Park-and-Ride	113	104	92%
Addicks Park-and-Ride	290	279	96%
West Belt Park-and-Ride	64	61	95%
Memorial Express	122	114	93%
Wilcrest Express	69	61	88%
Total	683	644	94%
October 1990			
Kingsland Park-and-Ride	110	106	96%
Addicks Park-and-Ride	280	267	95%
West Belt Park-and-Ride	90	88	98%
Memorial Express	146	124	85%
Wilcrest Express	75	72	96%
Uptown Post Oak Express	15	15	100%
Total	716	672	94%

Table 34.
On-Board Transit User Survey Distribution,
North, Northwest and Gulf HOV Lane Bus Routes

North HOV Lane Bus Routes	Surveys Distributed	Surveys Completed	Response Rate
January 1986			
Kuykendahl Park-and-Ride	582	557	96%
North Shepherd Park-and-Ride	212	208	98%
Spring Park-and-Ride	246	234	95%
Seton Lake Park-and-Ride	151	144	95%
FM 1960 Express	104	104	100%
Total	1,295	1,247	96%
October 1990	489	453	92%
Kuykendahl Park-and-Ride	145	142	98%
North Shepherd Park-and-Ride	170	158	93%
Spring Park-and-Ride	189	184	97%
Seton Lake Park-and-Ride	56	52	93%
N. Shepherd/Texas Medical Center Park-and-Ride	1,049	989	94%
Total			
Northwest HOV Lane Bus Routes	**Surveys Distributed**	**Surveys Completed**	**Response Rate**
October 1989			
Northwest Station Park-and-Ride	172	169	98%
West Little York Park-and-Ride	48	48	100%
Total	220	217	99%
October 1990			
Northwest Station Park-and-Ride	222	214	96%
West Little York Park-and-Ride	50	49	98%
Pinemont Park-and-Ride	32	31	97%
Total	304	294	97%
Gulf HOV Lane Bus Routes	**Surveys Distributed**	**Surveys Completed**	**Response Rate**
October 1989			
Bay Area Park-and-Ride	216	197	91%
Edgebrook Park-and-Ride	215	205	95%
South Belt Express	65	63	97%
Total	496	465	94%

A survey was mailed to each address (excluding corporate addresses and leasing agencies). A postage-paid return envelope was included with each of the surveys. Carpool and vanpool drivers were asked to complete the survey and return it to TTI. This same procedure was followed for the 1988, 1989 and 1990 carpool/vanpool surveys. An example survey instrument used is included in the Appendix. Response rates to the Katy, North, Northwest and Gulf HOV Lane carpool/vanpool surveys are presented in Table 35.

Table 35.
Carpool/Vanpool Survey Distribution,
Katy, North, Northwest and Gulf HOV Lanes

Survey Group	License Plates Read	Surveys Mailed or Distributed	Surveys Returned Address Unknown or Vehicle Not on HOV Lane	Surveys Completed	Response Rate (% of Surveys Mailed or Distributed)
Katy HOV Lane, March 1985					
Vanpool Drivers & Passengers	—	689	—	465	67%
Katy HOV Lane, October 1985					
Carpool Drivers & Passengers	—	121	—	81	67%
North HOV Lane, January 1986					
Vanpool Drivers & Passengers	—	2,323	—	1,637	70%
Katy HOV Lane, April 1986					
Carpool & Vanpool Drivers & Passengers	—	977	—	637	65%
Katy HOV Lane, April 1987					
Carpool & Vanpool Drivers	2,459	1,603	147	607	38%
Katy HOV Lane, October 1987					
Carpool & Vanpool Drivers	2,502	1,536	111	605	39%
Katy HOV Lane, November 1988					
Carpool & Vanpool Drivers	1,704	1,033	81	409	40%
Northwest HOV Lane, November 1988					
Carpool & Vanpool Drivers	797	553	71	261	47%
Gulf HOV Lane, November 1988					
Carpool & Vanpool Drivers	500	363	27	124	34%
Katy HOV Lane, October 1989					
Carpool & Vanpool Drivers	2,204	1,507	91	590	39%
Northwest HOV Lane, October 1989					
Carpool & Vanpool Drivers	917	596	42	253	42%
Gulf HOV Lane, October 1989					
Carpool & Vanpool Drivers	567	367	19	122	33%
Katy HOV Lane, October 1990					
Carpool & Vanpool Drivers	5,546[1]	2,807	253	767	27%
North HOV Lane, October 1990					
Carpool & Vanpool Drivers	887	537	43	190	35%
Northwest HOV Lane, October 1990					
Carpool & Vanpool Drivers	743	561	43	239	43%

[1] *Just prior to the time the 1990 survey was performed, METRO had recorded license plate numbers of HOV lane carpoolers/vanpoolers during both the a.m. and p.m. peak periods for the purpose of mailing out informational packets containing a brochure on HOV lane enforcement and a letter encouraging poolers to alter their evening travel schedule in order to reduce p.m. congestion on the HOV lane. TTI used the license plate numbers provided by METRO for the carpool/vanpool survey.*

Non HOV Lane User Surveys

During the 6:00 a.m. - 9:30 a.m. peak period, license plate numbers of motorists traveling inbound on the Katy, North, Northwest and Gulf Freeway mainlanes were recorded by TTI observers. The survey procedures followed were essentially identical to those described previously for the 1987-1990 carpool/vanpool surveys. (TxDOT Division of Motor Vehicle license plate files were accessed to obtain addresses. A survey was mailed to each address, excluding corporate addresses and leasing agencies. Motorists were asked to complete the survey and return it to TTI in the postage paid envelope provided.) Response rates to the motorist surveys are presented in Table 36. An example of the survey questionnaire used is included in the Appendix.

Table 36.
Motorist (Non HOV Lane User) Survey Distribution,
Katy, North, Northwest and Gulf Freeways

Motorists	License Plates Read	Surveys Mailed	Surveys Returned Address Unknown or Vehicle Not on Freeway	Surveys Completed	Response Rate (% of Surveys Mailed)
Katy Freeway, March 1985	2,090	1,435	121	454	32%
North Freeway, January 1986	2,470	1,585	154	422	27%
Katy Freeway, April 1986	2,817	1,714	106	744	43%
Katy Freeway, April 1987	3,220	2,030	154	910	45%
Katy Freeway, October 1987	5,118	3,241	221	1,436	44%
Katy Freeway, November 1988	3,910	2,018	97	1,069	53%
Katy Freeway, October 1989	4,876	3,069	207	1,135	37%
Northwest Freeway, October 1989	5,045	3,271	215	1,133	35%
Gulf Freeway, October, 1989	3,820	2,290	172	656	29%
Katy Freeway, October 1990	1,153	624	39	194	31%
North Freeway, October 1990	3,289	2,212	160	653	30%
Northwest Freeway, October 1990	3,046	2,003	117	734	37%

Comparison to Previous Data

Several of the survey questions used in the Katy, North and Gulf HOV Lane user and nonuser surveys are similar to those used in surveys of park-and-ride users and nonusers along the Katy, North and Gulf Freeways conducted by TTI in 1981 and 1984. When possible, for comparative purposes, the 1981 and 1984 data are also presented. During the 1981 and 1984 survey efforts, no priority treatment of any form was available along the Katy or Gulf Freeways. On the North Freeway, however, a contraflow lane was available for authorized buses and vanpools at the time of the 1981 and 1984 surveys.

CHAPTER 5
HOV LANE TRANSIT USER SURVEYS

HOV lane transit user surveys were performed on six different occasions in the Katy Freeway corridor (once yearly between 1985 and 1990). North HOV Lane bus user surveys were performed in 1986 and 1990. Northwest HOV Lane bus patrons were surveyed in 1989 and 1990; transit users on the Gulf HOV Lane were surveyed in 1989. In general, responses from users of the park-and-ride services within each HOV lane corridor are similar. The responses from the express route(s) surveyed in each corridor differ in some respects from the park-and-ride responses and are, therefore, presented separately. The surveys of Katy, North, Northwest and Gulf HOV Lane transit users were primarily designed to address the following three areas:

- Personal characteristics;
- Travel patterns and trip characteristics; and
- Attitudes and impacts pertaining to the HOV lanes.

Personal Characteristics

Questions pertaining to the transit patrons' age, sex, occupation and last year of school completed were asked. Responses to these questions follow.

Age

As indicated in Table 37, the median age of the HOV lane park-and-ride patrons is in the mid to late 30s. These data are consistent with previous park-and-ride transit user surveys

conducted in 1981 and 1984. The median ages for riders of the express routes which utilize the HOV lanes are traditionally several years higher, however.

Table 37.
Median Age of HOV Lane Transit Users,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

Age (years)	Katy HOV Lane					
	1985	1986	1987	1988	1989	1990
Total Sample	(n=351)	(n=568)	(n=613)	(n=746)	(n=615)	(n=655)
Median	33	32	35	34	35	36
Park-and-Ride Routes	(n=219)	(n=409)	(n=341)	(n=506)	(n=451)	(n=451)
Median	33	31	34	34	34	35
Express Routes	(n=132)	(n=159)	(n=272)	(n=240)	(n=164)	(n=204)
Median	37	37	37	36	36	40

Age (years)	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
	1986	1990	1989	1990	1989
Total Sample	(n=1226)	(n=953)	(n=202)	(n=284)	(n=440)
Median	34	38	34	35	34
Park-and-Ride Routes	(n=1129)	(n=953)	(n=202)	(n=284)	(n=387)
Median	33	38	34	35	34
Express Routes	(n=97)	—	—	—	(n=53)
Median	42	—	—	—	36

Sex

Most recent survey data indicate that between 57% and 70% of the park-and-ride ridership within each corridor is female (Katy - 57%, North - 60%, Northwest - 57%, and Gulf - 70%). In addition, 71% of the express route riders on the Gulf HOV Lane express route are female. Conversely, 58% of the express route riders on the Katy HOV Lane are male (Table 38).

Table 38.
Sex of HOV Lane Transit Users,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

Sex	Katy HOV Lane					
	1985	1986	1987	1988	1989	1990
Total Sample	(n=351)	(n=565)	(n=607)	(n=741)	(n=593)	(n=638)
Male	49%	44%	42%	42%	47%	48%
Female	51%	56%	58%	58%	53%	52%
Park-and-Ride Routes	(n=218)	(n=402)	(n=332)	(n=504)	(n=435)	(n=441)
Male	47%	40%	36%	40%	44%	43%
Female	53%	60%	64%	60%	56%	57%
Express Routes	(n=133)	(n=163)	(n=275)	(n=237)	(n=158)	(n=197)
Male	53%	54%	49%	46%	54%	58%
Female	47%	46%	51%	54%	46%	42%

Sex	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
	1986	1990	1989	1990	1989
Total Sample	(n=1203)	(n=941)	(n=205)	(n=276)	(n=432)
Male	44%	40%	41%	43%	30%
Female	56%	60%	59%	57%	70%
Park-and-Ride Routes	(n=1105)	(n=941)	(n=205)	(n=276)	(n=377)
Male	41%	40%	41%	43%	30%
Female	59%	60%	59%	57%	70%
Express Routes	(n=98)	—	—	—	(n=55)
Male	74%	—	—	—	29%
Female	26%	—	—	—	71%

Occupation

More than three-fourths of the current riders on all routes serving the Katy, North, Northwest an Gulf HOV Lanes are employed in "professional," "clerical," or "managerial" job positions (Table 39). The greatest number of park-and-ride and express bus riders on the Katy, North and Northwest HOV Lanes is "professional." By contrast, the greatest number of riders on the Gulf HOV Lane express route is classified as "clerical."

Table 39.
Occupation of HOV Lane Transit Users,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

Occupation	Katy HOV Lane					
	1985	1986	1987	1988	1989	1990
Total Sample	(n=343)	(n=550)	(n=603)	(n=718)	(n=584)	(n=638)
Professional	56%	46%	44%	44%	51%	50%
Managerial	13%	20%	14%	26%	15%	19%
Clerical	21%	26%	27%	24%	26%	20%
Sales	4%	4%	6%	3%	3%	5%
Student	3%	3%	3%	1%	1%	2%
Other	3%	1%	6%	2%	4%	4%
Park-and-Ride Routes	(n=215)	(n=391)	(n=334)	(n=487)	(n=432)	(n=439)
Professional	57%	47%	47%	46%	52%	49%
Managerial	13%	20%	11%	24%	14%	19%
Clerical	22%	28%	31%	26%	28%	23%
Sales	4%	3%	5%	2%	3%	4%
Student	1%	1%	5%	0%	2%	1%
Other	3%	1%	1%	2%	1%	4%
Express Routes	(n=128)	(n=159)	(n=269)	(n=231)	(n=152)	(n=199)
Professional	54%	45%	41%	40%	48%	51%
Managerial	14%	22%	19%	29%	15%	19%
Clerical	20%	19%	22%	21%	23%	14%
Sales	4%	4%	8%	3%	2%	5%
Student	5%	6%	5%	3%	—	4%
Other	3%	4%	5%	4%	12%	7%

Occupation	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
	1986	1990	1989	1990	1989
Total Sample	(n=1140)	(n=900)	(n=199)	(n=270)	(n=437)
Professional	38%	43%	36%	45%	41%
Managerial	23%	12%	12%	17%	16%
Clerical	30%	30%	40%	25%	32%
Sales	3%	3%	5%	8%	2%
Student	1%	2%	2%	1%	4%
Other	5%	10%	5%	4%	5%
Park-and-Ride Routes	(n=1092)	(n=900)	(n=199)	(n=270)	(n=381)
Professional	38%	43%	36%	45%	43%
Managerial	22%	12%	12%	17%	17%
Clerical	32%	30%	40%	25%	31%
Sales	3%	3%	5%	8%	2%
Student	0%	2%	2%	1%	3%
Other	5%	10%	5%	4%	4%
Express Routes	(n=98)	—	—	—	(n=56)
Professional	41%	—	—	—	29%
Managerial	34%	—	—	—	14%
Clerical	12%	—	—	—	34%
Sales	6%	—	—	—	5%
Student	3%	—	—	—	11%
Other	4%	—	—	—	7%

Education

As has been found in previous park-and-ride surveys, users of this type of bus service are highly educated. The average HOV lane bus patron (park-and-ride and express route) has completed at least two years of college (Table 40).

Table 40.
Average Educational Level of HOV Lane Transit Users,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

	Katy HOV Lane					
Education (years)	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
Total Sample Average	(n=346) 15.6	(n=570) 15.4	(n=591) 15.4	(n=739) 15.2	(n=593) 15.3	(n=641) 15.5
Park-and-Ride Routes Average	(n=215) 15.4	(n=409) 15.4	(n=326) 15.3	(n=502) 15.2	(n=438) 15.3	(n=441) 15.4
Express Routes Average	(n=131) 16.0	(n=161) 15.5	(n=265) 15.5	(n=237) 15.4	(n=155) 15.1	(n=200) 15.6

	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
Education (years)	**1986**	**1990**	**1989**	**1990**	**1989**
Total Sample Average	(n=1214) 14.9	(n=920) 14.9	(n=195) 14.5	(n=280) 15.2	(n=432) 14.2
Park-and-Ride Routes Average	(n=1112) 14.9	(n=920) 14.9	(n=195) 14.5	(n=280) 15.2	(n=378) 14.2
Express Routes Average	(n=102) 15.8	— —	— —	— —	(n=54) 14.2

Travel Patterns and Trip Characteristics

Questions relating to trip origin, trip destination, trip purpose, whether the employer pays for part of the bus fare, and whether a car was available for the trip were asked. Responses to these questions are highlighted on the following pages.

Trip Origin

Transit riders were asked to identify the Zip Code origin of their a.m. trip. Data for the Katy HOV Lane routes are illustrated in Figures 14-19 and summarized in Table 41. Data for the North HOV Lane routes are shown in Figures 20-24 and outlined in Table 42. Northwest HOV Lane route data are illustrated in Figures 25-27 and summarized in Table 43; Gulf HOV Lane route data are shown in Figures 28-30 and outlined in Table 44. The park-and-ride route origin data are consistent with market areas as defined in previous surveys.

Katy HOV Lane Routes

As to be expected, the 1985-1990 ridership on the Memorial Express route primarily originates from Zip Codes immediately adjacent to Memorial Drive. Similarly, the 1987-1990 ridership on the Wilcrest Express route primarily originates from Zip Codes immediately adjacent to Wilcrest. Virtually all of the ridership on the Uptown-Post Oak Express route (whose morning departure is from the Addicks Park-and-Ride Lot) originates from Zip Codes north of the Katy Freeway.

Both the West Belt and Addicks Park-and-ride Lots are located north of the Katy Freeway. In 1985, approximately 60% of the ridership for the West Belt lot originated from Zip Codes north of the freeway. In 1986, however, the north/south ridership split was 50%/50%. In 1987, trip origins shifted once again; about 65% of the riders originated from north of the freeway. About 65% of the 1988 and 1989 riders also originated from north of the freeway. In 1990, approximately 56% of the West Belt park-and-ride patrons listed Zip Code origins north of the freeway.

Most recent data for the Addicks lot indicate that about 56% of its current ridership originates from north of the Katy Freeway (as compared to 60% in 1989, 65% in 1987 and 1986 and 70% in 1985 originating from north of the freeway).

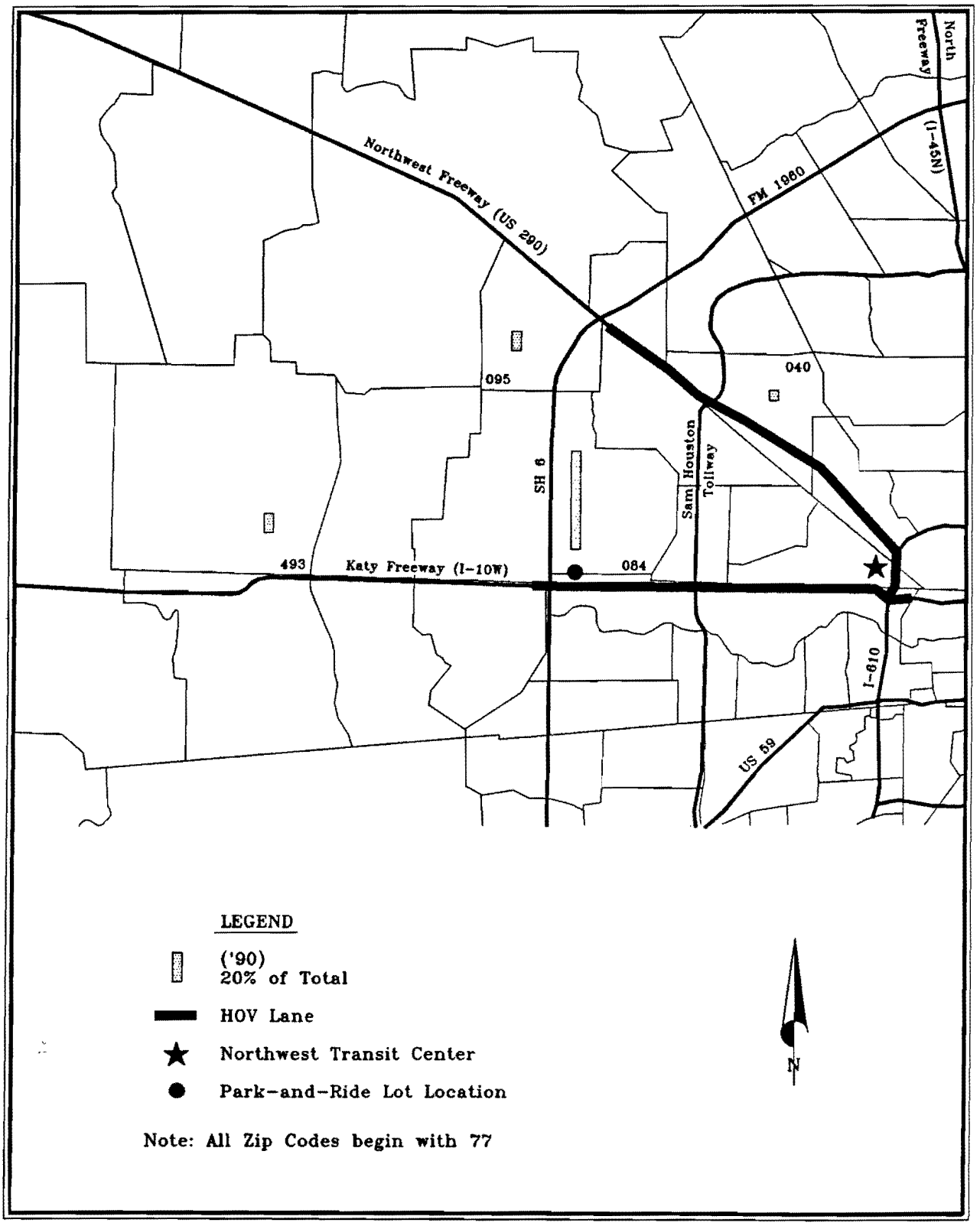


Figure 14. Home Origins of Patrons of the Uptown-Post Oak Express Route

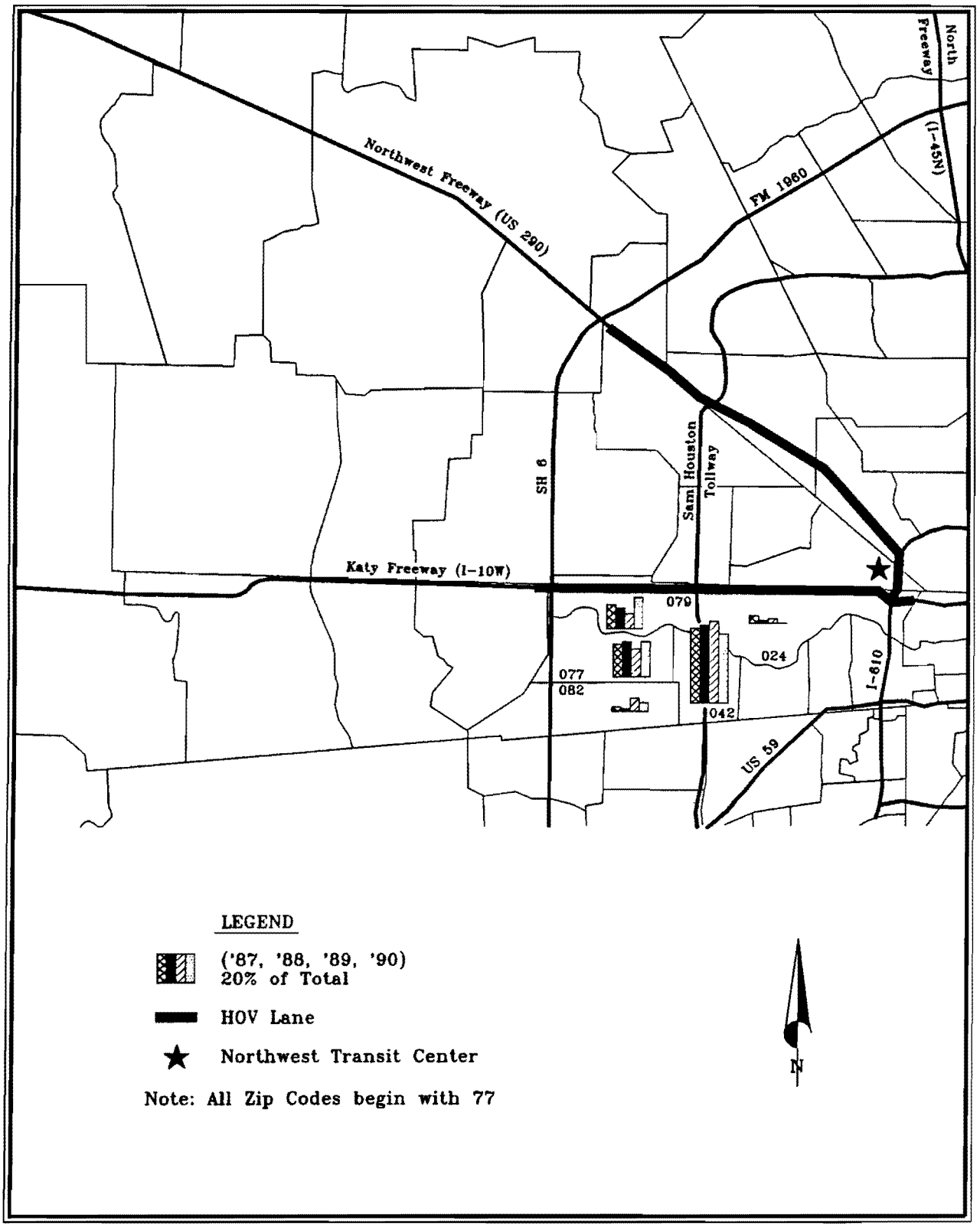


Figure 15. Home Origins of Patrons of the Wilcrest Express Route

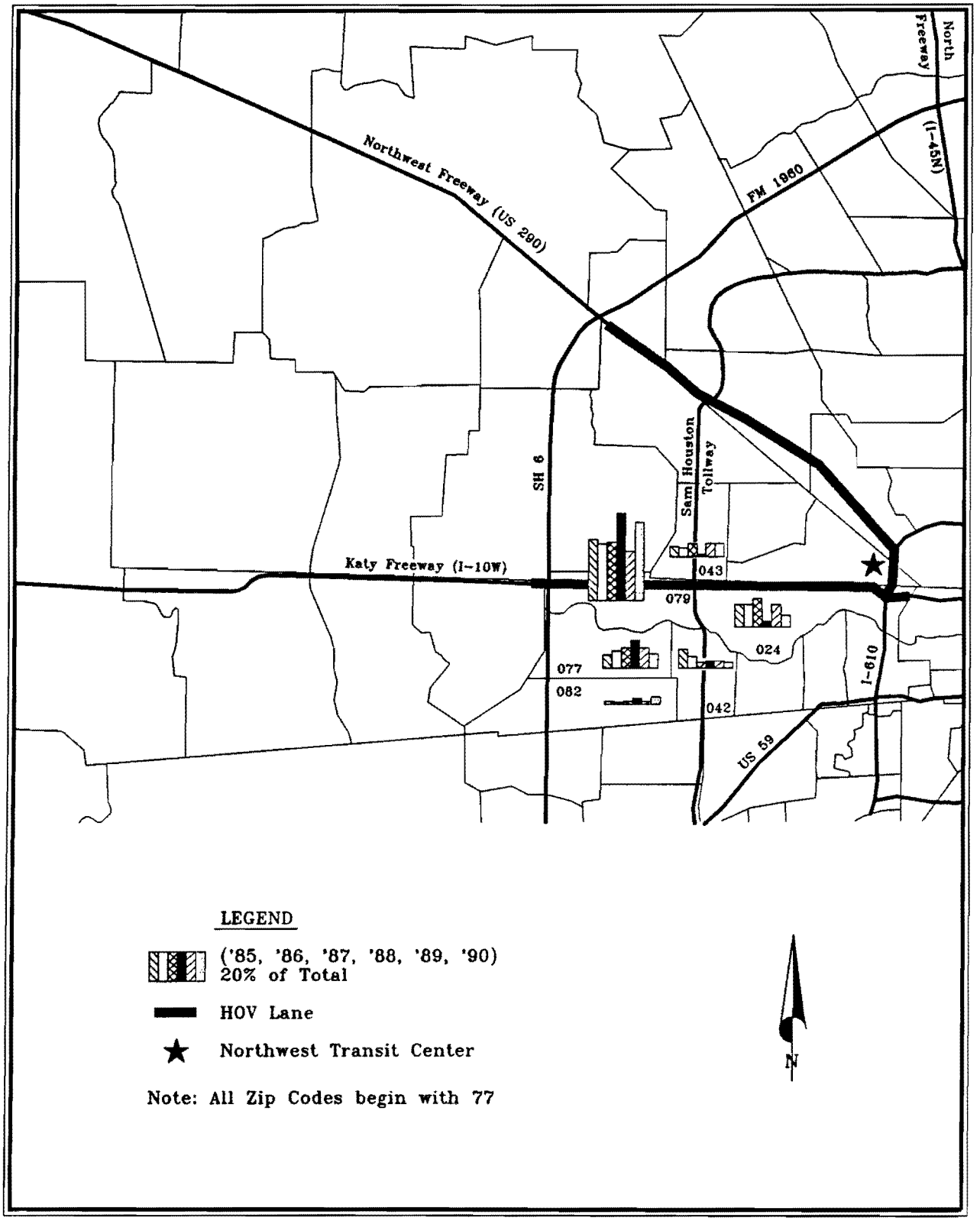


Figure 16. Home Origins of Patrons of the Memorial Express Route

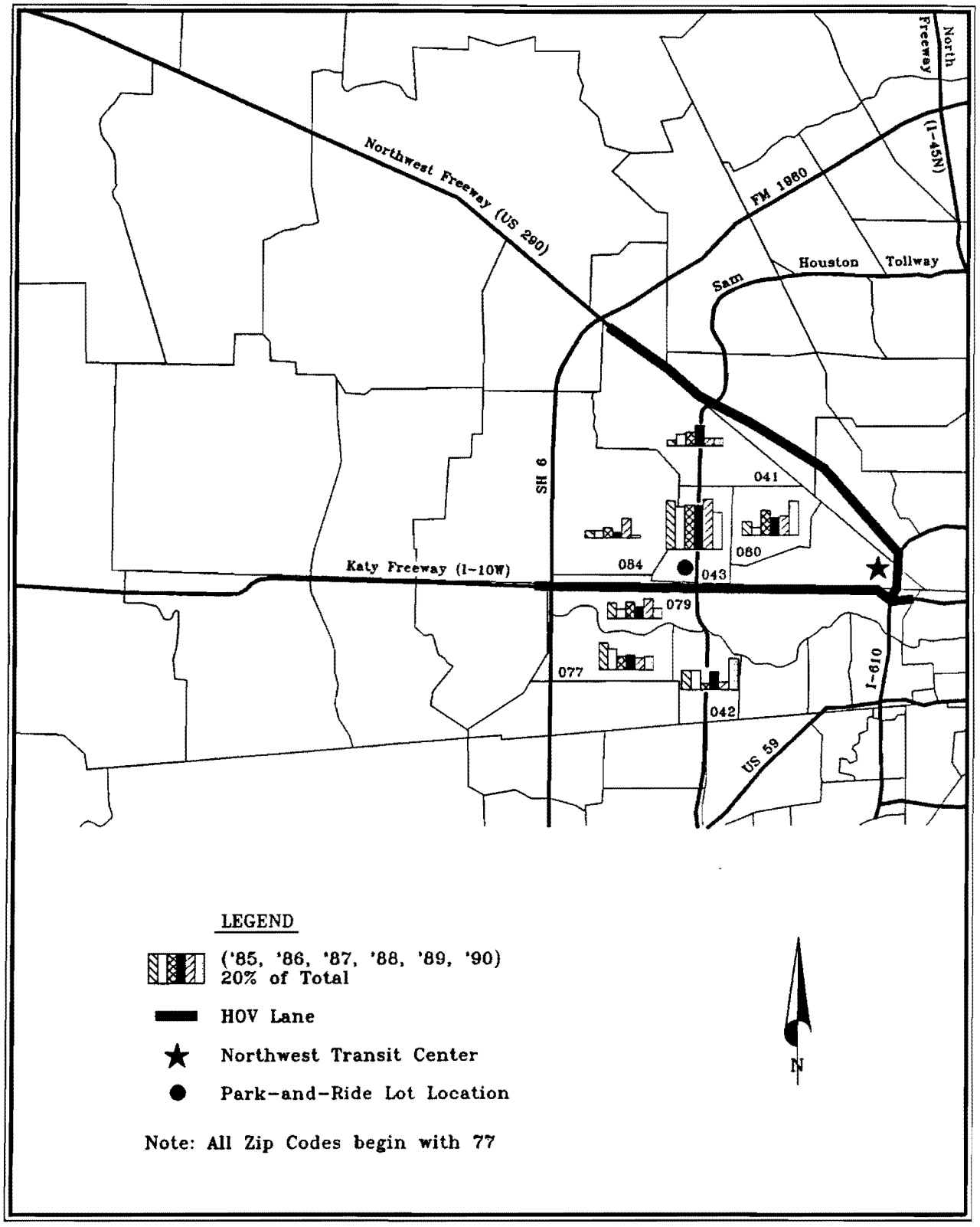


Figure 17. Home Origins of Patrons of the Katy-West Belt Park-and-Ride Service

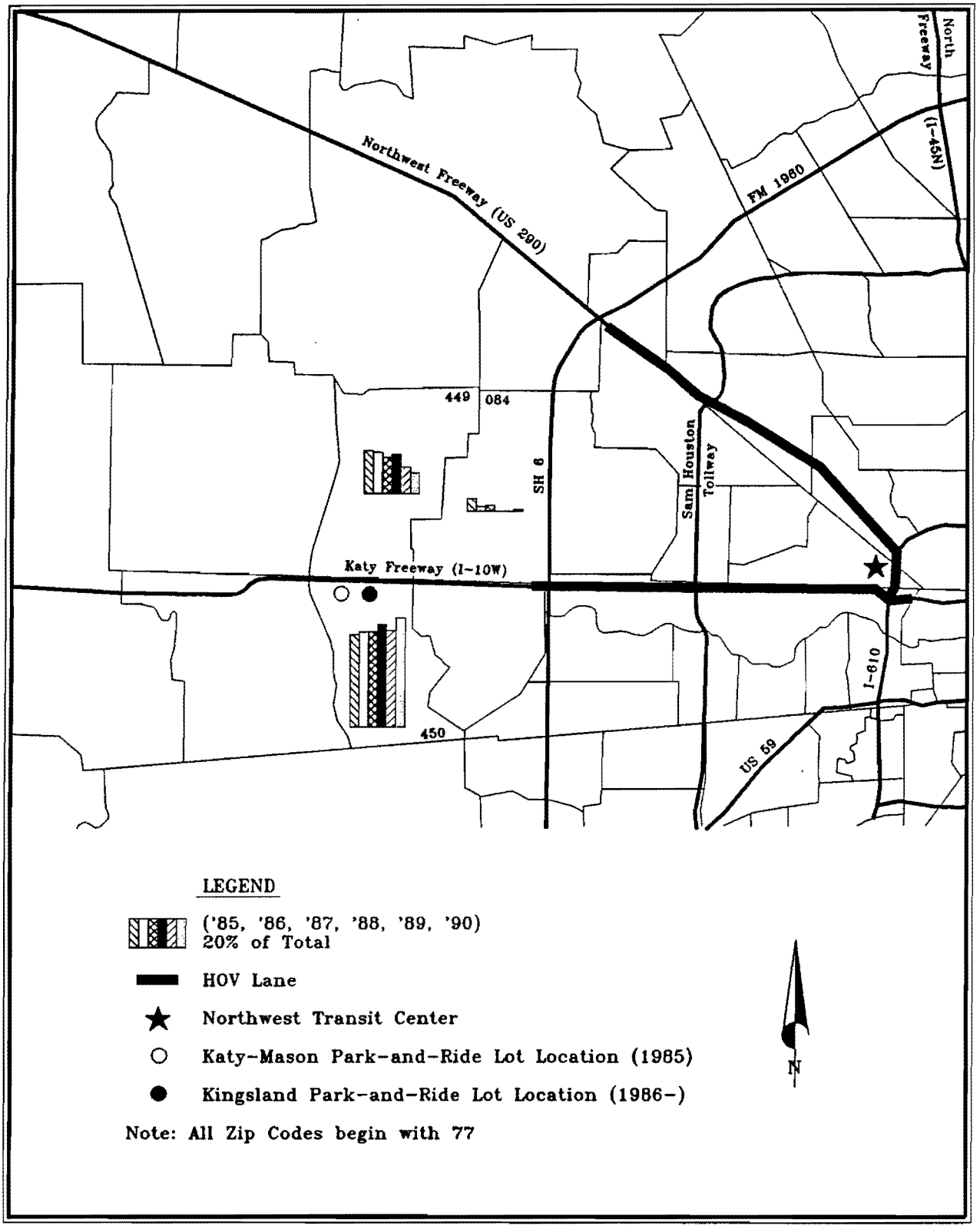


Figure 18. Home Origins of Patrons of the Katy-Mason/Kingsland Park-and-Ride Service

