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16. Abstract

This report is the fourth research document prepared in the study of land use and transportation impacts under Project 9-10-85-1085 (between the State and Barry Goodman Associates) and Project 2-10-85-1086 (between the State and the Texas Transportation Institute). The details of the data collection and analysis conform to the basic procedures used in other impact studies and to the study's work program (Technical Report 1086-2). This five year research effort examines transportation and land use impacts resulting from implementation of an extensive priority system of busways and park-and-ride facilities in Houston, Texas. Over the duration of this research, three high-occupancy vehicle (HOV) lanes with supporting park-and-ride facilities will be placed in operation in Houston's north (I-45N), west (I-10W) and southeast (I-45S) freeway corridors. The results of a preliminary pilot test of the study method proposed to identify the land use and transportation impacts resulting from the HOV treatments within the north corridor (I-45N) are presented in this research report. Any definitive assessment of impacts, particularly land use impacts, will not be operational and established as integral elements in the corridor's transportation system. Preliminary results suggest that while the HOV priority treatments implemented in the corridor have produced substantial, positive transportation impacts, the land use impacts appear to be relatively insignificant at this time.

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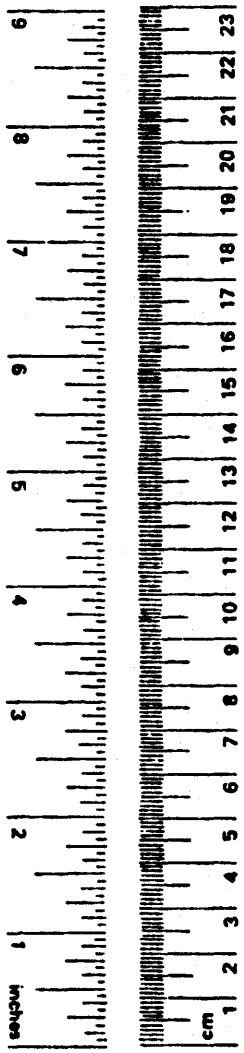
Unclassified	Unclassified	49	

Form DOT F 1700.7 (8-69)

METRIC CONVERSION FACTORS

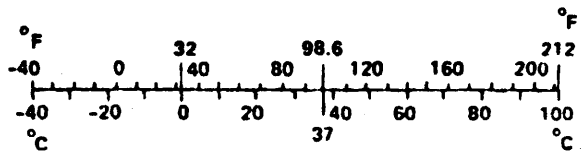
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

LAND USE AND INNOVATIVE FUNDING IMPACTS IN A PERMANENT BUSWAY/PARK-AND-RIDE TRANSIT SYSTEM: PRELIMINARY ASSESSMENT OF LAND USE IMPACTS IN HOUSTON'S NORTH (I-45N) TRANSITWAY CORRIDOR

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Technical Report 1086-4
Study Number 2-10-85-1086

Sponsored by

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Urban Mass Transportation Administration

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

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ABSTRACT

This report is the fourth research document prepared in the study of land use and transportation impacts under Project 9-10-85-1085 (between the State and Barry Goodman Associates) and Project 2-10-85-1086 (between the State and the Texas Transportation Institute). The details of the data collection and analysis conform to the basic procedures used in other impact studies and to the study's work program (Technical Report 1086-2). This five year research effort examines transportation and land use impacts resulting from implementation of an extensive priority system of busways and park-and-ride facilities in Houston, Texas. Over the duration of this research, three high-occupancy vehicle (HOV) lanes with supporting park-and-ride facilities will be placed in operation in Houston's north (I-45N), west (I-10W) and southeast (I-45S) freeway corridors. The results of a preliminary pilot test of the study method proposed to identify the land use and transportation impacts resulting from the HOV treatments within the north corridor (I-45N) are presented in this research report. Any definitive assessment of impacts, particularly land use impacts, will not be possible until the transitway and associated support facilities have become fully operational and established as integral elements in the corridor's transportation system. Preliminary results suggest that while the HOV priority treatments implemented in the corridor have produced substantial, positive transportation impacts, the land use impacts appear to be relatively insignificant at this time.

Key Words: Land Use, Transportation Impacts, Transitways, Busways, HOV Lanes, Park-and-Ride, Priority Treatment, Development, Mode Split, Travel Demand, Transportation Planning, Fixed Guideway, Bus Rapid Transit, Express Bus, Impact Studies, Economic Assessment.

IMPLEMENTATION STATEMENT

This research is oriented toward assisting the Texas State Department of Highways and Public Transportation (SDHPT) in the planning and impact evaluation of high-occupancy vehicle (HOV) lanes or transitways. The study concentrates on the freeway corridors in Houston, Texas where priority facilities for HOVs are being operated and expanded. Identification of secondary data sources and a prior survey (Technical Report 1086-1) of similar impact studies provided the data bases for developing the multi-year work program (Technical Report 1086-2). The results of this research, when completed, should assist the State Department of Highways and Public Transportation in evaluating potential land use and transportation impacts resulting from implementation of transitways and/or park-and-ride facilities within the major urban areas.

Results of this research may be applied nationwide by local, state and federal officials responsible for, or concerned with, busway/park-and-ride system development. Evaluation of land use impacts (if any) associated with permanent transit facility construction will provide valuable guidance to transportation planners and policy makers in assessing alternative improvements.

The study findings will be of particular interest to the State Department of Highways and Public Transportation, the Urban Mass Transportation Administration, and Federal Highway Administration, other State Departments of Transportation, local transit agencies, city planners, and various professional societies or organizations (e.g., ITE, TRB, ASCE, AASHTO).

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the opinions, findings and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Urban Mass Transportation Administration (UMTA), U.S. Department of Transportation or of the Texas State Department of Highways and Public Transportation (SDHPT). This report does not constitute a standard, specification or regulation.

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Gordon D. Zwillenberg, Houston METRO
Upton Officer, Houston METRO

SUMMARY

The results of a preliminary pilot test of methods to identify land use and transportation impacts resulting from the implementation of HOV treatments in the North Freeway (I-45N) Corridor in Houston, Texas are presented in this report. Preliminary results indicate that while the HOV priority treatments implemented in the corridor have produced substantial improvements in corridor capacity, the land use impacts appear to be relatively insignificant at this time.

Overall, corridor-wide traffic operation has progressively improved since the implementation of the median transitway. Occupancy rates on the total facility climbed from 1.5 passengers per vehicle to 1.7 passengers per vehicle. Based upon average transitway volumes in the first year of transitway operation, transitway users cumulatively realized an average travel time savings of almost 2,200 person-hours per day over parallel freeway mainlane travelers. These travel time savings translate into a benefit of almost $4.3 million each year. Combining these travel time savings with reduced bus operating cost savings, a total direct benefit of $42.0 million over a 20-year period is anticipated. With direct costs of $15.2 million, the transitway confirms its cost-effectiveness with a benefit/cost ratio of almost 3:1.

The preliminary results of the land use impacts phase of the research are inconclusive. No substantial land use changes of a nature which would appear to be related to the presence of the transitway and/or park-and-ride lots could be identified. It appears that a more definitive assessment of the land use impacts will not be possible until some time after the transitway and associated support facilities have become fully operational and established as integral elements in the corridor's transportation system. The North Freeway corridor study sites all have substantial amounts of undeveloped land and, as such, should serve as excellent test sites for monitoring the long-term land use impacts of park-and-ride lots.

The preliminary results of the study suggest that continued monitoring of land uses in the Houston transitway corridors, along with completion of the developer interview portions of the research, should result in a reasonable assessment of the potential land use impacts of transitway systems.

PRELIMINARY ASSESSMENT OF LAND USE IMPACTS IN HOUSTON'S NORTH (I-45N) TRANSITWAY CORRIDOR

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (CONT'D)

LIST OF TABLES

1. INTRODUCTION

1.1 BACKGROUND

The Houston Metropolitan area is currently implementing one of the most extensive high-occupancy vehicle (HOV) priority treatment networks in the nation. Over 40 miles of transitways are currently under construction with another 23 miles in the final planning and design stages. The ultimate commitment to transitways may result in over 100 miles of these facilities in operation with a total capital cost in excess of $1 billion (1). The current status of the transitway system for the Houston area is shown in Figure 1.

Because few transitways within North America are in operation, limited experience exists regarding the planning, design, and operation of such facilities (2). Previous transitway assessments have focused primarily on the "transportation" impacts of transitways, rather than on the "land use" impacts. One objective of this research is to examine the impacts of Houston's Transitway system on land uses in the Houston Metropolitan area. This assessment should provide the basis for a comprehensive evaluation of the costs, benefits, and land use impacts resulting from transitway projects.

A review (2) of transitways currently in operation in the United States and Canada identified the design and operating features and summarized the general character of the urban areas in which the projects were located. The results of the review provided preliminary data for evaluating the transferability of similar project work to this Houston study. In addition, a comprehensive summary (3) of economic and land use changes resulting from major transportation improvements provided the framework or plan (4) for guiding this research work.

1.2 SCOPE

There are three basic types of HOV lanes that can be implemented on urban freeways: 1) contraflow lanes; 2) concurrent flow lanes; and 3) transitways. The first two types of HOV lanes are frequently classified as

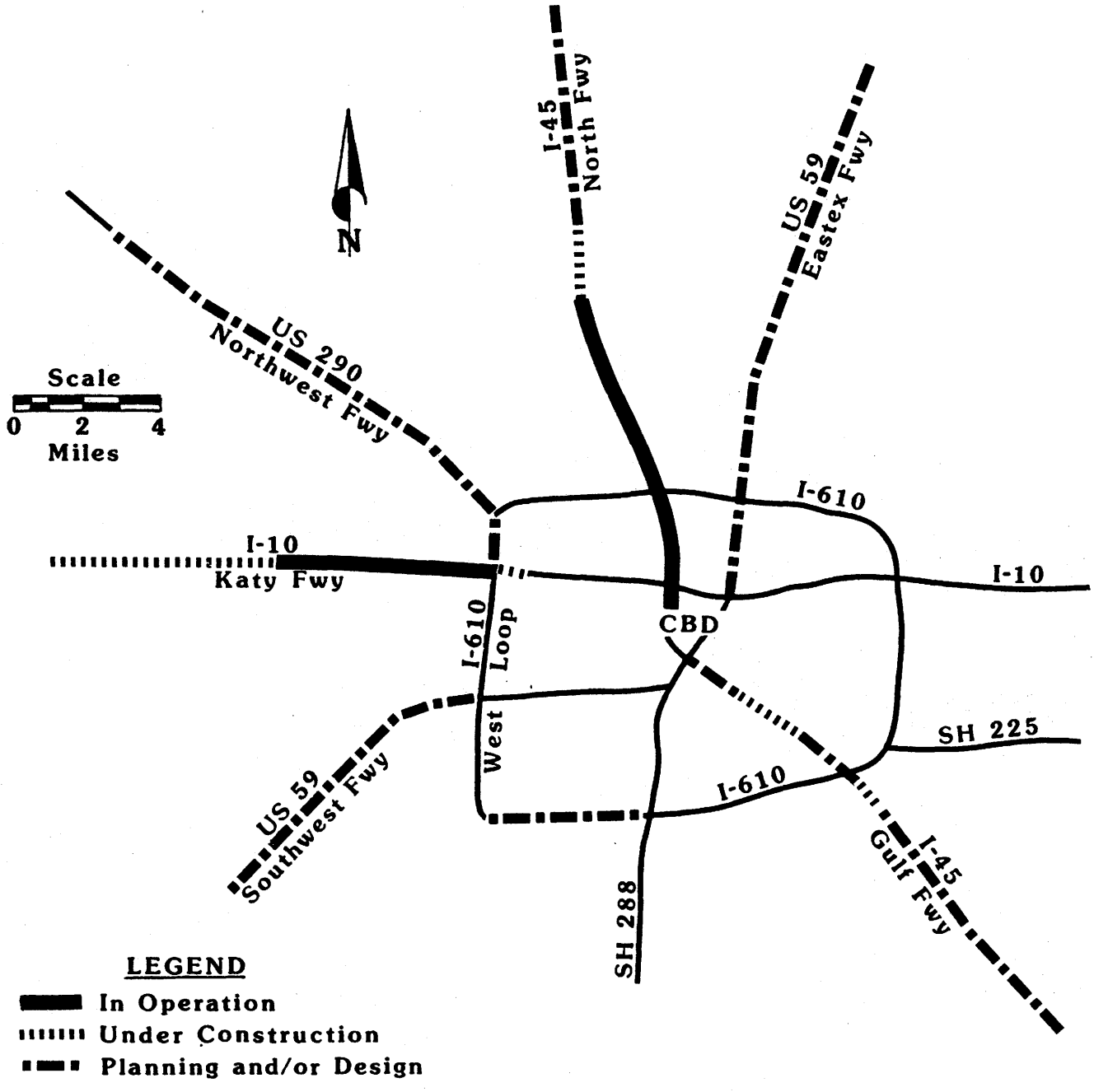


Figure 1. Status of Houston Transitway System as of July 1986

commuter lanes. The fundamental difference between commuter lanes and transitways is in terms of the level of service provided. Transitways, by design, provide a higher level of service than commuter lanes. Transitways contain special features to provide this higher level of service, including: ramp connectors to employment centers; turning movement ramps through freeway to freeway interchanges; and, in some systems, on-line transit stations (5).

