TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTA/TX-90/1086-8F		

4. Title and Subtitle	5. Report Date
Land Use Impacts of the Houston Transitway System: Summary Report	October 1989
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Earl J. Washington and Robert W. Stokes	Technical Report 1086-8F

9. Performing Organization Name and Address	10. Work Unit No.
Texas Transportation Institute Texas A&M University System College Station, Texas 77843	11. Contract or Grant No. Study No. 2-10-85-1086

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Texas State Department of Highways and Public Transportation: Transportation Planning Div. P.O. Box 5051 Austin, Texas 78763	Draft - September 1985 September 1989
	14. Sponsoring Agency Code

15. Supplementary Notes

Research performed in cooperation with DOT, UMTA.
Research Study Title: Land Use and Innovative Funding Impacts in a Permanent Busway/ Park-and-Ride Transit System

16. Abstract

This report provides a summary of a five year study of the transportation and land use impacts resulting from the implementation of an extensive priority system of busways (transitways) and park-and-ride facilities in Houston, Texas. Over the duration of this study, four high-occupancy vehicle (HOV) lanes with supporting park-and-ride facilities were placed in operation in Houston's North (I-45N), Katy (I-10W), Gulf (I-45S) and Northwest (US 290) Freeway corridors. The impacts resulting from three of these HOV treatments (I-45N, I-45S, I-10W) are the object of this study. Preliminary results indicate that while the transportation impacts of those elements of the Houston Transitway system which are operational have been substantial, no substantial land use impacts can be identified at this time. It appears that a more definitive assessment of land use impacts may not be possible until the transitway system is fully operational andmore fully integrated into the community's total transportation system.

17. Key Words	18. Distribution Statement
Land Use, Transitways, Busways, HOV Lanes, Park-and-Ride, Priority Treatment, Development, Bus Rapid Transit, Express Bus, Impact Studies, Economic Assessment, Land Use Impacts,Land Use Change Freeway Corridor, Transitway Corridor, Impact area.	No restrictions. This document is available to the public through the National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	83	

Form DOT F 1700.7 (8-69)

LAND USE IMPACTS OF THE HOUSTON TRANSITWAY SYSTEM: SUMMARY REPORT

by

Earl J. Washington
Assistant Research Planner
and
Robert W. Stokes
Associate Research Planner

Technical Report 1086-8F
Study Number 2-10-85-1086
Land Use and Innovative Funding Impacts in a
Permanent Busway/Park-and-Ride Transit System

Sponsored by
Texas State Department of Highways and Public Transportation
in cooperation with
U.S. Department of Transportation
Urban Mass Transportation Administration

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

October 1989

This study was financed in part through a grant from the Urban Mass Transportation Administration, United States Department of Transportation under the Urban Mass Transportation Act of 1964, as amended.

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				
in²	square inches	645.2	millimetres squared	mm²
ft²	square feet	0.0929	metres squared	m²
yd²	square yards	0.836	metres squared	m²
mi²	square miles	2.59	kilometres squared	km²
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
ft³	cubic feet	0.0328	metres cubed	m³
yd³	cubic yards	0.0765	metres cubed	m³

NOTE: Volumes greater than 1000 L shall be shown in m³.

TEMPERATURE (exact)

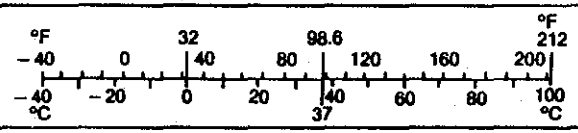
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimetres	0.039	inches	in
m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi
AREA				
mm²	millimetres squared	0.0016	square inches	in²
m²	metres squared	10.764	square feet	ft²
km²	kilometres squared	0.39	square miles	mi²
ha	hectores (10 000 m²)	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
m³	metres cubed	35.315	cubic feet	ft³
m³	metres cubed	1.308	cubic yards	yd³

TEMPERATURE (exact)

°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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

* SI is the symbol for the International System of Measurements

ABSTRACT

This report provides a summary of a five year study of the transportation and land use impacts resulting from the implementation of an extensive priority system of busways (transitways) and park-and-ride facilities in Houston, Texas. Over the duration of this study, four high-occupancy vehicle (HOV) lanes with supporting park-and-ride facilities were placed in operation in Houston's North (I-45N), Katy (I-10W), Gulf (I-45S) and Northwest (US 290) Freeway corridors. The impacts resulting from three of these HOV treatments (I-45N, I-45S, I-10W) are the object of this study. Preliminary results indicate that while the transportation impacts of those elements of the Houston Transitway system which are operational have been substantial, no substantial land use impacts can be identified at this time. It appears that a more definitive assessment of land use impacts may not be possible until the transitway system is fully operational and more fully integrated into the community's total transportation system.

Key Words: Land Use, Transitways, Busways, HOV Lanes, Park-and-Ride, Priority Treatment, Development, Bus Rapid Transit, Express Bus, Impact Studies, Economic Assessment, Land Use Impacts, Land Use Changes, Freeway Corridor, Transitway Corridor, Impact Area.

IMPLEMENTATION STATEMENT

This project 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 constructed. The study findings will be of particular interest to the Texas State Department of Highways and Public Transportation, the Urban Mass Transportation Administration, the Federal Highway Administration, other State Departments of Transportation, local transit agencies, city planners, and various professional societies or organizations.

DISCLAIMER

SUMMARY

This report is a summary of a five year study of the land use and transportation impacts resulting from implementation of HOV priority treatments in the North (I-45N), Katy (I-10W) and Gulf (I-45S) Freeway corridors in Houston, Texas.

Overall, the land use impacts of the Houston Transitway System monitored as part of this study, appear to be relatively insignificant. Only a few possible examples of the potential land use impacts have appeared in the past three years, with only one in the past two years.