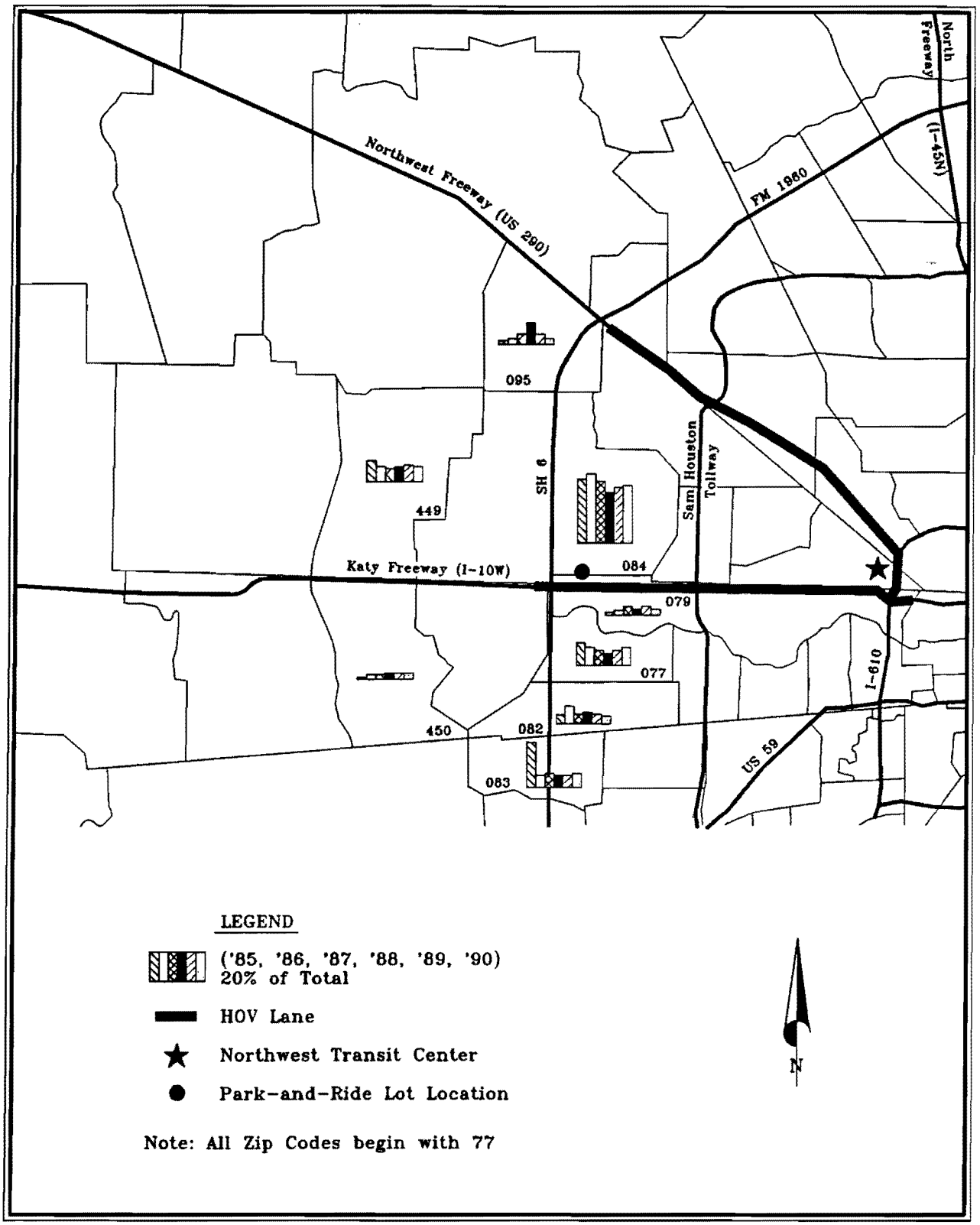


Figure 19. Home Origins of Patrons of the Addicks Park-and-Ride Service

Table 41.
Zip Code Origins for Katy HOV Lane Transit Trips,
Katy HOV Lane Transit User Surveys

Katy HOV Lane Bus Route	Zip Code	Location Relative to Katy Freeway	Percent of Total Origins					
			1985	1986	1987	1988	1989	1990
Uptown - Post Oak Express	77084	——	—	—	—	—	—	67%
	77095	——	—	—	—	—	—	13%
	77493	——	—	—	—	—	—	13%
	77040	——	—	—	—	—	—	7%
Wilcrest Express	77042	——	—	—	51%	53%	56%	47%
	77077	——	—	—	22%	24%	19%	24%
	77079	——	—	—	16%	14%	10%	21%
	77024	——	—	—	5%	2%	3%	—
	77082	——	—	—	3%	2%	9%	6%
	Other	——	—	—	3%	5%	3%	2%
Memorial Express	77079	——	41%	38%	39%	59%	33%	53%
	77024	——	15%	15%	19%	4%	15%	8%
	77042	——	13%	8%	4%	5%	5%	4%
	77077	——	9%	12%	14%	19%	14%	10%
	77043	——	7%	6%	9%	2%	9%	9%
	77082	——	2%	1%	2%	4%	2%	5%
	Other	——	13%	20%	13%	7%	22%	11%
Katy/West Belt Park-and-Ride	77043	North	33%	29%	30%	30%	34%	25%
	77077	South	18%	14%	9%	10%	8%	9%
	77042	South	13%	13%	4%	12%	5%	21%
	77041	North	4%	8%	9%	14%	5%	5%
	77079	South	10%	6%	11%	8%	13%	7%
	77080	North	9%	5%	17%	12%	13%	23%
	77084	North	5%	5%	7%	4%	13%	2%
	Other	——	8%	20%	13%	10%	9%	8%
Kingsland Park-and-Ride	77450	South	62%	64%	64%	69%	65%	73%
	77449	North	29%	28%	24%	27%	18%	13%
	77084	North	8%	3%	4%	—	—	1%
	Other	——	1%	5%	8%	4%	17%	13%
Addicks Park-and-Ride	77084	North	43%	47%	42%	34%	38%	39%
	77077	South	15%	12%	10%	8%	10%	12%
	77449	North	14%	10%	9%	10%	11%	10%
	77082	South	6%	12%	7%	8%	7%	5%
	77083	South	3%	8%	9%	8%	8%	9%
	77095	North	3%	4%	7%	15%	7%	4%
	77079	South	2%	3%	6%	4%	6%	4%
	77450	South	1%	3%	3%	4%	4%	4%
	Other	——	13%	1%	7%	9%	9%	13%

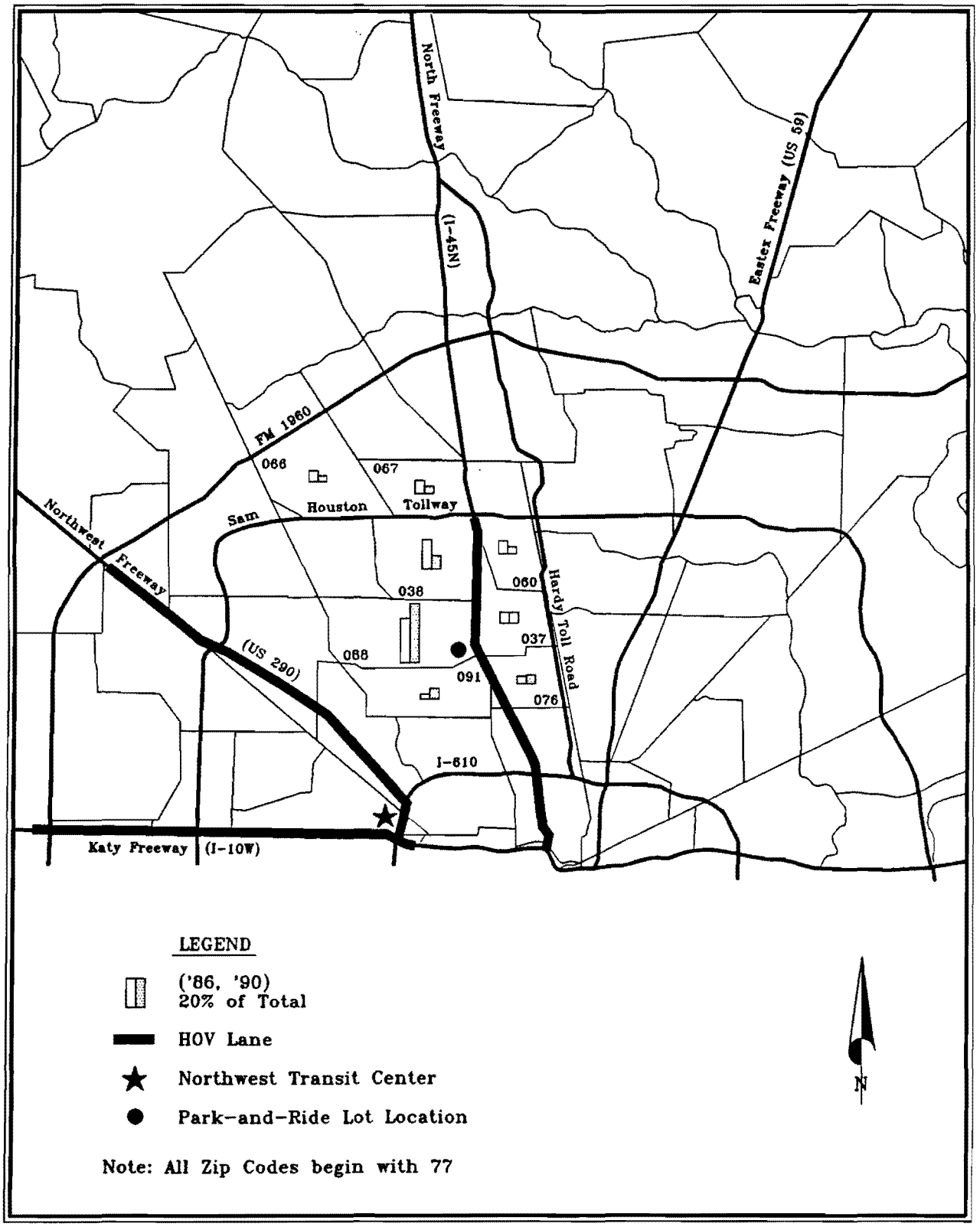


Figure 20. Home Origins of Patrons of the North Shepherd Park-and-Ride Service

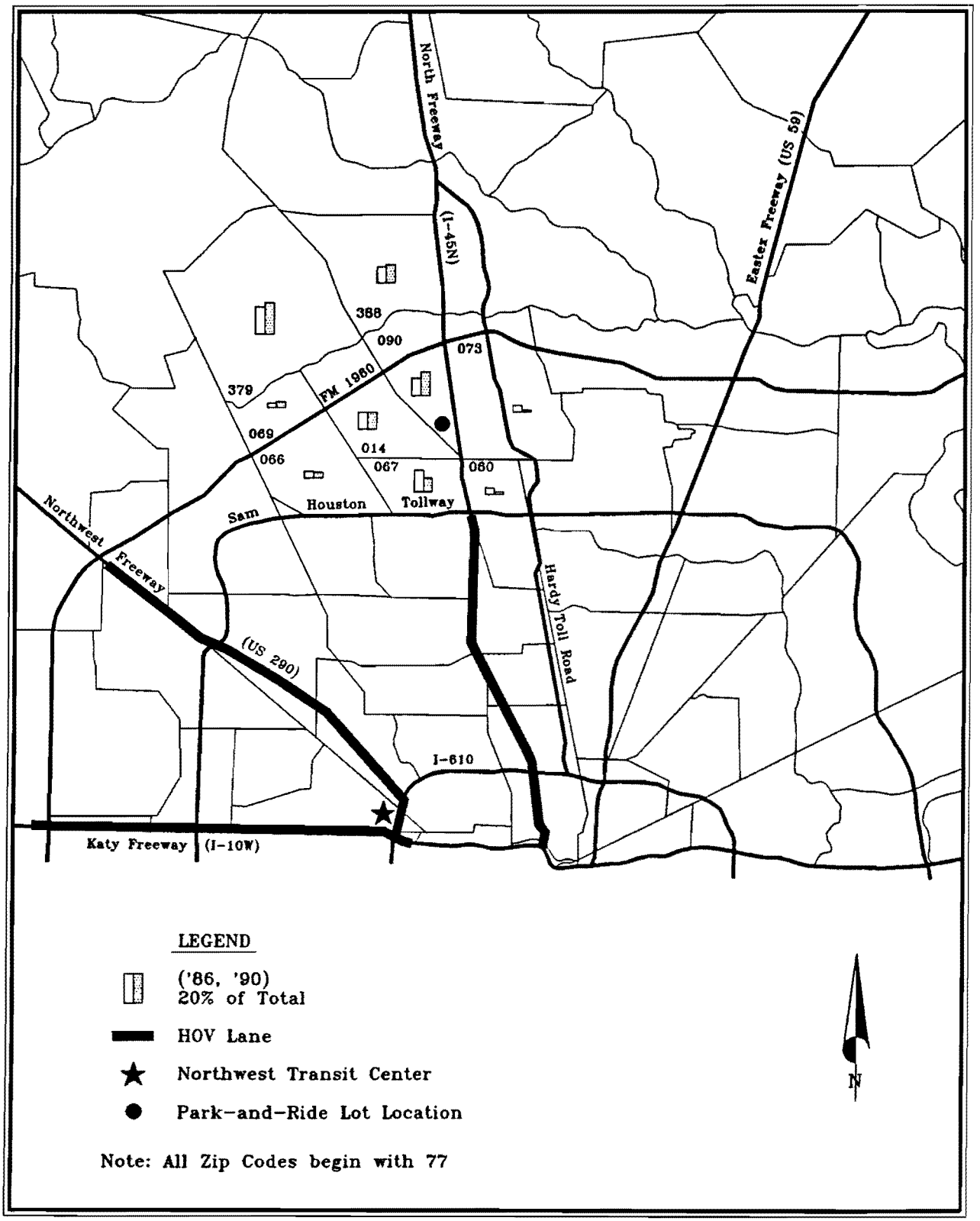


Figure 21. Home Origins of Patrons of the Kuykendahl Park-and-Ride Service

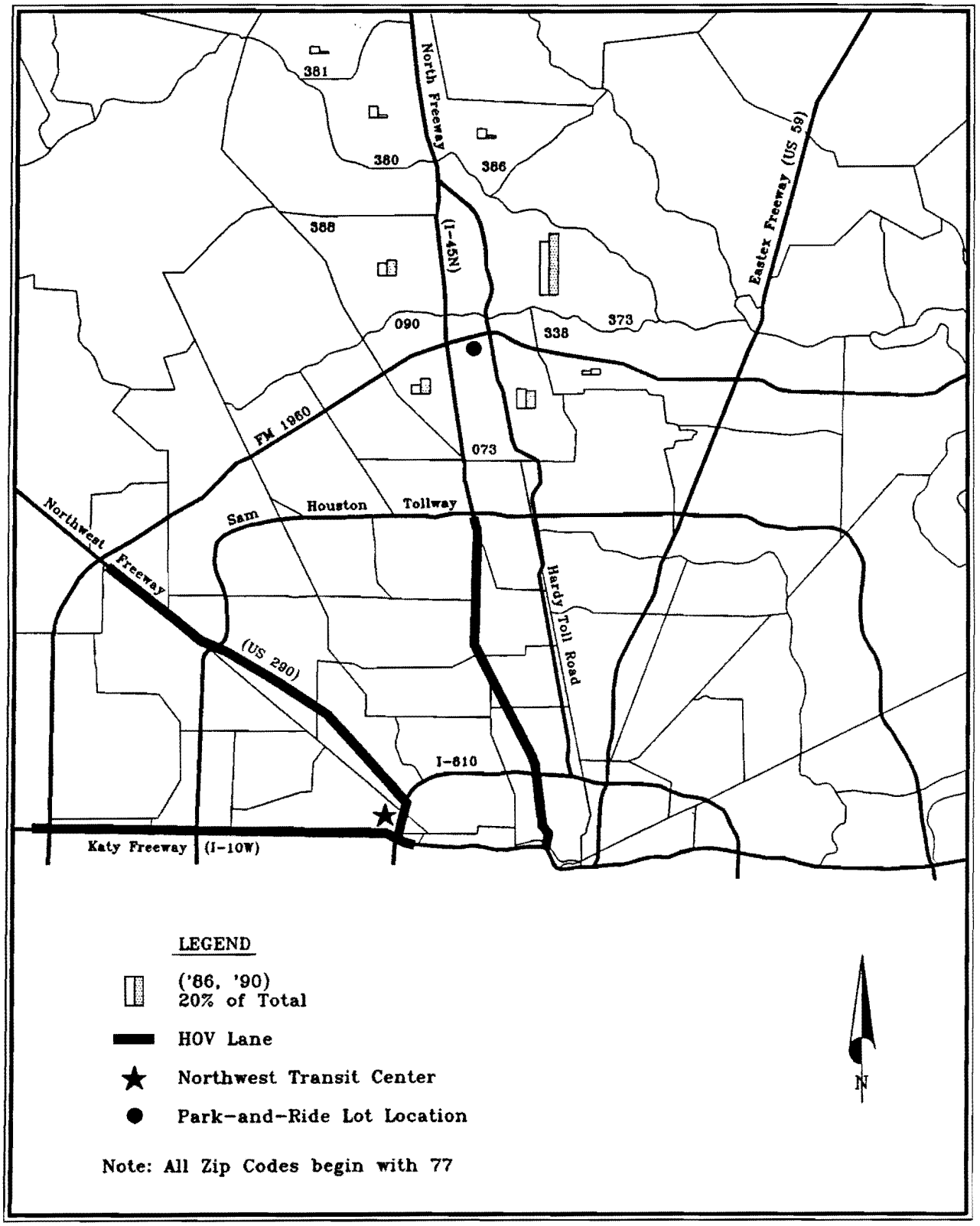


Figure 22. Home Origins of Patrons of the Spring Park-and-Ride Service

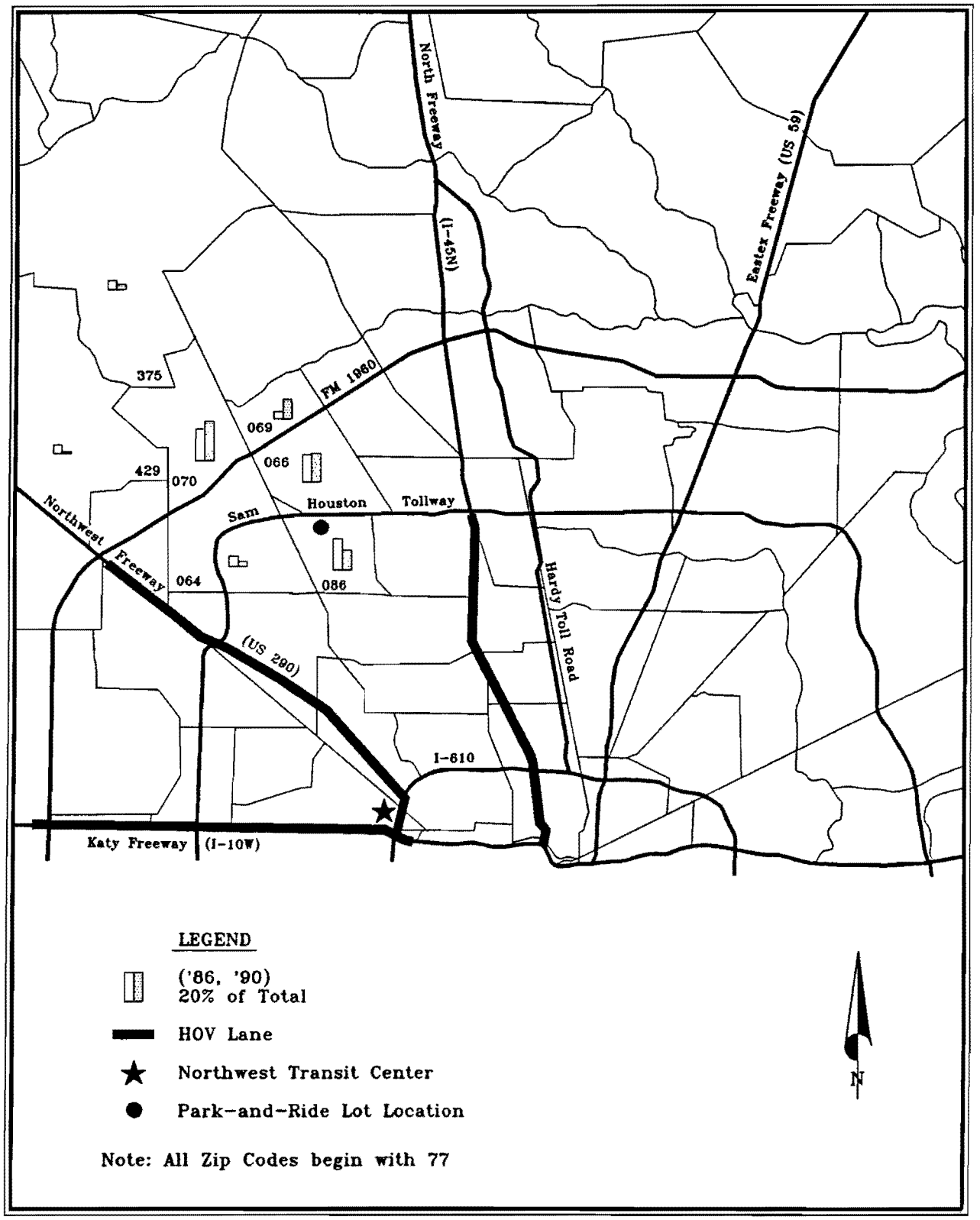


Figure 23. Home Origins of Patrons of the Seton Lake Park-and-Ride Service

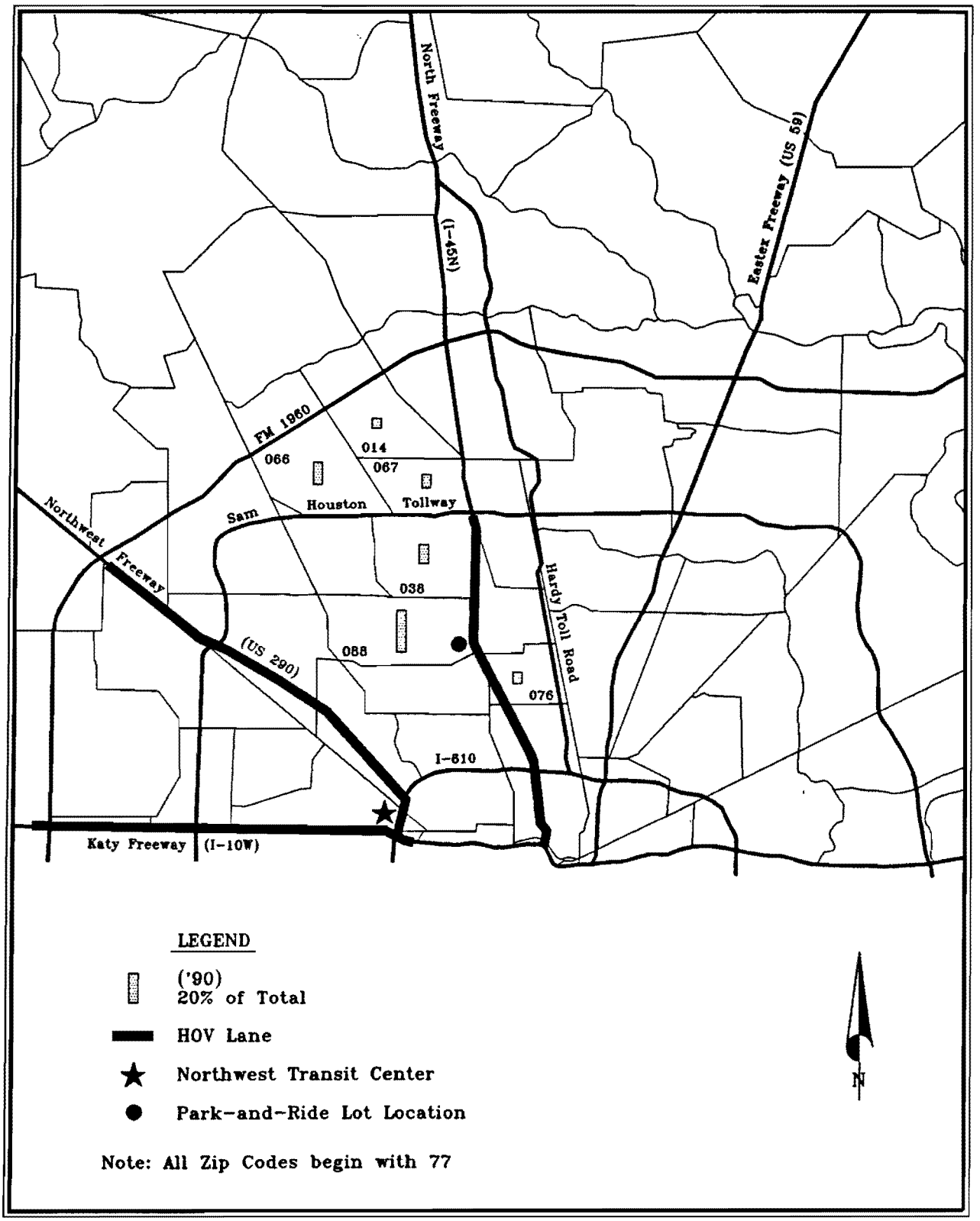


Figure 24. Home Origins of Patrons of the North Shepherd-Texas Medical Center Park-and-Ride Service

Table 42.
Zip Code Origins for North HOV Lane Transit Trips,
North HOV Lane Transit User Surveys

North HOV Lane Bus Route	Zip Code	Location Relative to North Freeway	Percent of Total Origins	
			1986	1990
North Shepherd Park-and-Ride	77088	West	30%	40%
	77038	West	20%	9%
	77060	East	9%	7%
	77067	West	9%	5%
	77066	West	7%	4%
	77037	East	7%	7%
	77076	East	5%	6%
	77091	West	3%	7%
	Other	——	10%	15%
Kuykendahl Park-and-Ride	77379	West	18%	21%
	77067	West	14%	9%
	77090	West	12%	16%
	77388	West	11%	12%
	77014	West	11%	11%
	77066	West	5%	4%
	77060	East	4%	2%
	77073	East	4%	1%
	77069	West	3%	4%
	Other	——	18%	20%
Spring Park-and-Ride	77373	East	36%	41%
	77073	East	13%	12%
	77380	West	8%	2%
	77388	West	8%	10%
	77386	East	6%	2%
	77090	West	6%	10%
	77381	West	5%	1%
	77338	East	3%	4%
	Other	——	15%	18%
Setou Lake Park-and-Ride	77070	West	21%	27%
	77086	West	21%	13%
	77066	West	18%	19%
	77064	West	7%	3%
	77375	West	6%	3%
	77429	West	6%	1%
	77069	West	5%	13%
	Other	——	16%	21%
North Shepherd - Texas Medical Center Park-and-Ride	77088	West	—	28%
	77066	West	—	15%
	77038	West	—	13%
	77067	West	—	9%
	77014	West	—	7%
	77076	East	—	7%
	77379	West	—	7%
	Other	——	—	14%

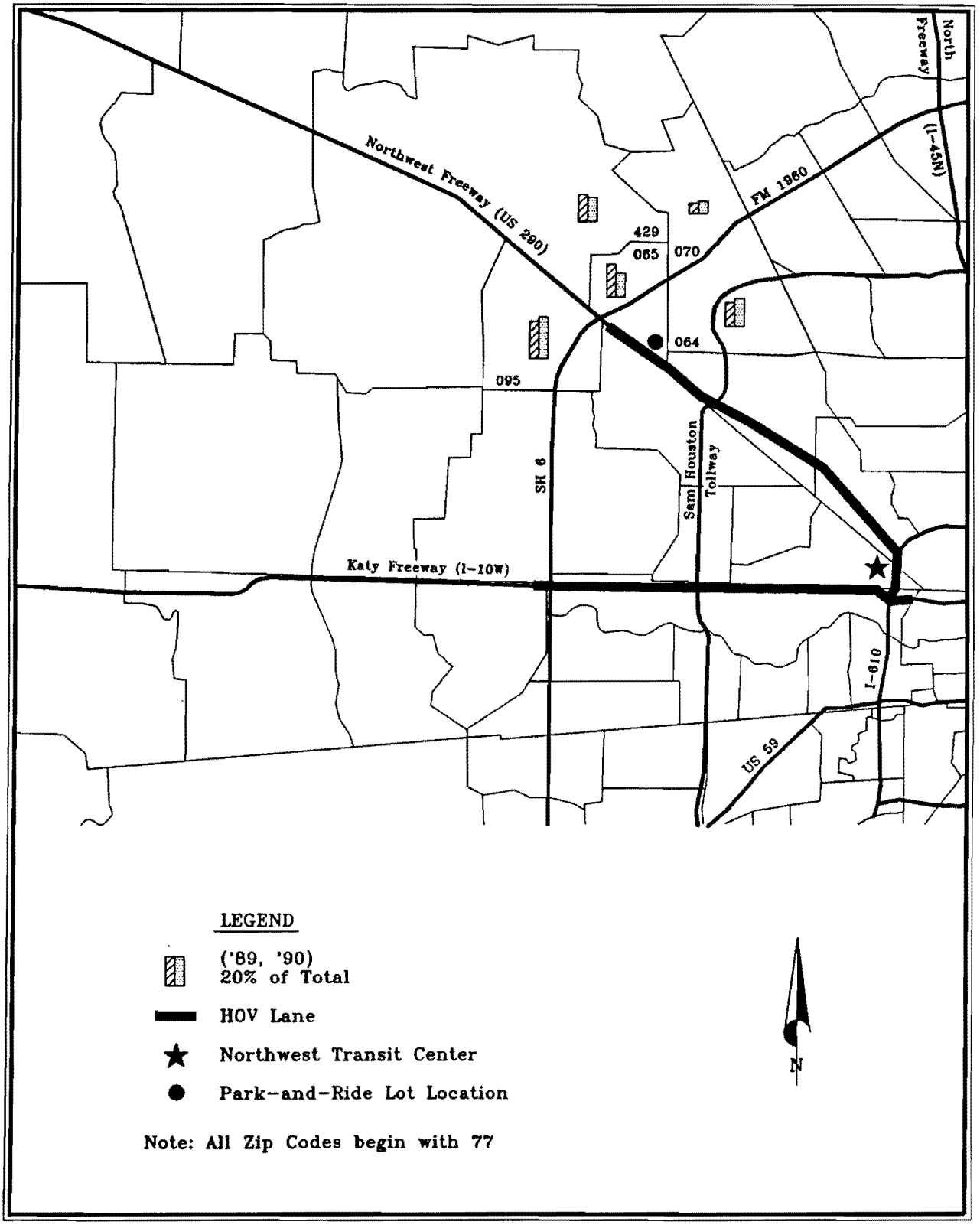


Figure 25. Home Origins of Patrons of the Northwest Station Park-and-Ride Service

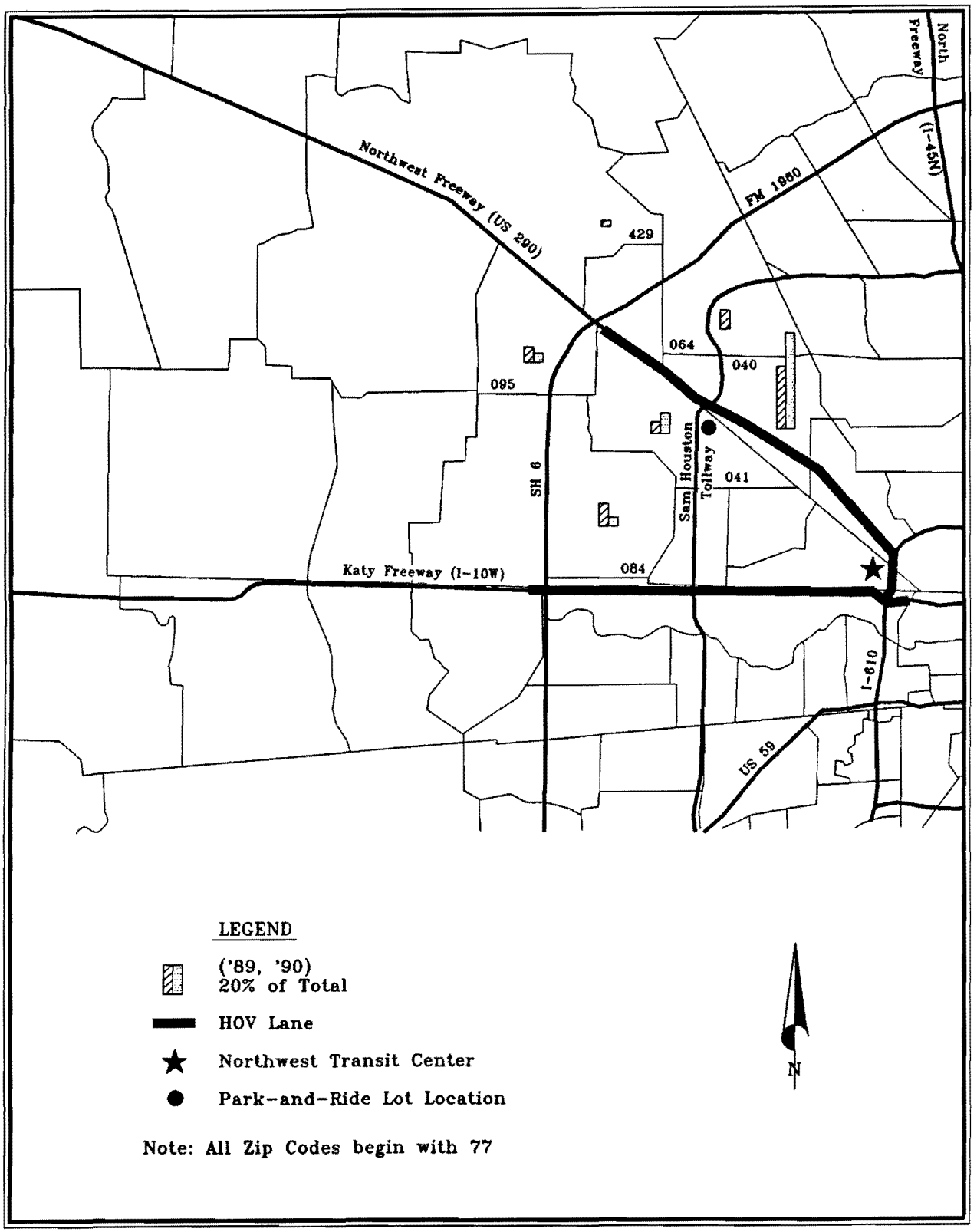


Figure 26. Home Origins of Patrons of the West Little York Park-and-Ride Service

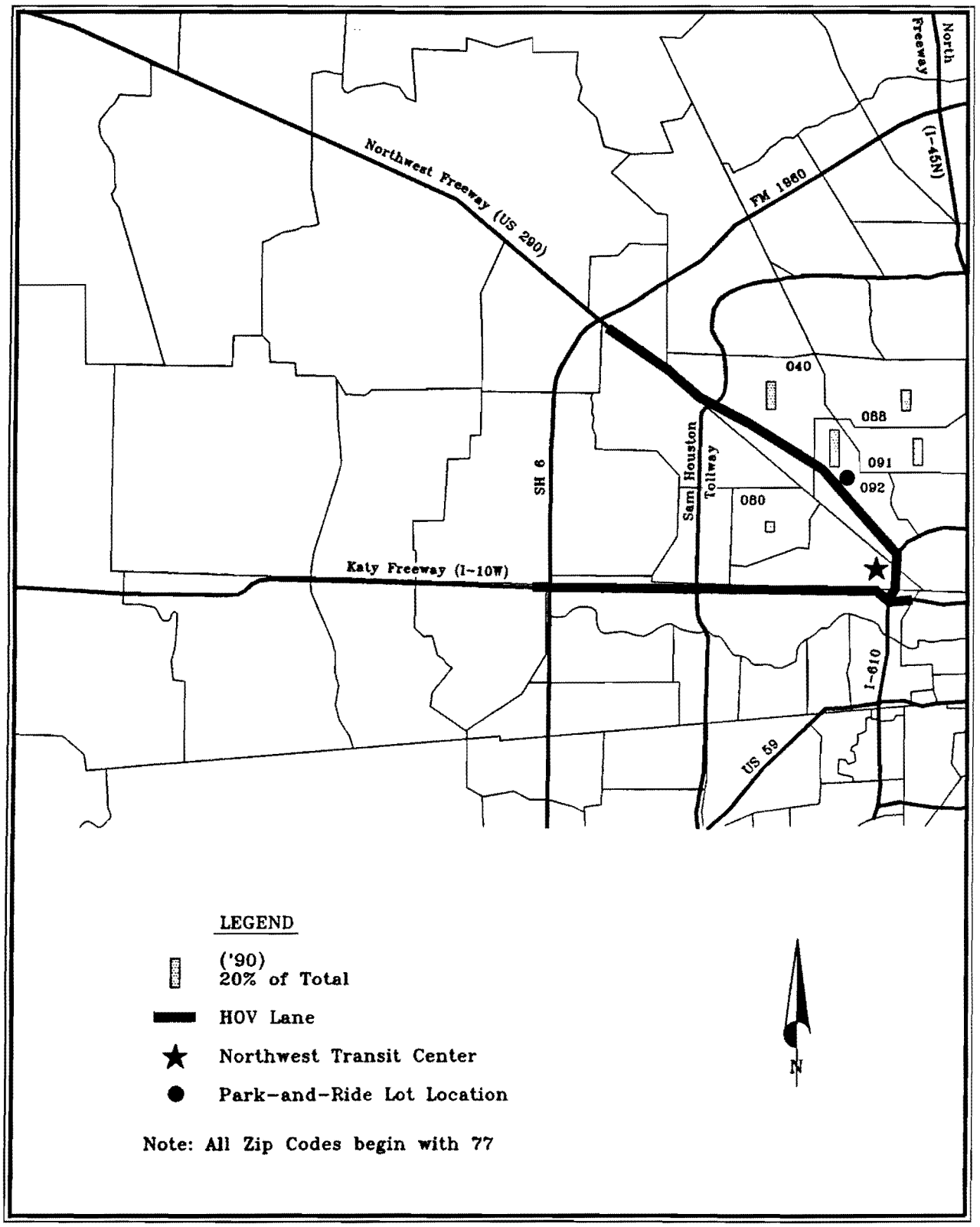


Figure 27. Home Origins of Patrons of the Pinemont Park-and-Ride Service

Table 43.
Zip Code Origins for Northwest HOV Lane Transit Trips,
Northwest HOV Lane Transit User Surveys