The Houston North (I-45N) Corridor is unique within the study area in that the transitway was preceded by a contraflow commuter lane. This lane, opening in 1979, provided priority treatment for buses and vanpools in advance of the more permanent replacement transitway. Early priority treatment and associated public awareness along the I-45N corridor distinguishes the facility from the Gulf (I-45S) and Katy (I-10W) Corridors.

As set forth in the work program (4), land use impacts of the I-45N contraflow lane, and its supporting park-and-ride facilities, are to be examined and the evaluation used to develop and refine the research procedures for other Houston corridors. Land use patterns for the "before period" are compared with those for the "after period" with the location, extent, and nature of any changes documented. The effects of the contraflow lane and park-and-ride facilities on these land use changes are to be evaluated through interviews with developers and property owners within the corridor. While the interviews are to focus on those within the primary zones of influence, the geographic boundaries of the analyses will be expanded or contracted when the interviews suggest that such re-definitions may be necessary.

1.3 THE CORRIDOR EVOLUTION

1.3.1 General

The North Transitway, or Authorized Vehicle Lane (AVL), is a one-lane reversible authorized bus and vanpool facility located in the median of IH-45N, locally known as the North Freeway. Implementation of the project was divided into four phases as shown in Figure 2. Phases I and II extend 9.6 miles from the Houston Central Business District (CBD) at Franklin Street to

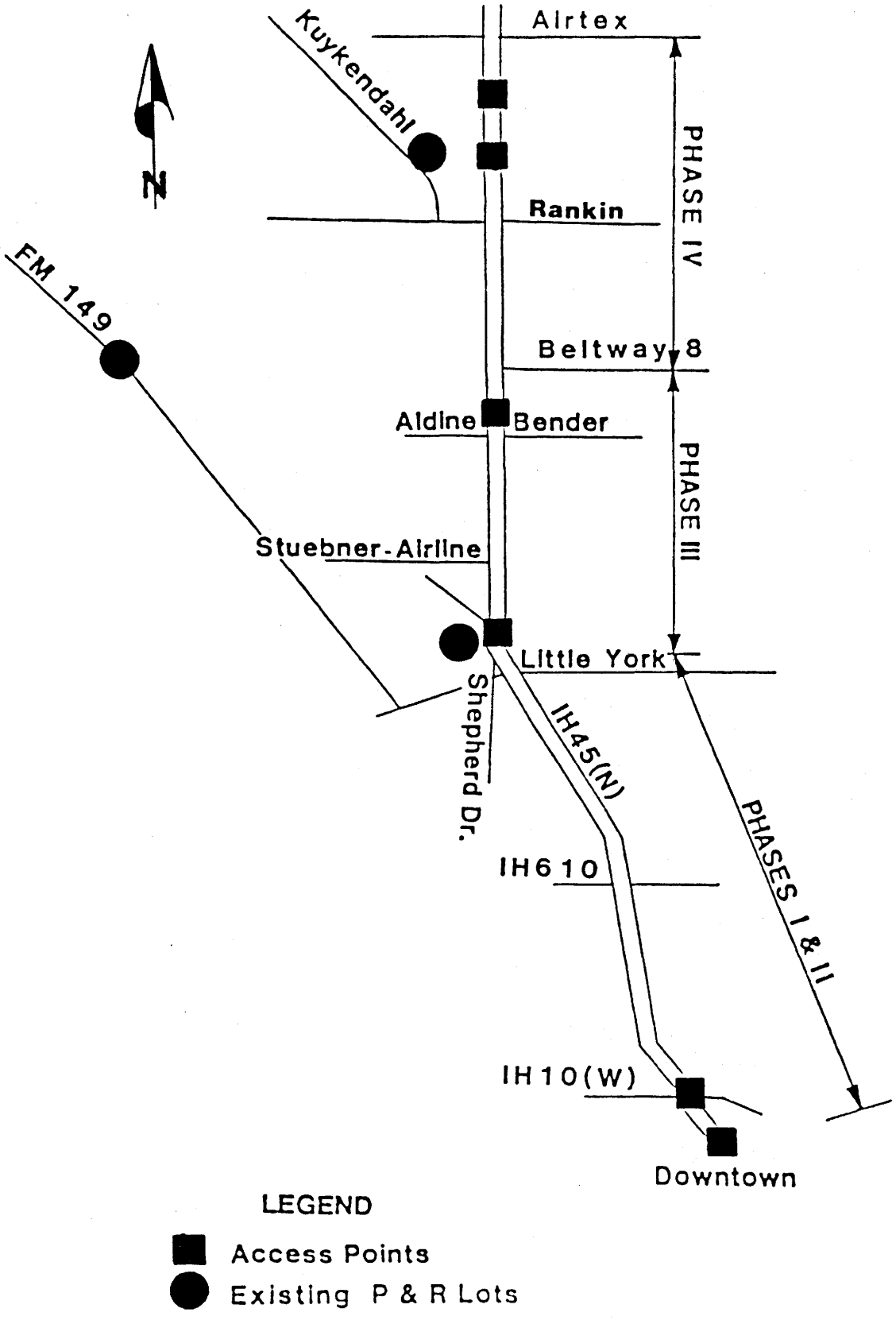


Figure 2. Four Phase Segmentation of the North (I-45N) Transitway Project

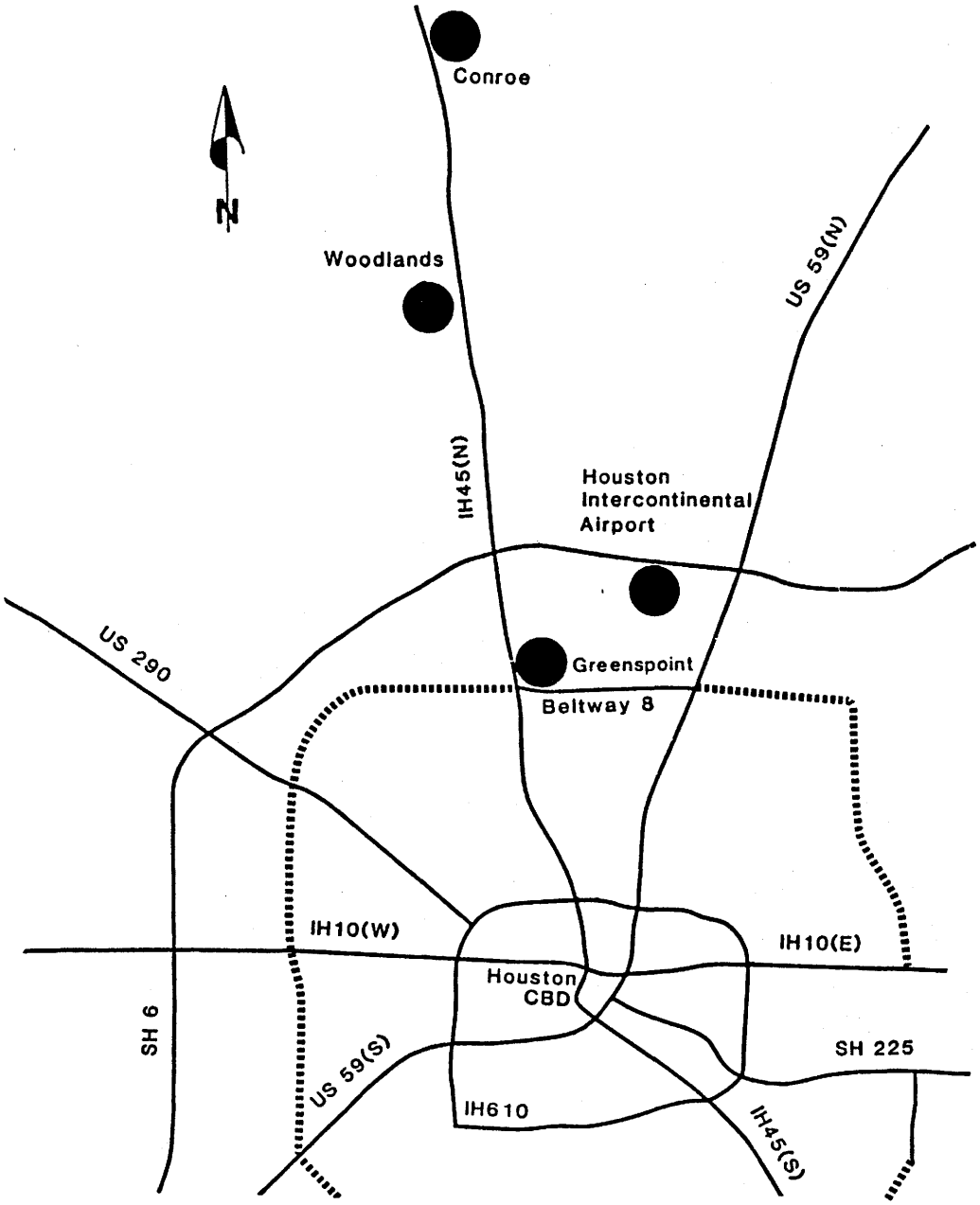
North Shepherd/Veterans Memorial Drive Interchange (6, 7). Phase III extends 4.9 miles from North Shepherd/Veterans Memorial Drive Interchange to Beltway 8; locally known as the North Belt. Phase IV of the transitway development includes an additional 3.1 miles from Beltway 8 to Airtex Drive, approximately 3 miles south of FM 1960 (6, 7).

The entire 17.6 mile transitway improvement is a joint project between the State Department of Highways and Public Transportation (SDHPT) and the Metropolitan Transit Authority of Harris County (METRO). Financial assistance for the median facility and the interchange ramps is being provided by the Federal Highway Administration (FHWA) and the Urban Mass Transportation Administration (UMTA).

The I-45N Corridor is one of Houston's more heavily traveled corridors and is bordered by significant residential and commercial activity. The facility serves the central business district, the Greenspoint Development at Beltway 8, the Houston Intercontinental Airport, a large concentration of office towers and apartments along Beltway 8 between I-45N and the airport, and a number of other high-growth residential developments (e.g., the Woodlands and Conroe area) as illustrated in Figure 3.

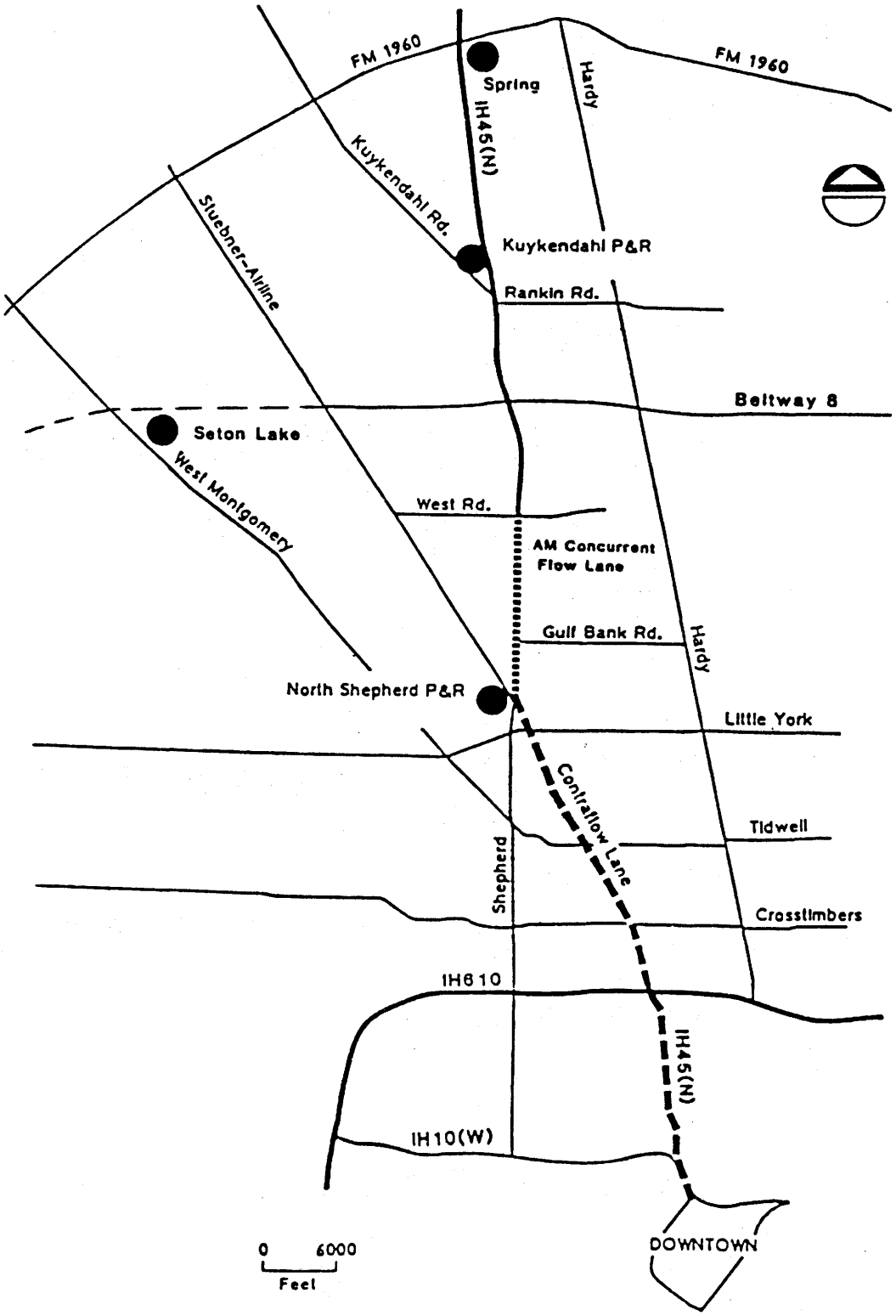
1.3.2 Contraflow Lane and Transitway Conversion