Northwest HOV Lane Bus Route	Zip Code	Location Relative to Northwest Freeway	Percent of Total Origins	
			1989	1990
Northwest Station Park-and-Ride	77095	South	25%	28%
	77065	North	22%	16%
	77429	North	18%	16%
	77064	North	16%	19%
	77070	North	7%	8%
	Other	——	12%	13%
West Little York Park-and-Ride	77040	North	42%	65%
	77084	South	15%	6%
	77064	North	13%	——
	77095	South	10%	6%
	77041	South	8%	14%
	77429	North	4%	——
	Other	——	8%	9%
Pinemont Park-and-Ride	77092	South	——	25%
	77040	North	——	18%
	77091	North	——	18%
	77088	North	——	14%
	77080	North	——	7%
	Other	——	——	18%

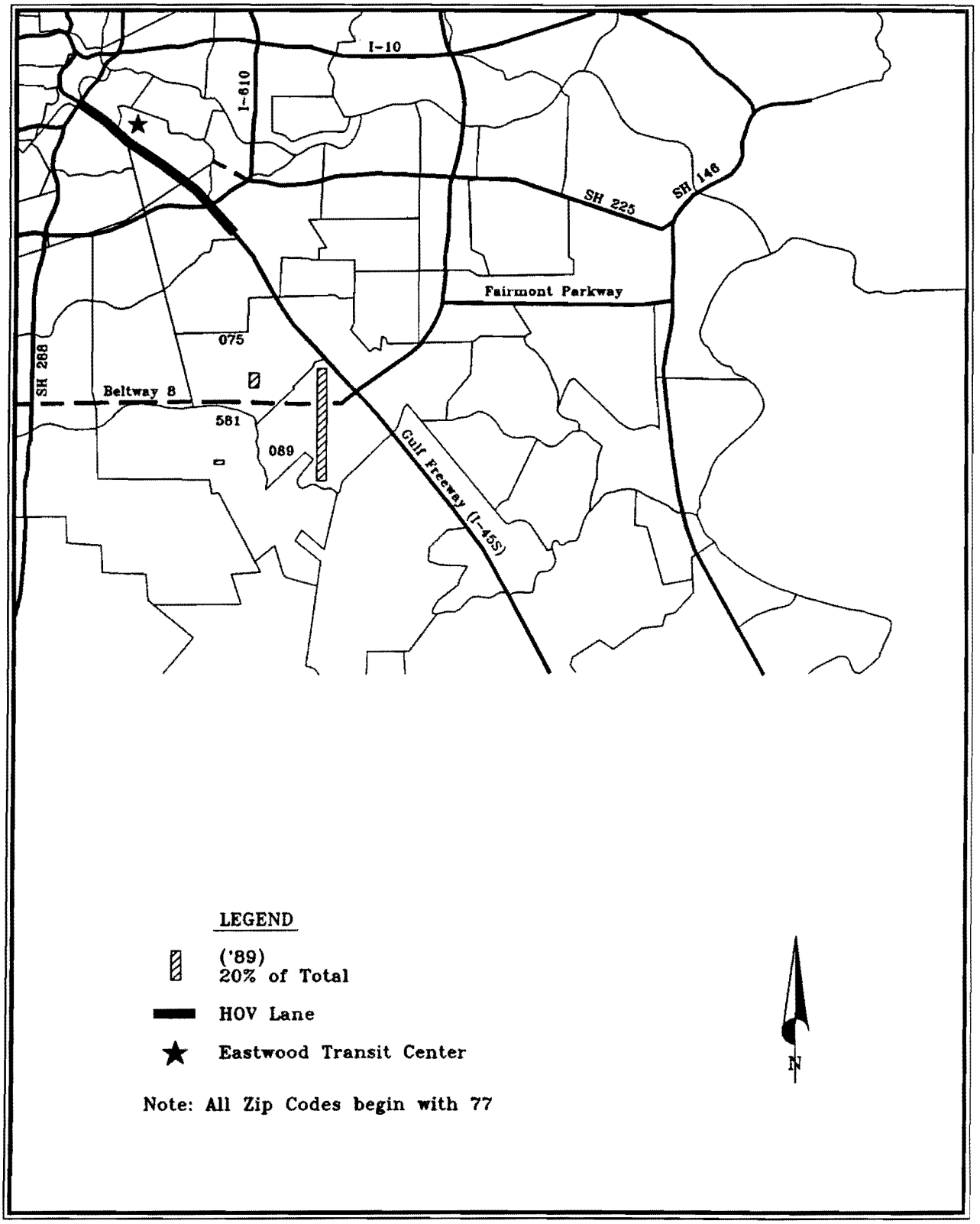


Figure 28. Home Origins of Patrons of the South Belt Express Route

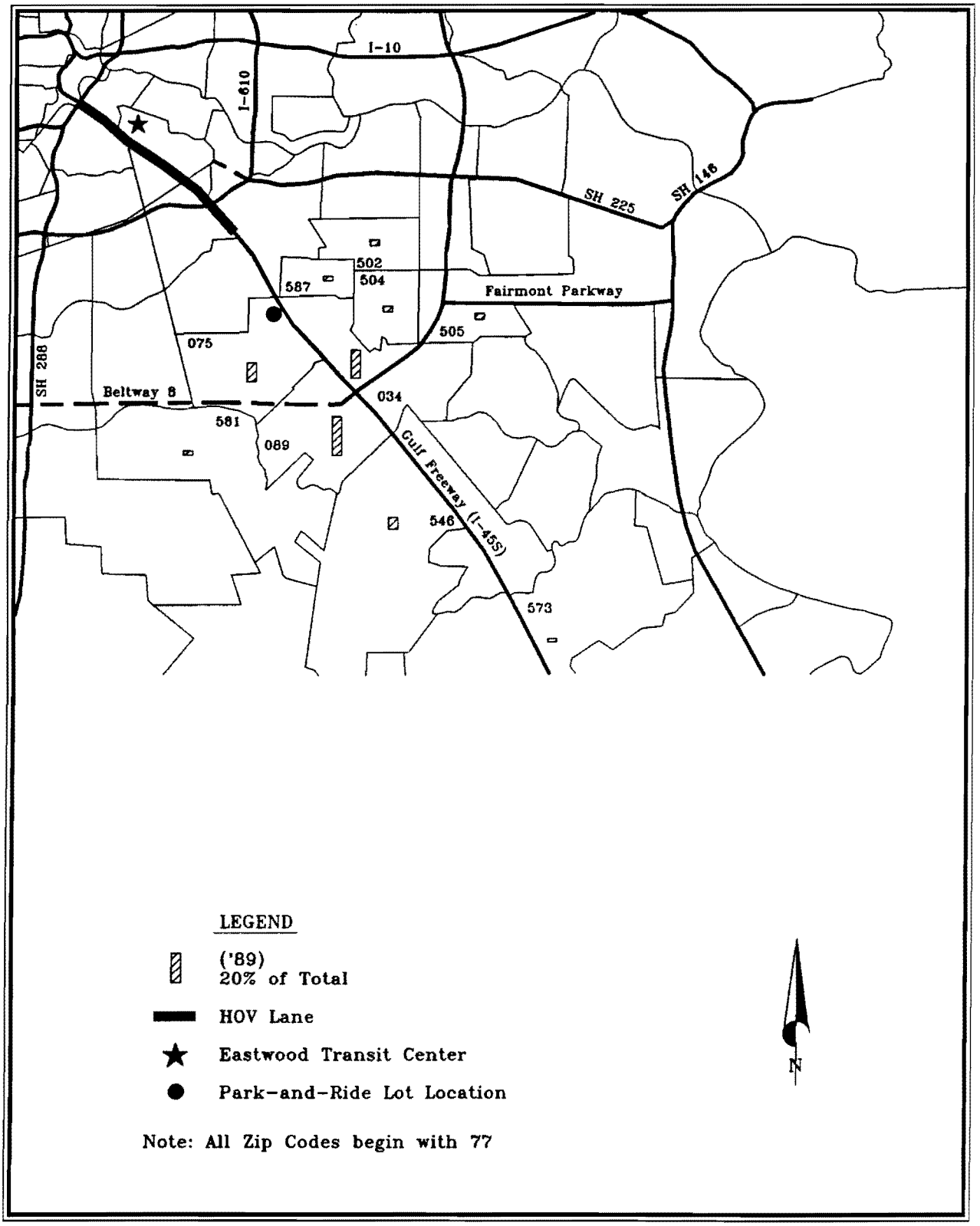


Figure 29. Home Origins of Patrons of the Edgebrook Park-and-Ride Service

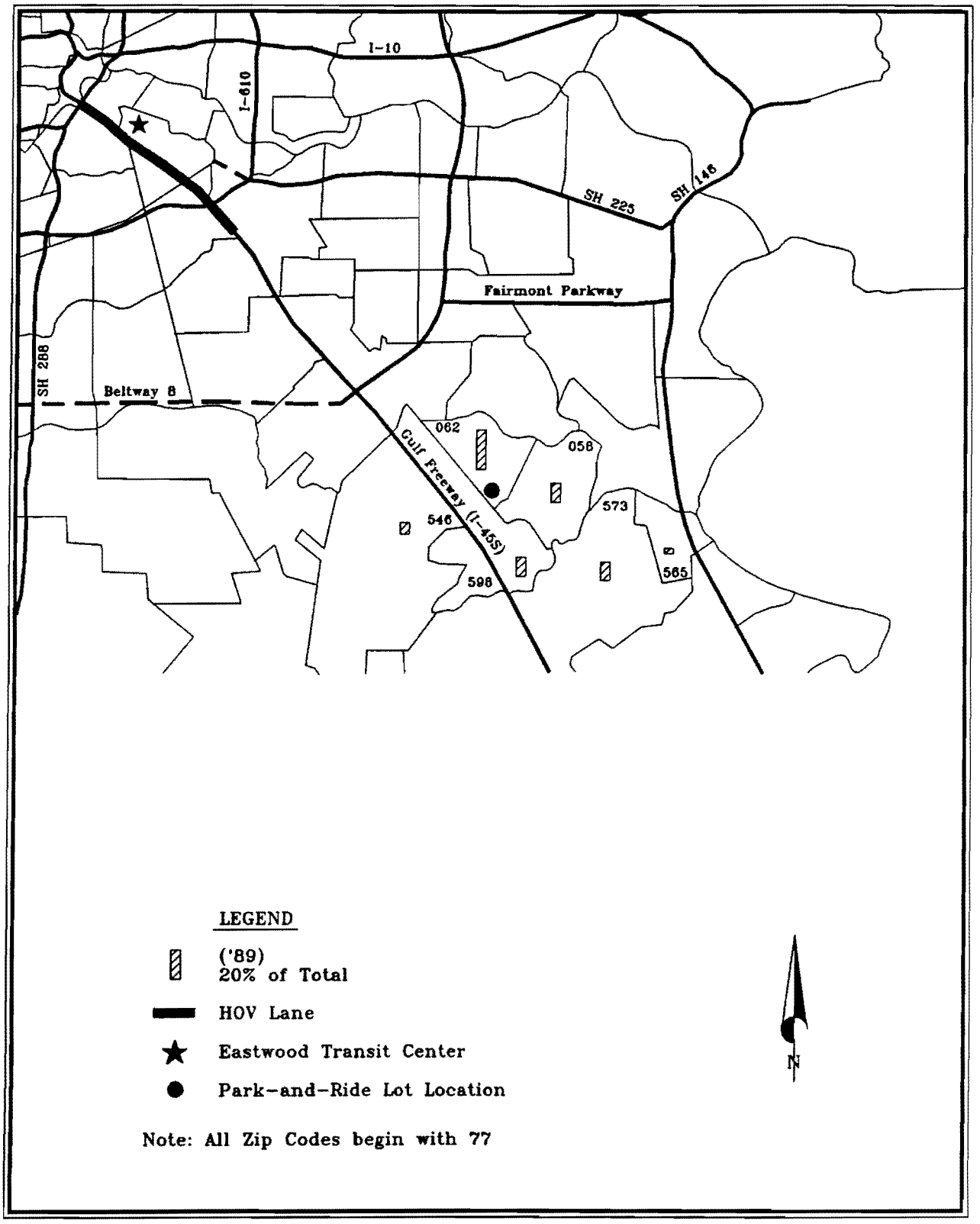


Figure 30. Home Origins of Patrons of the Bay Area Park-and-Ride Service

Table 44.
Zip Code Origins for Gulf HOV Lane Transit Trips,
Gulf HOV Lane Transit User Surveys

Gulf HOV Lane Bus Route	Zip Code	Location Relative to Gulf Freeway	Percent of Total Origins 1989
South Belt Express	77089	West	76%
	77075	West	10%
	77581	West	3%
	Other	—	11%
Edgebrook Park-and-Ride	77089	West	26%
	77034	East	19%
	77075	West	13%
	77546	West	8%
	77502	East	4%
	77504	East	4%
	77505	East	4%
	77581	West	3%
	77587	East	3%
	77573	East	2%
	Other	—	14%
Bay Area Park-and-Ride	77062	East	27%
	77058	East	13%
	77598	West	13%
	77573	East	12%
	77546	West	8%
	77565	East	4%
	Other	—	23%

The Katy-Mason Park-and-Ride Lot and the Kingsland Lot (which replaced the Katy-Mason Lot) are located south of the Katy Freeway. Each year, more than 60% of the ridership from this area originates from Zip Codes south of the Katy Freeway.

North HOV Lane Routes

The Kuykendahl, North Shepherd and Seton Lake Park-and-Ride Lots are located west of the North Freeway; the vast majority of the transit ridership for these three lots originates from Zip Codes west of the freeway. In fact, 100% of the Seton Lake ridership, more than 70% of the North Shepherd ridership and at least 75% of the Kuykendahl and North Shepherd-Texas Medical Center ridership originates from the west side of the freeway. The Spring Park-

and-Ride Lot, located on the east side of the North Freeway, draws more than 60% of its ridership from east of the freeway.

Northwest HOV Lane Routes

Situated on the north side of the Northwest Freeway, both the Northwest Station and the Pinemont Park-and-Ride Lots attract more than 60% of their ridership from Zip Code areas north of the freeway. Although the West Little York Park-and-Ride Lot is located south of the Northwest Freeway, more than 60% of its patrons listed Zip Code origins north of the freeway.

Gulf HOV Lane Routes

More than 75% of the ridership on the South Belt Express route originates from the 77089 Zip Code area located just west of the Gulf Freeway. The Edgebrook Park-and-Ride Lot, located on the west side of the Gulf Freeway, draws approximately 70% of its riders from Zip Code areas west of the freeway. The Bay Area Park-and-Ride Lot, situated on the east side of the Gulf Freeway, attracts approximately 80% of its patrons from the east side of the freeway.

Trip Destinations

Since the only destination served directly by the vast majority of the Katy HOV Lane bus operations is the downtown area, it is to be expected that virtually all of the Katy HOV Lane bus trips being served would be downtown trips. In fact, such was the case in 1985 through 1988. In 1989 and 1990, however, 16% of the Katy HOV Lane express route bus trips were destined to locations other than downtown (Table 45). Although the North HOV Lane primarily serves the downtown area, limited service is also provided to the Texas Medical Center, the Galleria and Greenway Plaza. Nevertheless, more than 90% of all the transit trips being served by the North HOV Lane are downtown trips.

Table 45.
Trip Destinations of HOV Lane Transit Users,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

Trip Destination	Katy HOV Lane					
	1985	1986	1987	1988	1989	1990
Total Sample	(n=357)	(n=575)	(n=632)	(n=776)	(n=641)	(n=671)
Downtown	96%	95%	94%	97%	94%	93%
Galleria	—	0%	1%	0%	2%	2%
Texas Medical Center	1%	1%	1%	1%	1%	1%
Greenway Plaza	0%	0%	1%	0%	0%	1%
Other	3%	4%	3%	2%	3%	3%
Park-and-Ride Routes	(n=222)	(n=409)	(n=349)	(n=525)	(n=469)	(n=460)
Downtown	97%	96%	96%	98%	97%	98%
Galleria	—	0%	—	—	1%	—
Texas Medical Center	1%	1%	1%	1%	1%	0%
Greenway Plaza	—	—	1%	—	0%	1%
Other	2%	3%	2%	1%	1%	1%
Express Routes	(n=135)	(n=166)	(n=283)	(n=251)	(n=172)	(n=211)
Downtown	94%	90%	91%	95%	84%	84%
Galleria	—	1%	2%	1%	4%	7%
Texas Medical Center	1%	2%	2%	2%	2%	2%
Greenway Plaza	1%	1%	—	0%	—	0%
Other	4%	6%	5%	2%	10%	7%

Trip Destination	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
	1986	1990	1989	1990	1989
Total Sample	(n=1252)	(n=988)	(n=215)	(n=293)	(n=464)
Downtown	94%	91%	97%	95%	86%
Galleria	1%	0%	—	2%	1%
Texas Medical Center	1%	6%	2%	1%	5%
Greenway Plaza	2%	0%	—	0%	0%
Other	2%	3%	1%	2%	8%
Park-and-Ride Routes	(n=1149)	(n=988)	(n=215)	(n=293)	(n=402)
Downtown	95%	91%	97%	95%	91%
Galleria	1%	0%	—	2%	1%
Texas Medical Center	1%	6%	2%	1%	4%
Greenway Plaza	2%	0%	—	0%	0%
Other	1%	3%	1%	2%	4%
Express Routes	(n=103)	—	—	—	(n=62)
Downtown	91%	—	—	—	48%
Galleria	1%	—	—	—	1%
Texas Medical Center	1%	—	—	—	18%
Greenway Plaza	—	—	—	—	1%
Other	7%	—	—	—	32%

The only destination served directly by the Northwest HOV Lane bus service is the downtown area, and at least 95% of the Northwest HOV Lane transit trips are downtown trips. Such is not the case in the Gulf HOV Lane corridor, however. Although more than 90% of the

HOV lane park-and-ride trips have destinations in downtown Houston, less than half of the HOV lane trips served by the South Belt Express route are downtown trips; an additional 18% of the passengers are destined to the Texas Medical Center, and 32% are destined to other locations.

Trip Purpose

The overwhelming majority of all the HOV lane transit trips surveyed are work trips (Table 46).

Table 46.
Trip Purpose of HOV Lane Transit Users,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

	Katy HOV Lane					
Trip Purpose	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
Total Sample	(n=358)	(n=580)	(n=634)	(n=777)	(n=644)	(n=672)
Work	99%	97%	98%	98%	97%	97%
School	1%	2%	1%	1%	2%	2%
Other	0%	1%	1%	1%	1%	1%
Park-and-Ride Routes	(n=222)	(n=412)	(n=349)	(n=525)	(n=469)	(n=461)
Work	100%	98%	100%	99%	98%	99%
School	0%	2%	0%	0%	2%	1%
Other	0%	0%	0%	1%	0%	0%
Express Routes	(n=136)	(n=168)	(n=285)	(n=252)	(n=175)	(n=211)
Work	96%	96%	96%	96%	94%	94%
School	3%	3%	3%	3%	2%	4%
Other	1%	1%	1%	1%	4%	2%

	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
Trip Purpose	**1986**	**1990**	**1989**	**1990**	**1989**
Total Sample	(n=1256)	(n=989)	(n=217)	(n=294)	(n=465)
Work	99%	98%	98%	99%	96%
School	1%	2%	2%	1%	4%
Other	—	—	—	—	0%
Park-and-Ride Routes	(n=1152)	(n=989)	(n=217)	(n=294)	(n=403)
Work	99%	98%	98%	99%	97%
School	1%	2%	2%	1%	3%
Other	—	—	—	—	—
Express Routes	(n=104)	—	—	—	(n=62)
Work	97%	—	—	—	87%
School	3%	—	—	—	8%
Other	—	—	—	—	5%

Auto Availability

In general, riders of the Katy, North and Northwest HOV Lane bus routes are "choice" riders; the vast majority have an auto available for the trip, but prefer to ride a bus instead (Table 47). The same is true for Gulf HOV Lane park-and-ride users. For approximately 29% of the Gulf HOV Lane express route riders, however, transit is the only means available for making the trip.

Table 47.
Auto Availability for HOV Lane Transit Users,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

Auto Available for Trip	Katy HOV Lane					
	1985	1986	1987	1988	1989	1990
Total Sample	(n=354)	(n=575)	(n=622)	(n=772)	(n=638)	(n=667)
No	7%	7%	10%	6%	10%	9%
Yes, but inconvenient	10%	7%	8%	7%	7%	8%
Yes, but prefer bus	83%	86%	82%	87%	83%	83%
Park-and-Ride Routes	(n=220)	(n=410)	(n=343)	(n=522)	(n=467)	(n=459)
No	5%	5%	7%	4%	8%	7%
Yes, but inconvenient	8%	6%	5%	4%	6%	6%
Yes, but prefer bus	87%	89%	88%	92%	86%	87%
Express Routes	(n=134)	(n=165)	(n=279)	(n=250)	(n=171)	(n=208)
No	11%	12%	14%	9%	15%	13%
Yes, but inconvenient	13%	11%	11%	13%	8%	12%
Yes, but prefer bus	76%	77%	75%	78%	77%	75%

Auto Available for Trip	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
	1986	1990	1989	1990	1989
Total Sample	(n=1246)	(n=982)	(n=216)	(n=294)	(n=457)
No	5%	5%	8%	8%	13%
Yes, but inconvenient	5%	8%	10%	6%	7%
Yes, but prefer bus	90%	87%	82%	86%	80%
Park-and-Ride Routes	(n=1142)	(n=982)	(n=216)	(n=294)	(n=399)
No	5%	5%	8%	8%	11%
Yes, but inconvenient	4%	8%	10%	6%	7%
Yes, but prefer bus	91%	87%	82%	86%	82%
Express Routes	(n=104)	—	—	—	(n=58)
No	10%	—	—	—	29%
Yes, but inconvenient	17%	—	—	—	7%
Yes, but prefer bus	73%	—	—	—	64%

Employer Contribution to Bus Fare

Most recent survey results show that, for 14%-17% of the HOV lane bus riders, the employer pays the entire cost of the transit fare (Table 48). An additional 44%-54% of the bus patrons have at least part of their fares paid by the employer.

Table 48.
Employer Payment of Bus Fare for HOV Lane Transit Users,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

Employer Payment of Bus Fare	Katy HOV Lane					
	1985	1986	1987	1988	1989	1990
Total Sample	(n=355)	(n=574)	(n=628)	(n=772)	(n=635)	(n=669)
Pays all	19%	15%	13%	16%	14%	17%
Pays part	38%	41%	43%	47%	43%	44%
Pays none	43%	44%	44%	37%	43%	39%
Park-and-Ride Routes	(n=221)	(n=408)	(n=347)	(n=522)	(n=464)	(n=458)
Pays all	21%	18%	18%	17%	17%	19%
Pays part	45%	46%	52%	52%	46%	50%
Pays none	34%	36%	30%	31%	37%	31%
Express Routes	(n=134)	(n=166)	(n=281)	(n=250)	(n=171)	(n=211)
Pays all	17%	7%	6%	14%	6%	13%
Pays part	26%	31%	33%	38%	34%	29%
Pays none	57%	62%	61%	48%	60%	58%

Employer Payment of Bus Fare	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
	1986	1990	1989	1990	1989
Total Sample	(n=1247)	(n=982)	(n=211)	(n=294)	(n=453)
Pays all	17%	16%	15%	17%	14%
Pays part	46%	48%	49%	54%	48%
Pays none	37%	36%	36%	29%	38%
Park-and-Ride Routes	(n=1144)	(n=982)	(n=211)	(n=294)	(n=393)
Pays all	18%	16%	15%	17%	15%
Pays part	47%	48%	49%	54%	51%
Pays none	35%	36%	36%	29%	34%
Express Routes	(n=103)	—	—	—	(n=60)
Pays all	9%	—	—	—	3%
Pays part	39%	—	—	—	28%
Pays none	52%	—	—	—	69%

Attitudes and Impacts Pertaining to the HOV Lanes

At least half of the questions contained on the HOV lane transit user surveys focused on data concerning the HOV lanes. For presentation purposes, these responses can be grouped into the following four categories.

- Perceived travel time savings and duration of HOV lane use;
- Modal selection and prior mode;
- Impacts of the HOV lane on mode choice; and
- Perception of the level of HOV lane utilization.

Perceived Travel Time Savings and Duration of HOV Lane Use

Travel Time Savings

The HOV lane users' perception of time saved by using the Katy, North, Northwest or Gulf HOV Lanes is presented in Table 49. As indicated in this table, park-and-ride patrons using the Katy HOV Lane perceived a greater travel time savings in 1986 than 1985. This is probably the result of the western terminus of the HOV lane being extended 1.7 miles from Gessner to West Belt after the 1985 survey. Thus, park-and-ride users on the HOV lane during the 1986 were able to bypass a section of severe congestion on the freeway. Following the 1986 survey, the Katy HOV Lane was extended an additional 5.1 miles from West Belt to State Highway 6. This extension did not increase the median travel time savings reported by park-and-ride users during the 1987 survey, however. Median travel time savings for the a.m. did increase (by 5 minutes) in 1988, however. This increase may have been due to the fact that the 1988 survey was performed 3 weeks after the carpool occupancy requirement was raised during the a.m. peak; park-and-riders may have perceived fewer vehicles on the lane and thus a greater travel time savings. Median travel time savings perceived by park-and-ride users for 1989 and 1990 remained at 20 minutes for both the a.m. and p.m.

Table 49.
Perceived Travel Time Savings by HOV Lane Transit Users,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

Travel Time Savings	Katy HOV Lane					
	1985	1986	1987	1988	1989	1990
Perceived HOV Lane Travel Time Savings (minutes)						
Total Sample	(n=328)	(n=530)	(n=590)	(n=726)	(n=588)	(n=639)
a.m. (median)	9	15	15	20	20	18
p.m. (median)	13	20	15	20	20	20
Park-and-Ride Routes	(n=208)	(n=388)	(n=334)	(n=501)	(n=433)	(n=441)
a.m. (median)	10	15	15	20	20	20
p.m. (median)	15	20	20	20	20	20
Express Routes	(n=120)	(n=142)	(n=256)	(n=225)	(n=155)	(n=198)
a.m. (median)	8	15	10	15	15	15
p.m. (median)	7	15	15	17	20	20
Actual HOV Lane Travel Time Savings (minutes)[1]						
a.m. (6:00-9:30 a.m.)	6.8	3.0	4.4	5.1	7.9	9.4
p.m. (3:30-7:00 p.m.)	5.5	4.0	1.0	2.7	1.1	6.0

Travel Time Savings	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
	1986	1990	1989	1990	1989
Perceived HOV Lane Travel Time Savings (minutes)					
Total Sample	(n=1147)	(n=924)	(n=185)	(n=280)	(n=386)
a.m. (median)	20	15	15	18	10
p.m. (median)	25	20	15	18	15
Park-and-Ride Routes	(n=986)	(n=924)	(n=185)	(n=280)	(n=335)
a.m. (median)	20	15	15	18	10
p.m. (median)	25	20	15	18	15
Express Routes	(n=94)	—	—	—	(n=51)
a.m. (median)	25	—	—	—	15
p.m. (median)	20	—	—	—	15
Actual HOV Lane Travel Time Savings (minutes)[1]					
a.m. (6:00-9:30 a.m.)	4.2	3.3	-4.6	2.4	3.1
p.m. (3:30-7:00 p.m.)	8.0	0.1	-5.7	1.8	-3.1

[1] *TTI travel time studies*

Generally speaking, users of the Memorial Express route do not perceive as great a travel time savings as do the park-and-ride patrons or the other express route patrons (during any of

the survey years). A possible explanation for the differences in their perception of p.m. travel time savings may be the difference in the p.m. route configuration. Because there is not sufficient distance available to safely maneuver from the Gessner exit of the HOV lane (across three mainlanes) to the Gessner exit of the Katy Freeway, Memorial Express buses must exit the HOV lane at Gessner, exit the freeway at West Belt and "backtrack" to Gessner.

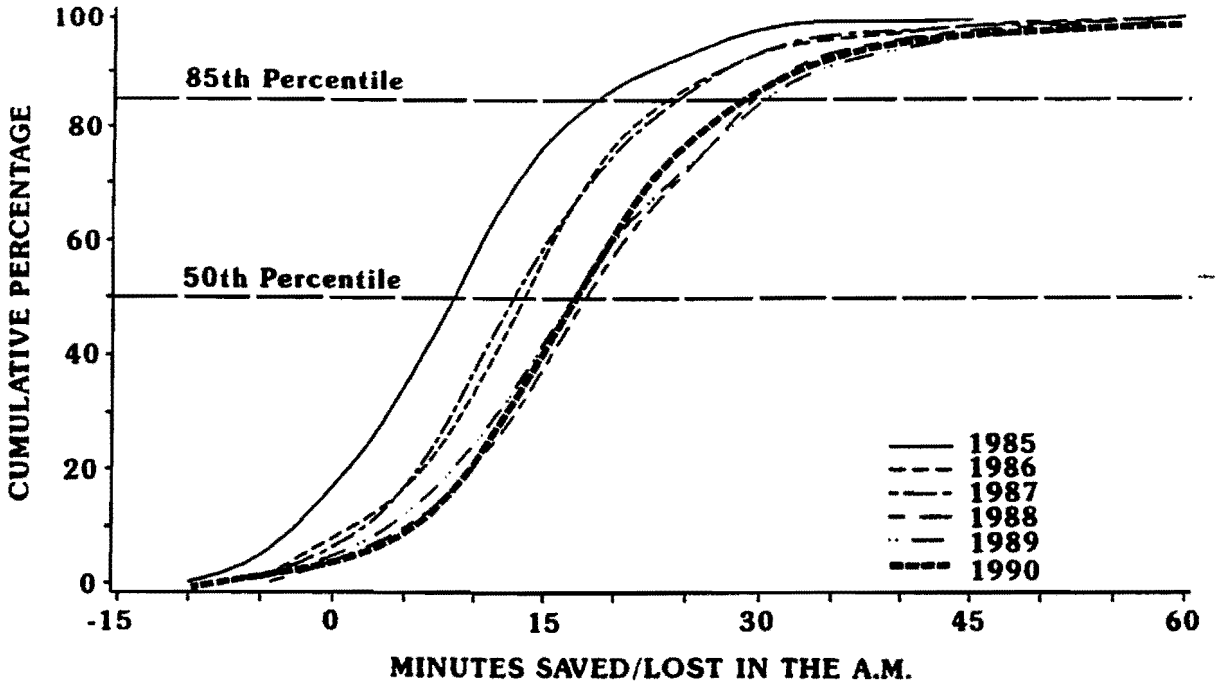
It is interesting to note that median travel time savings perceived by park-and-ride and express route patrons did not increase in 1990, even though the eastern extension to the HOV lane had become operational and buses had direct access to/from the Katy Freeway (without having to travel on surface streets and pass through two signalized intersections as they had in past survey years).

In general, transit users on the North HOV Lane reported lower travel time savings figures in 1990 than in 1986. This may be due to the perception of less congestion in the North Freeway corridor following the expansion of the mainlanes and the implementation of the Hardy Toll Road (which runs parallel to the North Freeway).

In the Northwest HOV Lane corridor, park-and-ride users perceived a median travel time savings of 15 minutes in 1989 and 18 minutes in 1990 (in both the morning and afternoon). The higher savings perceived in 1990 was expected since the HOV lane had been extended 3.9 miles February 1990.

Median travel time savings reported by Gulf HOV Lane express route users totaled 15 minutes during both the a.m. and p.m. Similarly, Gulf HOV Lane park-and-ride users reported a 15-minute time savings in the afternoon but only a 10-minute savings in the morning.

Frequency distributions of perceived travel time savings along the Katy, North, Northwest and Gulf HOV Lanes are presented in Figures 31, 32, 33 and 34, respectively.



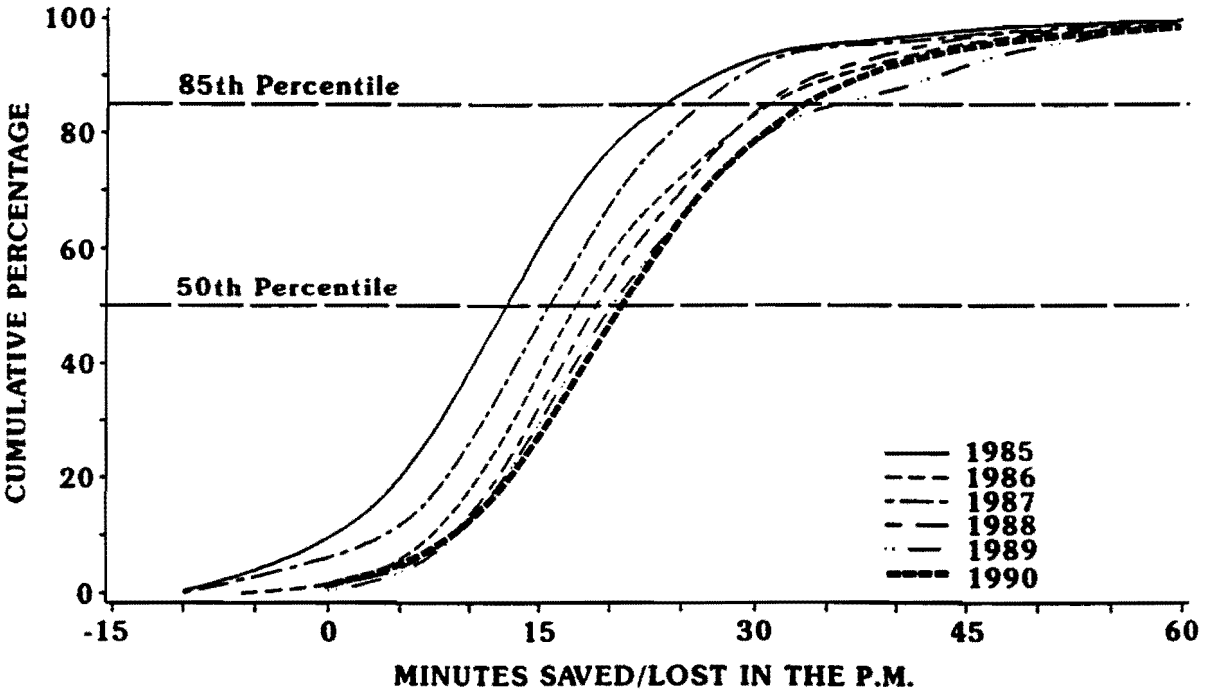
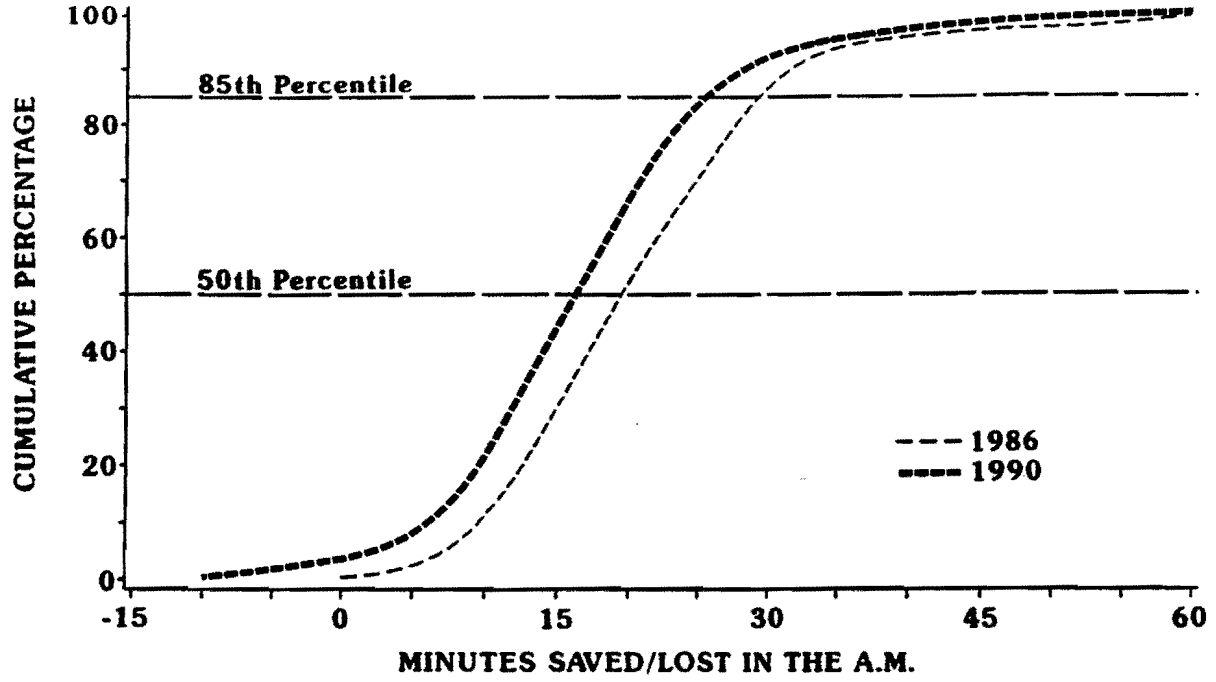


Figure 31. Perceived Katy HOV Lane Travel Time Savings, Katy HOV Lane Transit User Surveys



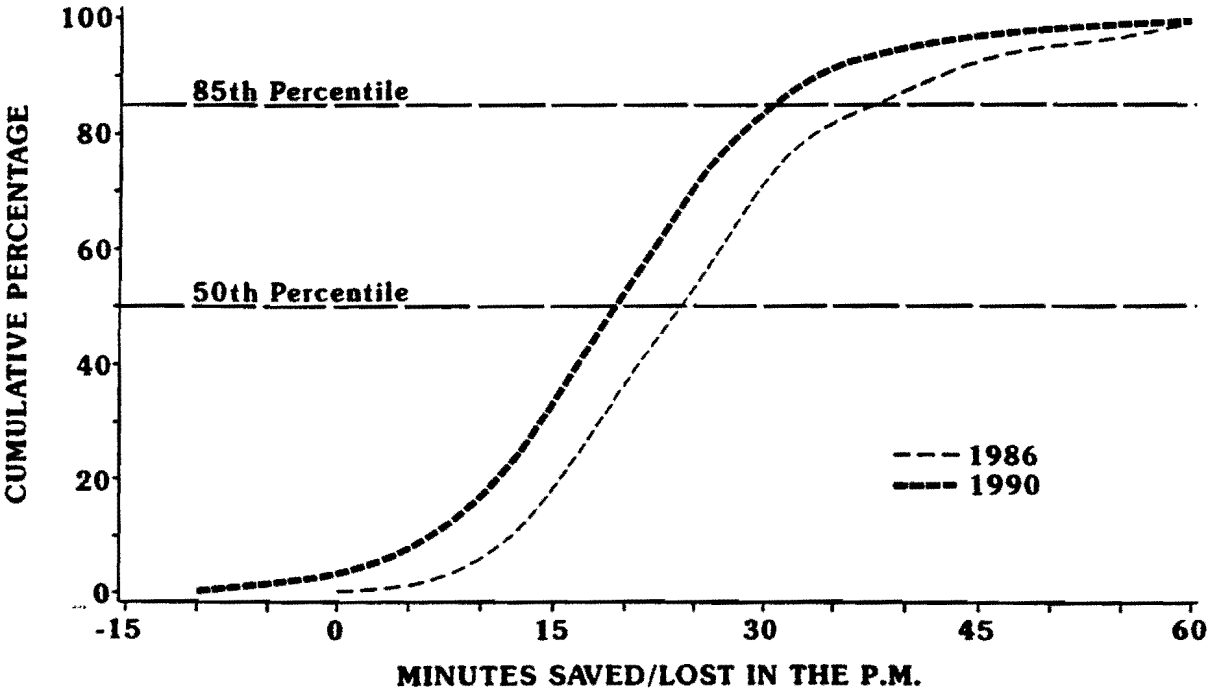
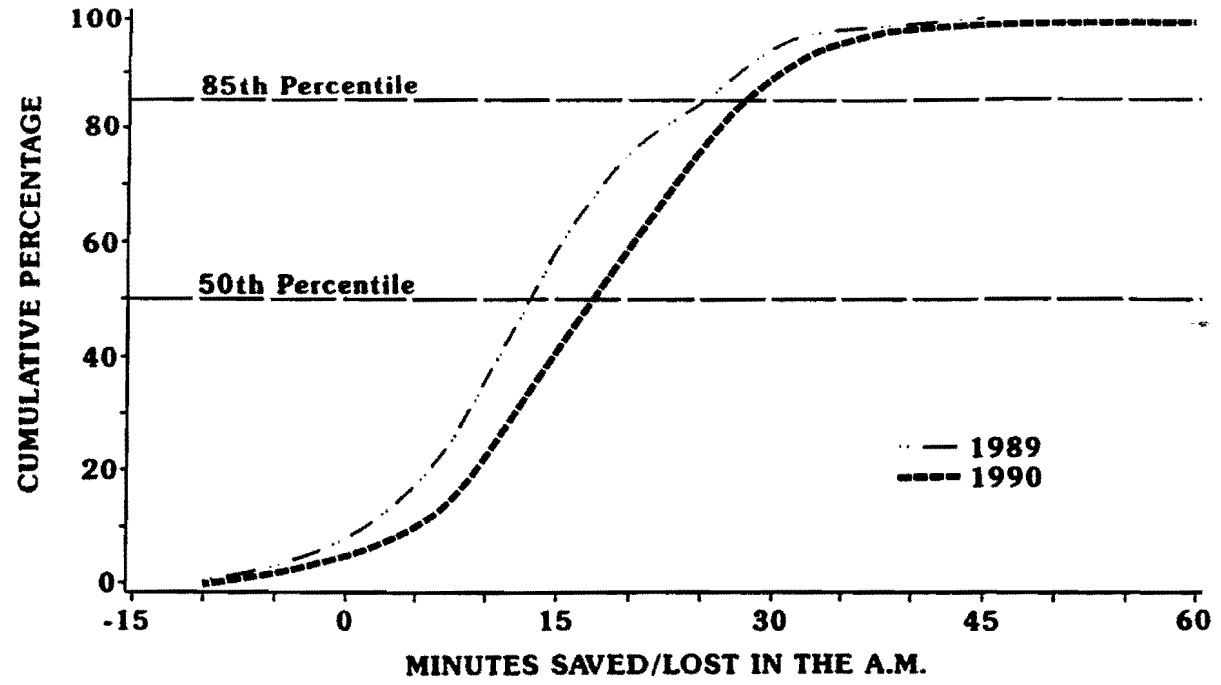


Figure 32. Perceived North HOV Lane Travel Time Savings, North HOV Lane Transit User Surveys



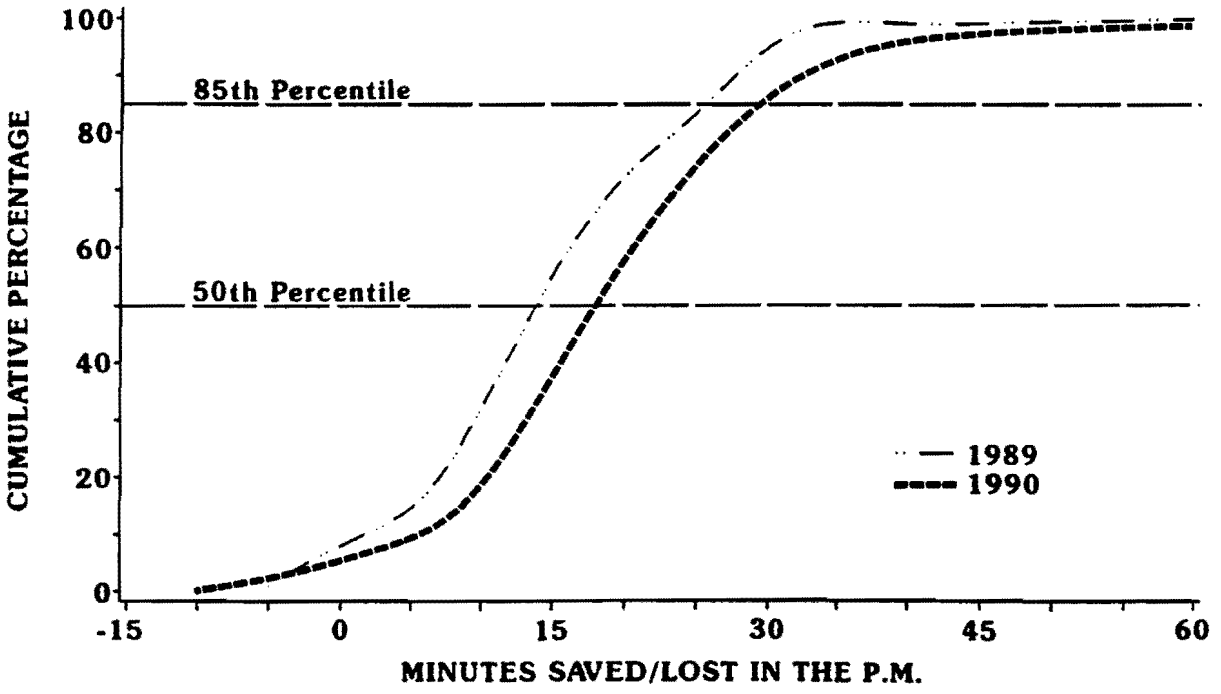
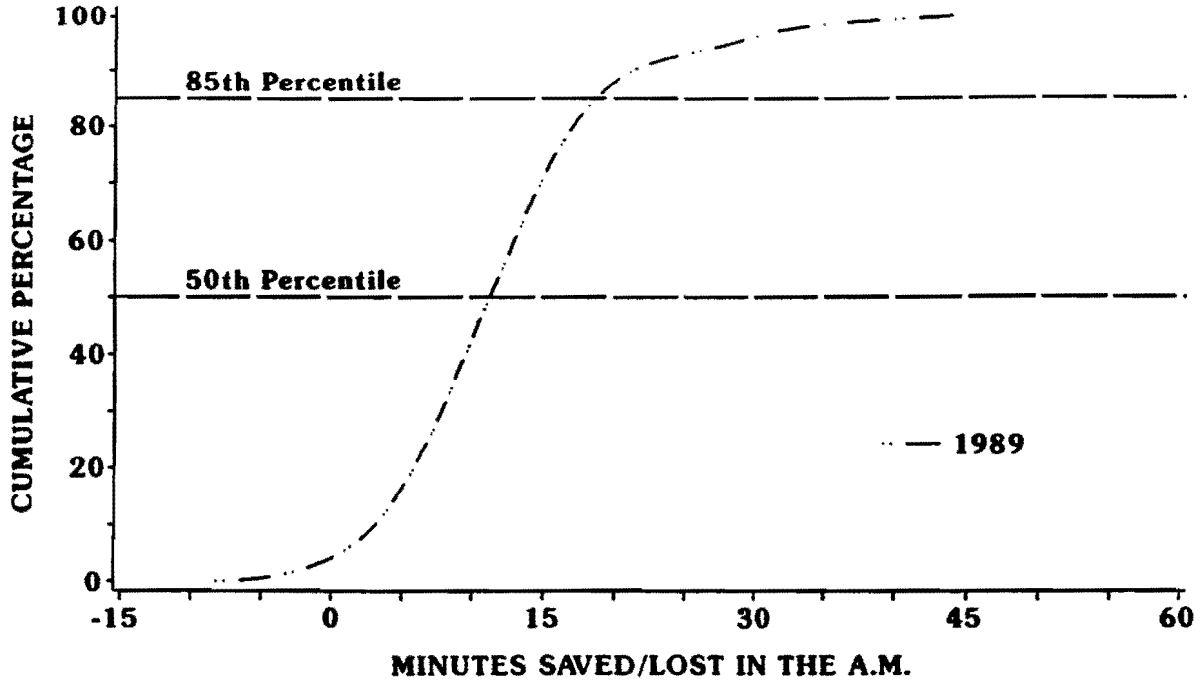


Figure 33. Perceived Northwest HOV Lane Travel Time Savings, Northwest HOV Lane Transit User Surveys



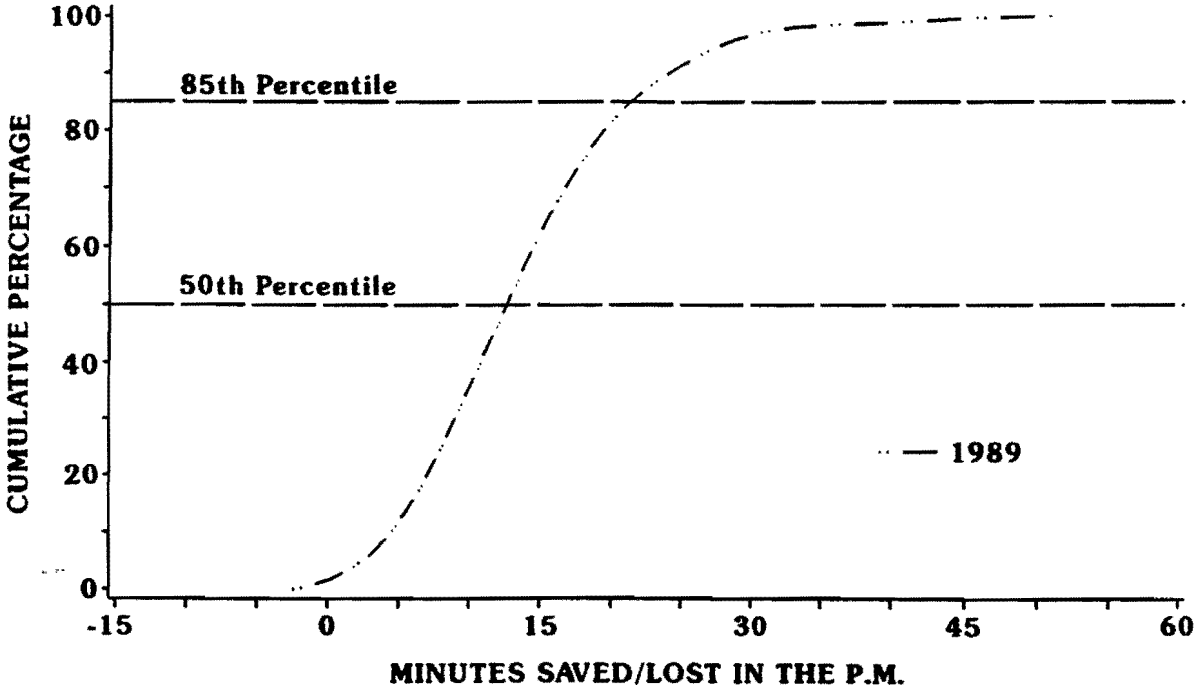


Figure 34. Perceived Gulf HOV Lane Travel Time Savings, Gulf HOV Lane Transit User Surveys

Duration of HOV Lane Use

The average number of months transit riders have been using the HOV lane in their area is presented in Table 50. The most recent surveys in each corridor indicate that the average bus rider in the Katy corridor has used the HOV lane more than two years, the average rider in the North corridor has used the HOV lane for almost three years, and Northwest and Gulf HOV Lane bus riders have used these facilities for a little over a year.

Table 50.
Duration of HOV Lane Use by HOV Lane Transit Users,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

Duration of HOV Lane Use (months)	Katy HOV Lane					
	1985	1986	1987	1988	1989	1990
Total Sample Average	(n=352) 4.0	(n=562) 11.5	(n=618) 18.8	(n=755) 20.7	(n=606) 25.2	(n=656) 27.1
Park-and-Ride Routes Average	(n=222) 4.0	(n=405) 11.1	(n=345) 18.2	(n=514) 20.1	(n=448) 24.9	(n=457) 26.3
Express Routes Average	(n=130) 4.2	(n=157) 12.5	(n=273) 19.5	(n=241) 21.8	(n=158) 26.4	(n=199) 28.9
Number of Months HOV Lane Open	5	18	36	48	60	72

Duration of HOV Lane Use (months)	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
	1986	1990	1989	1990	1989
Total Sample Average	(n=1240) 24.3	(n=968) 35.8	(n=212) 9.8	(n=286) 15.3	(n=456) 12.9
Park-and-Ride Routes Average	(n=1138) 23.9	(n=968) 35.8	(n=212) 9.8	(n=286) 15.3	(n=397) 13.4
Express Routes Average	(n=102) 28.9	— —	— —	— —	(n=59) 10.2
Number of Months HOV Lane Open	96	71	15	27	18

Data also indicate that 13% of the bus patrons using the Katy HOV Lane, 23% of those using the North HOV Lane, 29% of those on the Northwest HOV Lane, and 57% of the riders on the Gulf HOV Lane have been traveling the facilities since they opened (the Katy HOV Lane

had been open 72 months, the North -- 71 months, the Northwest -- 27 months and the Gulf -- 18 months at the time these surveys were undertaken).

Previous Travel Mode

Transit riders using the Katy, North, Northwest and Gulf HOV Lanes were asked to identify how they normally made the trip prior to riding a bus on the HOV lane. Their responses are summarized in Table 51. On the Katy HOV Lane routes, approximately 49% of the 1990 ridership either drove alone, carpooled or vanpooled. An additional 19% either rode a park-and-ride or regular route bus and 32% did not previously make the trip. (Note: Park-and-ride service was available in the Katy Freeway corridor prior to the opening of the HOV lane.)

On the North HOV Lane, 56% of the transit patrons had previously driven alone, carpooled or vanpooled. Fifteen percent reported that they had traveled by transit, and 28% did not previously make the trip. (Note: Park-and-ride service in the North Freeway corridor did not exist prior to the opening of the North Freeway contraflow lane.)

Approximately 55% of the Northwest HOV Lane bus ridership and 52% of the Gulf HOV Lane ridership either drove alone, carpooled or vanpooled prior to using a bus on the HOV lane. An additional 24% of the Northwest HOV Lane bus patrons and 30% of those riding Gulf HOV Lane buses were already riding buses prior to the opening of the HOV lanes.

Impact of HOV Lane on Mode Choice

Transit riders were asked if they would be riding a bus if the HOV lane was not available. Their responses are included in Table 52.

Table 51.
Previous Travel Mode of HOV Lane Transit Users,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

Previous Travel Mode	Katy HOV Lane					
	1985	1986	1987	1988	1989	1990
Total Sample	(n=355)	(n=573)	(n=630)	(n=771)	(n=631)	(n=665)
Drove alone	24%	35%	34%	38%	37%	36%
Carpool	5%	5%	9%	9%	10%	10%
Vanpool	4%	6%	2%	4%	4%	3%
Bus	54%	34%	33%	21%	20%	19%
Didn't make trip	12%	18%	21%	28%	29%	32%
Other	1%	2%	1%	0%	0%	0%
Park-and-Ride Routes	(n=222)	(n=409)	(n=348)	(n=523)	(n=466)	(n=458)
Drove alone	30%	37%	34%	36%	37%	37%
Carpool	4%	5%	8%	10%	11%	9%
Vanpool	6%	7%	3%	4%	5%	3%
Bus	45%	29%	30%	19%	16%	15%
Didn't make trip	14%	19%	23%	31%	31%	36%
Other	1%	3%	2%	—	—	—
Express Routes	(n=133)	(n=164)	(n=282)	(n=248)	(n=165)	(n=207)
Drove alone	14%	30%	33%	42%	34%	34%
Carpool	6%	6%	10%	8%	7%	13%
Vanpool	1%	3%	2%	3%	2%	3%
Bus	67%	47%	37%	23%	32%	28%
Didn't make trip	11%	13%	18%	23%	24%	22%
Other	1%	1%	—	1%	1%	0%

Previous Travel Mode	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
	1986	1990	1989	1990	1989
Total Sample	(n=1240)	(n=979)	(n=214)	(n=289)	(n=457)
Drove alone	35%	39%	46%	46%	38%
Carpool	10%	9%	9%	6%	8%
Vanpool	7%	8%	3%	3%	6%
Bus	22%	15%	21%	24%	30%
Didn't make trip	25%	28%	18%	21%	18%
Other	1%	1%	3%	—	0%
Park-and-Ride Routes	(n=1137)	(n=979)	(n=214)	(n=289)	(n=396)
Drove alone	35%	39%	46%	46%	36%
Carpool	9%	9%	9%	6%	7%
Vanpool	8%	8%	3%	3%	6%
Bus	22%	15%	21%	24%	32%
Didn't make trip	25%	28%	18%	21%	19%
Other	1%	1%	3%	—	—
Express Routes	(n=103)	—	—	—	(n=61)
Drove alone	34%	—	—	—	51%
Carpool	19%	—	—	—	12%
Vanpool	1%	—	—	—	8%
Bus	21%	—	—	—	16%
Didn't make trip	25%	—	—	—	11%
Other	0%	—	—	—	2%

Table 52.
Ride Bus If HOV Lane Had Not Opened,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

Ride Bus if No HOV Lane	Katy HOV Lane					
	1985	1986	1987	1988	1989	1990
Total Sample	(n=356)	(n=575)	(n=629)	(n=773)	(n=641)	(n=670)
Yes	69%	43%	52%	35%	32%	35%
No	15%	26%	20%	33%	36%	31%
Not sure	16%	31%	28%	32%	32%	34%
Park-and-Ride Routes	(n=221)	(n=410)	(n=345)	(n=522)	(n=468)	(n=460)
Yes	62%	37%	52%	31%	27%	29%
No	22%	31%	24%	38%	41%	38%
Not sure	16%	32%	24%	31%	32%	33%
Express Routes	(n=135)	(n=165)	(n=284)	(n=251)	(n=173)	(n=210)
Yes	79%	56%	53%	46%	44%	48%
No	5%	14%	15%	21%	22%	17%
Not sure	16%	30%	32%	33%	34%	35%

Ride Bus if No HOV Lane	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
	1986	1990	1989	1990	1989
Total Sample	(n=1247)	(n=981)	(n=215)	(n=291)	(n=457)
Yes	23%	33%	41%	41%	56%
No	41%	37%	39%	35%	22%
Not sure	36%	30%	20%	24%	22%
Park-and-Ride Routes	(n=145)	(n=981)	(n=215)	(n=291)	(n=396)
Yes	22%	33%	41%	41%	58%
No	42%	37%	39%	35%	20%
Not sure	36%	30%	20%	24%	22%
Express Routes	(n=102)	—	—	—	(n=61)
Yes	34%	—	—	—	48%
No	28%	—	—	—	31%
Not sure	38%	—	—	—	21%

In 1985, 69% of the Katy HOV Lane bus riders answered "yes." By 1990, however, only 35% said "yes" (and an additional 34% were "not sure"), indicating that the presence of the HOV lane has become much more important in recent years.

Elsewhere, 41% of the Northwest HOV Lane and 56% of the Gulf HOV Lane bus riders reported they would still be riding a bus if the HOV lane was not available. On the North HOV Lane, however, 37% of the bus riders state that they would *not* ride the bus if the HOV lane had not opened, and an additional 30% were not sure.

A related question asked how important the HOV lane is in their decision to ride a bus. Their responses to this question (Table 53) are consistent with their responses to the previous question.

Table 53.
Importance of HOV Lane in Mode Choice Decision,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

How Important Was HOV Lane in Decision to Ride Bus	Katy HOV Lane					
	1985	1986	1987	1988	1989	1990
Total Sample	(n=357)	(n=573)	(n=626)	(n=774)	(n=634)	(n=667)
Very important	39%	57%	54%	68%	72%	72%
Somewhat important	26%	27%	24%	18%	17%	19%
Not important	35%	16%	22%	14%	11%	9%
Park-and-Ride Routes	(n=222)	(n=409)	(n=345)	(n=522)	(n=464)	(n=458)
Very important	47%	62%	57%	73%	75%	79%
Somewhat important	27%	25%	24%	17%	15%	14%
Not important	26%	13%	19%	10%	10%	7%
Express Routes	(n=135)	(n=164)	(n=281)	(n=252)	(n=170)	(n=209)
Very important	25%	44%	50%	58%	62%	56%
Somewhat important	24%	30%	25%	20%	24%	30%
Not important	51%	26%	25%	22%	14%	14%

How Important Was HOV Lane in Decision to Ride Bus	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
	1986	1990	1989	1990	1989
Total Sample	(n=1250)	(n=977)	(n=216)	(n=293)	(n=462)
Very important	76%	73%	71%	76%	54%
Somewhat important	17%	17%	21%	15%	22%
Not important	7%	10%	8%	9%	24%
Park-and-Ride Routes	(n=1146)	(n=977)	(n=216)	(n=293)	(n=401)
Very important	76%	73%	71%	76%	51%
Somewhat important	17%	17%	21%	15%	23%
Not important	7%	10%	8%	9%	26%
Express Routes	(n=104)	—	—	—	(n=61)
Very important	72%	—	—	—	74%
Somewhat important	12%	—	—	—	15%
Not important	16%	—	—	—	11%

In 1985, 39% of the Katy HOV Lane bus riders indicated that the transitway was "very important" in their decision; in 1986, 1987 and 1988, this percentage continued to increase. By 1989, the percentage increased again (to 72%) and remained at that high level in 1990, further

indicating that the HOV lane's role in mode choice decisions has become more important in recent years.

Most current data in the other three corridors show that the presence of the HOV lane was "very important" to 54% of the bus riders on the Gulf HOV Lane, 73% of those on the North HOV Lane and 76% of those on the Northwest HOV Lane.

Perception of HOV Lane Utilization

One of the most important issues addressed in the HOV lane user (and nonuser) surveys involves commuter perception of HOV lane utilization. One of the main reasons for permitting carpools on the Katy HOV Lane (and later the other three HOV lanes) was to increase the perception of utilization. Transit patrons were asked whether they felt the HOV lane is sufficiently utilized to justify the project. Their responses are presented in Table 54.

As to be expected, on the Katy HOV Lane, as actual HOV lane utilization has increased (1985-1987), so has the perception of utilization. In 1988 (after the utilization of the HOV lane was restricted to 3+ vehicles between 6:45 a.m. and 8:15 a.m.), both the actual and perceived utilization declined somewhat. In 1989, however, both the actual and perceived utilization increased once again, and by 1990 (following a further increase in vehicle volumes), 87% of those surveyed felt the HOV lane is being sufficiently utilized.

Elsewhere, increases in actual HOV utilization have also resulted in increases in the perception of utilization. Most current data show that 75% of the Gulf HOV Lane bus riders and 88% of the North and Northwest HOV Lane transit patrons stated these HOV lanes are sufficiently utilized to justify the projects.

In considering these responses, it should be noted, however, that the typical bus rider views the HOV lane from inside a crowded bus. He does not have a clear idea of the number

of vehicles traveling on the lane and is more likely to think in terms of the number of persons moved per bus.

Table 54.
Perception of HOV Lane Utilization,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

Is HOV Lane Sufficiently Utilized to Justify Project	Katy HOV Lane					
	1985[1]	1986[2]	1987[3]	1988[4]	1989[4]	1990[5]
Total Sample	(n=348)	(n=567)	(n=618)	(n=763)	(n=630)	(n=658)
Yes	49%	66%	77%	72%	85%	87%
No	33%	14%	7%	8%	5%	4%
Not sure	18%	20%	16%	20%	10%	9%
Park-and-Ride Routes	(n=218)	(n=404)	(n=339)	(n=515)	(n=461)	(n=452)
Yes	55%	71%	81%	77%	88%	89%
No	26%	11%	5%	6%	5%	3%
Not sure	19%	18%	14%	17%	7%	8%
Express Routes	(n=130)	(n=163)	(n=279)	(n=248)	(n=169)	(n=206)
Yes	37%	53%	72%	62%	78%	83%
No	46%	21%	10%	12%	7%	7%
Not sure	17%	26%	18%	26%	15%	10%
HOV Lane Vehicle Volumes (A.M. Peak Period)[6]	138	256	2412	2032	2186	2635

Is HOV Lane Sufficiently Utilized to Justify Project	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
	1986[1]	1990[5]	1989[5]	1990[5]	1989[3]
Total Sample	(n=1230)	(n=972)	(n=207)	(n=286)	(n=450)
Yes	81%	88%	72%	88%	75%
No	6%	4%	6%	5%	9%
Not sure	13%	8%	22%	7%	16%
Park-and-Ride Routes	(n=1129)	(n=972)	(n=207)	(n=286)	(n=391)
Yes	81%	88%	72%	88%	75%
No	6%	4%	6%	5%	9%
Not sure	13%	8%	22%	7%	16%
Express Routes	(n=101)	—	—	—	(n=59)
Yes	79%	—	—	—	75%
No	5%	—	—	—	8%
Not sure	16%	—	—	—	17%
HOV Lane Vehicle Volumes (A.M. Peak Period)[6]	393	1595	1463	2099	1139

[1] *Authorized buses and vanpools only (before carpools were allowed)*
[2] *Authorized buses, vanpools and 3+ carpools*
[3] *2+ vehicles, no authorization*
[4] *3+ vehicles, no authorization between 6:45 a.m. and 8:15 a.m.; 2+ vehicles, no authorization at all other times*
[5] *3+ vehicles, no authorization between 6:45 a.m. and 8:00 a.m.; 2+ vehicles, no authorization at all other times*
[6] *Source: TTI Research Report 484-12 and TTI HOV lane volume counts*

Comments

Survey participants were encouraged to use the back of the forms for additional comments. Approximately 20%-25% of the participants did provide comments. These comments are summarized in Table 55 below.

Table 55.
Additional Comments,
Katy, North, Northwest and Gulf HOV Lane Transit User Surveys

Comment	Percent of Total comments					
	Katy HOV Lane					
	1985	1986	1987	1988	1989	1990
Extend the HOV lane	22%	5%	1%	—	—	—
Provide more and/or bigger peak period buses	16%	13%	11%	21%	19%	23%
Poor entry/exit design	16%	7%	10%	8%	6%	2%
Lose time due to bus routing on/off HOV lane	8%	7%	2%	1%	4%	6%
Bus fare too high	7%	2%	1%	3%	3%	0%
Good job METRO/HOV lane is great	3%	13%	26%	23%	27%	25%
HOV lane too crowded with 2+ carpools[1]	—	—	30%	20%	7%	11%
Dislike old buses	—	—	—	—	0%	3%
Other	28%	53%	19%	24%	34%	30%

Comment	Percent of Total Comments				
	North HOV Lane		Northwest HOV Lane		Gulf HOV Lane
	1986	1990	1989	1990	1989
Extend the HOV lane	23%	—	—	—	—
Provide more and/or bigger peak period buses	14%	9%	18%	47%	9%
Poor entry/exit design	—	2%	2%	1%	6%
Lose time due to bus routing on/off HOV lane	—	0%	5%	1%	3%
Bus fare too high	4%	2%	1%	1%	0%
Good job METRO/HOV lane is great	14%	25%	23%	20%	25%
HOV lane too crowded with 2+ carpools	—	9%	—	1%	—
Dislike old buses	5%	4%	1%	6%	0%
Other	40%	49%	50%	23%	57%

[1] *On the 1988, 1989 and 1990 Katy HOV Lane surveys, the comment was "HOV lane too crowed with 2+ carpools -- morning 3+ carpool restriction is a good move."*

CHAPTER 6
HOV LANE CARPOOL/VANPOOL SURVEYS

As noted in Chapter 4, the surveys of HOV lane carpoolers and vanpoolers performed in 1985 and 1986 included both drivers and passengers, while the 1987, 1988, 1989 and 1990 surveys included drivers only.

Previous reports (TTI Research Reports 484-4 and 484-8) categorize the 1985 and 1986 survey data by vanpool driver, vanpool passenger, carpool driver and carpool passenger. In this report, however, carpool and vanpool responses have been combined. This was done for two reasons. First, the 1987, 1988, 1989 and 1990 surveys included carpool/vanpool drivers only; therefore, no passenger data are available for these survey years. Second, since vanpools now comprise such a small percent of the total sample of poolers, presenting separate vanpool responses is not warranted.

As was the case with the HOV lane transit user surveys, the surveys of HOV lane carpool/vanpool users primarily addressed the following three areas:

- Personal characteristics;
- Travel patterns and trip characteristics; and
- Attitudes and impacts pertaining to the HOV lanes.

Personal Characteristics

Carpoolers/vanpoolers traveling the HOV lanes were asked a series of questions concerning their age, sex, occupation and level of education. Their responses are presented in Tables 56 and 57.