Traffic congestion on I-45N and the need for increased capacity prompted METRO and SDHPT to open the 9.6 mile contraflow lane between downtown Houston and North Shepherd Drive in August 1979. Borrowing a lane from off-peak direction flow during peak periods permitted authorized high-occupancy vehicles (vans and buses) to save about 15 to 20 minutes in travel time in each direction between North Shepherd/Veterans Memorial Drive Interchange and Franklin Street in the CBD. An additional 10 minute travel time savings could also be realized by those southbound (a.m.) vehicles using a 3.3 mile concurrent flow lane to the north of North Shepherd Drive (6). The extent of the contraflow and concurrent flow projects are illustrated in Figure 4.



Source: Reference (6), p. 4.

Figure 3. Major Activity Centers Served by the North (I-45N) Transitway Corridor



Source: Reference (6), p. 5.

Figure 4. Contraflow and Concurrent Flow Lane Limits in the North (I-45N) Transitway Corridor

The freeway contraflow project was very successful in attracting riders to vanpools and buses with the number increasing more than 400% between 1979 and 1984. As shown in Table 1 and in Figure 5, the contraflow lane carried close to 8,000 people per peak period in March 1984 (6, 8).

The contraflow lane required the reservation of an off-peak direction travel lane for use by authorized buses and vans traveling in the peak direction. As off-peak traffic volumes continued to increase, that approach began to result in unacceptable congestion in the off-peak travel direction (6). As a result, a commitment by SDHPT and METRO was made to replace the contraflow lane between North Shepherd Drive and the Houston CBD with Phases I and II of the I-45N transitway.

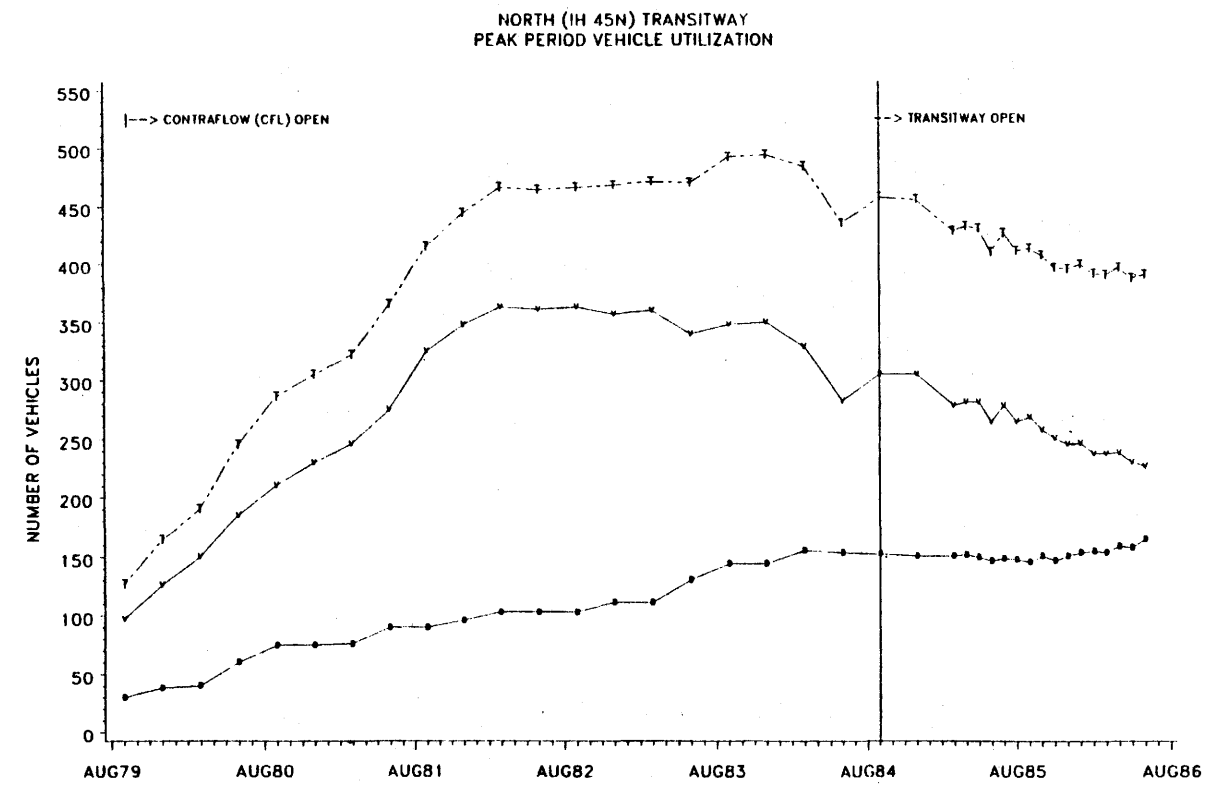
Subsequently, a commitment was made to implement Phase III, which extends the one-lane reversible facility from North Shepherd Drive to Beltway 8. Phase IV, the extension from Beltway 8 to Airtex Drive, responds to the high traffic volumes originating north of FM 1960 and to the need for a bypass to the imminent heavy congestion on I-45N from Beltway 8 to Airtex (6). Ongoing studies are being conducted which are investigating the feasibility of extending the transitway an additional 5 to 10 miles (7) to near the Harris/Montgomery County Line.

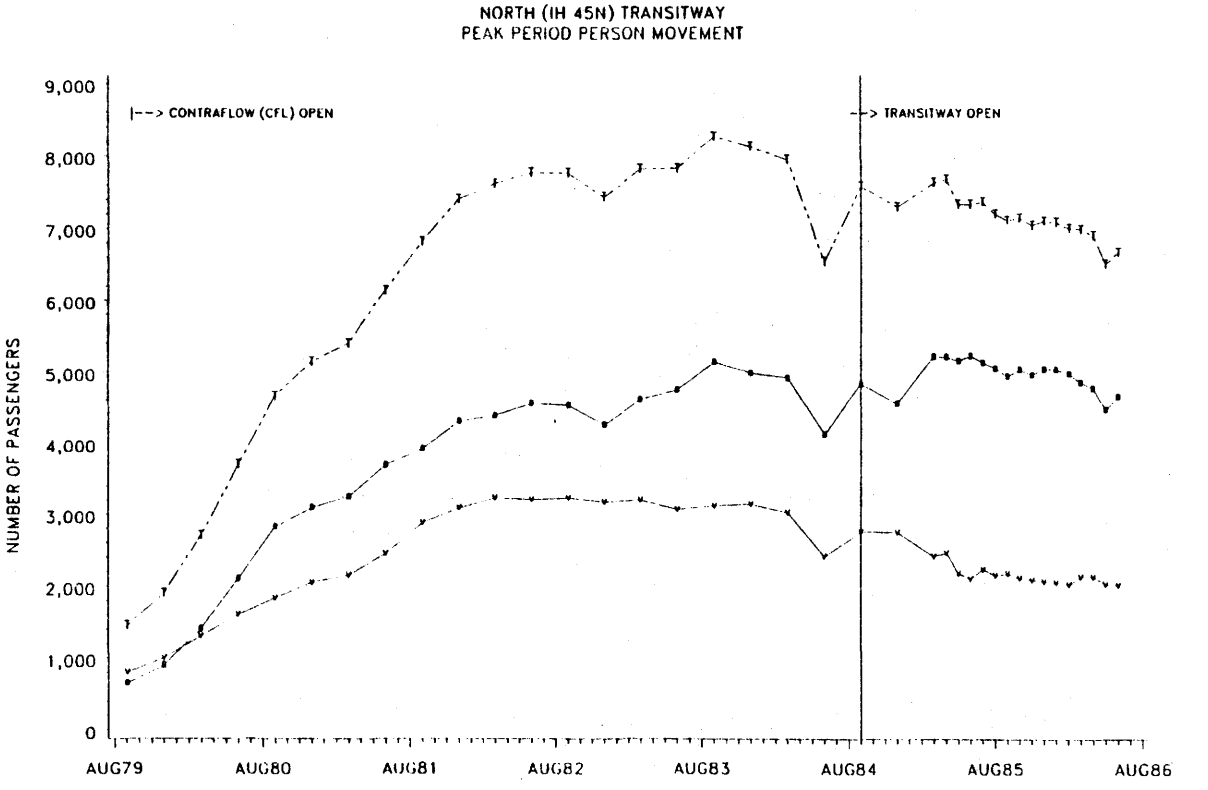
SDHPT and METRO agreed to pursue a more permanent transitway in the I-45N median in order to replace the contraflow lane with a safer, better design. The freeway rehabilitation includes wider bridges, better pavement, and more efficient and safer lighting in addition to the transitway facility. This contraflow replacement was initiated in April 1983 with Phase IA to remove light poles and sign structures from the freeway median; the work was scheduled so as not to interfere with the a.m. and p.m. contraflow operation (7). Phase IB, awarded to a second contractor, commenced one year later (1984), required 179 calendar days to complete, and included: 1) guardrail removal; 2) concrete paving of the median; and, 3) interim placement of the concrete traffic barriers. Phase II, initiated early in 1985, has a $1 million bonus for completion within 550 calendar days and involves widening the freeway mainlanes and repaving (7). Phases I and II are illustrated by typical cross-sections in Figure 6 and 7, respectively.

Table 1. North (I-45N) Transitway Peak Period Utilization (Persons and Vehicles)

Month	Person Trips			Vehicle Trips		
	Bus	Vanpool	Total	Bus	Vanpool	Total
SEP79	650	800	1450	30	97	127
DEC79	900	1000	1900	38	126	164
MAR80	1400	1300	2700	40	150	190
JUN80	2100	1600	3700	60	185	245
SEP80	2828	1832	4660	75	211	286
DEC80	3100	2050	5150	75	230	305
MAR81	3250	2150	5400	76	246	322
JUN81	3691	2448	6139	90	275	365
SEP81	3923	2888	6811	90	325	415
DEC81	4308	3097	7405	96	348	444
MAR82	4387	3231	7618	103	363	466
JUN82	4557	3209	7766	103	361	464
SEP82	4531	3231	7762	103	363	466
DEC82	4258	3177	7435	111	357	468
MAR83	4611	3204	7815	111	360	471
JUN83	4750	3075	7825	130	340	470
SEP83	5140	3125	8265	144	348	492
DEC83	4983	3143	8126	144	350	494
MAR84	4915	3030	7945	155	329	484
JUN84	4125	2411	6536	153	282	435
SEP84	4828	2754	7582	152	305	457
DEC84	4549	2745	7294	150	305	455
MAR85	5215	2415	7630	150	278	428
APR85	5210	2464	7674	151	281	432
MAY85	5155	2178	7333	149	281	430
JUN85	5230	2103	7333	146	264	410
JUL85	5130	2234	7364	148	278	426
AUG85	5050	2149	7199	147	264	411
SEP85	4935	2172	7107	145	268	413
OCT85	5030	2113	7143	150	257	407
NOV85	4955	2087	7042	146	250	396
DEC85	5035	2064	7099	150	245	395
JAN86	5030	2051	7081	153	246	399
FEB86	4970	2025	6995	154	237	391
MAR86	4850	2130	6980	153	237	390
APR86	4765	2131	6896	158	238	396
MAY86	4470	2032	6502	157	230	387
JUN86	4645	2013	6658	164	226	390
Average (Prior 12 mo.)	4905	2100	7005	152	248	400

Source: Texas Transportation Institute and Reference (8).