Table 56.
Personal Characteristics of HOV Lane Carpoolers/Vanpoolers,
Katy HOV Lane Carpool/Vanpool Surveys

Characteristic	Katy HOV Lane Carpools/Vanpools				
	1985	1986	1987	1988	1989
Age (years)	(n=539)	(n=635)	(n=570)	(n=381)	(n=578)
Median	38	38	36	36	38
Sex	(n=542)	(n=612)	(n=568)	(n=377)	(n=574)
Male	55%	55%	58%	54%	55%
Female	45%	45%	42%	46%	45%
Occupation	(n=533)	(n=609)	(n=561)	(n=545)	(n=550)
Professional	55%	54%	44%	44%	45%
Managerial	20%	17%	19%	19%	18%
Clerical	18%	21%	16%	12%	15%
Sales	2%	4%	8%	8%	6%
Student	0%	3%	5%	4%	4%
Service Worker	—	0%	1%	6%	2%
Craftsman	0%	—	3%	2%	3%
Homemaker	0%	0%	2%	3%	4%
Other	5%	1%	2%	2%	3%
Education (years)	(n=535)	(n=615)	(n=561)	(n=371)	(n=565)
Average	15.5	15.3	15.6	15.5	15.3

Table 57.
Personal Characteristics of HOV Lane Carpoolers/Vanpoolers,
North, Northwest and Gulf HOV Lane Carpool/Vanpool Surveys

Characteristic	North HOV Lane Carpools/Vanpools		Northwest HOV Lane Carpools/Vanpools			Gulf HOV Lane Carpools/Vanpools	
	1986[1]	1990	1988	1989	1990	1988	1989
Age (years)	(n=1532)	(n=188)	(n=255)	(n=249)	(n=238)	(n=121)	(n=119)
Median	39	37	35	36	36	35	37
Sex	(n=1538)	(n=189)	(n=253)	(n=247)	(n=234)	(n=118)	(n=118)
Male	55%	53%	53%	50%	38%	42%	41%
Female	45%	47%	47%	50%	62%	58%	59%
Occupation	(n=1512)	(n=174)	(n=239)	(n=239)	(n=231)	(n=117)	(n=118)
Professional	45%	38%	44%	44%	49%	33%	46%
Managerial	24%	21%	17%	18%	20%	14%	15%
Clerical	23%	21%	20%	18%	15%	31%	26%
Sales	7%	11%	13%	9%	7%	11%	4%
Student	1%	2%	0%	3%	5%	1%	1%
Service Worker	0%	1%	2%	2%	2%	4%	3%
Craftsman	0%	5%	2%	4%	1%	4%	2%
Homemaker	—	1%	1%	—	1%	—	—
Other	0%	—	1%	2%	0%	2%	3%
Education (years)	(n=1523)	(n=176)	(n=245)	(n=243)	(n=230)	(n=118)	(n=118)
Average	15.0	14.8	14.2	14.1	15.2	14.1	14.3

[1] *Includes responses from vanpoolers only; carpools were not allowed on the HOV lane at the time of this survey.*

Age

Throughout the survey years, the median age of HOV lane carpoolers/vanpoolers is in the mid to upper 30s.

Sex

At least half of the Katy and North HOV Lane poolers surveyed most recently are male; whereas 59% of the Gulf HOV Lane poolers and 62% of the Northwest HOV Lane poolers are female.

Occupation

Most recent survey data indicate that the majority of the HOV lane carpoolers/vanpoolers surveyed are employed in either "professional," "managerial," or "clerical" job positions. More specifically:

- Between 38% and 49% of the poolers' occupations are classified as "professional";
- Between 15% and 21% are employed in "managerial" positions; and
- Between 15% and 26% are employed in "clerical" positions.

Education

The average Katy and Northwest HOV Lane carpooler/vanpooler has completed at least 3 years of college; the average North and Gulf HOV Lane pooler has completed more than 2 years of college.

Travel Patterns and Trip Characteristics

Carpoolers and vanpoolers using the Katy, North, Northwest and Gulf HOV Lanes were asked a series of questions pertaining to the formation and operation of the carpool/vanpool on the HOV lane. Responses to these questions follow.

Year Joined Carpool/Vanpool

The year HOV lane poolers joined their present carpool/vanpool is presented in Table 58. As to be expected, surveys performed shortly after each HOV lane opened showed markedly higher percentages of poolers joining their present carpool/vanpool *before* the HOV lane opened. However, most recent survey results show that 54% of the North and Gulf HOV Lane poolers, 79% of the Northwest HOV Lane poolers and 92% of the Katy HOV Lane poolers reported joining their present carpool/vanpool *after* the opening of the HOV lane.

Median Age of Carpools/Vanpools

As shown below, the median age of HOV lane carpools/vanpools surveyed most recently (which ranged from 4 to 13 months) is less than or equal to the number of months the HOV lane has been open (to carpools).

HOV Lane	*Median Age (months) of Carpools/Vanpools*	*Number of Months HOV Lane Open as of Survey Date*
Katy (1989)	*13*	*54*
North (1990)	*4*	*4*
Northwest (1990)	*9*	*27*
Gulf (1989)	*12*	*18*

Table 58.
Year Joined Present Carpool/Vanpool,
Katy, North, Northwest and Gulf HOV Lane Carpool/Vanpool Surveys

Characteristic	Katy HOV Lane Carpools/Vanpools			North HOV Lane Carpools/Vanpools	
	1985	1986	1989	1986[1]	1990
Year Joined Present Carpool/Vanpool	(n=549)	(n=628)	(n=447)	(n=1600)	(n=159)
Before 1980	10%	10%	0%	10%	4%
1980	10%	5%	1%	9%	2%
1981	10%	5%	1%	11%	1%
1982	12%	4%	0%	11%	0%
1983	13%	8%	1%	10%	—
1984	28%	12%	5%	14%	3%
1985	17%	38%	2%	32%	3%
1986	—	18%	6%	3%	0%
1987	—	—	16%	—	6%
1988	—	—	31%	—	5%
1989	—	—	37%	—	9%
1990	—	—	—	—	67%
Joined Present Carpool/Vanpool	(n=549)	(n=628)	(n=447)	(n=1600)	(n=159)
Before HOV Lane Opened	75%	66%	8%	59%	46%
After HOV Lane Opened	25%	34%	92%	41%	54%

Characteristic	Northwest HOV Lane Carpools/Vanpools			Gulf HOV Lane Carpools/Vanpools	
	1988	1989	1990	1988	1989
Year Joined Present Carpool/Vanpool	(n=222)	(n=199)	(n=196)	(n=111)	(n=102)
Before 1980	3%	1%	0%	6%	5%
1980	2%	—	—	3%	1%
1981	2%	0%	2%	1%	4%
1982	2%	—	0%	2%	1%
1983	2%	2%	1%	4%	1%
1984	4%	4%	2%	1%	6%
1985	4%	3%	2%	5%	4%
1986	10%	4%	2%	6%	3%
1987	11%	8%	4%	13%	8%
1988	60%	27%	11%	59%	22%
1989	—	51%	23%	—	45%
1990	—	—	53%	—	—
Joined Present Carpool/Vanpool	(n=222)	(n=199)	(n=196)	(n=111)	(n=102)
Before HOV Lane Opened	66%	35%	21%	51%	46%
After HOV Lane Opened	34%	65%	79%	49%	54%

[1] *Includes responses from vanpoolers only; carpools were not allowed on the HOV lane at the time of this survey.*

Note: The Katy HOV Lane opened to vanpools in October 1984 and to carpools in April 1985; the North HOV Lane opened to vanpools November 1984 and to carpools in June 1990.

Trip Purpose

It has been estimated that the majority of trips served by the HOV lanes during the a.m. peak period are work or school trips. As shown below, the results of the most recent surveys in each corridor confirm this theory:

HOV Lane	*Trip Purpose*
Katy	*86% Work; 3% School; 11% Other*
North	*98% Work; 2% School; 0% Other*
Northwest	*90% Work; 10% School*
Gulf	*98% Work; 2% School*

Home Zip Codes

A review of home Zip Code data for HOV lane carpoolers and vanpoolers indicates the following:

- The majority (63%) of Katy HOV Lane poolers reside in one of 5 Zip Code areas in west Houston (Table 59; Figure 35);
- More than 60% of the North HOV Lane carpoolers and vanpoolers reside in one of 9 Zip Code areas in North Houston (Table 59; Figure 36);
- About two-thirds of the Northwest HOV Lane poolers reside in one of 5 Zip Code areas in northwest Houston (Table 59; Figure 37); and
- Carpoolers and vanpoolers using the Gulf HOV Lane typically reside in one of 8 Zip Code areas in southeast Houston (Table 59; Figure 38).

Table 59.
Home Zip Codes of Carpoolers/Vanpoolers,
Katy, North Northwest and Gulf HOV Lane Carpool/Vanpool Surveys

Home Zip Code	1985	1986	1987	1988	1989	1990
Katy HOV Lane Carpools/Vanpools	(n=649)	(n=621)	(n=570)	(n=384)	(n=576)	(n=730)
77079	18%	18%	14%	11%	10%	12%
77084	18%	15%	14%	20%	18%	15%
77450	14%	19%	15%	21%	21%	17%
77077	12%	11%	9%	7%	8%	11%
77449	12%	14%	16%	12%	13%	8%
77042	5%	3%	4%	1%	3%	3%
77043	5%	3%	3%	2%	3%	4%
77082	3%	2%	4%	2%	3%	4%
77083	4%	5%	4%	4%	5%	5%
Other	9%	10%	17%	20%	16%	21%
North HOV Lane Carpools/Vanpools	—	(n=1554)[1]	—	—	—	(n=188)
77373	—	11%	—	—	—	6%
77380	—	10%	—	—	—	1%
77379	—	9%	—	—	—	11%
77381	—	8%	—	—	—	5%
77388	—	8%	—	—	—	11%
77090	—	5%	—	—	—	4%
77066	—	4%	—	—	—	6%
77073	—	3%	—	—	—	2%
77069	—	3%	—	—	—	5%
77014	—	2%	—	—	—	3%
77060	—	2%	—	—	—	5%
77067	—	2%	—	—	—	6%
77088	—	2%	—	—	—	7%
77038	—	1%	—	—	—	4%
Other	—	30%	—	—	—	24%
Northwest HOV Lane Carpools/Vanpools	—	—	—	(n=256)	(n=252)	(n=238)
77040	—	—	—	24%	16%	22%
77095	—	—	—	14%	15%	16%
77064	—	—	—	13%	12%	14%
77065	—	—	—	8%	9%	7%
77070	—	—	—	8%	5%	5%
77429	—	—	—	8%	12%	8%
77041	—	—	—	7%	7%	4%
77084	—	—	—	4%	6%	6%
77088	—	—	—	3%	3%	5%
Other	—	—	—	11%	15%	13%
Gulf HOV Lane Carpools/Vanpools	—	—	—	(n=122)	(n=120)	—
77089	—	—	—	17%	25%	—
77034	—	—	—	9%	9%	—
77061	—	—	—	7%	4%	—
77062	—	—	—	7%	6%	—
77546	—	—	—	7%	7%	—
77573	—	—	—	7%	2%	—
77598	—	—	—	6%	1%	—
77017	—	—	—	5%	3%	—
Other	—	—	—	35%	43%	—

[1] *Includes responses from vanpoolers only; carpools were not allowed on the HOV lane at the time of this survey.*

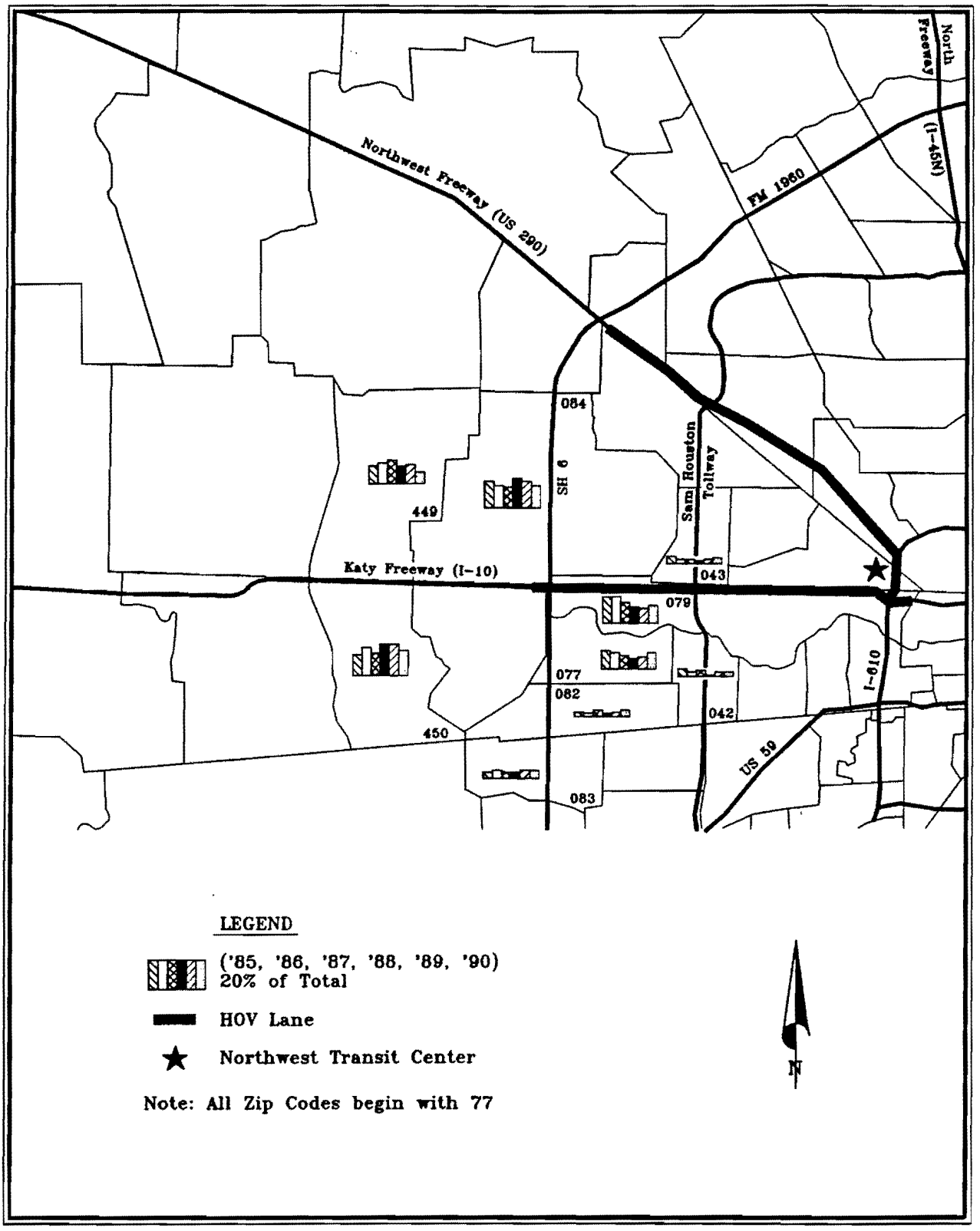


Figure 35. Home Origins of Katy HOV Lane Carpoolers/Vanpoolers

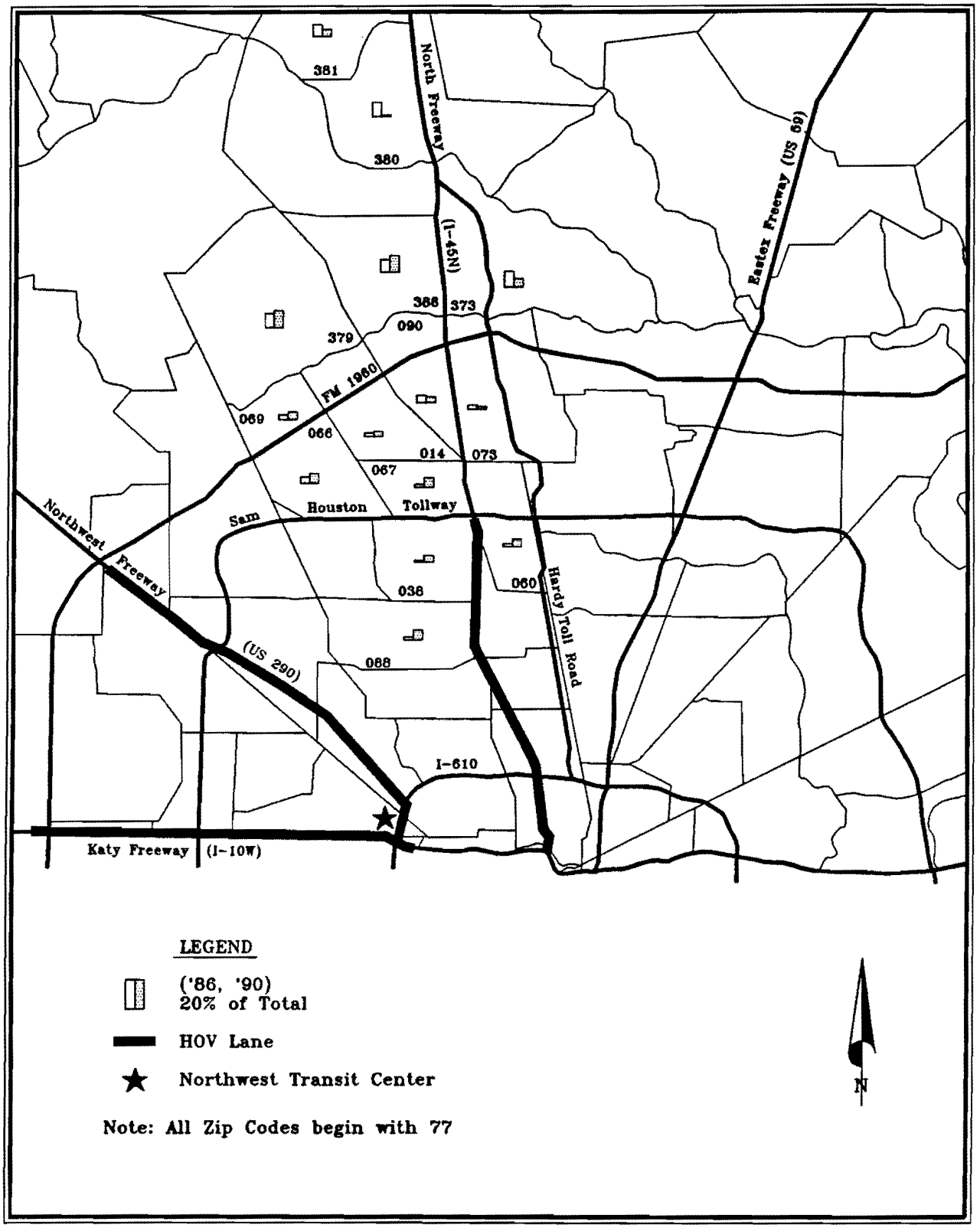


Figure 36. Home Origins of North HOV Lane Carpoolers/Vanpoolers

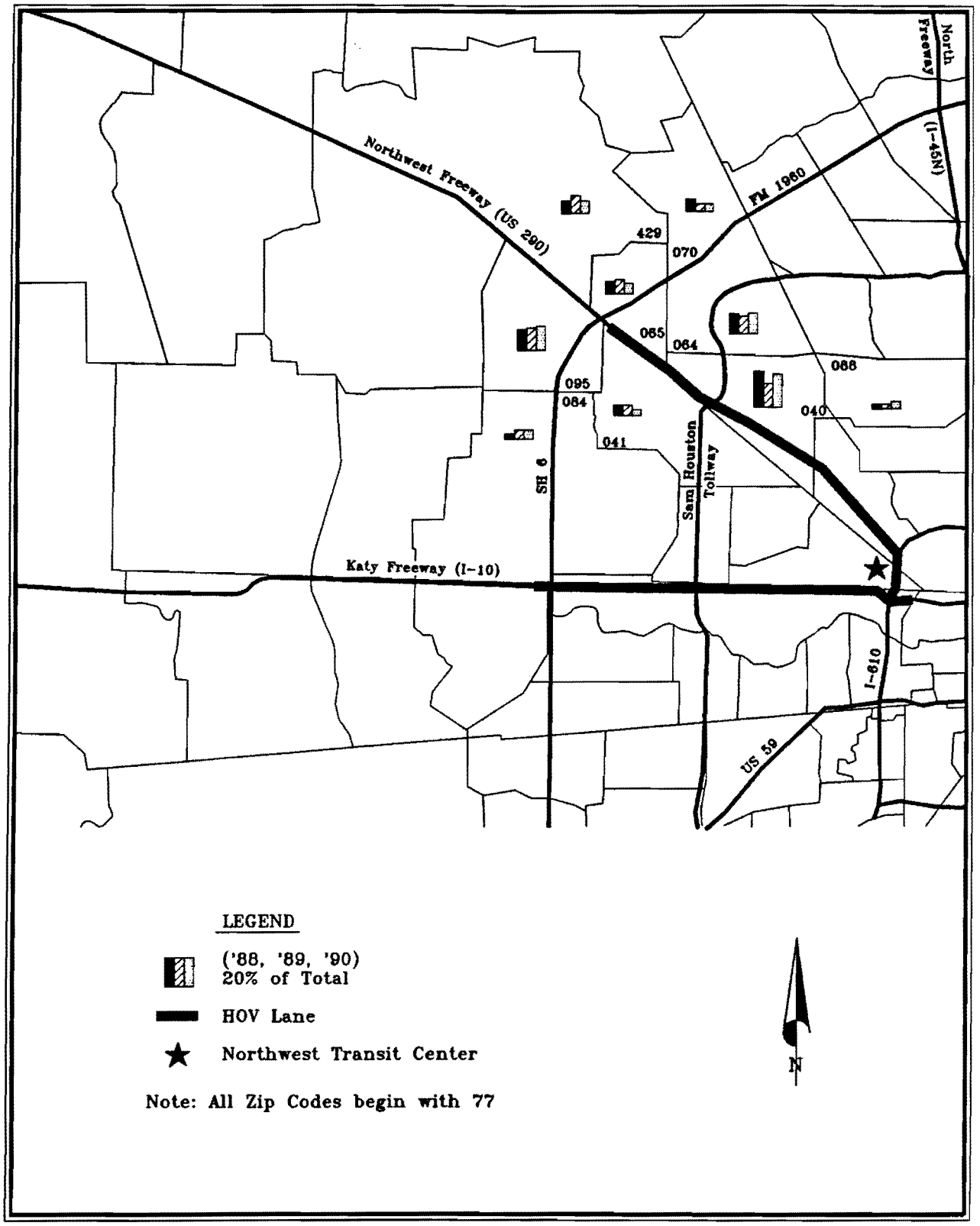


Figure 37. Home Origins of Northwest HOV Lane Carpoolers/Vanpoolers

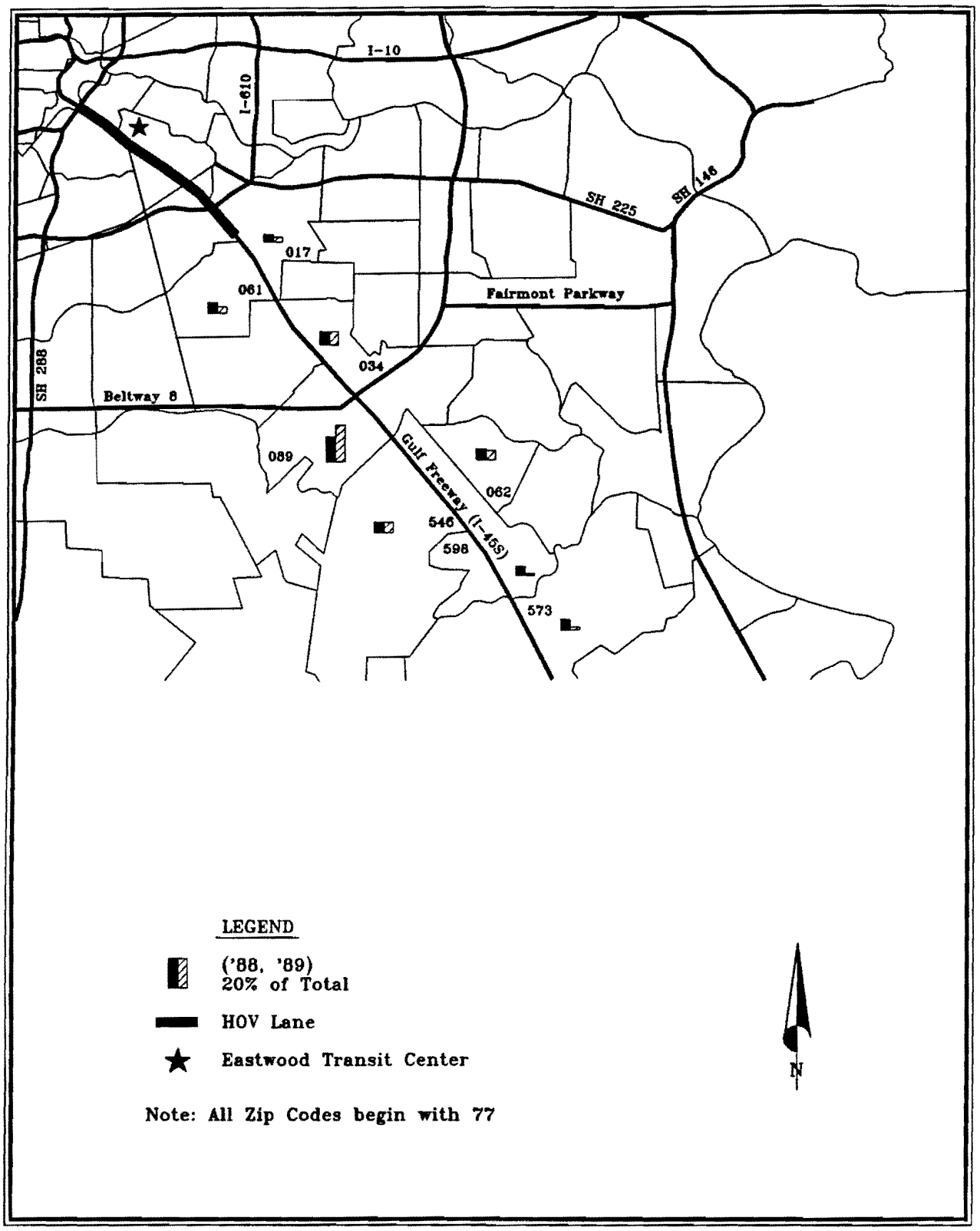


Figure 38. Home Origins of Gulf HOV Lane Carpoolers/Vanpoolers

HOV Lane Entrance Ramp

The Katy, North and Gulf HOV Lanes each have three entrances in the inbound direction (for the a.m. operation), and the Northwest HOV Lane has five entrances. HOV lane poolers were asked which of the entrances they typically use to access the HOV lane in the a.m. Most recent results along the Katy HOV Lane indicate that 55% use the I-10 ramp just west of SH 6, 23% use the flyover ramp located at the Addicks Park-and-Ride Lot, and the remaining 22% enter the HOV lane via the Gessner slip ramp.

On the North HOV Lane, approximately 63% typically use the North Belt mainlane entrance ramp, 19% use the Aldine-Bender wishbone ramp, and the remaining 18% access the HOV lane from the North Shepherd ramp. On the Gulf HOV Lane, 62% of those surveyed enter the HOV lane via the Broadway ramp, 36% enter from the south Loop (I-610) and 1% use the Eastwood (Lockwood) ramp.

In the Northwest corridor, 32% of the carpoolers and vanpoolers reported entering the HOV lane at the FM 1960 slip ramp, 25% from the Northwest Station ramp, 26% from the Little York flyover ramp and the remaining 17% from the Pinemont ramp (no poolers reported using the Dacoma entrance to the HOV lane).

Vehicle Occupancies

Katy HOV Lane

At the time of the 1985 survey, utilization of the Katy HOV Lane was restricted to authorized carpools carrying 4 or more registered persons. During the 1986 survey, the minimum occupancy for authorized carpools had been lowered to 3 persons. By the time of the 1987 survey, the passenger requirement had been lowered to 2 persons and all authorization procedures were eliminated. Shortly before the 1988 survey, the minimum carpool passenger

requirement was raised from 2 to 3 persons between the hours of 6:45 a.m. and 8:15 a.m. This 3+ operating restriction was also in effect during the 1989 survey. In 1990, the 3+ passenger requirement had been modified to 6:45 a.m. through 8:00 a.m.

The actual occupancies of the carpools/vanpools traveling on the Katy HOV Lane are shown in Table 60. In 1990, Katy HOV Lane carpools/vanpools carried an average of 2.4 persons per vehicle.

Table 60.
Vehicle Occupancies of HOV Lane Carpools/Vanpools,
Katy, North, Northwest and Gulf HOV Lane Carpool/Vanpool Surveys

Characteristic	Katy HOV Lane Carpools/Vanpools					
	1985	1986	1987	1988	1989	1990
Vehicle Occupancy	(n=97)	(n=123)	(n=592)	(n=409)	(n=568)	(n=734)
2 or less	—	1%	78%	65%	60%	72%
3	19%	30%	15%	24%	27%	20%
4	15%	23%	4%	9%	10%	5%
5	4%	4%	1%	2%	2%	1%
6	10%	5%	1%	0%	1%	1%
7	9%	3%	1%	—	0%	0%
8	15%	8%	0%	—	—	0%
9	15%	4%	—	—	—	1%
10	2%	6%	—	—	—	—
11	5%	6%	—	—	—	—
12	4%	5%	0%	—	—	0%
More than 12	2%	5%	—	—	—	0%
Average	6.8	6.0	2.3	2.5	2.6	2.4

Characteristic	North HOV Lane Carpools/Vanpools		Northwest HOV Lane Carpools/Vanpools			Gulf HOV Lane Carpools/Vanpools	
	1986[1]	1990	1988	1989	1990	1988	1989
Vehicle Occupancy	(n=202)	(n=187)	(n=261)	(n=251)	(n=239)	(n=124)	(n=122)
2 or less	—	77%	79%	80%	77%	78%	74%
3	—	14%	17%	18%	17%	13%	15%
4	1%	3%	3%	2%	6%	6%	7%
5	2%	3%	1%	0%	—	2%	2%
6	7%	1%	—	—	—	1%	—
7	9%	—	—	—	—	—	—
8	14%	—	—	—	—	—	—
9	13%	1%	—	—	—	—	—
10	16%	1%	—	—	—	—	—
11	9%	—	—	—	—	—	—
12	17%	0%	—	—	—	—	1%
More than 12	12%	0%	—	—	—	—	1%
Average	9.7	2.5	2.3	2.2	2.3	2.3	2.5

[1] *Includes responses from vanpoolers only; carpools were not allowed on the HOV lane at the time of this survey.*

North HOV Lane

During the 1986 survey, vanpool utilization of the North HOV Lane was limited to authorized 8+ vanpools. About four months before the 1990 survey, the passenger requirement for vehicles had been lowered to 2 persons, and all authorization procedures were eliminated. Reported carpool/vanpool occupancies for 1986 and 1990 are presented in Table 60. As this table indicates, the average occupancy of North HOV Lane pools dropped from 9.7 in 1986 to 2.5 in 1990.

Northwest and Gulf HOV Lanes

At the time of each of the surveys performed in the Northwest and Gulf corridors, both facilities were open to all 2+ vehicles with no authorization; reported vehicle occupancies are presented in Table 60. The average vehicle occupancy of Northwest carpools/vanpools was 2.3 persons in 1988, 2.2 persons in 1989 and 2.3 persons in 1990. The average occupancy of Gulf HOV Lane pools rose slightly from 2.3 persons in 1988 to 2.5 persons in 1989.

Carpool/Vanpool Composition

As part of the more recent survey efforts, HOV lane poolers were asked to identify the composition of their carpool/vanpool group. As indicated below, between 56% and 65% of those responding are carpooling with family members; an additional 25% to 32% are pooling with co-workers.

HOV Lane	*Carpool Composition*
Katy	*56% Family Members; 32% Co-Workers; 12% Neighbors*
North	*62% Faimly Members; 25% Co-Workers; 13% Neighbors*
Northwest	*62% Family Members; 25% Co-Workers; 13% Neighbors*
Gulf	*65% Family Members; 27% Co-Workers; 8% Neighbors*

Duration of HOV Lane Use

The median number of months carpoolers/vanpoolers have been using the HOV lane in their area is shown below. Because the North HOV Lane had been open to carpools for only a few months at the time of the 1990 survey, carpool/vanpool responses are listed separately. It is interesting to note that both the typical vanpooler and the typical carpooler reported using the North HOV Lane "since it opened."

HOV Lane	*Duration of HOV Lane Use (median number of months)*	*Number of Months HOV Lane Was Open at the Time of Survey*
Katy (1990)	*Carpools/Vanpools - 24*	*Vanpools - 72; Carpools - 66*
North (1990)	*Vanpools - 71; Carpools - 5*	*Vanpools - 71; Carpools - 5*
Northwest (1990)	*Carpools/Vanpools - 14*	*Carpools/Vanpools - 27*
Gulf (1989)	*Carpools/Vanpools 11*	*Carpools/Vanpools - 11*

Trip Destinations

Since 1985, the downtown area has continued to be the single largest attractor of HOV lane carpool/vanpool trips (Table 61). In fact, most recent survey data show that 40% of the poolers using the Northwest HOV Lane, 53% of those using the Katy HOV Lane, 76% of those using the North HOV Lane and 78% of those traveling the Gulf HOV Lane are destined to the downtown area. In addition, carpools and vanpools have also demonstrated the capability of serving trips to numerous locations other than downtown, as evidenced by the large number of trips to the Galleria, Texas Medical Center, Greenway Plaza and other locations.

Previous Travel Mode

Prior to traveling in a carpool or vanpool on the HOV lane, more than half of the current Katy HOV Lane poolers drove alone. By contrast, 34% of the Northwest HOV Lane poolers,

39% of the North HOV Lane poolers, and 44% of the Gulf HOV Lane poolers were already carpooling or vanpooling prior to using the HOV lane (Table 61). Table 61 also shows that in the North corridor, only 3% of the carpoolers were attracted from vanpools, but 15% were attracted from buses.

Those traveling the Northwest HOV Lane were also asked if they had used the Katy HOV Lane on a regular basis prior to using the North HOV Lane. Approximately 15% of the carpoolers/vanpoolers responding in 1988, 14% of those in 1989 and 13% of those responding in 1990 replied "yes."

Table 61.
Trip Destination and Previous Travel Mode of HOV Lane Carpoolers/Vanpoolers, Katy, North, Northwest and Gulf HOV Lane Carpool/Vanpool Surveys

	Katy HOV Lane Carpools/Vanpools						
Characteristic	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	
Trip Destination	(n=95)	(n=123)	(n=597)	(n=404)	(n=567)	(n=708)	
Downtown	57%	55%	39%	42%	39%	53%	
Galleria	12%	14%	22%	19%	20%	13%	
Greenway Plaza	6%	2%	6%	3%	5%	5%	
Texas Medical Center	4%	5%	5%	5%	5%	6%	
Other	21%	24%	28%	31%	31%	23%	
Previous Travel Mode	(n=549)	(n=624)	(n=588)	(n=391)	(n=522)	(n=699)	
Drove alone	36%	39%	50%	45%	51%	57%	
Carpool	22%	17%	29%	33%	26%	27%	
Vanpool	12%	9%	3%	3%	4%	3%	
Bus	13%	13%	9%	7%	8%	9%	
Didn't make trip	17%	22%	9%	12%	11%	4%	
	North HOV Lane Carpools/Vanpools		**Northwest HOV Lane Carpools/Vanpools**			**Gulf HOV Lane Carpools/Vanpools**	
Characteristic	**1986[1]**	**1990**	**1988**	**1989**	**1990**	**1988**	**1989**
Trip Destination	(n=199)	(n=189)	(n=268)	(n=250)	(n=235)	(n=123)	(n=122)
Downtown	61%	76%	38%	41%	40%	81%	78%
Galleria	7%	3%	26%	22%	28%	9%	6%
Greenway Plaza	8%	2%	4%	4%	5%	3%	1%
Texas Medical Center	4%	7%	4%	2%	6%	—	4%
Other	20%	12%	28%	31%	21%	7%	11%
Previous Travel Mode	(n=1622)	(n=178)	(n=239)	(n=242)	(n=225)	(n=97)	(n=117)
Drove alone	30%	42%	34%	43%	53%	28%	40%
Carpool	21%	39%	60%	45%	34%	53%	44%
Vanpool	12%	3%	1%	3%	1%	6%	7%
Bus	14%	15%	4%	4%	8%	5%	4%
Didn't make trip	23%	1%	1%	5%	4%	8%	5%

[1] *Includes responses from vanpoolers only; carpools were not allowed on the HOV lane at the time of this survey.*

Attitudes and Impacts Pertaining to the HOV Lanes

A number of questions were intended to collect information concerning attitudes toward and impacts of implementing the HOV lanes. The responses to these questions can be categorized as follows: 1) impacts of the HOV lane on modal selection; 2) perceived travel time savings as a result of using the HOV lane versus the regular freeway lanes; and 3) perception of HOV lane utilization.

Impacts of the HOV Lane on Mode Choice

A question was asked to determine whether individuals would be carpooling or vanpooling if the HOV lanes had not opened. Responses to this question are summarized in Table 62. Initial surveys performed in the Katy, Northwest and Gulf HOV Lane corridors show strong similarities. Between 70% and 84% of the individuals surveyed in the Katy corridor (in 1985) and in the Northwest and Gulf corridors (in 1988) responded "yes." Results of later surveys performed in the Katy corridor, however, showed 42% of those responding in 1989 and 43% of those responding in 1990 said they would *not*. This same trend is being observed in the Northwest and Gulf HOV Lane corridors.

In the North HOV Lane corridor, a significant percentage (30%) of the vanpoolers surveyed in 1986 were "not sure" if they would be vanpooling if not for the HOV lane. By 1990, however, the percentage of "not sure" responses decreased to 12% and the percentage of carpoolers/vanpoolers who stated they would *not* be pooling if not for the HOV lane reached 40%.

A related question asked how important is the HOV lane in the decision to carpool or vanpool. Most recent survey results in each corridor show that between 67% and 83% of those surveyed said the HOV lane is either "very important" or "somewhat important" in their decision to carpool/vanpool (Table 62).

Table 62.
Perceived Impacts of the HOV Lane on Mode Choice,
Katy, North, Northwest and Gulf HOV Lane Carpool/Vanpool Surveys

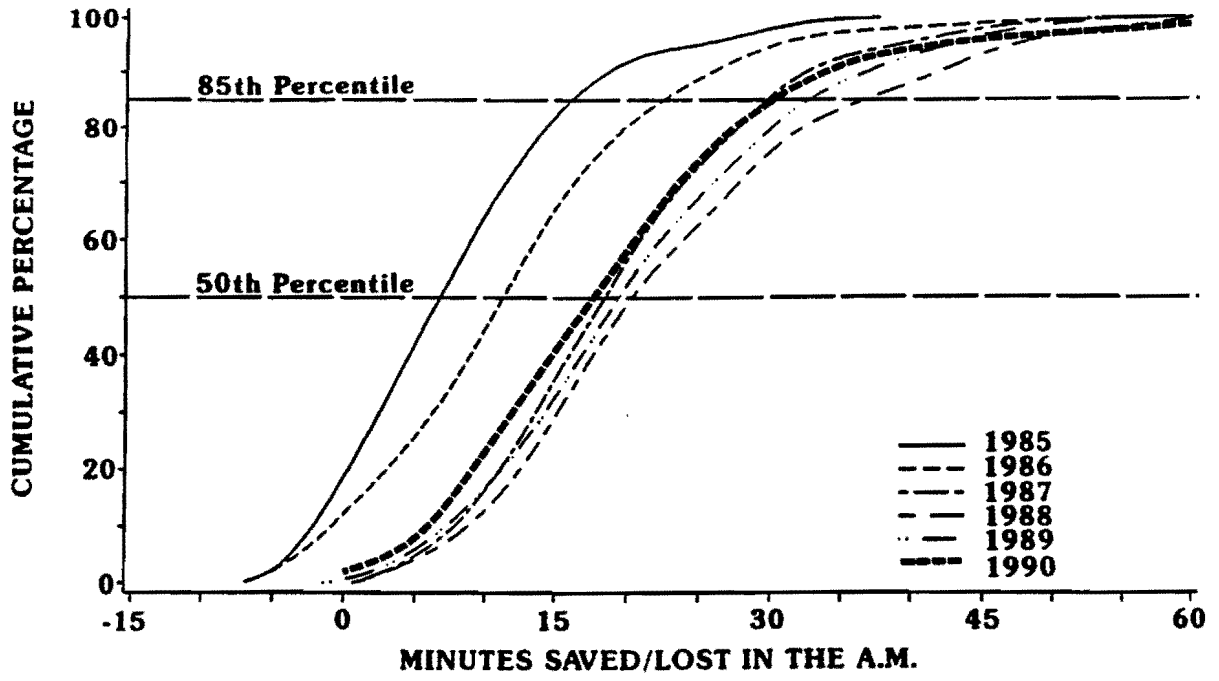
Impact	Katy HOV Lane Carpools/Vanpools					
	1985	1986	1987	1988	1989	1990
Use Carpool/Vanpool Mode If No HOV Lane	(n=551)	(n=633)	(n=588)	(n=398)	(n=559)	(n=702)
Yes	84%	68%	50%	54%	42%	37%
No	8%	16%	37%	35%	42%	43%
Not sure	8%	16%	13%	11%	16%	20%
Importance of HOV Lane in Decision to Carpool/Vanpool	(n=547)	(n=632)	—	—	(n=557)	(n=709)
Very Important	28%	46%	—	—	73%	64%
Somewhat Important	16%	16%	—	—	14%	19%
Not Important	56%	38%	—	—	13%	17%

Impact	North HOV Lane Carpools/Vanpools		Northwest HOV Lane Carpools/Vanpools			Gulf HOV Lane Carpools/Vanpools	
	1986[1]	1990	1988	1989	1990	1988	1989
Use Carpool/Vanpool Mode If No HOV Lane	(n=1632)	(n=185)	(n=255)	(n=247)	(n=237)	(n=122)	(n=120)
Yes	43%	48%	70%	52%	45%	75%	68%
No	27%	40%	21%	30%	39%	14%	20%
Not sure	30%	12%	9%	18%	16%	11%	12%
Importance of HOV Lane in Decision to Carpool/Vanpool	(n=1618)	(n=187)	(n=253)	(n=249)	(n=238)	(n=122)	(n=120)
Very Important	68%	60%	53%	56%	74%	43%	49%
Somewhat Important	18%	21%	15%	20%	9%	22%	18%
Not Important	14%	19%	32%	24%	17%	35%	33%

[1] *Includes responses from vanpoolers only; carpools were not allowed on the HOV lane at the time of this survey.*

Perceived HOV Lane Travel Time Savings

Frequency distributions of carpooler/vanpooler perceived travel time savings as a result of being able to use the Katy, North, Northwest and Gulf HOV Lanes are presented in Figures 39-42, respectively.



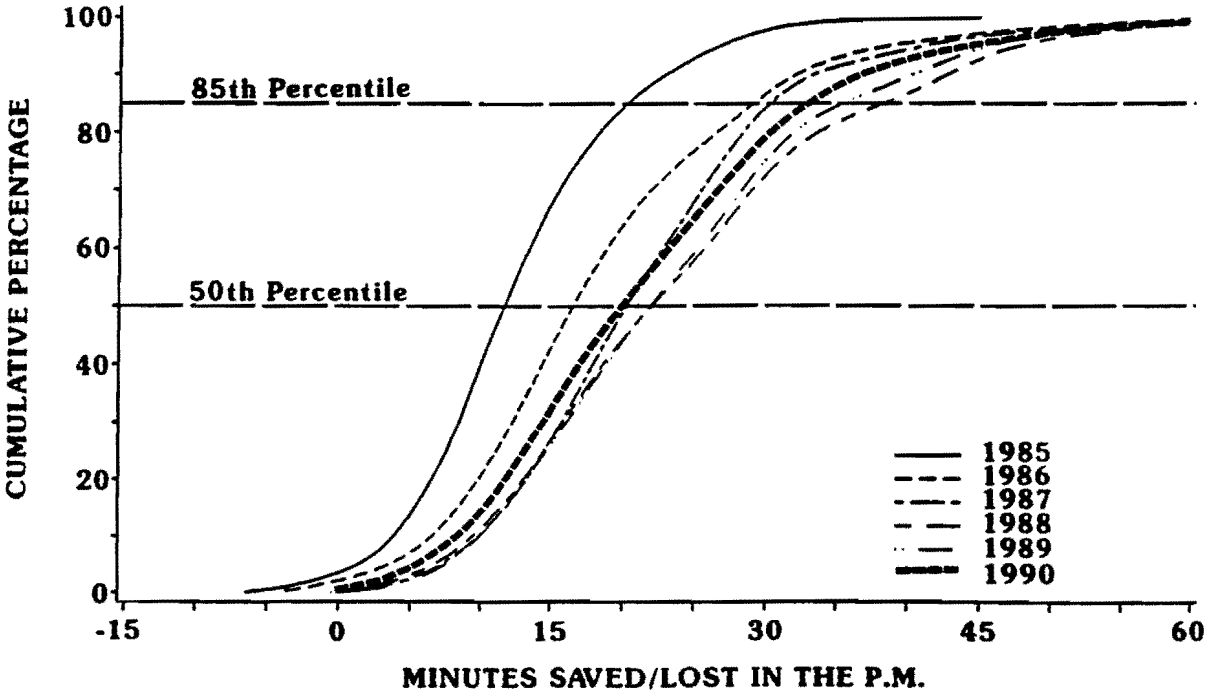
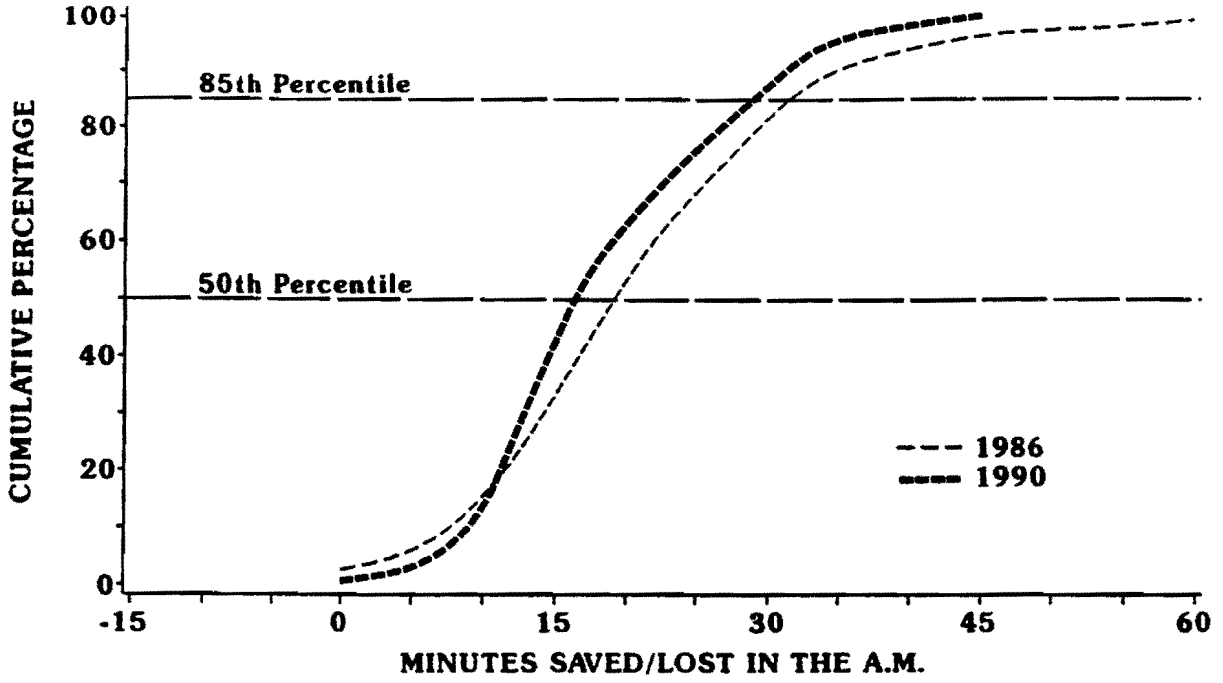


Figure 39. Perceived Katy HOV Lane Travel Time Savings, Katy HOV Lane Carpool/Vanpool Surveys



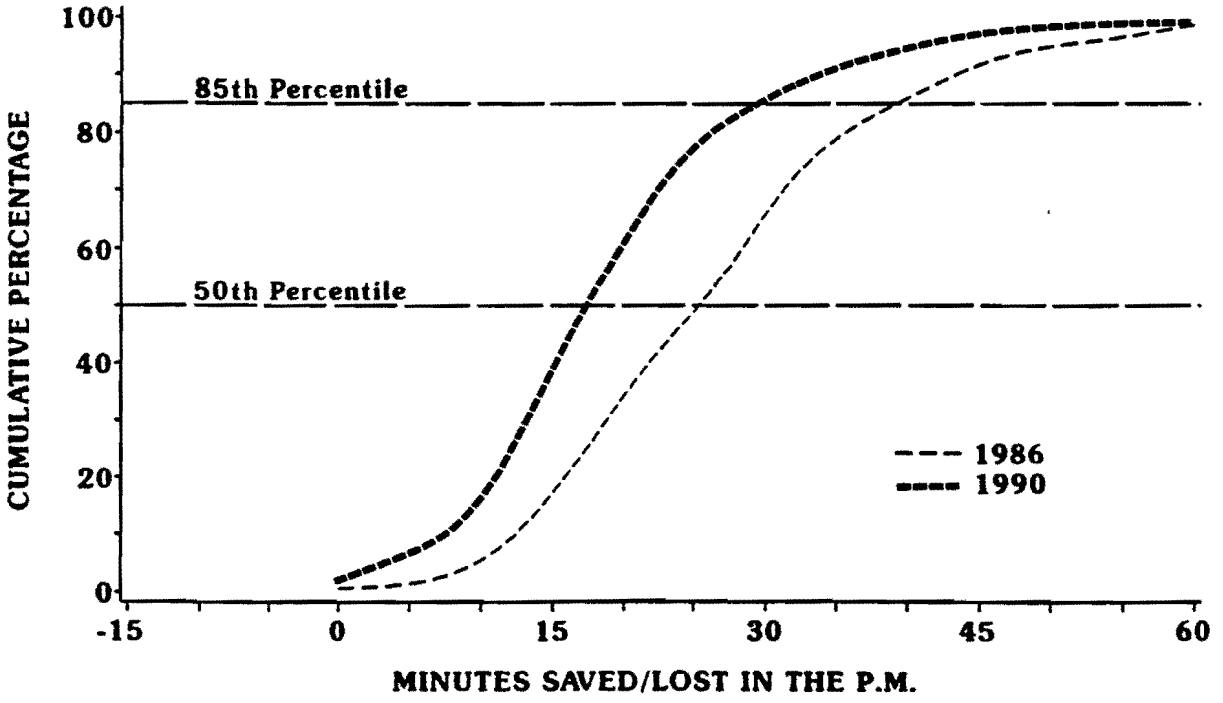
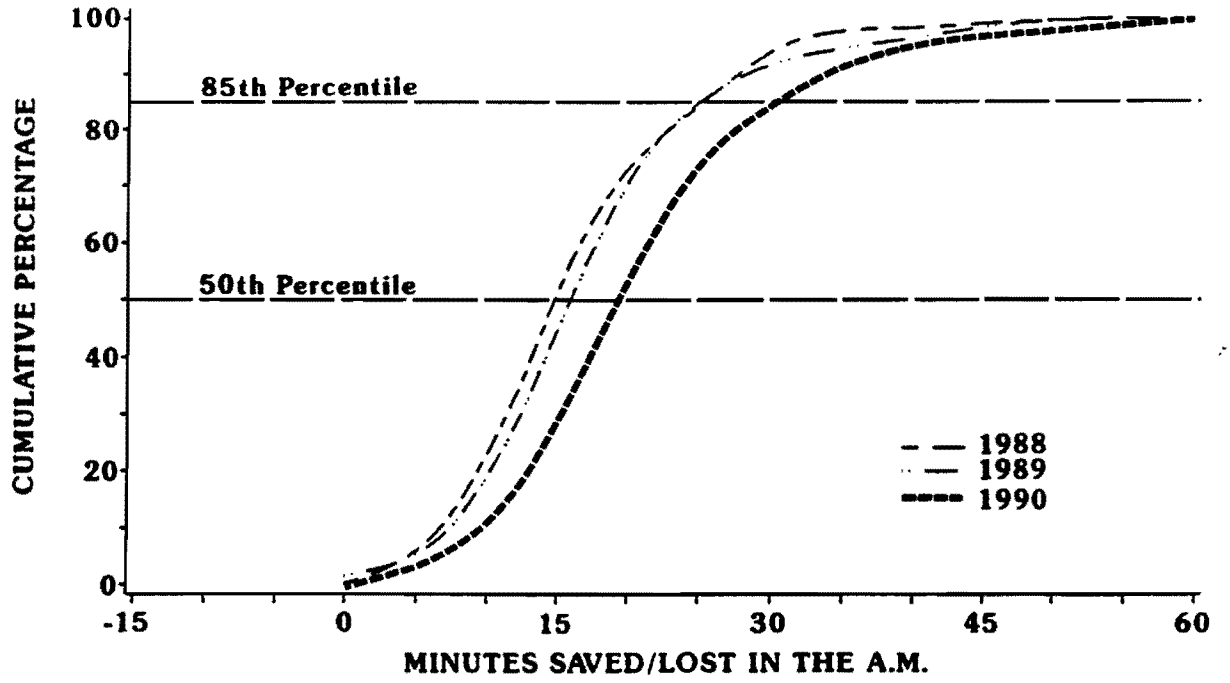


Figure 40. Perceived North HOV Lane Travel Time Savings, North HOV Lane Carpool/Vanpool Surveys



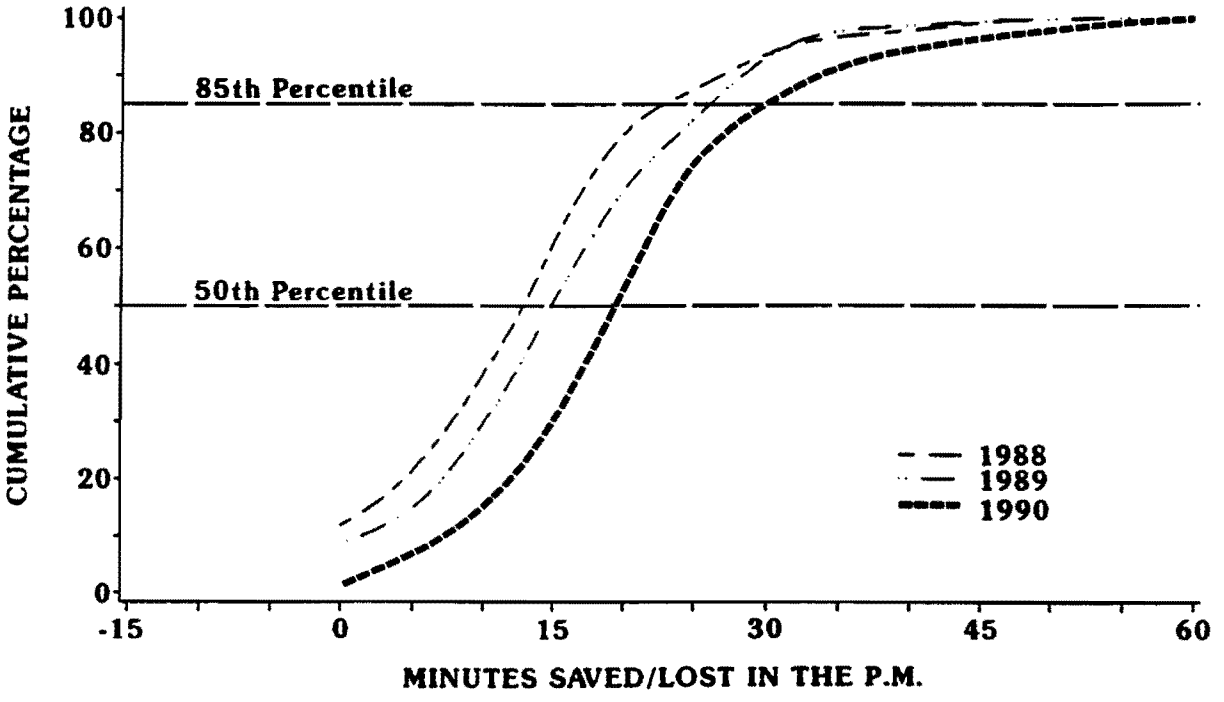


Figure 41. Perceived Northwest HOV Lane Travel Time Savings, Northwest HOV Lane Carpool/Vanpool Surveys

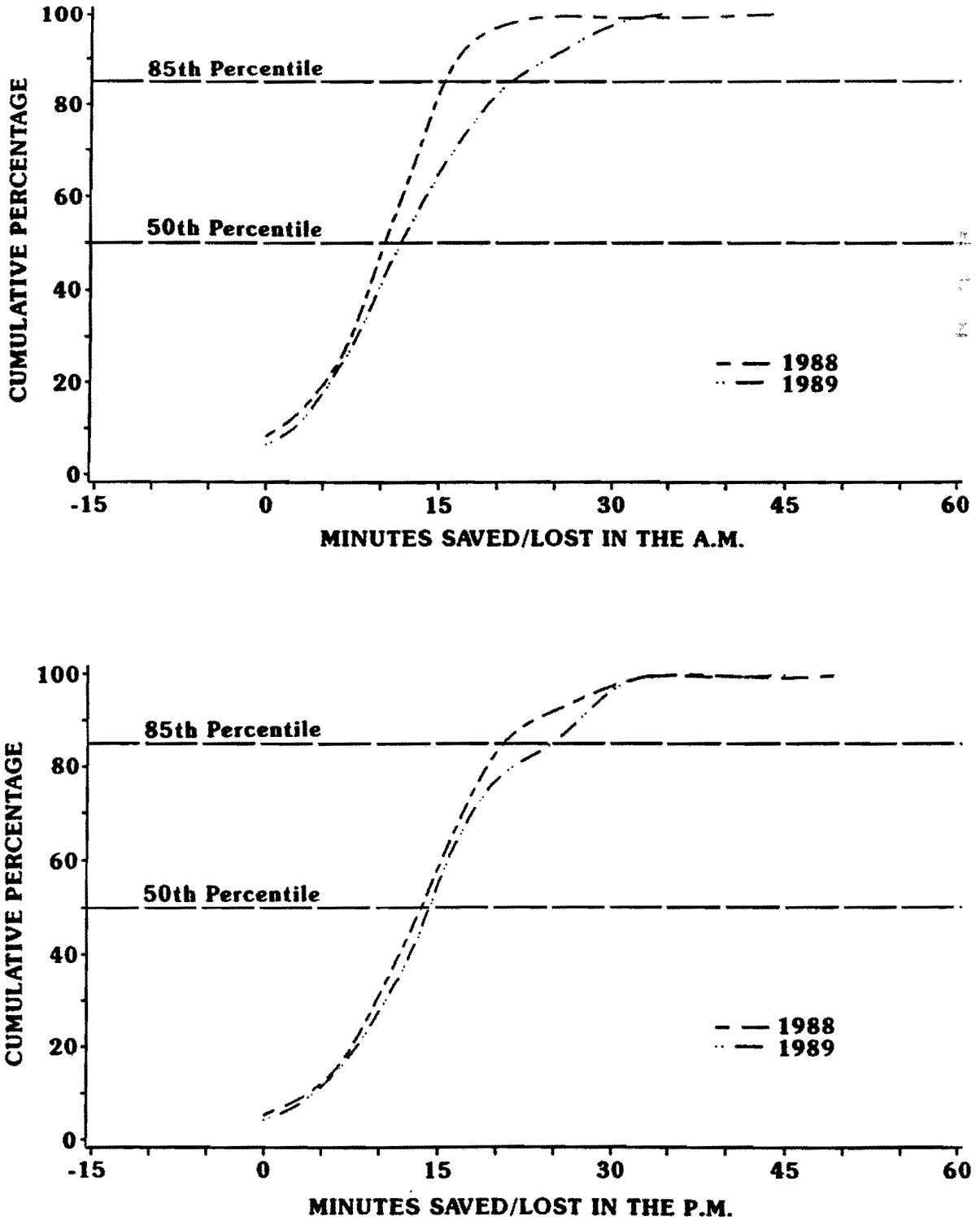


Figure 42. Perceived Gulf HOV Lane Travel Time Savings, Gulf HOV Lane Carpool/Vanpool Surveys

Katy HOV Lane

In 1985 and 1986, Katy HOV Lane poolers perceived a greater travel time savings in the afternoon than in the morning (Table 63). As to be expected, perceived travel time savings in 1986 (after the HOV lane was extended to West Belt) are greater than those in 1985. In addition, perceived travel time savings in 1987, 1988 and 1989 (after the HOV lane was extended to SH 6) are greater yet. Median perceived travel time savings in 1989 were 20 minutes for both the a.m. and p.m. Surprisingly, median travel time savings perceived by carpoolers and vanpoolers did not increase in 1990, even though the eastern extension to the HOV lane had become operational and vehicles had direct access to/from the Katy Freeway (without having to travel on arterial streets and pass through two signalized intersections in order to make the connection).

Table 63.
Perceived Impacts of the HOV Lane on Travel Time Savings,
Katy, North, Northwest and Gulf HOV Lane Carpool/Vanpool Surveys

Impact	Katy HOV Lane Carpools/Vanpools						
	1985	1986	1987	1988	1989	1990	
Perceived HOV Lane Travel Time Savings (minutes)	(n=505)	(n=588)	(n=592)	(n=394)	(n=565)	(n=639)	
a.m. (median)	8	10	20	20	20	20	
p.m. (median)	12	17	20	22	20	20	
Actual HOV Lane Travel Time Savings (minutes)[1]							
a.m. (6:00-9:30 a.m.)	6.8	3.0	4.4	5.1	7.9	9.4	
p.m. (3:30-7:00 p.m.)	5.5	4.0	1.0	2.7	1.1	6.0	
Impact	**North HOV Lane Carpools/Vanpools**		**Northwest HOV Lane Carpools/Vanpools**			**Gulf HOV Lane Carpools/Vanpools**	
	1986[2]	1990	1988	1989	1990	1988	1989
Perceived HOV Lane Travel Time Savings (minutes)	(n=1595)	(n=184)	(n=256)	(n=245)	(n=235)	(n=121)	(n=121)
a.m. (median)	20	17	15	15	20	15	12
p.m. (median)	30	20	15	15	20	15	15
Actual HOV Lane Travel Time Savings (minutes)[1]							
a.m. (6:00-9:30 a.m.)	4.2	3.3	3.1	-4.6	2.4	3.3	3.1
p.m. (3:30-7:00 p.m.)	8.0	0.1	1.3	-5.7	1.8	7.7	-3.1

[1] *Source: TTI Research Report 484-12 and TTI travel time studies.*
[2] *Includes responses from vanpoolers only; carpools were not allowed on the HOV lane at the time of this survey.*

North HOV Lane

Vanpoolers using the North HOV Lane in 1986 apparently did not perceive a.m. freeway traffic congestion to be as severe as p.m. congestion and, therefore, did not perceive as great a time savings in the a.m. as in the p.m. Median travel time savings reported by North HOV Lane vanpools (in 1986) was 20 minutes in the a.m. and 30 minutes in the p.m. By 1990, perceived travel time savings had dropped to 17 minutes and in the a.m. and 20 minutes in the p.m. A possible explanation for this decline may be that poolers felt the construction of additional freeway lanes and the opening of the Hardy Toll Road have provided some relief to congestion on the North Freeway mainlanes.

Northwest HOV Lane

On the Northwest HOV Lane, median perceived travel time savings of 15 minutes were reported by carpoolers and vanpoolers in both 1988 and 1989. Median time savings reported by poolers increased by 5 minutes for both the a.m. and p.m. in 1990, however, following the completion and opening of the 3.9-mile extension of the HOV lane to FM 1960.

Gulf HOV Lane

Carpoolers and vanpoolers traveling the Gulf HOV facility reported a travel time savings of 15 minutes during both the morning and afternoon in 1988. In 1989, median perceived travel time savings dropped to 12 minutes in the a.m. but remained at 15 minutes for the p.m.

Perception of HOV Lane Utilization

One of the primary reasons for permitting carpools to utilize the HOV lanes is to maximize both the actual and perceived utilization of the facilities. Accordingly, carpoolers and

vanpoolers were asked whether they felt the HOV lane is sufficiently utilized to justify the project. Their responses are summarized in Table 64.

Table 64.
Perception of HOV Lane Utilization,
Katy, North, Northwest and Gulf HOV Lane Carpool/Vanpool Surveys

Perception	Katy HOV Lane Carpools/Vanpools						
	1985[1]	1986[2]	1987[3]	1988[4]	1989[4]	1990[5]	
Is HOV Lane Sufficiently Utilized to Justify the Project	(n=534)	(n=622)	(n=606)	(n=371)	(n=570)	(n=715)	
Yes	31%	42%	82%	47%	76%	75%	
No	50%	33%	9%	27%	14%	15%	
Not sure	19%	25%	9%	26%	10%	10%	
HOV Lane Vehicle Volumes (a.m. peak period)[6]	138	256	2412	2032	2186	2635	
Perception	North HOV Lane Carpools/Vanpools		Northwest HOV Lane Carpools/Vanpools			Gulf HOV Lane Carpools/Vanpools	
	1986[7,8]	1990[5]	1988[5]	1989[5]	1990[5]	1988[5]	1989[5]
Is HOV Lane Sufficiently Utilized to Justify the Project	(n=1616)	(n=185)	(n=257)	(n=246)	(n=236)	(n=118)	(n=118)
Yes	84%	88%	69%	75%	87%	65%	72%
No	7%	5%	14%	12%	6%	21%	14%
Not sure	9%	7%	17%	13%	7%	14%	14%
HOV Lane Vehicle Volumes (a.m. peak period)[6]	393	1595	961	1463	2099	681	1139

[1] *Authorized buses and vanpools only at the time of the 1985 vanpool survey; authorized buses, vanpools and 4+ carpools at the time of the 1985 carpool survey.*
[2] *Authorized buses, vanpools and 3+ carpools.*
[3] *2+ vehicles, no authorization.*
[4] *3+ vehicles, no authorization between 6:45 a.m. and 8:15 a.m.; 2+ vehicles, no authorization at all other times.*
[5] *3+ vehicles, no authorization between 6:45 a.m. and 8:00 a.m.; 2+ vehicles, no authorization at all other times.*
[6] *Source: TTI Research Report 484-12 and TTI HOV lane vehicle volume counts.*
[7] *Authorized buses and vanpools.*
[8] *Includes responses from vanpoolers only; carpools were not allowed on the HOV lane at the time of this survey.*

Katy HOV Lane

Generally speaking, on the Katy HOV Lane, as actual HOV lane utilization has increased (1985-1987), so has the perception of utilization. In fact, in 1987 when a.m. peak period vehicular utilization was approximately 2,400 vehicles, 82% of the poolers surveyed felt the HOV lane was sufficiently utilized. In 1988 (after the utilization of the facility was restricted

to 3+ vehicles between 6:45 a.m. and 8:15 a.m.), both the actual and perceived utilization of the HOV lane declined; less than half of those surveyed in 1988 felt the HOV lane was sufficiently utilized with the 3+ restriction. In 1989, however, both actual and perceived utilization increased; more than three-fourths of the Katy HOV Lane poolers felt the lane was sufficiently utilized. In 1990, actual utilization climbed to more than 2,600 vehicles. It is interesting to note that even though actual utilization in 1990 was higher than that in 1987, the perception of utilization in 1990 (with the a.m. 3+ occupancy restriction in effect) was lower than that in 1987 (when 2+ vehicles were allowed during all operating hours). Nevertheless, 75% of the Katy HOV Lane poolers felt the HOV lane is sufficiently traveled to justify the improvement.

Other HOV Lanes

Most recent survey results in the other HOV corridors are also very favorable. In fact, 72% of the Gulf and 86% of the Northwest HOV Lane poolers felt these facilities are sufficiently utilized to justify the project. Furthermore, 88% of the North HOV Lane poolers felt that lane is sufficiently utilized.

Comments

During each survey effort, HOV lane carpoolers and vanpoolers were encouraged to offer additional comments, and many did so. Carpooler/vanpooler comments are summarized in Table 65.

Table 65.
Additional Comments,
Katy, North, Northwest and Gulf HOV Lane Carpool/Vanpool Surveys

Comment	Katy HOV Lane Carpools/Vanpools						
	1985	1986	1987	1988	1989	1990	
HOV lane is great	7%	20%	51%	24%	16%	15%	
Extend the HOV lane	26%	13%	3%	—	2%	2%	
HOV lane is underutilized	5%	9%	2%	1%	2%	4%	
3-person carpools a good move	6%	2%	—	7%[1]	1%	3%	
Lower carpool occupancy requirement	1%	6%	—	—	—	—	
Poor HOV lane entry/exit design	12%	8%	14%	13%	22%	9%	
Enforce 55 mph minimum speed	—	1%	12%	16%	5%	6%	
Keep carpool requirement at 2+	—	—	7%	14%[2]	22%[2]	22%[2]	
Other	43%	41%	11%	25%	30%	39%	
	North HOV Lane Carpools/Vanpools		Northwest HOV Lane Carpools/Vanpools			Gulf HOV Lane Carpools/Vanpools	
Comment	1986[3]	1990	1988	1989	1990	1988	1989
HOV lane is great	16%	26%	28%	18%	31%	23%	15%
Extend the HOV lane	29%	9%	27%	20%	1%	43%	29%
HOV lane is underutilized	—	—	—	1%	—	—	2%
Poor HOV lane entry/exit design	—	9%	11%	20%	23%	8%	12%
Enforce 55 mph minimum speed	—	8%	5%	8%	7%	10%	12%
Keep carpool requirement at 2+	—	3%	8%	2%	5%	—	1%
Need concrete median barriers entire length of HOV lane	8%	—	—	—	—	—	—
Allow carpools on HOV lane	5%	—	—	—	—	—	—
Keep HOV lane open longer hours	10%	—	—	—	—	—	—
Other	32%	45%	21%	31%	33%	16%	29%

[1] *On this survey, the comment was "3-person carpools between 6:45 and 8:15 a.m. a good move."*
[2] *On this survey, the comment was "return carpool occupancy requirement to 2+ during more/all hours of operation."*
[3] *Includes responses from vanpoolers only; carpools were not allowed on the HOV lane at the time of this survey.*

Comparison of Houston Survey Data to Santa Clara County Survey Data

Several of the questions used in the Houston surveys of HOV lane carpoolers/vanpoolers are similar to those used in a survey of carpoolers/vanpoolers traveling on the Route 237 HOV Lane in Santa Clara County, California. Table 66 compares the most recent survey data collected in Houston with that collected in Santa Clara County. As this table indicates, in many instances, the characteristics of Route 237 HOV Lane poolers show strong similarities to those of Houston HOV Lane poolers. More specifically:

- At least half of the HOV Lane poolers are in their 30s or 40s;

Table 66.
Selected Characteristics of Houston and Santa Clara County HOV Lane Carpoolers/Vanpoolers

Characteristic	Houston HOV Lanes				Santa Clara Co. HOV Lane
	Katy 1990	North 1990	Northwest 1990	Gulf 1989	Route 237 1988[2]
Age (years)	(n=578)[1]	(n=188)	(n=238)	(n=119)	(n=215)
18 or under	1%	—	0%	1%	2%
19-29	14%	21%	22%	17%	23%
30-39	43%	37%	45%	36%	32%
40-49	28%	25%	26%	35%	25%
50-64	12%	17%	7%	10%	16%
65 or over	2%	—	0%	1%	1%
Sex	(n=574)[1]	(n=189)	(n=234)	(n=118)	(n= 215)
Male	55%	53%	38%	41%	55%
Female	45%	47%	62%	59%	45%
Occupation	(n=550)[1]	(n=174)	(n=231)	(n=118)	(n=207)
Professional	45%	38%	49%	46%	51%
Managerial	18%	21%	20%	15%	20%
Clerical	15%	21%	15%	26%	13%
Other	22%	20%	16%	13%	16%
Trip Purpose	(n=727)	(n=190)	(n=239)	(n=122)	(n=215)
Work	86%	98%	90%	98%	94%
School	3%	2%	10%	2%	4%
Other	11%	0%	—	—	4%
Vehicle Occupancy	(n=734)	(n=187)	(n=239)	(n=122)	(n=215)
2	72%	77%	77%	74%	66%
3	20%	14%	17%	15%	23%
4+	8%	9%	6%	11%	10%
Average	2.4	2.5	2.3	2.5	2.5
Carpool Composition	(n=614)[1]	(n=205)	(n=260)	(n=133)	(n=215)
Family Members	56%	62%	62%	65%	51%
Co-Workers	32%	25%	25%	27%	33%
Friends/Neighbors	12%	13%	13%	8%	12%
Previous Travel Mode	(n=699)	(n-178)	(n=225)	(n=117)	(n=215)
Drove Alone	57%	42%	53%	40%	56%
Carpooled	27%	39%	34%	44%	12%
Vanpooled	3%	3%	1%	7%	1%
Bus	9%	15%	8%	4%	2%
Didn't Make Trip	4%	1%	4%	5%	22%
Carpool If No HOV Lane	(n=702)	(n=185)	(n=237)	(n=120)	(n=215)
Yes	37%	48%	45%	68%	69%
No	53%	40%	39%	20%	26%
Not sure	20%	12%	16%	12%	5%
Perceived Travel Time Savings (minutes - a.m. peak period)	(n=637)	(n=184)	(n=235)	(n=121)	(n=180)
10 or less	29%	20%	11%	49%	36%
11-15	19%	30%	26%	19%	37%
16-20	23%	18%	25%	17%	14%
More than 20	32%	32%	38%	15%	13%

[1] *1989 data.*
[2] *Percentages do not add up to 100%.*

- Most all of the poolers are employed in "professional," "managerial," or "clerical" job positions;

- The average occupancy of HOV lane carpools is 2.3 to 2.5 persons per vehicle;

- The vast majority are using the HOV lane to travel to and from work;

- Although a significant percentage are carpooling with co-workers, more than half are carpooling with family members;

- At least 40% of the poolers drove alone prior to carpooling on the HOV lane (an additional 22% of the Santa Clara County trips were "new trips"); and

- 20% or more would not be carpooling if not for the HOV lane.