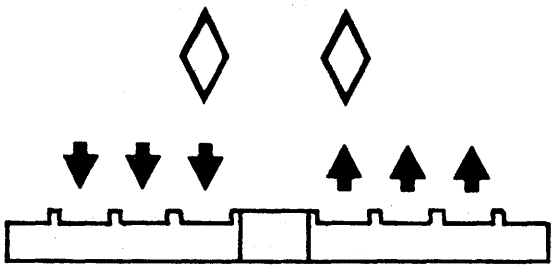
NORTH CFL FROM DOWNTOWN TO NORTH SHEPHERD (9.6 MI.) OPENED AUGUST, 1979
CONCURRENT FLOW LANE (A.M. ONLY) FROM NORTH SHEPHERD TO WEST RD (3.3 MI.) OPENED MARCH, 1981
NORTH TRANSITWAY FROM DOWNTOWN TO NORTH SHEPHERD (9.6 MI.) OPENED SEPTEMBER, 1984

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

SOURCE : TEXAS TRANSPORTATION INSTITUTE AND METRO

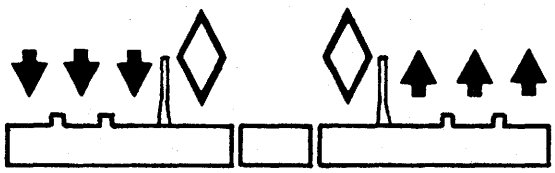
Figure 5. Historic Contraflow Lane Volumes in Vehicles and Persons

INITIAL SECTION



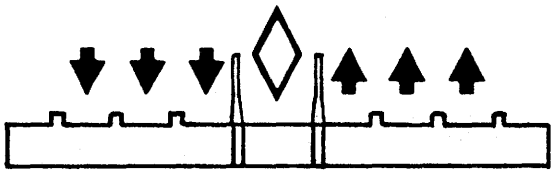
- 12 ft Lanes
- 16 to 20 ft Median
- 10 ft Shoulder

CONSTRUCTION SECTION



- 10 to 12 ft Lanes
- No Shoulder
- 10.75 ft Transitway
- 40 to 50 ft Construction Area

FINAL SECTION

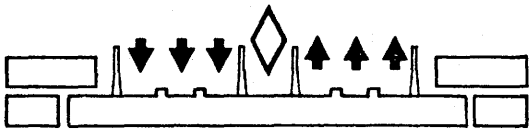


- 11 to 13 ft Lanes
- 10 ft Shoulder
- 12 to 16 ft Transitway

Source: Reference (7), p. 10.

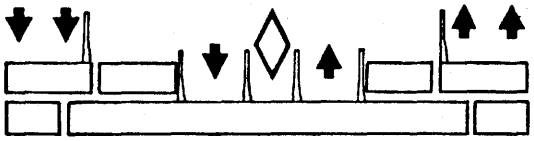
Figure 6. Phase I Cross-Sections for Contraflow Lane Replacement

CONSTRUCTION SECTION #1



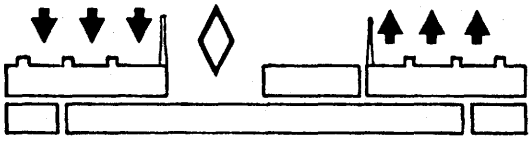
- 10 to 12 ft Lanes
- No Shoulder
- 12 to 16 ft Transitway
- 20 to 30 ft Construction Area (Each Side)

CONSTRUCTION SECTION #2



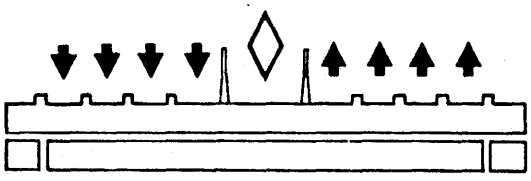
- 10 to 14 ft Lanes
- No Shoulder
- 12 to 16 ft Transitway
- 20 to 30 ft Construction Area (Each Side)

CONSTRUCTION SECTION #3



- 10 to 12 ft Lanes
- 6 to 10 ft Shoulder
- 16 ft Transitway
- 20 to 30 ft Construction Area

FINAL SECTION



- 11 to 13 ft Lanes
- 10 ft Shoulder
- 19.5 ft Transitway

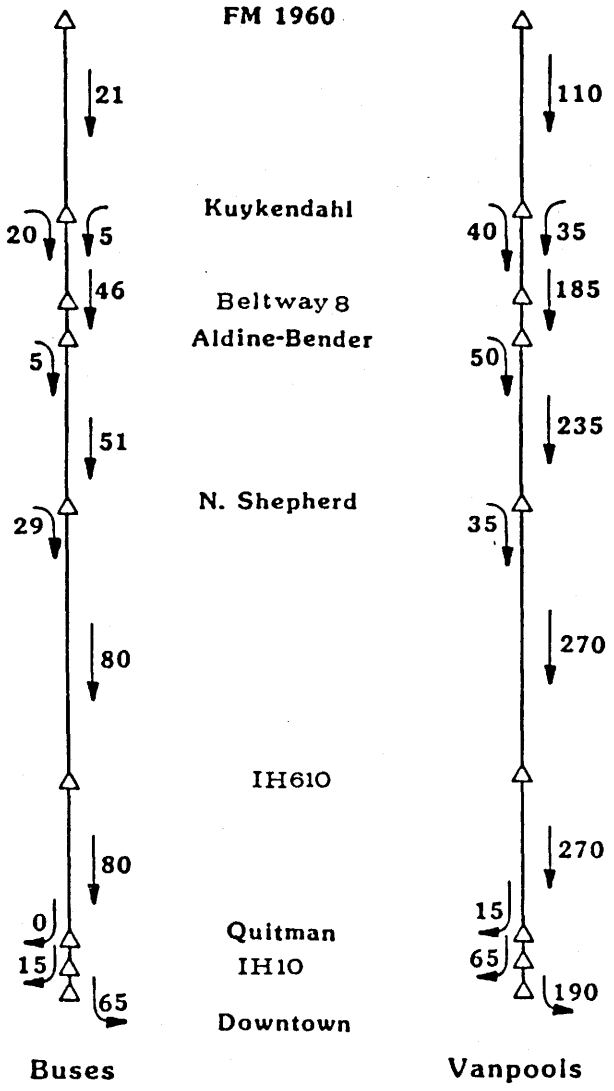
Source: Reference (7), p. 11.

Figure 7. Phase II Cross-Sections for Contraflow Lane Replacement

The transitway is primarily an at-grade, one-lane (19.75 feet wide) median facility, separated from unauthorized traffic by two concrete median barriers spaced 22 feet apart, center to center. The transitway, as completed, will operate in reversible flow, with high-occupancy authorized vehicles traveling inbound toward the CBD during the morning and outbound during the evening.

Estimates of potential transitway utilization were made in 1984 by TTI (6) for 1987 by using a variety of techniques: 1) a demand estimation procedure for high-occupancy vehicle lanes developed for the Federal Highway Administration; 2) a procedure based on mode split; 3) a procedure developed by TTI for estimating park-and-ride demand; and, 4) an analogy to prior contraflow operations. These demand estimates, shown for the peak direction, peak-hour in Figure 8, are by ramp and are divided into bus and vanpool volumes. Based on previous analyses performed for the Houston area (6), peak-hour volume (person movement) was assumed to represent 40% of daily directional volume. Each peak-hour bus is assumed to carry 45 persons and each vanpool 9 persons (6). Actual demand volume, measured during the course of this research, can be compared to these early estimates in order to refine or verify the estimating techniques. Initially (in 1979-80), fewer than 30 buses and 60 vanpools operated on the contraflow lane during each peak-period; at the present time, some 160 buses plus 230 vanpools use the transitway facility (8). The current 1986 usage amounts to about 34% of expected vanpool usage and 80% of expected bus usage projected for 1987. Figure 9 summarizes the observed morning (a.m.) and afternoon (p.m.) freeway and transitway usage in 15-minute increments. As shown, peak person movement for the corridor and the transitway occurs at about 6:45 a.m. and again at 5:15 p.m.

Median construction of the transitway progressed from January through November 1984. Although adverse impacts both to mainlane and contraflow traffic operations were observed during construction, most of the impacts were not permanent. Speeds and flow rates have returned to preconstruction levels in the peak direction, and speeds have continued to improve in the off-peak direction since the discontinuation of contraflow operation.

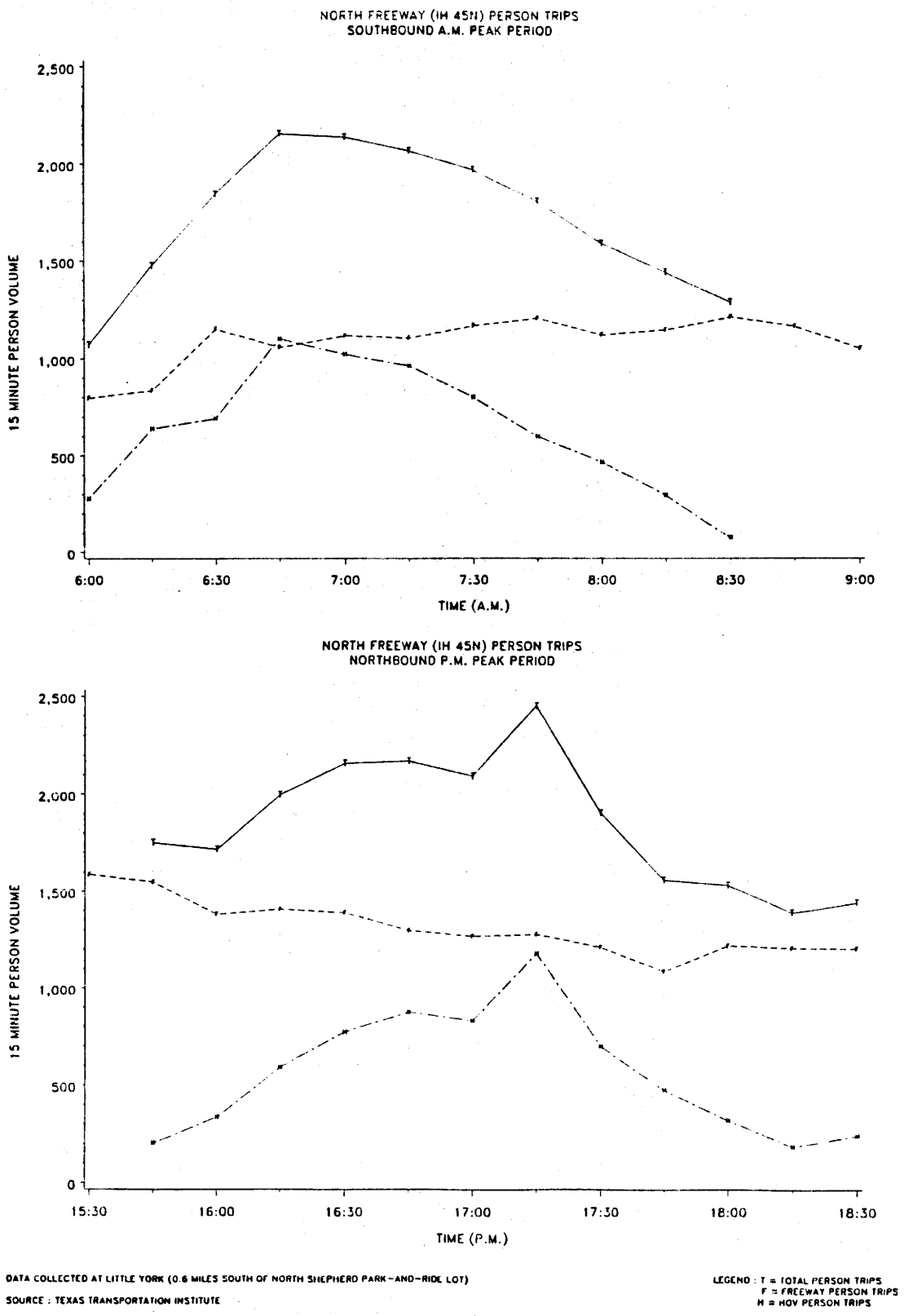


Source: Reference (6), p.22

Figure 8. Estimated 1987 A.M. Peak-Hour Transitway Demand for the North (I-45N) Corridor

Accident rates over both freeway directions have dropped to a level even lower than that which existed before construction began (8).