CHAPTER 7
FREEWAY MOTORIST SURVEYS

Surveys were conducted of motorists using the Katy, North, Northwest and Gulf Freeway mainlanes during the a.m. HOV lane operating periods. As was the case with the HOV lane user surveys, the motorist surveys primarily addressed:

- Personal characteristics;
- Travel patterns and trip characteristics; and
- Attitudes and impacts pertaining to the HOV lanes.

Several of the questions contained on these surveys are similar to questions asked in previous motorist surveys conducted before the Katy, North and Gulf HOV Lanes were opened. When possible, for comparative purposes, data from the previous surveys are also presented in this section. In most instances, the "before" and "after" data are similar.

Personal Characteristics

Questions were asked to identify age, sex, occupation and last year of school completed. The responses to these questions are summarized in Tables 67-70.

Age

Most recent survey data indicate that the median ages of freeway motorists vary from 36 years on the Northwest Freeway to 40 years on the Katy Freeway.

Table 67.
Personal Characteristics of Motorists on the Katy Freeway,
Katy Freeway Motorist Surveys

Characteristic	Before HOV Lane 1984	After HOV Lane			
		1985	1986	1987	1988	1989
Age (years)	(n=81)	(n=445)	(n=726)	(n=1422)	(n=1056)	(n=1119)
Median	32-41	40	40	39	41	40
Sex	(n=81)	(n=437)	(n=706)	(n=1401)	(n=1037)	(n=1096)
Male	56%	64%	66%	62%	65%	61%
Female	44%	36%	34%	38%	35%	39%
Occupation	(n=80)	(n=431)	(n=711)	(n=1365)	(n=1023)	(n=1067)
Professional	39%	51%	42%	41%	44%	45%
Managerial	29%	19%	26%	23%	22%	21%
Clerical	11%	9%	9%	13%	9%	7%
Sales	14%	12%	14%	12%	13%	13%
Craftsman	3%	3%	1%	4%	2%	3%
Service Worker	3%	2%	2%	2%	2%	2%
Student	1%	2%	2%	2%	3%	2%
Other	—	2%	4%	3%	5%	7%
Education (years)	(n=80)	(n=439)	(n=715)	(n=1401)	(n=1048)	(n=1101)
Average	15.0	15.7	15.9	15.5	15.8	15.9

Table 68.
Personal Characteristics of Motorists on the North Freeway,
North Freeway Motorist Surveys

Characteristic	Before HOV Lane		After HOV Lane	
	1981	1984	1986	1990
Age (years)	(n=449)	(n=52)	(n=404)	(n=644)
Median	40	32-41	36	39
Sex	(n=460)	(n-52)	(n=400)	(n=629)
Male	80%	56%	61%	57%
Female	20%	44%	39%	43%
Occupation	—	(n=51)	(n=392)	(n=617)
Professional	—	18%	38%	38%
Managerial	—	10%	21%	18%
Clerical	—	39%	15%	16%
Sales	—	0%	13%	12%
Craftsman	—	18%	3%	3%
Service Worker	—	8%	3%	3%
Student	—	2%	3%	4%
Other	—	5%	4%	6%
Education (years)	(n=444)	(n=52)	(n=397)	(n=634)
Average	15.4	14.5	14.8	14.8

Table 69.
Personal Characteristics of Motorists on the Northwest Freeway,
Northwest Freeway Motorist Surveys

Characteristic	After HOV Lane	
	1989	1990
Age (years)	(n=1124)	(n=728)
Median	37	36
Sex	(n=1105)	(n=718)
Male	61%	58%
Female	39%	42%
Occupation	(n=1081)	(n=694)
Professional	38%	39%
Managerial	25%	26%
Clerical	14%	14%
Sales	11%	13%
Craftsman	5%	6%
Service Worker	2%	1%
Student	1%	1%
Other	4%	0%
Education (years)	(n=1106)	(n=721)
Average	15.0	15.0

Table 70.
Personal Characteristics of Motorists on the Gulf Freeway,
Gulf Freeway Motorist Surveys

Characteristic	Before HOV Lane	After HOV Lane
	1981	1989
Age (years)	(n=182)	(n=648)
Median	36	37
Sex	(n=179)	(n=632)
Male	55%	49%
Female	45%	51%
Occupation	—	(n=625)
Professional	—	30%
Managerial	—	22%
Clerical	—	20%
Sales	—	6%
Craftsman	—	8%
Service Worker	—	3%
Student	—	4%
Other	—	7%
Education (years)	(n=177)	(n=634)
Average	13.9	14.2

Sex

The majority (57% +) of the Katy, North, and Northwest Freeway motorists surveyed are male; whereas, a slight majority (51%) of the Gulf Freeway motorists surveyed are female.

Occupation

As was the case with the HOV lane users, the majority of the motorists surveyed in 1985-1990 are employed in occupations which are classified as either "professional" or "managerial."

Education

Generally speaking, motorists traveling on the Katy, North, Northwest and Gulf Freeways are a well educated group. On the average, Katy and Northwest Freeway motorists have completed at least 3 years of college and North and Gulf Freeway users have completed more than 2 years of college.

Travel Patterns and Trip Characteristics

Motorists were asked a series of questions regarding the selection of the auto mode, trip propose, usual travel mode, trip frequency, vehicle occupancy, trip origin and trip destination. Responses to these questions are highlighted in the following sections.

Trip Origin

Two questions were asked which were related to trip origin. The first requested the home Zip Code; the second asked for the freeway entrance ramp that was used in the morning.

The 1985 Katy Freeway motorist survey was conducted at locations between Campbell and Voss. Because the Katy HOV Lane had been extended prior to the other surveys, the 1986-1990 surveys were conducted at locations between Wilcrest and Barker-Cypress. The North Freeway motorist surveys were conducted between Greens Road and FM 1960. The Northwest Freeway motorist surveys were performed at locations in the areas of FM 529 and FM 1960; the Gulf Freeway motorist survey was conducted at locations between Monroe/SH 3 and Edgebrook.

Katy Freeway

Home Zip Codes listed by Katy Freeway motorists surveyed are summarized in Table 71 and illustrated in Figure 43; a.m. freeway entrance ramps used are also summarized in Table 71.

Table 71.
Characteristics of Trip Origins of Katy Freeway Motorists,
Katy Freeway Motorist Surveys

Characteristic	1985	1986	1987	1988	1989	1990
Home Zip Code	(n=444)	(n=729)	(n=1425)	(n=1058)	(n=1127)	(n=194)
77079	20%	35%	24%	41%	40%	12%
77024	12%	3%	1%	1%	1%	1%
77043	9%	9%	6%	7%	6%	1%
77077	7%	21%	12%	14%	13%	18%
77080	7%	1%	0%	0%	1%	1%
77084	6%	3%	10%	7%	12%	19%
77042	6%	9%	3%	4%	3%	1%
77055	5%	1%	0%	0%	1%	2%
77450	5%	3%	20%	6%	2%	5%
77082	2%	5%	3%	2%	4%	5%
77449	4%	1%	12%	3%	3%	5%
77083	3%	2%	1%	3%	4%	12%
Other	14%	7%	8%	12%	10%	18%
A.M. Freeway Entrance Ramp	(n=438)	(n=726)	(n=1045)	(n=1031)	(n=1099)	—
Gessner	13%	2%	3%	5%	4%	—
Wilcrest	12%	40%	19%	24%	18%	—
Blalock	10%	1%	0%	0%	0%	—
West Belt	9%	15%	—	3%	3%	—
Dairy Ashford	9%	20%	14%	13%	14%	—
Bunker Hill	9%	1%	1%	1%	1%	—
SH 6	8%	4%	5%	15%	24%	—
Kirkwood	8%	5%	12%	22%	21%	—
Fry Road	6%	3%	17%	3%	2%	—
Mason	4%	1%	13%	4%	1%	—
Barker-Cypress	3%	1%	9%	1%	2%	—
Other	9%	7%	7%	9%	10%	—

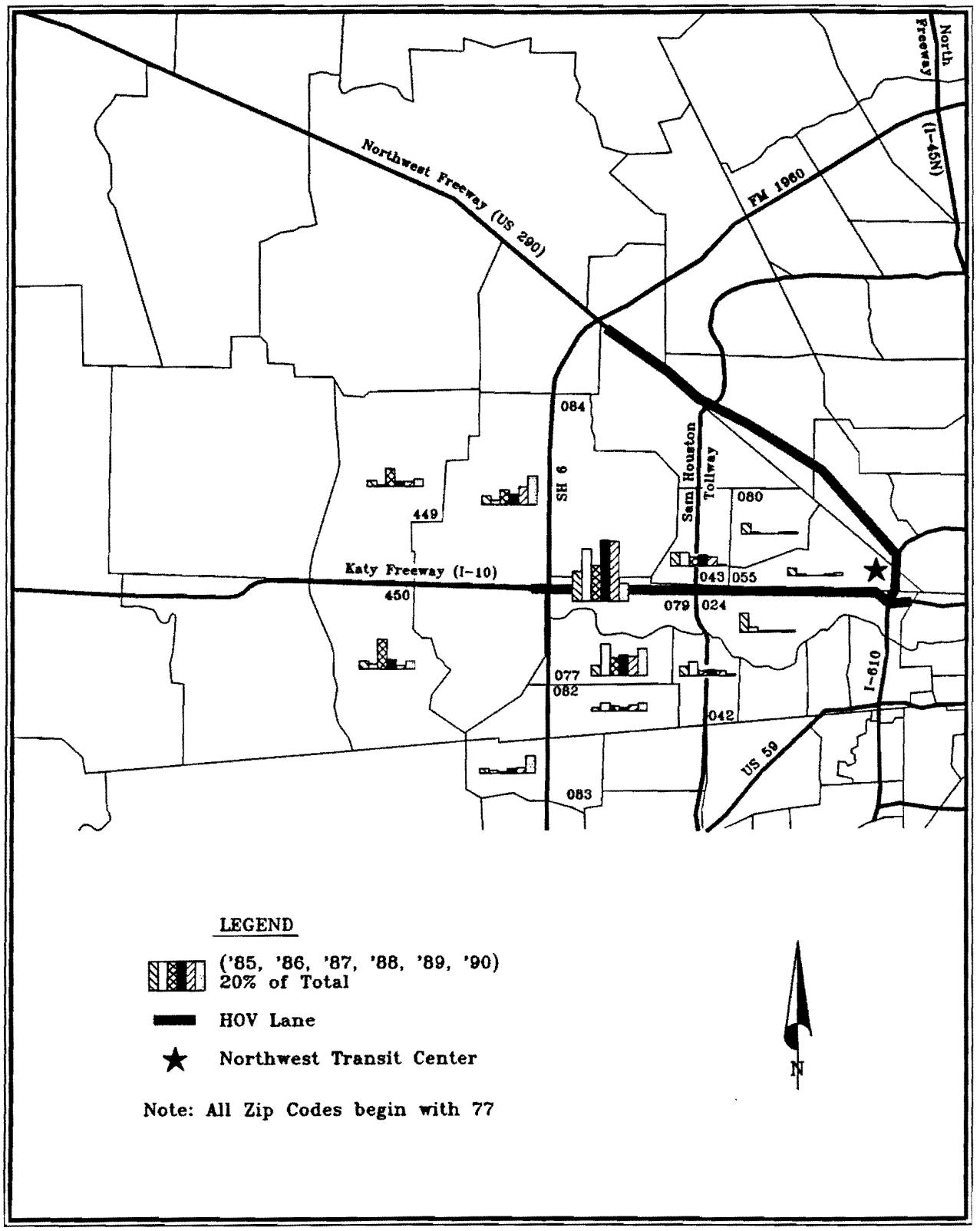


Figure 43. Home Origins of Katy Freeway Motorists

Home Zip Codes. Between 1985 and 1990, the number of different Zip Codes listed by Katy Freeway motorists ranged from a low of 38 (in 1991) to a high of 70 (in 1987). In the more recent survey years, the most commonly listed Zip Codes included 77079, 77077 and 77084. In fact, almost half the motorists surveyed in 1990 reside in one of these three Zip Code areas.

A.M. Freeway Entrance Ramp. In 1985-1988, the most common entrance ramp used by motorists to access the Katy Freeway in the a.m. was the Wilcrest ramp. In 1989, however, the SH 6 and Kirkwood ramps were used most often, with the Wilcrest ramp coming in third. A total of 63% of the motorists responding to the 1989 survey entered the Katy Freeway at either SH 6, Kirkwood or Wilcrest.

North Freeway

Home Zip Code data and a.m. freeway entrance ramps used by North Freeway motorists are summarized in Table 72; North Freeway motorist home Zip Code data are also presented graphically in Figure 44.

Home Zip Codes. More than 60 different Zip Codes were listed by North Freeway motorists in 1986 and 1990. The most frequently listed North Freeway area Zip Code during both survey years was 77090.

A.M. Freeway Entrance Ramp. In 1986, the most common entrance ramps used by motorists entering the North Freeway in the morning included ramps adjacent to FM 1960, FM 149 (also known as W. Mount Houston, SH 249, Tomball Parkway and W. Montgomery) and Greens Road.

In 1990, FM 1960 again lead the list as the most frequently used entrance ramp, followed by FM 149, Kuykendahl and West Road; almost 80% of the motorists use one of these three entrances to the North Freeway.

Table 72.
Characteristics of Trip Origins of North Freeway Motorists,
North Freeway Motorist Surveys

Characteristic	1986	1990
Home Zip Code	(n=407)	(n=650)
77090	14%	15%
77067	13%	3%
77373	10%	6%
77073	8%	6%
77088	5%	4%
77060	5%	5%
77070	5%	4%
77066	5%	5%
77379	3%	8%
77069	3%	2%
77014	3%	6%
77038	1%	10%
77068	1%	4%
77086	1%	4%
Other	23%	18%
A.M. Freeway Entrance Ramp	(n=406)	(n=622)
FM 1960	32%	28%
FM 149[1]	21%	18%
Greens Road	16%	3%
Kuykendahl	5%	18%
North Belt	4%	3%
West Road	3%	15%
FM 2920	3%	1%
Hidden Valley	3%	—
Other	13%	14%

[1] *Also known as W. Mt. Houston, SH 249, Tomball Pkwy. and W. Montgomery.*

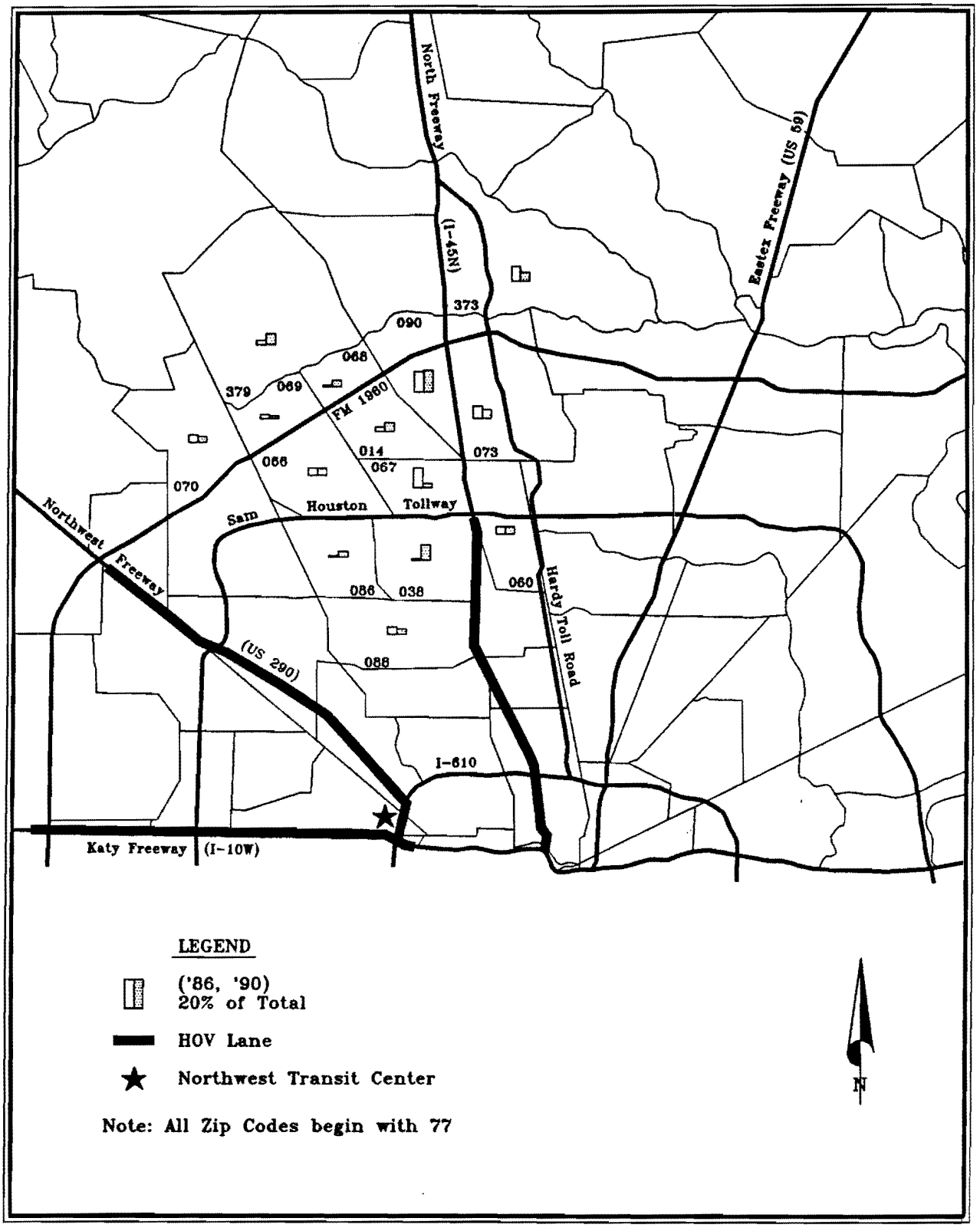


Figure 44. Home Origins of North Freeway Motorists

Northwest Freeway

Home Zip Codes of Northwest Freeway motorists are summarized in Table 73 and illustrated in Figure 45; a.m. freeway entrance ramps used by motorists to access the Northwest Freeway are listed in Table 73.

Home Zip Codes. Northwest Freeway motorists listed 55 different Zip Codes in 1989 and 39 in 1990. More than half of the motorists surveyed in 1990 live in one of 3 Zip Code areas: 77095, 77065 or 77070.

A.M. Freeway Entrance Ramp. In 1989, the Jones Road and Huffmeister entrance ramps were the two most commonly used to gain access to the Northwest Freeway in the morning. In 1990, however, the SH 6/FM 1960 entrance was the most commonly used entrance, followed by the Jones Road and West Road entrances.

Table 73.
Characteristics of Trip Origins of Northwest Freeway Motorists,
Northwest Freeway Motorist Survey

Characteristic	1989	1990
Home Zip Code	(n=1129)	(n=733)
77429	19%	7%
77065	19%	15%
77095	18%	34%
77064	14%	11%
77070	10%	12%
77041	2%	5%
77084	0%	5%
Other	18%	11%
A.M. Freeway Entrance Ramp	(n=1077)	(n=712)
Jones Road	18%	22%
Huffmeister	18%	3%
SH 6/FM 1960	12%	40%
West Road	10%	13%
Telge Road	8%	1%
Eldridge	7%	11%
Little York	7%	2%
Other	20%	8%

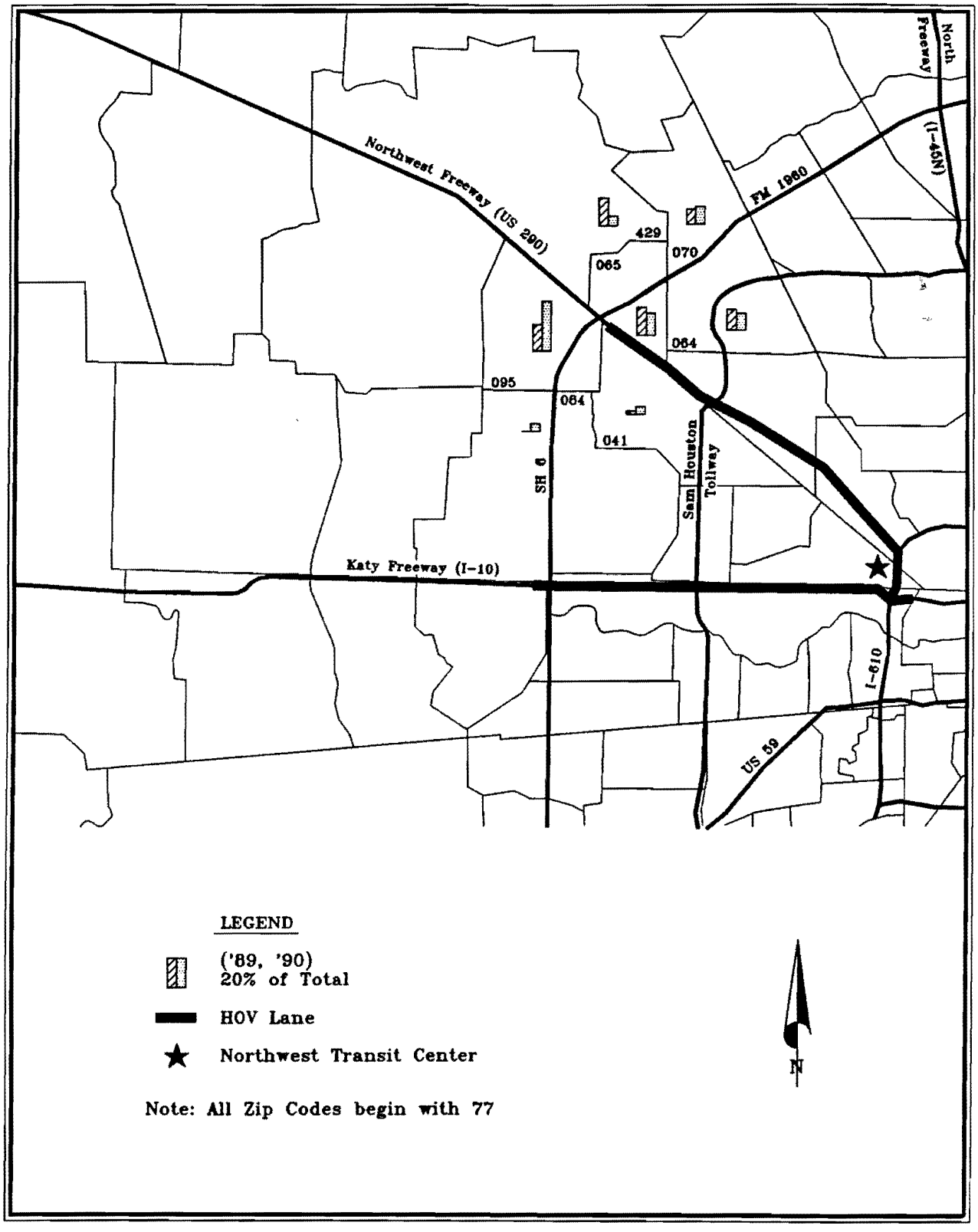


Figure 45. Home Origins of Northwest Freeway Motorists

Gulf Freeway

Home Zip Codes of Gulf Freeway motorists are summarized in Table 74 and illustrated in Figure 46.

Home Zip Codes. Although 65 different home Zip Code areas were listed by motorists traveling the Gulf Freeway, 59% of those responding reported living in either the 77034, 77075, or 77089 Zip Code areas.

A.M. Freeway Entrance Ramp. More than half of the Gulf Freeway motorists surveyed typically enter the freeway at either Edgebrook or Monroe in the mornings (Table 74).

Table 74.
Characteristics of Trip Origins of Gulf Freeway Motorists, Gulf Freeway Motorist Surveys

Characteristic	1989
Home Zip Code	(n=647)
77034	31%
77075	14%
77089	14%
77504	5%
77587	4%
77062	4%
Other	28%
A.M. Freeway Entrance Ramp	(n=633)
Edgebrook	37%
Monroe	20%
College-Airport	8%
FM 3251	4%
Fuqua	4%
Almeda-Genoa	4%
El Dorado	2%
Other	21%

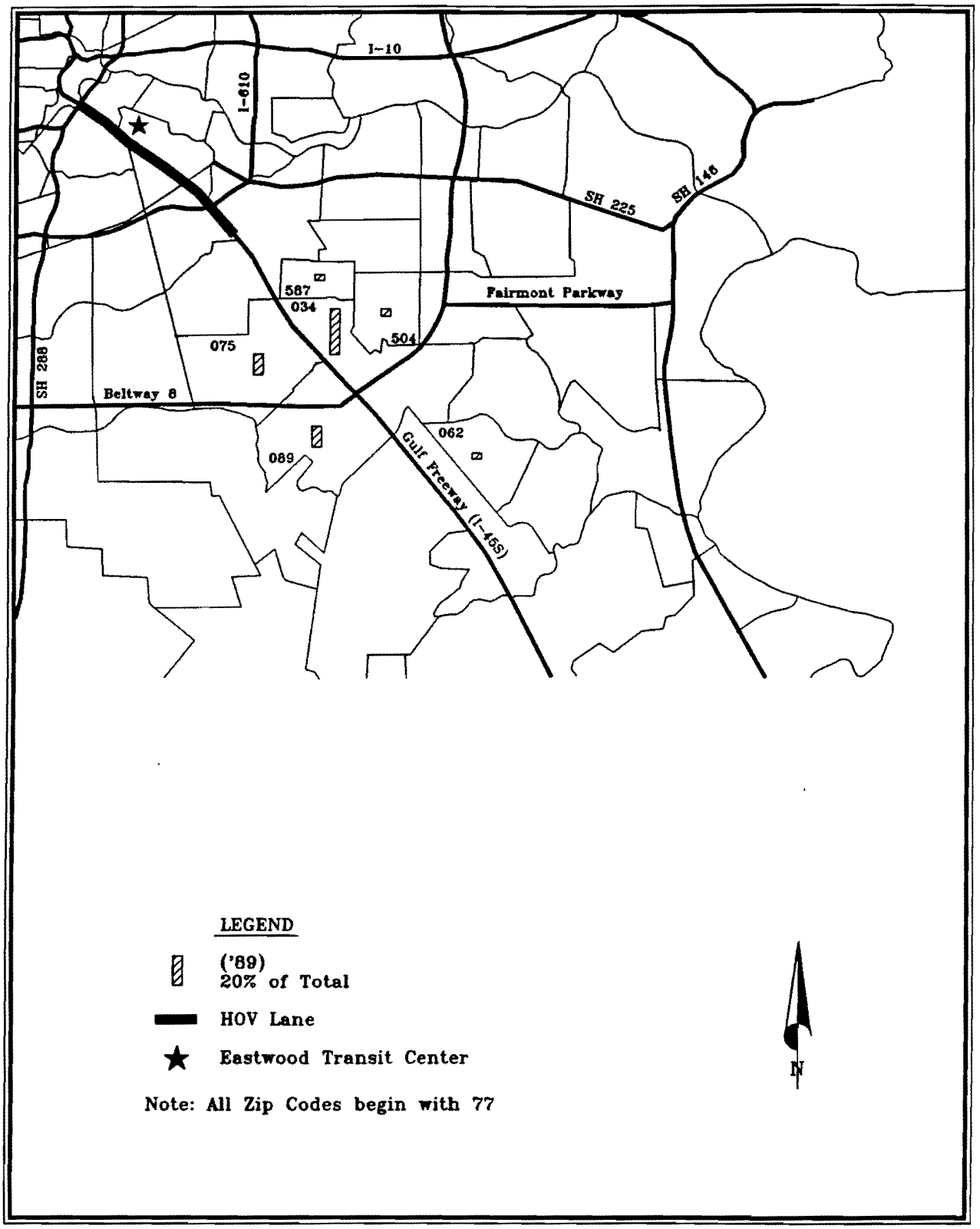


Figure 46. Home Origins of Gulf Freeway Motorists

Trip Purpose

Trip purpose data for the freeway motorists are presented in Table 75. As was the case with the transit and carpool/vanpool surveys, the vast majority of peak period motorists trips are work trips.

Trip Frequency

More than three-fourths of the freeway motorist trips surveyed occurred 5 or more days per week (Table 75).

Vehicle Occupancy

On the Katy Freeway, peak period vehicle occupancies averaged 1.2 persons per vehicle during all 6 survey years (1985-1990). On the North, Northwest and Gulf Freeways, vehicle occupancies also averaged 1.2 persons per vehicle during all survey years (Table 75).

Reasons for Choosing the Auto Mode

The reasons most often given for using an auto in the mixed-flow lanes of the freeway rather than a high-occupancy vehicle in the HOV lane are summarized in Table 76. In general, most individuals stated they use an auto because of the following reasons: 1) need car for job; 2) convenience and flexibility; 3) no convenient bus, carpool or vanpool available; and 4) work irregular hours. Furthermore, of those freeway motorists surveyed between 1985 and 1990, at least 75% drive alone on a regular basis (Table 76).

Table 75.
Trip Characteristics of Motorists on the Katy, North, Northwest and Gulf Freeways,
Katy, North, Northwest and Gulf Freeway Motorist Surveys

Characteristic	Katy Freeway						
	1985	1986	4/1987	10/1987	1988	1989	1990
Trip Purpose	(n=451)	(n=741)	(n=950)	(n=1431)	(n=1064)	(n=1131)	(n=194)
Work	94%	91%	90%	92%	90%	86%	81%
School	3%	2%	3%	3%	4%	3%	2%
Other	3%	7%	7%	5%	6%	11%	17%
Trip frequency (days/week)	(n=442)	(n=722)	—	(n=1417)	(n=1049)	(n=1110)	—
0-1	5%	6%	—	9%	7%	9%	—
2	4%	3%	—	3%	4%	4%	—
3	3%	3%	—	3%	5%	5%	—
4	4%	4%	—	2%	4%	4%	—
5 or more	84%	84%	—	83%	80%	78%	—
Vehicle Occupancy (persons/vehicle)	(n=445)	(n=734)	—	(n=1434)	(n=1065)	(n=1133)	(n=189)
1	83%	89%	—	84%	87%	84%	86%
2	12%	7%	—	13%	10%	12%	10%
3	3%	2%	—	2%	2%	2%	3%
4 or more	2%	2%	—	1%	1%	2%	1%
Average	1.2	1.2	—	1.2	1.2	1.2	1.2

Characteristic	North Freeway		Northwest Freeway		Gulf Freeway
	1986	1990	1989	1990	1989
Trip Purpose	(n=425)	(n=648)	(n=1122)	(n=732)	(n=655)
Work	90%	91%	95%	94%	87%
School	3%	4%	2%	2%	4%
Other	7%	5%	3%	4%	9%
Trip Frequency (days/week)	(n=415)	(n=641)	(n=1115)	(n=724)	(n=644)
0-1	9%	5%	3%	5%	6%
2	2%	3%	1%	2%	2%
3	3%	2%	2%	3%	4%
4	3%	4%	2%	3%	2%
5 or more	83%	86%	92%	87%	86%
Vehicle Occupancy (persons/vehicle)	(n=420)	(n=648)	(n=1131)	(n=732)	(n=654)
1	84%	84%	84%	86%	83%
2	13%	12%	13%	11%	14%
3	2%	3%	3%	2%	2%
4 or more	1%	1%	0%	1%	1%
Average	1.2	1.2	1.2	1.2	1.2

Table 76.
Reasons for Selecting the Auto Mode,
Katy, North, Northwest and Gulf Freeway Motorist Surveys

Characteristic	Katy Freeway						
	Before HOV Lane 1984	After HOV Lane					
		1985	1986	1987	1988	1989	1990
Why Chose Auto[1]	—	(n=564)	(n=838)	(n=2121)	(n=1655)	(n=1776)	(n=265)
Need car for job	—	22%	25%	21%	23%	24%	20%
Convenience/flexibility	—	17%	26%	21%	23%	21%	26%
No bus/carpool/vanpool available	—	22%	21%	18%	18%	16%	15%
Work odd hours	—	10%	10%	25%	24%	22%	16%
Don't work in CBD	—	6%	3%	8%	7%	4%	0%
Other	—	23%	15%	7%	5%	13%	23%
Usual Mode of Travel	(n=81)	(n=445)	(n=738)	(n=1424)	(n=1053)	(n=1122)	(n=192)
Drive alone	83%	88%	90%	85%	91%	89%	92%
Carpool	10%	8%	6%	12%	8%	9%	5%
Vanpool	6%	1%	1%	0%	0%	0%	—
Other	1%	3%	3%	3%	1%	2%	3%

Characteristic	North Freeway				Northwest Freeway After HOV Lane		Gulf Freeway After HOV Lane 1989
	Before HOV Lane		After HOV Lane				
	1981	1984	1986	1990	1989	1990	
Why Chose Auto[1]	—	—	(n=498)	(n=952)	(n=1629)	(n=1065)	(n=934)
Need car for job	—	—	15%	21%	19%	24%	17%
Convenience/flexibility	—	—	16%	22%	22%	23%	27%
No bus/carpool/vanpool available	—	—	20%	19%	21%	17%	20%
Work odd hours	—	—	9%	24%	21%	22%	21%
Don't work in CBD	—	—	7%	—	5%	—	3%
Other	—	—	33%	14%	12%	14%	12%
Usual Mode of Travel	(n=482)	(n=52)	(n=423)	(n=644)	(n=1130)	(n=727)	(n=651)
Drive alone	56%	58%	87%	87%	85%	87%	88%
Carpool	15%	27%	8%	9%	13%	9%	9%
Vanpool	11%	9%	1%	0%	0%	0%	0%
Other	18%	6%	4%	4%	2%	4%	3%

Trip Destination

Although the downtown area was the predominant destination of HOV lane users, less than 40% of the motorists surveyed on the Katy, North, Northwest and Gulf Freeways are destined to downtown (Table 77). In fact, only 17% of those traveling on the Northwest Freeway, 26% of those on the Katy Freeway, 28% of those using the Gulf Freeway and 31% of those traveling the North Freeway reported downtown trip destinations. A significant number

of trips are also destined to the Galleria, Greenway Plaza and the Texas Medical Center areas. Furthermore, in both 1989 and 1990, more Northwest Freeway motorists were destined to the Galleria than to any other single location (including downtown).