Transitway demand stablized during the first year of barrier-separated median operation. In an average day, the transitway carries more than 14,000 people in some 800 vehicles (buses and vans). Transitway users are able to save an average of 9 minutes on every trip made in the transitway (approximately one-minute per mile traveled).



Note: Person Volumes Recorded on Dec. 18, 1985 (Wed.), March 19, 1986 (Wed.) and June 11, 1986 (Wed.).

Figure 9. Peak Period Person Movement in the North (I-45N) Corridor

Transitway operation hours extend from 6:00 to 8:30 in the morning and from 3:45 to 6:30 in the afternoon. The facility is currently controlled manually by an on-site METRO crew, however, by 1987, the facility is expected to be fully automated with an integrated system of closed-circuit television surveillance and centralized computer controls. Over the first year of transitway operation, approximately 8.5 vehicles per month either became or were found disabled within the transitway. Less than 50% of these disabled vehicles had to be towed out of the facility. Accidents (including near misses and all other incidents involving any physical damage to vehicles or to facility equipment) occurred at a rate of 1.6 incidents per month. Finally, more than 112 unauthorized vehicles entered the transitway each month with a vast majority of these violators occurring in the afternoon or outbound period (8).

Overall, corridor-wide traffic operation has progressively improved since the implementation of the median transitway. Occupancy rates on the total facility climbed from 1.5 passengers per vehicle to 1.7 passengers per vehicle (8). Based upon average transitway volumes in the first year of transitway operation, transitway users cumulatively realized an average travel time savings of almost 2,200 person-hours per day over parallel freeway mainlane travelers. These travel time savings translate into a benefit of almost $4.3 million each year. Combining these travel time savings with reduced bus operating cost savings, a total direct benefit of $42.0 million over a 20-year period is anticipated. With direct costs of $15.2 million, the transitway confirms its cost-effectiveness with a benefit/cost ratio of almost 3:1 (8).

1.3.3 North Shepherd Park-and-Ride

The North Shepherd Park-and-Ride lot (Figure 10) was Houston METRO's first major mode change facility located some 9 miles from the downtown area (7). Initial development of a 765 space lot was performed in 1980 by SDHPT with federal funding assistance. The lot was subsequently expanded by METRO in 1983 to its current capacity of 1605 spaces (7, 9). Ramps are provided between the park-and-ride facility and the North (I-45N) Transitway as illustrated in Figure 11. Approximately 730 vehicles (8) and 900 persons utilize

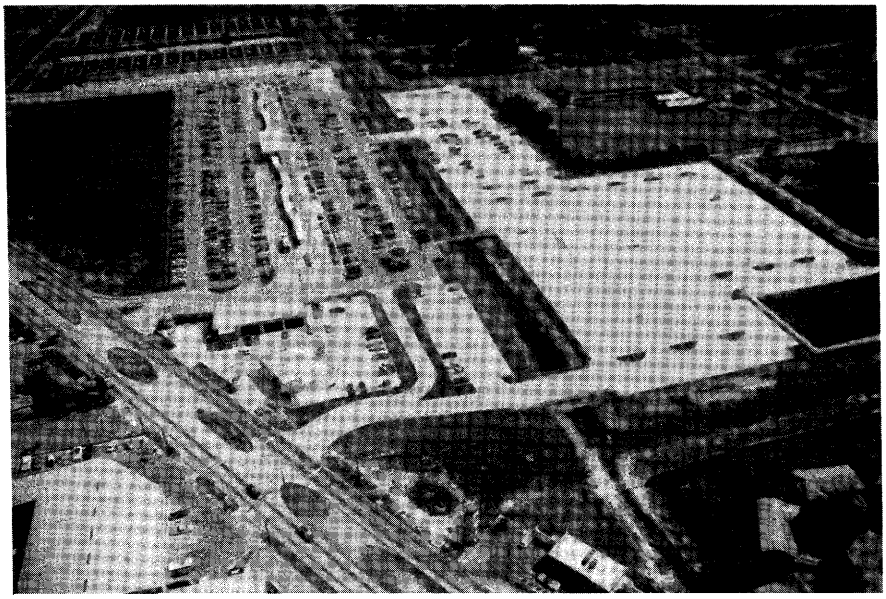
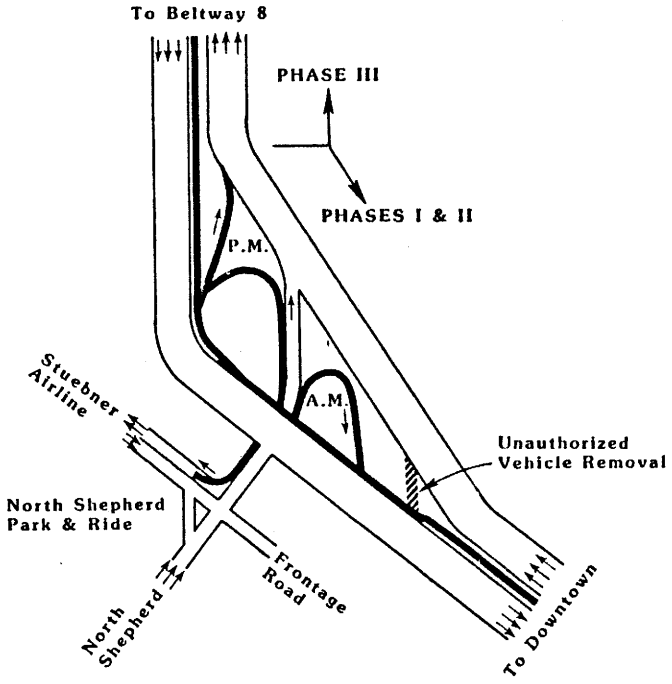


Figure 10. Aerial View of N. Shepherd Park-and-Ride Lot Looking to the Southwest



Source: Reference (7), p. 12

Figure 11. Access Ramps Between the North (I-45N) Transitway and the North Shepherd Park-and-Ride Facility

the park-and-ride service on a typical weekday (7, 9). METRO bus route 201 provides direct service, via the transitway, to Houston's Central Business District (CBD) and also provides service to the Texas Medical Center (7).

1.3.4 Aldine-Bender Interchange

As previously discussed (See Figure 2), the North (I-45N) Transitway development is being completed in four phases. Phase III extends the priority lane some 4.9 miles from the North Shepherd/Veterans Memorial Interchange to the Beltway 8 Interchange. This construction includes an elevated "wish bone" interchange at Aldine-Bender (Figure 12) to allow egress/ingress of priority vehicles as illustrated in Figure 13. The flyover ramp design will allow buses and vanpools to access Beltway 8 without the necessity of weaving across the four freeway mainlanes (7).

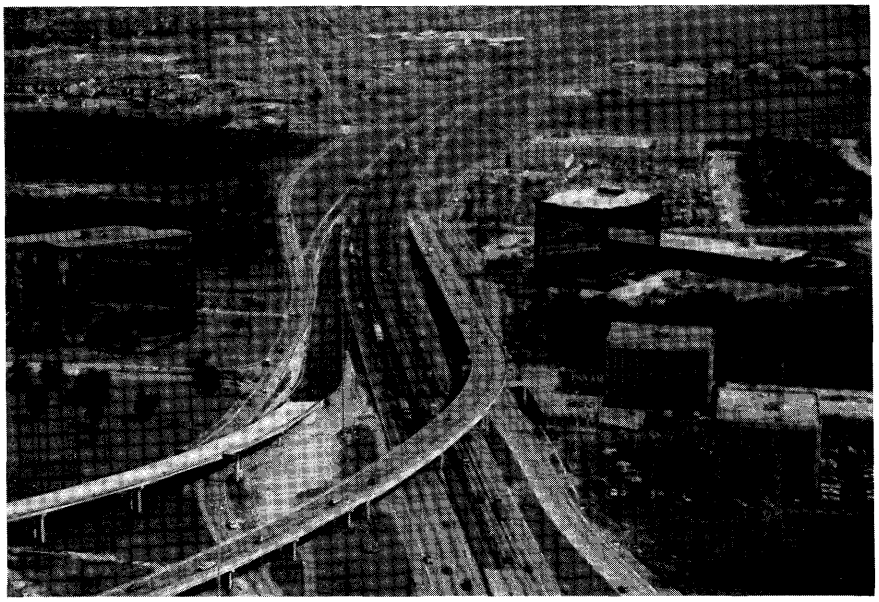
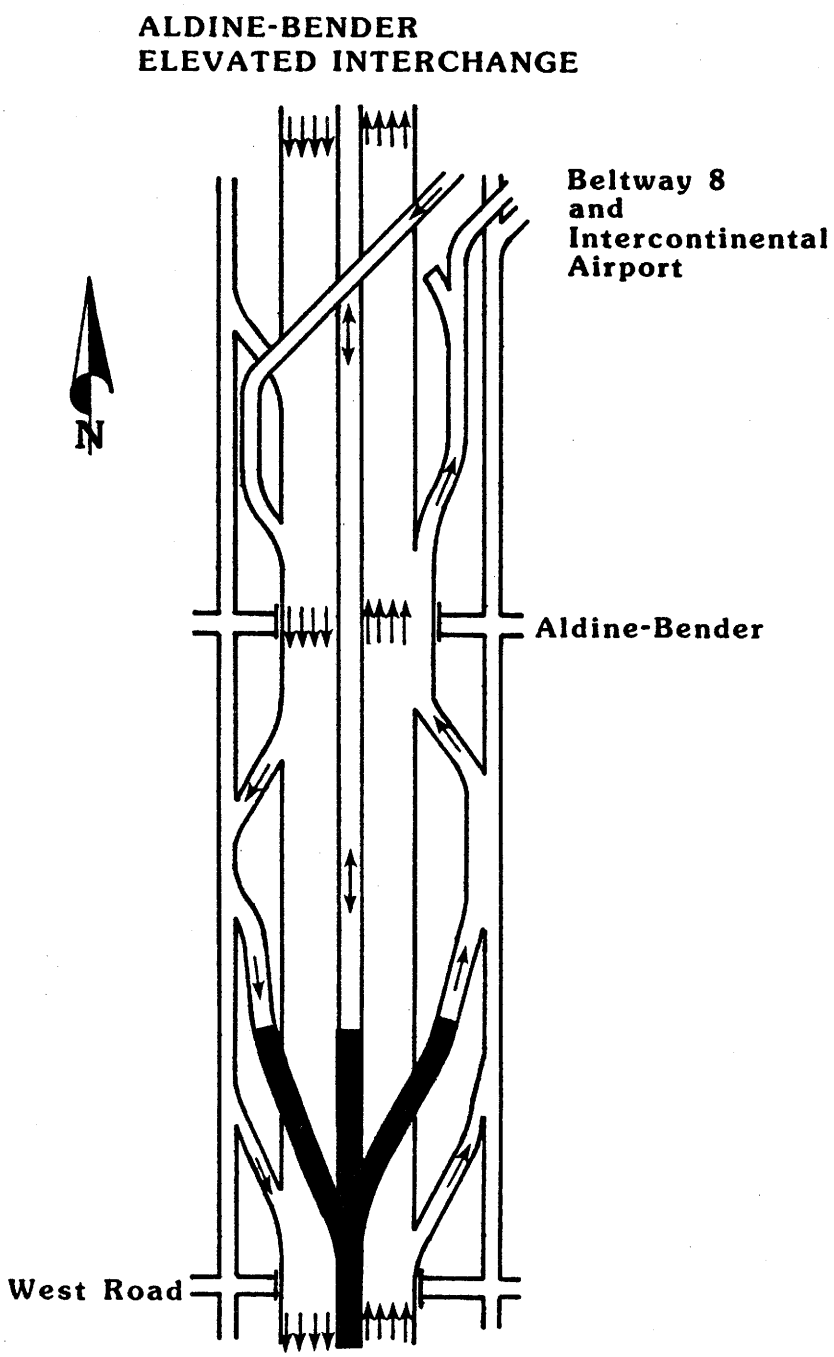


Figure 12. Aerial View of Aldine-Bender Interchange Area Looking to the South



Source: Reference (7), p. 13.

Figure 13. Elevated, Wish Bone Interchange Between the North (I-45N) Transitway and Aldine-Bender

1.3.5 Kuykendahl Park-and-Ride

The Kuykendahl Park-and-Ride lot (Figure 14), located approximately 16 miles from downtown Houston, is METRO's largest mode change facility (7). Initially constructed in 1980 with 1290 spaces, the lot was expanded in 1983 to a total capacity of 2246 (8, 9). The facility provides 100 spaces for drop-off/pick-up (kiss-and-ride) service plus 16 handicapped spaces. The bus loading area can simultaneously accommodate 3 articulated buses (60 feet long) or 5 standard (40 feet long) buses (7). At the present time, some 1900 commuters (7) and approximately 1830 vehicles (8) utilize the facility on a typical weekday. Phase IV of the transitway development program (See Figure 2) will extend the priority freeway lane from the Aldine-Bender Interchange some 3.1 miles to a temporary terminus at Airtex Drive as shown in Figure 15. As part of Phase IV, an elevated interchange will be constructed to allow direct access between the Kuykendahl Park-and-Ride Facility and the North (I-45N) Transitway (7). This elevated "T-Interchange" is illustrated in Figure 16. METRO bus route 202 provides direct service to downtown Houston from the facility and also to the Galleria and Greenway Plaza complexes (two major business areas) (7).

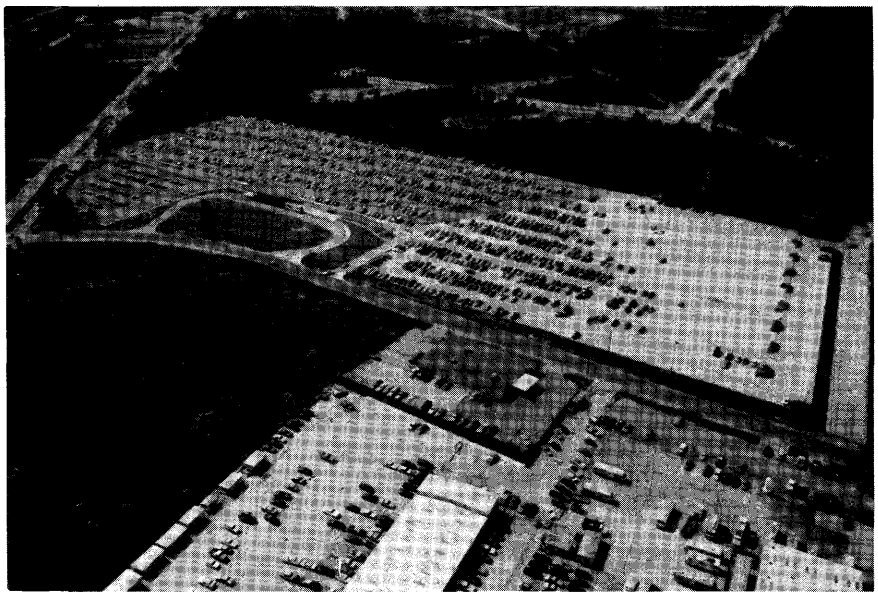
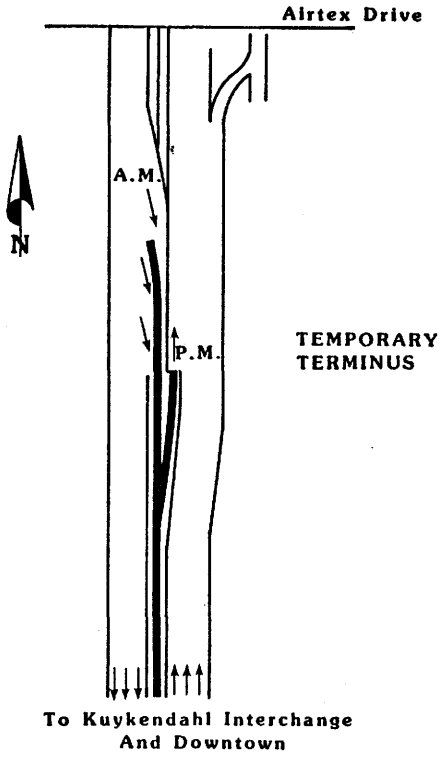
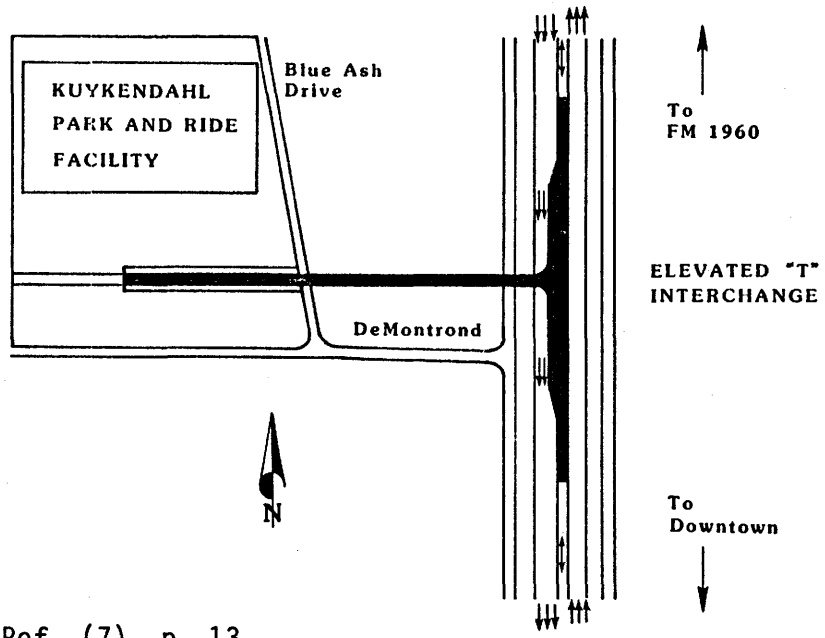


Figure 14. Aerial View of Kuykendahl Park-and-Ride Lot Looking to the North



Source: Ref. (7), p. 13.

Figure 15. Temporary Terminus of North (I-45N) Transitway at Airtex Drive



Source: Ref. (7), p. 13.

Figure 16. Elevated T-Interchange Between the North (I-45N) Transitway and the Kuykendahl Park-and-Ride Facility

1.3.6 Spring Park-and-Ride

The Spring Park-and-Ride facility (Figure 17) was opened in 1982 through Houston METRO's Turnkey development process (9). The 1280 space facility is adjacent to the I-45N and FM 1960 Interchange and is some 20 miles north of downtown Houston. Approximately 1000 persons per day utilizes the lot which is served by METRO bus route 204 (7, 9).

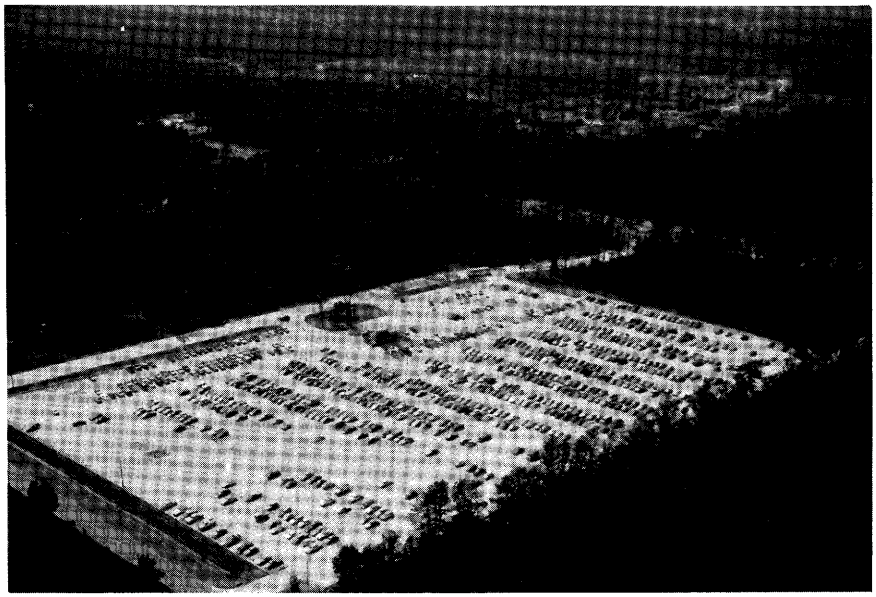


Figure 17. Aerial View of Spring Park-and-Ride Looking to the Northwest

1.3.7 Seton Lake Park-and-Ride

The Seton Lake Park-and-Ride Facility, developed through the turnkey process (9), was opened in 1983 and is located some 16 miles from the Houston CBD (7). This 1286 space lot is adjacent to FM 149 and FM 1960 or about 8 miles west of the I-45N freeway. Currently, the mode change facility accommodates some 696 vehicles and 800 persons per typical weekday with service provided by METRO bus route 212 (7, 8, 9). Given the remote location (8 miles) from the North (I-45N) Transitway, the Seton Lake Park-and-Ride facility is not included in the land use monitoring/analysis work of this research.

2. SURVEY OF LAND USES IN THE NORTH (I-45N) TRANSITWAY CORRIDOR

2.1 STUDY CORRIDOR

The North (I-45N) Freeway carries more than 150,000 vehicles each weekday. Population in the freeway corridor is expected to grow 38% by 1995, with traffic volumes expected to increase accordingly (10). The transitway will be built and operated in four phases as discussed in the "introduction" section of this report. Construction of Phases I and II of the facility began in January 1984 and became operational in May 1985. Phase III construction began in August 1985 with a completion data scheduled for June 1987. Phase IV construction, originally anticipated to begin in August 1985 and to end in June 1987 (10), is awaiting design pending SDHPT freeway improvement plans (11).

The North (I-45N) transitway will be constructed in the median of the freeway and separated from the other mixed-flow traffic lanes by concrete barriers. Since the construction is part of SDHPT work to upgrade and expand the North Freeway to eight lanes, disruption for building the transitway will be minimal. When completed, the travel time for transitway users during peak periods is estimated to be half that for current mainlane users. The HOV facility will significantly increase the person-carrying capacity of the freeway and, during its first full year of operation, is expected to benefit 26,000 daily commuters (10).

The North Freeway had a highly successfully HOV contraflow lane for more than five years. Special measures were necessary to perpetuate priority transit ridership during the freeway rehabilitation and construction. METRO arranged to have the HOVs operate within the barrier protected median strip where construction was occurring. This barrier protected segment extended 6.1 miles from the CBD to Airline and was augmented by a median contraflow/concurrent flow segment extending an additional 3.5 miles from Airline to North Shepherd. (The segment operated contraflow in the morning and concurrent flow in the afternoon until July 1984; due to median pavement problems, mainlane contraflow operation was resumed at that time.)

Table 2. North (I-45N) Corridor Park-and-Ride Demand (Vehicles)

Date	North Shepherd	Kuykendahl	Spring	Seton Lake	Temp. Lots*	Total North
Sep 79	---	---	---	---	135	135
Dec 79	---	---	---	---	455	455
Feb 80	---	460	---	---	240	700
Jun 80	450	615	---	---	240	1305
Sep 80	570	730	---	---	240	1540
Dec 80	610	850	---	---	240	1700
Mar 81	710	880	---	---	240	1830
Jun 81	750	1070	---	---	240	2060
Sep 81	800	1300	---	---	260	2360
Dec 81	995	1390	---	---	400	2785
Mar 82	910	1470	---	---	400	2780
Jun 82	900	1430	---	---	370	2700
Sep 82	900	1430	---	---	320	2650
Dec 82	920	1377	577	---	---	2874
Mar 83	890	1306	647	---	---	2843
Jun 83	824	1379	741	475	---	3419
Jul 83	801	1296	790	406	---	3293
Aug 83	833	1325	826	473	---	3457
Sep 83	803	1342	861	540	---	3546
Oct 83	853	1453	859	607	---	3772
Nov 83	852	1426	875	543	---	3696
Dec 83	833	1387	840	631	---	3691
Jan 84	851	1397	884	636	---	3768
Feb 84	800	1448	870	580	---	3698
Mar 84	829	1382	813	652	---	3676
Apr 84	709	1432	852	577	---	3570
May 84	665	1367	697	650	---	3379
Jun 84	751	1374	827	650	---	3602
Jul 84	743	1286	784	650	---	3463
Aug 84	709	1361	752	650	---	3472
Sep 84	733	1394	847	650	---	3624
Oct 84	747	1462	920	650	---	3779
Nov 84	736	1470	848	650	---	3704
Dec 84	735	1466	887	650	---	3738
Jan 85	763	1519	888	652	---	3822
Feb 85	760	1649	1088	662	---	4159
Mar 85	689	1670	1073	681	---	4113
Apr 85	715	1682	1021	606	---	4024
May 85	748	1783	980	641	---	4152
Jun 85	710	1778	963	693	---	4144
Jul 85	675	1820	902	648	---	4045
Aug 85	739	1849	982	638	---	4208
Sep 85	754	1831	1023	651	---	4259
Oct 85	764	1863	1013	647	---	4287
Nov 85	692	1842	1036	664	---	4234
Dec 85	690	1737	961	668	---	4056
Jan 86	798	1894	1050	713	---	4455
Feb 86	737	1760	1046	743	---	4286
Mar 86	755	1850	1189	775	---	4569
Apr 86	730	1840	1082	760	---	4412
May 86	761	1817	1053	751	---	4382
Jun 86	639	1894	976	689	---	4198
Jul 86	728	1712	867	700		4007
Average (Prior 12-mo)	732	1824	1023	700		4280

*Note: Two Temporary Lots (Champions and Greenspoint) were replaced with permanent facilities in 1982.
Source: Reference (8)

Approximately 4300 vehicles park at one of the four major Park-and-Ride facilities within the North (I-45N) freeway corridor during a typical day as shown in Table 2 (8). Given the 6417 vehicle capacity of the four lots (10), this average demand represents some 67% of all available spaces. Utilization of the corridor's Park-and-Ride facilities since August 1979 is presented graphically in Figure 18 (8).