Table 77.
A.M. Trip Destinations of Motorists on the Katy, North, Northwest and Gulf Freeways, Katy, North, Northwest and Gulf Freeway Motorist Surveys

Trip Destination	Katy Freeway						
	1985	1986	4/1987	10/1987	1988	1989	1990
	(n=302)	(n=728)	(n=944)	(n=1418)	(n=1056)	(n=1126)	(n=186)
Downtown	38%	33%	34%	23%	30%	28%	26%
Galleria	24%	10%	14%	13%	12%	13%	14%
Greenway Plaza	8%	4%	3%	5%	4%	4%	3%
Texas Medical Center	9%	3%	4%	3%	4%	4%	4%
Other	21%	50%	45%	56%	50%	51%	53%

Trip Destination	North Freeway		Northwest Freeway		Gulf Freeway 1989
	1986	1990	1989	1990	
	(n=421)	(n=648)	(n=1118)	(n=727)	(n=648)
Downtown	31%	31%	17%	17%	28%
Galleria	7%	9%	19%	19%	9%
Greenway Plaza	4%	4%	4%	6%	5%
Texas Medical Center	4%	7%	4%	3%	9%
Other	54%	49%	56%	55%	49%

Attitudes and Impacts Pertaining to the HOV Lanes

An additional set of survey questions was designed to identify attitudes towards the HOV lanes.

Perception of HOV Lane Utilization

As discussed previously in Chapter 3, the perception of whether or not the HOV lanes are sufficiently utilized is a major concern of METRO and TxDOT. This is particularly true

of the Katy HOV Lane since fewer than 150 vehicles per peak period used the priority lane during its first 6 months of operation.

Katy, North, Northwest and Gulf Freeway Motorists were asked whether, in terms of both person movement and vehicle movement, they felt the HOV lane was sufficiently utilized. Their responses are summarized in Table 78. On the Katy Freeway, the responses were overwhelmingly negative -- both before and one year after carpools were allowed (no carpools were present on the HOV lane at the time of the 1985 survey; approximately 100 carpools typically used the HOV lane at the time of the 1986 survey). Responses from Katy Freeway motorists were significantly more favorable in 1987, however.

In the spring of 1987, 36% of the Katy Freeway motorists felt the HOV lane was sufficiently utilized in terms of vehicle movement and 30% thought it was sufficiently utilized in terms of person movement. In the fall of 1987, 44% of the motorists felt there was sufficient vehicle utilization of the HOV lane, and 36% stated there was sufficient person utilization. (Note: By the time of the 1987 surveys, the passenger requirement for carpools had been lowered to 2 persons. Carpool utilization of the HOV lane averaged just under 2,300 vehicles during the a.m. peak at the time of the spring 1987 survey and more than 2,700 vehicles at the time of the fall 1987 survey.)

By the time of the 1988 survey, however, both actual and perceived utilization of the Katy HOV Lane had declined. In 1988, less than one-third of the Katy Freeway motorists felt the HOV lane was sufficiently utilized in terms of vehicle movement and less than one-fourth thought a sufficient number of persons was being transported (Table 78).

At the time of the 1989 survey, utilization of the HOV lane had increased only slightly from the 1988 level and the perception of utilization remained virtually the same. In 1990, both the actual and perceived utilization of the HOV lane increased; in 1990, with more than 2,600 vehicles present on the lane, 37% of the freeway motorists reported the HOV lane to be sufficiently utilized.

Table 78.
Perceptions of HOV Lane Utilization,
Katy, North, Northwest and Gulf Freeway Motorist Surveys

Measure of Effectiveness	Katy Freeway						
	1985[1]	1986[2]	4/1987[3]	10/1987[3]	1988[4]	1989[4]	1990[5]
Sufficient Number of Vehicles Utilizing HOV Lane?	(n=451)	(n=742)	(n=948)	(n=1420)	(n=1052)	(n=1123)	(n=192)
Yes	3%	3%	36%	44%	31%	30%	37%
No	90%	92%	55%	42%	55%	53%	45%
Not sure	7%	5%	9%	14%	14%	17%	18%
HOV Lane Vehicle Volumes (A.M. Peak Period)[6]	138	256	2,412	2,854	2,032	2,186	2,635
Sufficient Number of Persons Utilizing HOV Lane?	(n=451)	(n=741)	(n=950)	(n=1426)	(n=1051)	(n=1126)	—
Yes	4%	4%	30%	36%	24%	26%	—
No	85%	86%	58%	46%	58%	54%	—
Not sure	11%	10%	12%	18%	18%	20%	—
HOV Lane Persons Moved (A.M. Peak Period)[6]	2,456	3,156	7,769	8,599	7,210	7,801	9,717
Is the HOV Lane a Good Transportation Improvement?	(n=441)	(n=733)	(n=949)	(n=1423)	(n=1045)	(n=1110)	(n=193)
Yes	41%	36%	56%	64%	64%	66%	71%
No	35%	43%	29%	20%	22%	20%	16%
Not sure	24%	21%	15%	16%	14%	14%	13%

Measure of Effectiveness	North Freeway		Northwest Freeway		Gulf Freeway
	1986[1]	1990[3]	1989[3]	1990[3]	1989[3]
Sufficient Number of Vehicles Utilizing HOV Lane?	(n=418)	(n=641)	(n=1109)	(n=727)	(n=643)
Yes	26%	36%	22%	37%	21%
No	56%	40%	58%	45%	61%
Not sure	18%	24%	20%	18%	18%
HOV Lane Vehicle Volumes (A.M. Peak Period)[6]	393	1,595	1,463	2,099	1,139
Sufficient Number of Persons Utilizing HOV Lane?	(n=422)	(n=645)	(n=1121)	(n=730)	(n=652)
Yes	23%	32%	19%	29%	21%
No	57%	40%	57%	47%	55%
Not sure	20%	28%	24%	24%	24%
HOV Lane Persons Moved (A.M.Peak Period)[6]	6,647	8,512	4,098	5,737	3,956
Is the HOV Lane a Good Transportation Improvement?	(n=417)	(n=647)	(n=1109)	(n=731)	(n=647)
Yes	62%	81%	71%	75%	63%
No	20%	9%	13%	11%	21%
Not sure	18%	10%	16%	14%	16%

[1] *Authorized buses and vanpools (before carpools were allowed).*
[2] *Authorized buses, vanpools and 3+ carpools.*
[3] *2+ vehicles, no authorization.*
[4] *3+ vehicles, no authorization between 6:45 a.m. and 8:15 a.m., 2+ vehicles, no authorization at all other times.*
[5] *3+ vehicles, no authorization between 6:45 a.m. and 8:00 a.m., 2+ vehicles, no authorization at all other times.*
[6] *Source: TTI Research Report 484-12 and TTI HOV Lane vehicle volume and occupancy counts.*

On the North and Northwest Freeways, as actual utilization of the HOV lanes has increased over time, so has the perception of utilization by motorists. For example, on the North Freeway, 26% of the motorists surveyed in 1986 perceived there was sufficient person utilization of the HOV lane and 23% stated there was sufficient vehicle utilization. By 1990 (four months after carpools were allowed on the HOV lane and vehicle utilization had jumped from less than 400 to almost 1,600), 36% of the freeway motorists reported there was sufficient vehicle utilization, and 32% stated there was a sufficient number of persons being moved on the lane.

In the Northwest corridor, 37% of the freeway motorists surveyed in 1990 (as opposed to 22% of those surveyed in 1989) felt the HOV lane was sufficiently utilized in terms of the number of vehicles being moved. In terms of persons being moved, 29% of the motorists contacted in 1990 (as opposed to 19% in 1989) felt the HOV lane was sufficiently utilized.

On the Gulf Freeway, approximately one-fifth of the motorist felt there was sufficient person and vehicular utilization of the HOV lane.

Motorists in each freeway corridor were also asked if they felt the HOV lane is a good transportation improvement (Table 78). The percentage of Katy Freeway motorists who responded "yes" fluctuated from a low of 36% in 1986 to a high of 71% in 1990. In the other freeway corridors, 63% of the Gulf Freeway motorists, 75% of the Northwest Freeway motorists and 81% of the North Freeway motorists surveyed most recently indicated that the HOV lane in their area is a good transportation improvement. *The 1990 figures represent the highest percentages of favorable responses received to date regarding this issue.*

Additional Information on Travel Behavior

The 1990 surveys of Katy, North and Northwest Freeway motorists contained a final set of questions designed to obtain information about motorists' use of traffic reports and their knowledge of local park-and-ride service.

When asked if they normally listen to traffic reports on the radio at home, at work, or in their cars, the vast majority of motorists in all three travel corridors responded "yes" (Table 79); the vast majority also indicated that they have changed their original travel plans (taken an alternate route, altered their travel time, or used a bus or carpool) because of information obtained from traffic reports.

Table 79.
Use of Traffic Reports and Knowledge of Park-and-Ride Service,
1990 Katy, North and Northwest Motorist Surveys

Question	Katy Freeway	North Freeway	Northwest Freeway
Do You Normally Listen to Traffic Reports on the Radio?	(n=194)	(n=653)	(n=733)
Yes	87%	91%	91%
No	13%	9%	9%
If "Yes," Have You Ever Changed Travel Plans Because of Information Obtained from these Reports?	(n=166)	(n=595)	(n=667)
Yes	92%	92%	91%
No	8%	8%	9%
Do You Know the Location of the Park-and-Ride Lot Nearest Your Home?	(n=192)	(n=650)	(n=733)
Yes	80%	88%	90%
No	17%	9%	8%
Not sure	3%	3%	2%
Do You Know Enough About the Park-and-Ride Service to Confidently Begin Using it Tomorrow?	(n=186)	(n=633)	(n=718)
Yes	36%	36%	33%
No	55%	55%	59%
Not sure	9%	9%	8%

Between 80% and 90% of the freeway motorists surveyed know the location of the park-and-ride lot nearest their home. Furthermore, at least one-third of the motorists in each corridor know enough about the park-and-ride service currently being offered by METRO to confidently use it (Table 79.)

Comments

Motorists traveling the Katy, North, Northwest and Gulf Freeways were encouraged to offer comments. A summary of the comments received is presented in Table 80.

Table 80.
Additional Comments,
Katy, North, Northwest and Gulf Freeway Motorist Surveys

Comment	Katy Freeway						
	1985	1986	4/1987	10/1987	1988	1989	1990
HOV lane is a waste of money	14%	13%	10%	4%	5%	5%	7%
HOV lane is underutilized	12%	20%	9%	4%	9%	5%	7%
Open HOV lane to all	8%	6%	10%	7%	5%	6%	9%
Allow carpools on HOV lane	7%	5%[1]	6%[2]	3%[2]	10%[3]	12%[3]	3%[3]
Ban/restrict trucks on freeway	5%	4%	2%	2%	4%	2%	5%
HOV lane is a good idea	5%	6%	12%	16%	8%	11%	9%
Need more freeway lanes	4%	10%	9%	9%	10%	9%	5%
Provide more bus routes	3%	3%	2%	3%	4%	4%	5%
Congestion on freeway no better	3%	5%	4%	3%	9%[4]	6%[4]	3%
Poor HOV lane entry/exit design	0%	0%	9%	17%	18%	13%	11%
Promote HOV lane & ridesharing	3%	2%	2%	2%	1%	2%	—
Complete freeway/HOV lane const.	—	—	—	—	—	1%	1%
Extend/expand HOV lane	1%	1%	—	—	—	0%	—
Need a rail system	0%	0%	0%	0%	0%	3%	1%
Other	35%	25%	25%	30%	17%	21%	34%

Comment	North Freeway		Northwest Freeway		Gulf Freeway
	1986	1990	1989	1990	1989
HOV lane is a waste of money	3%	3%	4%	3%	6%
HOV lane is underutilized	6%	5%	6%	3%	7%
Open HOV lane to all	6%	0%	5%	1%	4%
Allow carpools on HOV lane	10%	—	1%[3]	—	0%[3]
Ban/restrict trucks on freeway	2%	1%	0%	0%	1%
HOV lane is a good idea	11%	14%	16%	13%	12%
Need more freeway lanes	5%	3%	3%	5%	5%
Provide more bus routes	3%	12%	9%	5%	5%
Congestion on freeway no better	5%	—	4%	3%	4%
Poor HOV lane entry/exit design	—	8%	8%	5%	7%
Promote HOV lane & ridesharing	—	7%	4%	4%	4%
Complete freeway/HOV lane const.	8%	—	20%	2%	11%
Extend/expand HOV lane	1%	2%	1%	2%	6%
Need a rail system	4%	5%	1%	3%	4%
Other	36%	40%	18%	51%	24%

[1] *Allow 2+ carpools on HOV lane.*
[2] *Allowing 2+ carpools on HOV lane is a good move.*
[3] *Allow 2+ carpools on all HOV lanes at all times.*
[4] *Congestion on freeway is worse since morning 3+ occupancy requirement began.*

CHAPTER 8
FINDINGS AND CONCLUSIONS AS OF OCTOBER 1990

Carpool utilization of the Katy HOV Lane was initiated as an experiment which would be evaluated periodically to determine whether or not the project has been successful. The evaluation of the individual criterion for the 66-month "after carpools" evaluation is summarized in Table 81. Based on that observation, as of October 1990, the Katy HOV Lane carpool experiment is judged to be "successful."

Table 81.
Overall Evaluation of the Katy HOV Lane Carpool Experiment, 66 Months After Carpools Were Allowed onto the HOV Lane

Criterion	Relative Weighting	Conclusion Pertaining to Experiment	Relevant Data
1. Change in Person Movement on the HOV Lane Directly Attributable to Carpooling	25%	"Highly Successful"	Carpools move 55% of total a.m. peak period person movement and 65% of the total daily person movement.
2. Nonuser Perception of Katy HOV Lane Utilization	30%	"Unsuccessful"	Less than 50% of the nonusers feel the HOV lane is sufficiently utilized.
3. Change in Travel Time on the HOV Lane	20%	"Highly Successful"	Average HOV lane speeds have increased by 1 mph.
4. Change in Delay to Mixed-Flow Traffic	15%	"Highly Successful"	Mixed-flow speeds have increased slightly.
5. Increase in Frequency of HOV Lane Breakdowns	5%	"Highly Unsuccessful"	Approximately 95% of HOV lane vehicle breakdowns are carpools. Approximately 10 breakdowns occur per week.
6. Increase in Authorization and Enforcement Costs	5%	"Successful"	Marginal increase in costs due to carpools has not been substantial.
TOTAL	100%	"Successful"	

If numerical values are assigned to the possible outcomes (with "highly successful" = 4; "successful" = 3; "unsuccessful" = 2; and "highly unsuccessful" = 1), the weighted value for the carpool experiment is 3.2. The criteria related to HOV lane person movement, HOV

lane travel time, and mixed-flow traffic delay were rated as "highly successful" and the criteria related to HOV lane enforcement costs were rated as "successful." The criteria rated as "unsuccessful" or "highly unsuccessful" included nonuser perception of HOV lane utilization and HOV lane breakdowns.

Since the introduction of carpools, the Katy HOV Lane has maintained at least a minimal level of success (defined as a rating greater than 2.5). Since the introduction of the 2+ vehicle occupancy requirement with no authorization procedures, the HOV lane has maintained a rating at or near the "successful" level (3.0±). The trends in HOV lane success are shown in Table 82.

Table 82.
Overall Evaluation of the Katy HOV Lane Carpool Experiment, 1985-1990

Criterion	Relative Weighting	Conclusion Pertaining to Experiment					
		Apr 1986	Apr 1987	Oct 1987	Oct 1988	Oct 1989	Oct 1990
1. Change in Person Movement on the HOV Lane Directly Attributable to Carpooling	25%	2.5	4	4	4	4	4
2. Nonuser Perception of Katy HOV Lane Utilization	30%	1	2	3	3	2	2
3. Change in Travel Time on the HOV Lane	20%	4	4	3	1	3	4
4. Change in Delay to Mixed-Flow Traffic	15%	4	4	4	4	4	4
5. Increase in Frequency of HOV Lane Breakdowns	5%	3	1	1	1	1	1
6. Increase in Authorization and Enforcement Costs	5%	3	3	3	3	3	3
TOTAL	100%	2.63	3.20	3.30	2.90	3.00	3.20

Scoring:
1 = "Highly Unsuccessful"
2 = "Unsuccessful"
3 = "Successful"
4 = "Highly Successful"

In addition to the evaluation of the effects associated with permitting carpools to use the Katy HOV Lane, as assessment of public attitudes concerning the Houston HOV lanes was also performed. This assessment was accomplished through the periodic distribution of survey questionnaires to both HOV lane users and nonusers. Some of the more important findings of

the most recent survey efforts in each freeway corridor (those which relate to trip destination, choice of commuting mode and perceptions of the HOV lanes) follow.

Trip Destinations

As indicated in Table 83, more than 90% of the a.m. peak period HOV lane bus trips are destined to downtown Houston. This is not surprising since essentially all bus service in the HOV lane corridors is oriented toward serving trips to the downtown area. In addition, more than three-fourths of the North and Gulf HOV Lane carpoolers and vanpoolers are also destined to the downtown area. Again, these relatively high percentages are not surprising as both the North and Gulf HOV Lanes terminate in the downtown area.

Table 83.
Trip Destinations of Katy, North, Northwest and Gulf Freeway Corridor Commuters

A.M. Trip Destination	Katy Corridor 1990	North Corridor 1990	Northwest Corridor 1990	Gulf Corridor 1989
HOV Lane Bus Users	(n=671)	(n=988)	(n=293)	(n=464)
Downtown	93%	91%	95%	86%
Galleria	2%	0%	2%	1%
Greenway Plaza	1%	0%	0%	0%
Texas Medical Center	1%	6%	1%	5%
Other	3%	3%	2%	8%
HOV Lane Carpools/Vanpools	(n=708)	(n=189)	(n=235)	(n=122)
Downtown	53%	76%	40%	78%
Galleria	13%	3%	28%	6%
Greenway Plaza	5%	2%	5%	1%
Texas Medical Center	6%	7%	6%	4%
Other	23%	12%	21%	11%
Freeway Motorists	(n=1860)	(n=648)	(n=727)	(n=648)
Downtown	26%	31%	17%	28%
Galleria	14%	9%	19%	9%
Greenway Plaza	3%	4%	6%	5%
Texas Medical Center	4%	7%	3%	9%
Other	53%	49%	55%	49%

By contrast, the location and configuration of both the Katy and the Northwest HOV Lanes permit convenient access to/from the Galleria-Post Oak area, Greenway Plaza, the Texas Medical Center and other locations without having to travel through the downtown area first.

Consequently, 47% of the Katy HOV Lane poolers and 60% of the Northwest HOV Lane poolers are destined to locations other than downtown Houston. In addition, 69% to 83% of the motorists traveling the Katy, North, Northwest and Gulf Freeway mainlanes are destined to locations other than downtown Houston.

Mode Choice Considerations

Previous Mode of Travel

In looking at previous travel modes of HOV lane users, significant percentages either drove alone or did not make the trip prior to using the HOV lane (Table 84).

Table 84.
Previous Travel Mode of Katy, North, Northwest and Gulf Freeway Corridor Commuters

Previous Travel Mode	Katy Corridor 1990	North Corridor 1990	Northwest Corridor 1990	Gulf Corridor 1989
HOV Lane Bus Users	(n=665)	(n=979)	(n=289)	(n=457)
Drove alone	36%	39%	46%	38%
Carpool	10%	9%	6%	8%
Vanpool	3%	8%	3%	6%
Bus	19%	15%	24%	30%
Didn't make trip	32%	28%	21%	18%
HOV Lane Carpools/Vanpools	(n=699)	(n=178)	(n=2250	(n=117)
Drove alone	57%	42%	53%	40%
Carpool	27%	39%	34%	44%
Vanpool	3%	3%	1%	7%
Bus	9%	15%	8%	4%
Didn't make trip	4%	1%	4%	5%
Freeway Motorists[1]	(n=192)	(n=644)	(n=727)	(n=651)
Drive alone	92%	87%	87%	88%
Carpool	5%	9%	9%	9%
Vanpool	—	0%	0%	0%
Other	3%	4%	4%	3%

[1] *For the motorists, this is the current mode they normally use.*

In addition:

- In the Katy HOV Lane corridor, the bus service attracted 13% of its ridership from carpools or vanpools; carpools and vanpools attracted 9% of their riders from buses.

- In the North HOV Lane corridor, transit service attracted 17% of its ridership from carpools or vanpools; carpools and vanpools attracted 15% of their riders from buses.

- In the Northwest HOV Lane corridor, transit attracted 9% of its ridership from carpools or vanpools; carpools/vanpools attracted 8% of their riders from transit.

- In the Gulf HOV Lane corridor, transit service attracted 14% of its riders from carpools or vanpools; carpools and vanpools gained 4% of their members from buses.

Impact of the HOV Lanes on Mode Choice

As shown in Table 85, the Katy, North, Northwest and Gulf HOV Lanes all appear to have had a definite effect on mode choice. While sizable percentages of the HOV lane users indicated that they would be using their current mode even if there was no HOV lane, between 22% and 43% said they would *not*.

Table 85.
Use of Current Mode by HOV Lane Users if HOV Lane Had Not Opened

Use Current Mode If No HOV Lane	Katy Corridor 1990	North Corridor 1990	Northwest Corridor 1990	Gulf Corridor 1989
HOV Lane Bus Users	(n=670)	(n=981)	(n=291)	(n=457)
Yes	35%	33%	41%	56%
No	31%	37%	35%	22%
Not sure	34%	30%	24%	22%
HOV Lane Carpools/Vanpools	(n=702)	(n=185)	(n=237)	(n=120)
Yes	37%	48%	45%	68%
No	43%	40%	39%	20%
Not sure	20%	12%	16%	12%

Perceived HOV Lane Travel Time Savings

One of the primary reasons for implementing the system of HOV lanes is to offer riders of high-occupancy vehicles a travel time advantage and travel time reliability over traveling in the regular freeway lanes. HOV lane users generally do perceive a travel time savings as a result of being able to use a priority lane (Table 86).

Table 86.
Perceived HOV Lane Travel Time Savings

Travel Time Savings	Katy Corridor 1990	North Corridor 1990	Northwest Corridor 1990	Gulf Corridor 1989
Perceived HOV Lane Travel Time Savings (minutes)				
HOV Lane Bus Users	(n=639)	(n=924)	(n=280)	(n=386)
a.m. (median)	18	15	18	10
p.m. (median)	20	20	18	15
HOV Lane Carpools/Vanpools	(n=639)	(n=184)	(n=235)	(n=121)
a.m. (median)	20	17	20	12
p.m. (median)	20	20	20	15
Actual Peak Period HOV Lane Travel Time Savings (minutes)[1]				
a.m. (6:00-9:30 a.m.)	9.4	3.3	2.4	3.1
p.m. (3:30-7:00 p.m.)	6.0	0.1	1.8	-3.1

In the Katy and Northwest HOV Lane corridors, the median perceived travel time savings reported by users is 18 minutes in the a.m. and 18 to 20 minutes in the p.m. Median travel time savings perceived by North HOV Lane users is in the range of 15 to 17 minutes in the a.m. and 20 minutes in the p.m.; median travel time savings perceived by Gulf HOV Lane users is somewhat less (10 to 12 minutes in the a.m. and 15 minutes in the p.m.).

Motorists' Attitudes Concerning the HOV Lanes

In the Katy, North and Northwest HOV lane corridors, at least one-third of the motorists operating in the freeway mainlanes (non HOV lane users) feel there is sufficient vehicular

utilization of the HOV lanes to justify the projects. Furthermore, between 71% and 81% of the motorists in these corridors feel the HOV lanes are good transportation improvements (Table 87). *These represent the highest percentages of favorable responses received to date regarding this issue.*

In the Gulf HOV Lane corridor, approximately one-fifth of the motorists feel there is sufficient vehicular utilization of the HOV lane to justify its existence. Nevertheless, 63% of the motorists did state the Gulf HOV Lane is a good transportation improvement.

Table 87.
Motorists' Attitudes Toward the HOV Lanes

Measure of Effectiveness or Success	Katy Freeway 1990[1]	North Freeway 1990[2]	Northwest Freeway 1990[2]	Gulf Freeway 1989[2]
In Terms of Vehicles Moved, Is the HOV Lane Sufficiently Utilized?	(n=192)	(n=641)	(n=727)	(n=643)
Yes	37%	36%	37%	21%
No	45%	40%	45%	61%
Not sure	18%	24%	18%	18%
HOV Lane Vehicle Volumes (A.M. Peak Period)[3]	2635	1595	2099	1139
Is the HOV Lane a Good Transportation Improvement?	(n=193)	(n=647)	(n=731)	(n=647)
Yes	71%	81%	75%	63%
No	16%	9%	11%	21%
Not sure	13%	10%	14%	16%

[1] *3+ vehicles, no authorization between 6:45 a.m. and 8:00 a.m., 2+ vehicles, no authorization at all other times.*
[2] *2+ vehicles, no authorization.*
[3] *Source: TTI vehicle volume and occupancy counts.*

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APPENDIX

Presented in this appendix are examples of the survey instruments and cover letters used in the surveys of Katy, North, Northwest and Gulf HOV Lane users and nonusers.

NORTH TRANSITWAY TRANSIT USER SURVEY

This survey is being undertaken by the Texas Transportation Institute, the Texas State Department of Highways and Public Transportation and METRO in order to obtain information about your use of the North Transitway. Please take a few minutes to answer the questions below and return this form to the survey taker before leaving the bus.

1. **What is the purpose of your bus trip this morning?** ____Work ____School ____Other

2. **What is the Zip Code of the area where this trip began?** (For example, if this trip began from your home this morning, you would list your home Zip Code.) _____

3. **What is your final destination on this trip?** ____Downtown ____Galleria/City Post Oak/Uptown
   ____Texas Medical Center ____Greenway Plaza ____Other (specify Zip Code_____)

4. **Have you ever carpooled or vanpooled on the transitway?** ____Yes, carpooled ____Yes, vanpooled ____No

5. **How important was the opening of the North Transitway in your decision to ride the bus?**
   ____Very important ____Somewhat important ____Not important

6. **If the North Transitway had <u>not</u> opened, would you be riding a bus now?**
   ____Yes ____No ____Not sure

7. **How many minutes, if any, do you believe this bus presently saves by using the North Transitway instead of the regular traffic lanes?** _____Minutes in the morning _____Minutes in the evening

8. **How long have you been a regular bus rider on the North Transitway?** _____

9. **Does your employer pay for any part of your bus pass?** ____Yes, all ____Yes, part ____No

10. **Was a car (or other vehicle) available to you for this trip? (check one)**
    ____No, bus was only practical means
    ____Yes, but with considerable inconvenience to others
    ____Yes, but I prefer to take the bus

11. **Before you began riding a bus on the North Transitway, how did you <u>normally</u> make this trip? (check one)**
    ____Drove alone
    ____Carpooled
    ____Vanpooled
    ____Rode a park-and-ride bus on the regular freeway lanes
    ____Rode a regular route or express bus
    ____Did not make this trip prior to using the North Transitway
    ____Other (specify_____)

12. **Do you feel that the North Transitway is, at present, being sufficiently utilized to justify the project?**
    ____Yes ____No ____Not sure

13. **What is your . . . Age?_____ Sex?_____ Occupation?_____**

14. **What is the last level of school you have completed?** _____

Comments:_____

_____

_____

_____

THANK YOU FOR YOUR COOPERATION.

Metropolitan Transit Authority
1201 Louisiana
P.O. Box 61429
Houston, Texas 77208-1429

Fax 739-4925
713 739-4000

METRO

Dear Carpooler/Vanpooler:

Your vehicle was observed recently traveling southbound on the North Transitway. Since you have first-hand knowledge of the transitway, we need your help in a special study being conducted by the Texas Transportation Institute, a transportation research agency of the Texas A&M University System. Because the North Transitway is one of the first transitways to operate in Texas, it is extremely important that we determine what effect it has had on your travel.

Please take a few minutes to answer the enclosed questionnaire. Your answers will provide valuable information concerning carpooling/vanpooling on the North Transitway. Because of the small number of poolers contacted, your specific reply is essential to ensure the success of the project. All information you provide will remain strictly confidential.

Your cooperation and timely return of the completed questionnaire in the enclosed postage-paid envelope will be greatly appreciated. Thank you for your time and assistance in this important undertaking.

METRO

Enclosures

NORTH TRANSITWAY CARPOOL/VANPOOL SURVEY

Undertaken by the Texas Transportation Institute, The Texas A&M University System in cooperation with the Texas State Department of Highways and Public Transportation, the Metropolitan Transit Authority of Harris County and the U.S. Department of Transportation

1. **Is your vehicle a carpool or a vanpool?** ____Carpool ____Vanpool
2. **What is the primary purpose of your a.m. carpool/vanpool trip?** ____Work ____School ____Other
3. **How many members are regularly in your carpool/vanpool (including yourself)?** _____
4. **Who makes up your carpool/vanpool group?** ____Family Members ____Neighborhood Friends ____Co-Workers
5. **Does your carpool/vanpool use a park-and-ride or park-and-pool lot as a staging area?**
   ____Yes (please specify which lot you typically use _____) ____No
6. **Does your carpool/vanpool use the Sam Houston Tollway?** ____Yes ____No
7. **How long have you been a regular user of the North Transitway?** _____
8. **Which transitway entrance do you normally use to access the North Transitway in the morning?**
   ____North Belt mainlane entrance ramp ____Aldine-Bender wishbone ramp ____North Shepherd ramp
9. **What time do you normally enter the transitway in the morning?** _____a.m.
10. **What is your a.m. carpool/vanpool destination?** ____Downtown ____Galleria/City Post Oak/Uptown
    ____Greenway Plaza ____Texas Medical Center ____Other (specify Zip Code_____)
11. **When did you join your present carpool/vanpool?** Month:_____ Year:_____
12. **How important was the North Transitway in your decision to carpool/vanpool?**
    ____Very important ____Somewhat important ____Not important
13. **If the North Transitway had not opened to carpools/vanpools, would you be carpooling/vanpooling now?**
    ____Yes ____No ____Not sure
14. **Prior to carpooling/vanpooling on the North Transitway, how did you normally make this trip?**
    ____On the transitway
    ____Bus ____Vanpool ____Carpool

    ____On the North Freeway general purpose lanes
    ____Bus ____Vanpool ____Carpool ____Drove Alone

    ____On a parallel street or highway (Street Name_____)
    ____Bus ____Vanpool ____Carpool ____Drove Alone

    ____Did not make this trip
15. **How many minutes, if any, do you believe your carpool/vanpool saves by using the North Transitway instead of the regular traffic lanes?** _____Minutes in the morning _____Minutes in the evening
16. **Do you feel that the North Transitway is, at present, sufficiently utilized to justify the project?**
    ____Yes ____No ____Not sure
17. **What is your . . . Age?**_____ **Sex?**_____ **Occupation?**_____
18. **What is the last level of school you have completed?**_____
19. **What is your home Zip Code?** _____

Please use the back of this form for additional comments.

Thank you for your cooperation. Please return this form at your earliest convenience in the postage-paid envelope provided.

Metropolitan Transit Authority
1201 Louisiana
P.O. Box 61429
Houston, Texas 77208-1429

Fax 739-4925
713 739-4000

METRO

Dear Motorist:

Your vehicle was recently observed traveling southbound on the North Freeway between 6:00 and 9:30 a.m. Since you have first-hand knowledge of traffic conditions on the North Freeway, we need your help in a special study being conducted by the Texas Transportation Institute, a research agency of the Texas A&M University System.

To help serve the travel demand, the State Department of Highways and Public Transportation and the Metropolitan Transit Authority have constructed the North Transitway for use by buses, carpools and vanpools. Vehicles using the transitway travel inbound toward downtown in the morning and outbound in the afternoon. The North Transitway has been constructed within the median of the freeway and is protected from other traffic by concrete barriers. The location of the transitway in the median has not reduced the number of general traffic lanes available to motorists.

Because the North Transitway is one of the first transitways to operate in Texas, we need your help to determine how it is working. Please take a few minutes to answer the enclosed questionnaire. The questions on this survey concern your routine trips made on the North Freeway in the morning, from 6:00 a.m. to 9:30 a.m. Because of the small number of motorists contacted, your specific reply is essential to ensure the success of the project. Your answers will remain strictly confidential.

Your cooperation and timely return of the completed questionnaire in the enclosed postage-paid envelope will be greatly appreciated. Thank you for your time and assistance in this important undertaking.

METRO

Enclosures

NORTH FREEWAY MOTORIST SURVEY

Undertaken by the Texas Transportation Institute, The Texas A&M University System
in cooperation with the Texas State Department of Highways and Public Transportation,
the Metropolitan Transit Authority of Harris County and the U.S. Department of Transportation

1. **What was the purpose of your trip?** ____Work ____School ____Other

2. **What are your reasons for driving your car on the freeway mainlanes rather than traveling in a high-occupancy vehicle on the transitway?**
____Need car for job
____Car is more convenient and flexible
____No convenient bus, vanpool or carpool available
____Work irregular hours
____Other (specify_____)

3. **How many days per week do you normally make this trip?** _____

4. **How do you usually make this trip?**
____Drive alone ____Vanpool ____METRO regular route or express bus
____Carpool ____METRO park-and-ride bus ____Other (specify_____)

5. **How many people (including yourself) were in your vehicle for this trip?** _____

6. **Which on-ramp did you use to enter the North Freeway for this trip?** _____

7. **What was the destination of your trip?**
____Downtown ____Texas Medical Center ____Other (specify Zip Code below)
____Greenway Plaza ____Galleria/City Post Oak/Uptown _____

8. **Based on your observation of the number of vehicles currently using the North Transitway, do you feel that it is being sufficiently utilized?** ____Yes ____No ____Not sure

9. **Based on your perception of the number of persons currently being moved on the North Transitway, do you feel that it is being sufficiently utilized?** ____Yes ____No ____Not sure

10. **Do you feel that the North Transitway is a good transportation improvement?**
____Yes ____No ____Not sure

11. **Do you normally listen to traffic reports on the radio at home, at work, or in your car?** ____Yes ____No

If "yes," have you ever changed your original travel plans (taken an alternate travel route, altered your travel time, or used a bus or carpool) because of information obtained from these reports? ____Yes ____No

12. **Do you know the location of the park-and-ride lot nearest your home?** ____Yes ____No ____Not sure

13. **Do you know enough about the park-and-ride service provided by METRO to confidently begin using it tomorrow?**
____Yes ____No ____Not sure

14. **What is your . . . Age?**_____ **Sex?**_____ **Occupation?**_____

15. **What is the last level of school you have completed?**_____

16. **What is your home Zip Code?**_____

Please use the back of this form for additional comments.

Thank you for your cooperation. Please return this form at your earliest convenience in the postage-paid envelope provided.