2.2 LAND USE TRENDS

2.2.1 Study Method

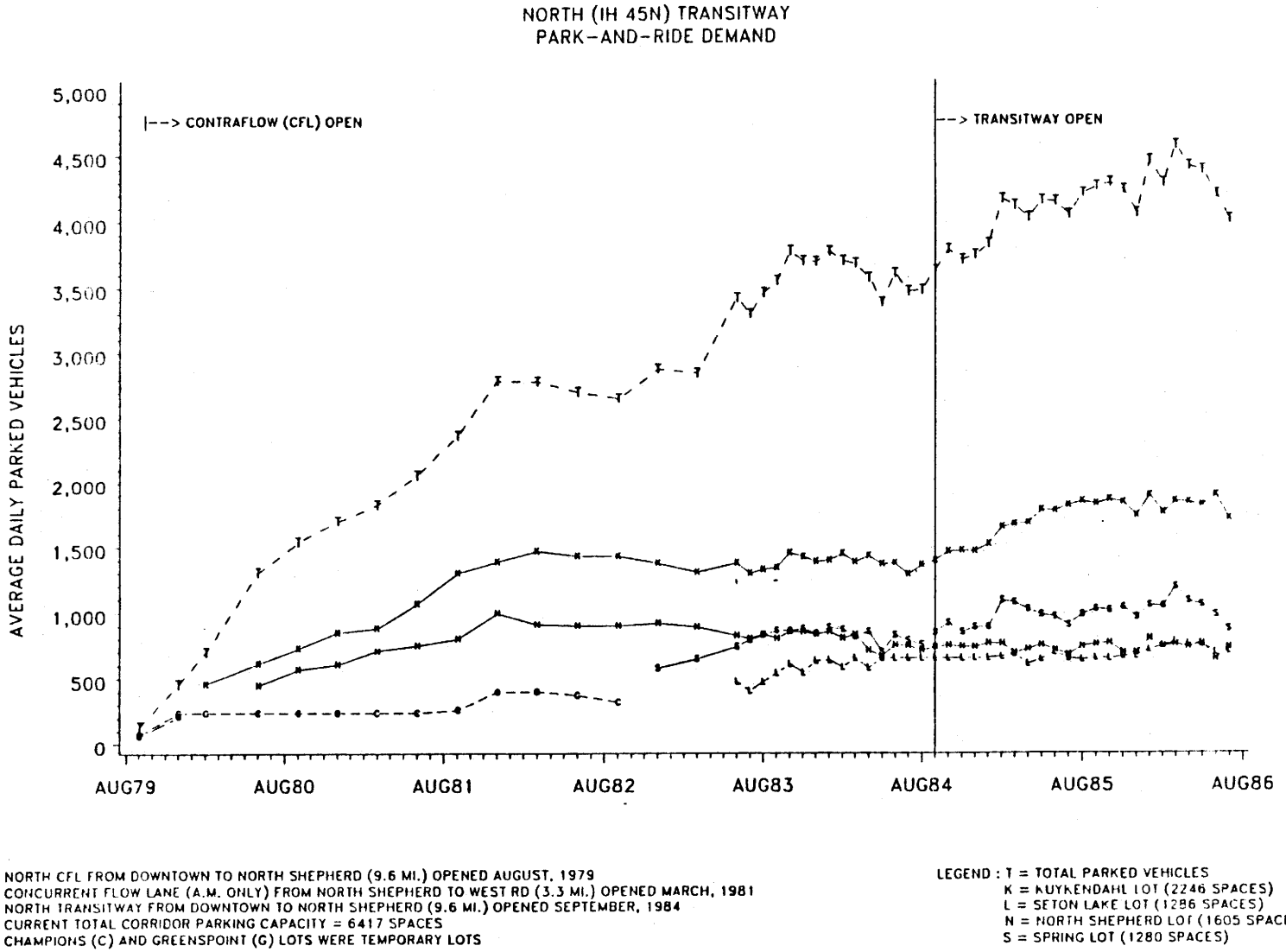
As detailed in the work plan (4) for the research project, a straightforward survey and evaluation of the land use impacts occurring in the North (I-45N) transitway corridor has been employed. Aerial photographs, taken at approximately 5-year increments by the SDHPT, were used to identify land use changes occurring in the vicinity of the following locations:

- North Shepherd Park-and-Ride
- Aldine-Bender Interchange (proposed)
- Kuykendahl Park-and-Ride
- Spring Park-and-Ride

The results of the aerial photography analysis were verified by field surveys of each of the four study areas. In addition to verification, the field surveys were used to determine the exact nature of the land use changes identified.

These locations provide major egress/ingress opportunities between the transitway facility and the users of the facility. Land use changes identified from the time-series photography provide the basis for subsequent monitoring, the developer interviews and for possible analysis of property value changes.

One short-coming of using aerial photography to identify land use changes is that only "new development" can be identified. Changes in the use



Source: Texas Transportation Institute

Figure 18. Utilization of the North (I-45N) Corridor's Park-and-Ride Facilities

of an existing structure, for example, cannot be identified from aerial photographs. Such changes will be identified in subsequent phases of the research through the developer interview process.

Results of this "pilot" evaluation will be used to guide the research procedures for the Gulf (I-45S) and Katy (I-10W) transitway corridors. Monitoring activities and data updates within the North (I-45N) corridor will continue during years 3 through 5 (1987-1989) of the study. A key element in the assessment of land use impacts resulting directly, in total or in part, from the implemented transit facilities (transitway and/or Park-and-Ride lots) is the developer interview portion of the research. Results of these interviews will be presented in subsequent research reports.

2.2.2 Summary of Survey Results

Land use changes in the vicinity of the North Shepherd Park-and-Ride Lot are shown on Figure 19. Land use changes range from auto-oriented sales and repair services to a real estate agency and a health center. None of the changes identified would appear to be of a nature that would benefit from the park-and-ride lot or the transitway. At this point in the analysis, there is little evidence to suggest that the North Shepherd Park-and-Ride Lot has has any effect on land uses.

Land use changes in the vicinity of the proposed Aldine-Bender Interchange (Figure 20) are generally more in line with the kinds of developments one might expect in the vicinity of a major transportation facility access point. For example, a number of apartment and office complex developments have occurred in recent years. However, since the Aldine-Bender transitway interchange is, at this time, only a proposed facility, the extent of the relationship (if any) between land uses and the transitway cannot be established. The results of the developer interview process should be very useful in this area.

As shown in Figure 20, there is a considerable amount of vacant land in the Northeast and Southwest quadrants of the Aldine-Bender Interchange. As a

result, the interchange area should provide any excellent test site to monitor the possible land use impacts of the North Freeway transitway.

Figure 21 shows land use changes in the vicinity of the Kuykendahl Park-and-Ride Lot. Land use changes in the study area appear to be exclusively auto sales establishments. The proximity of the transitway and the Kuykendahl Park-and-Ride Lot would not appear to be important factors in the site selection process for such establishments.

The area around the Kuykendahl Park-and-Ride Lot, like the Aldine-Bender area, is largely undeveloped. Consequently, the Kuykendahl area should also provide any excellent site for monitoring the long-term land use impacts of the transitway.

Recent land use changes in the vicinity of the Spring Park-and-Ride Lot are shown on Figure 22. The most significant new developments in the vicinity of the Spring Lot have been apartment complexes. These developments occurred prior to the construction of the park-and-ride lot and the influence of the lot on these developments is questionable.

There is a substantial amount of undeveloped land in the vicinity of the Spring Lot and, like the Kuykendahl and Aldine-Bender areas, the area should provide an excellent test site for monitoring the long-term land use impacts of a park-and-ride lot.

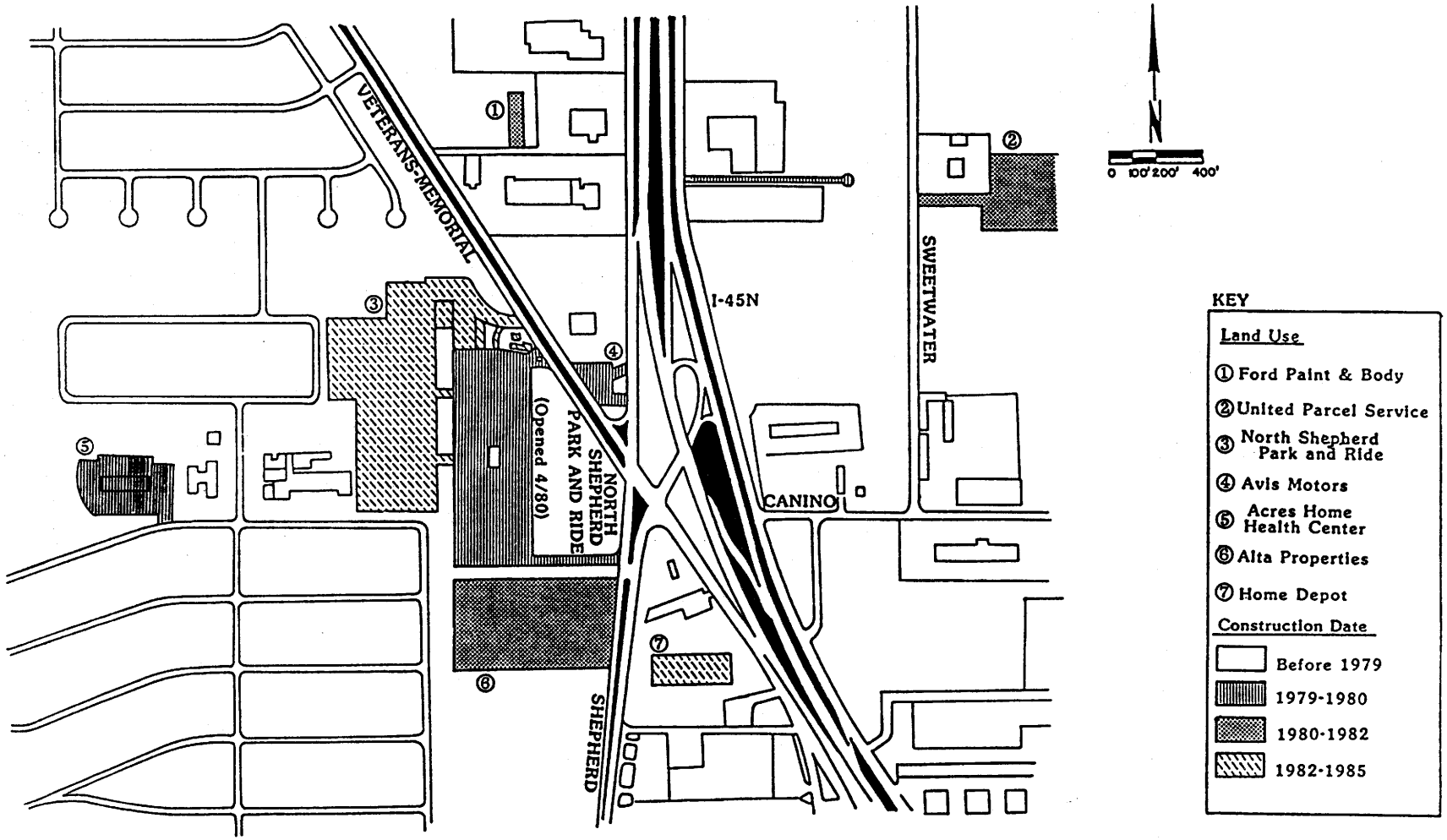


Figure 19. Land Use Trends in the Vicinity of the North Shepherd Park-and-Ride Lot (1979-85)

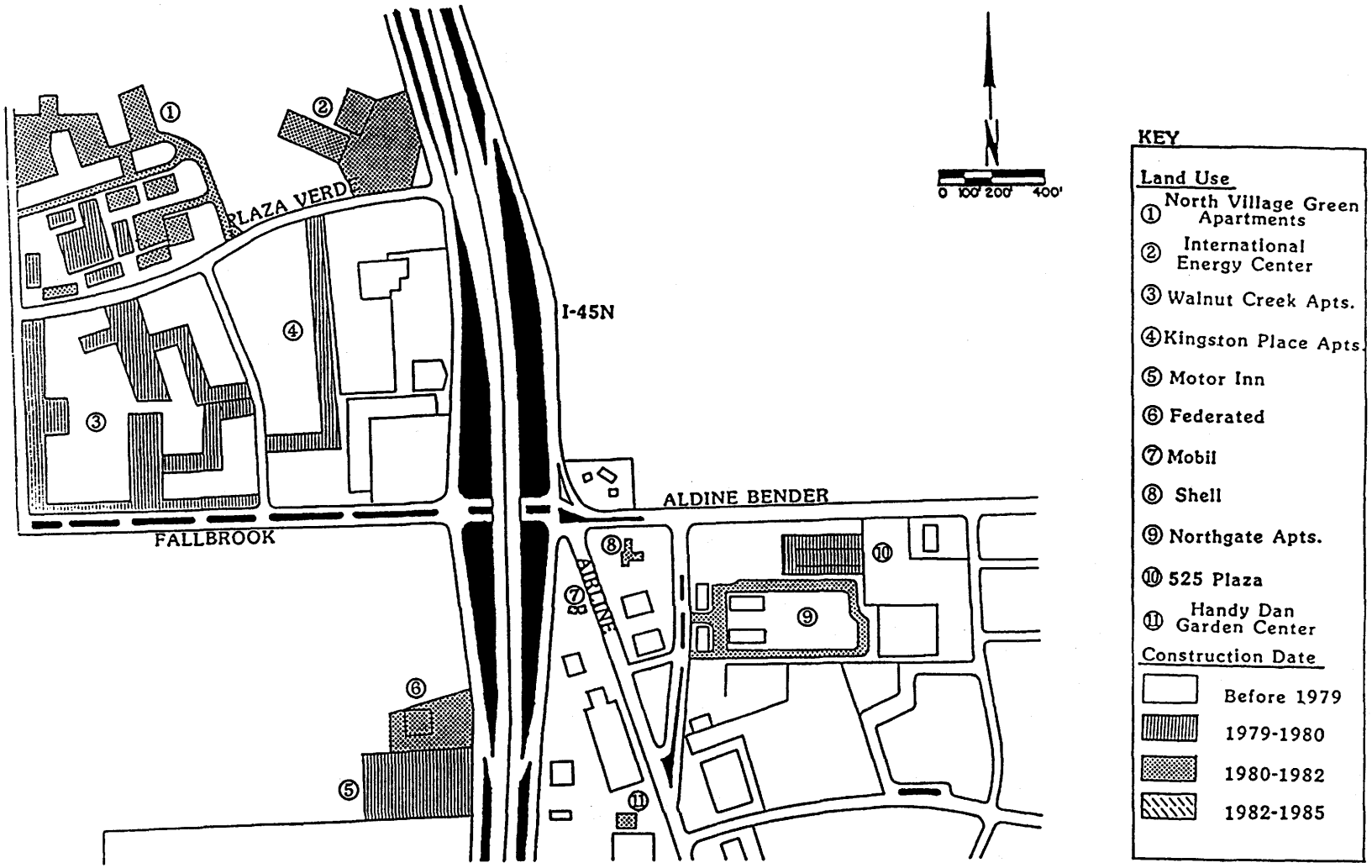


Figure 20. Land Use Trends in the Vicinity of the Proposed Aldine-Bender Transitway Interchange (1979-85)

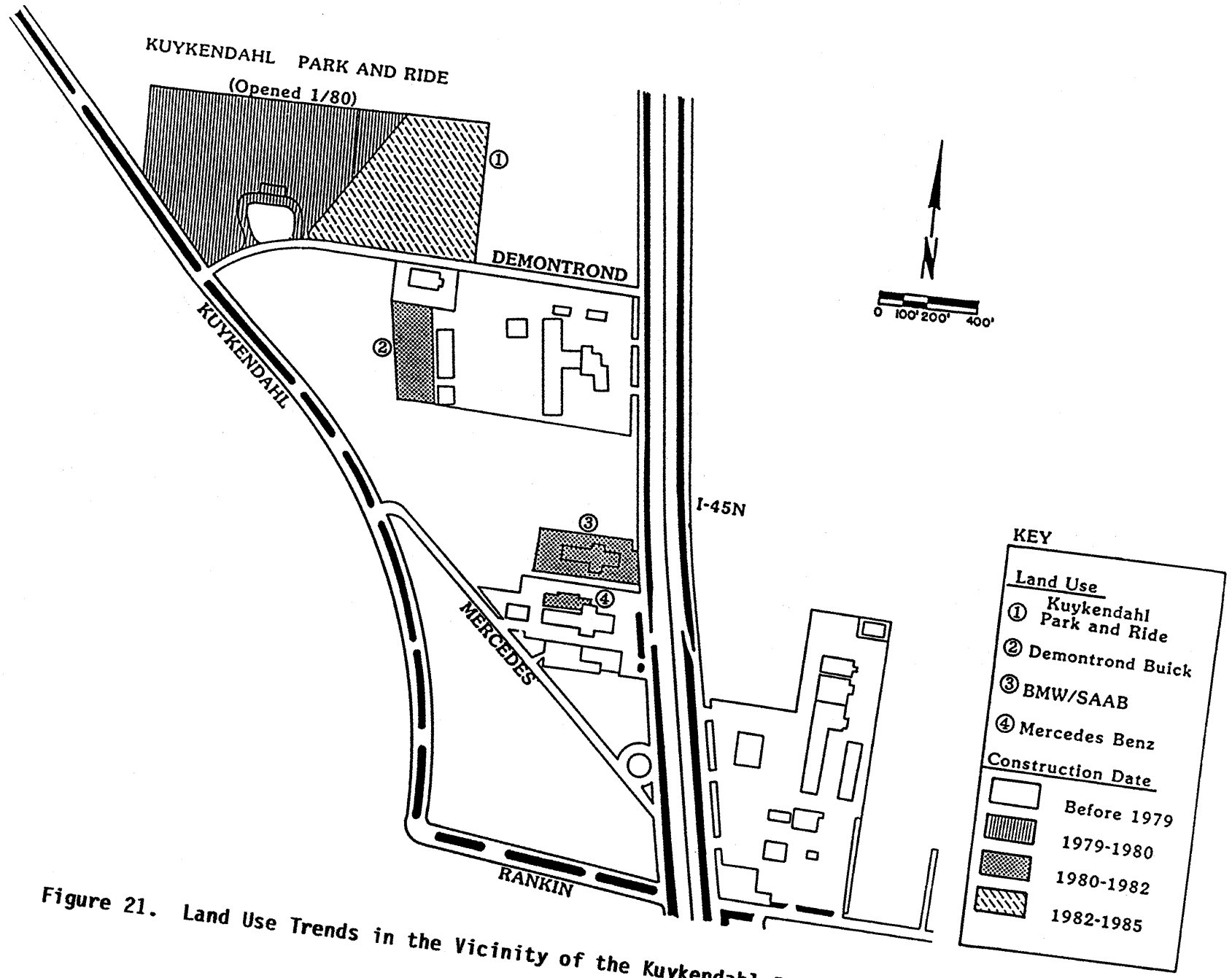


Figure 21. Land Use Trends in the Vicinity of the Kuykendahl Park-and-Ride Lot (1979-85)

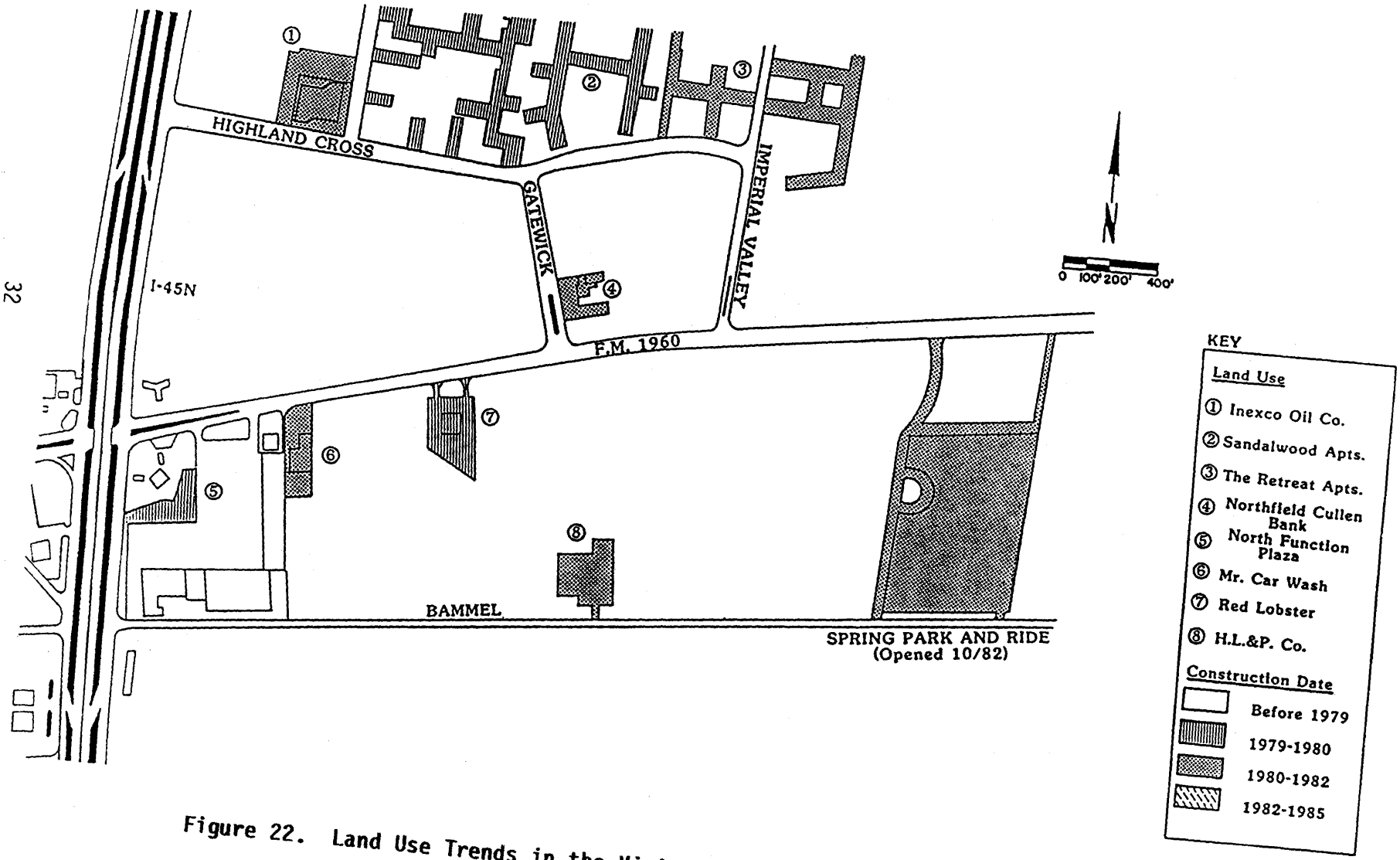


Figure 22. Land Use Trends in the Vicinity of the Spring Park-and-Ride Lot (1979-85)

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 CONCLUSIONS

The preliminary results of this study indicate that while the HOV priority treatments implemented in the I-45N corridor have produced substantial improvements in corridor capacity, the land use impacts of the HOV treatments have been relatively insignificant. However, the study areas in the corridor all have substantial amounts of undeveloped land and it may be necessary to wait until the transitway and associated support facilities become fully operational before a more definitive assessment of land use impacts will be possible. Continued monitoring of land uses and completion of the developer interview portions of the research should result in a reasonable assessment of the potential land use impacts of transitway systems.

3.2 RECOMMENDATIONS

Based on the preliminary results of the North Freeway Corridor pilot test, the following general recomendations for subsequent phases of the research are suggested:

1) Complete the developer interview portions of the research for the North transitway corridor. The information obtained from the interviews is essential is assessing the effects of the transitway on the location and timing of developments in the study areas. The developer interviews may also provide an indication of changes in uses of existing structures which may have occurred as a result of the transitway.

2) Implement the study procedures tested in the North transitway corridor in the west and southeast transitway corridors. The following study areas are suggested:

a) Addicks Park-and-Ride Lot in the Katy (I-10W) Transitway Corridor;

b) Kingsland Park-and-Ride Lot in the Katy (I-10W) Transitway Corridor; and

c) Lockwood Transit Center, Gulf (I-45S) Transitway Corridor.

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