Within the past two years, only one site (Spring Park-and-Ride Lot), which is in the North (I-45N) Freeway Corridor, has exhibited a land use change in the vicinity of the study site that may have been influenced by the location of the facility. At one other site (North Shepherd Park-and-Ride Lot), also along the North (I-45N) Freeway Corridor, a recent land use change at a parcel which last year was identified as exhibiting possible influence of a transitway facility has cast some doubt on that hypothesis. At all other sites along the North Freeway Corridor, as well as the other freeway corridors under study, there appear to have been no land use impacts within the past two years.

The results of this study of land use impacts are for the most part inconclusive. Only one of seven sites studied show any land use changes that could possibly be related to the presence of the transitway and/or its support facilities.

It appears that a more definite assessment of the land use impacts will not be possible until sometime after the transitway and associated support facilities have become fully operational and established as integral elements of the corridors' transportation systems. In addition, it is reasonable to assume that the economic situation in the Houston area has had a stagnating influence on potential land use development and potential land use changes. Given this assumption, it may also prove necessary to delay any final assessment of the land use impacts of transitways and transitway facilities until such time as the transitways become fully operational and the Houston economy fully recovers. Several of the study sites have substantial amounts of undeveloped land and should serve as excellent test sites for monitoring the long-term land use impacts of transitway facilities.

TABLE OF CONTENTS

	Page
ABSTRACT	iii
IMPLEMENTATION STATEMENT	v
DISCLAIMER	v
SUMMARY	vii
1. INTRODUCTION	1
1.1 Background	1
1.2 Study Objectives	4
1.3 Study Approach	5
1.3.1 General	5
1.3.2 Aerial Photographs/Site Visits	6
1.3.3 City Directory	6
1.3.4 Developer Interviews	6
1.3.5 Literature Review	7
1.3.6 Survey of Transitway Projects	7
1.4 Zone of Influence	7
1.5 Data Presentation	7
1.6 Survey of Transitway Projects	8
2. LITERATURE REVIEW	9
2.1 General	9
2.2 Relationship Between Land Use and Transportation	9
2.3 Impacts of Public Transportation on Land Use and Land Values	10
2.4 Recent Actions to Promote Coordinated Land Use and Transportation Planning	15
2.5 Summary	18

TABLE OF CONTENTS (Cont.)

	Page
3. HOUSTON'S TRANSITWAY CORRIDORS	21
3.1 North (I-45N) Transitway Corridor	21
3.2 Gulf (I-45S) Transitway Corridor	24
3.3 Katy (I-10W) Transitway Corridor	26
4. LAND USE IMPACTS	29
4.1. North (I-45N) Transitway Corridor	29
4.1.1 Aldine-Bender Transitway Interchange	29
4.1.2 Kuykendahl Park-and-Ride	31
4.1.3 North Shepherd Park-and-Ride	34
4.1.4 Spring Park-and-Ride	36
4.2 Gulf (I-45S) Transitway Corridor	39
4.2.1 Eastwood Transit Center	39
4.3 Katy (I-10W) Transitway Corridor	41
4.3.1 Addicks Park-and-Ride	41
4.3.2 Kingsland Park-and-Ride	44
5. CONCLUSIONS	47
REFERENCES	49
BIBLIOGRAPHY	53

LIST OF FIGURES

Page

1. Elements of the Houston Transitway System Monitored For This Study 2

2. I-45 North Freeway Transitway 22

3. I-45 Gulf Freeway Transitway 25

4. I-10 Katy Freeway Transitway 27

5. Land Use Trends in the Vicinity of the Proposed Aldine-Bender Transitway Interchange (1979-1988) 30

6. Land Use Trends in the Vicinity of the Kuykendahl Park-and-Ride Lot (1979-1988) 32

7. Land Use Trends in the Vicinity of the North Shepherd Park-and-Ride Lot (1979-1988) 35

8. Land Use Trends in the Vicinity of the Spring Park-and-Ride Lot (1979-1988) 37

9. Land Use Trends in the Vicinity of the Eastwood Transit Center (1979-1988) 40

10. Land Use Trends in the Vicinity of the Addicks Park-and-Ride Lot (1979-1988) 42

11. Land Use Trends in the Vicinity of the Kingsland Park-and-Ride Lot (1979-1988) 45

LIST OF TABLES

Page

1. North Transitway Operational Summary, December 1988 24

2. Gulf Transitway Operational Summary, December 1988 26

3. Katy Transitway Operational Summary, December 1988 28

4. Impact Area Development Assessment in the Vicinity of the Aldine-Bender Interchange: "Before" Period (1973-1980) 31

5. Impact Area Development Assessment in the Vicinity of the Aldine-Bender Interchange: "Before" Period (1981-1987) 31

6. Impact Area Development Assessment in the Vicinity of the Kuykendahl Park-and-Ride Lot: "Before" Period 33

7. Impact Area Development Assessment in the Vicinity of the Kuykendahl Park-and-Ride Lot: "After" Period 33

8. Impact Area Development Assessment in the Vicinity of the North Shepherd Park-and-Ride Lot: "Before" Period 36

9. Impact Area Development Assessment in the Vicinity of the North Shepherd Park-and-Ride Lot: "After" Period 36

10. Impact Area Development Assessment in the Vicinity of the Spring Park-and-Ride Lot: "Before" Period 38

11. Impact Area Development Assessment in the Vicinity of the Spring Park-and-Ride Lot: "After" Period 38

LIST OF TABLES (Cont.)

Page

12. Impact Area Development Assessment in the Vicinity of the Eastwood Transit Center: "Before" Period 39

13. Impact Area Development Assessment in the Vicinity of the Spring Park-and-Ride Lot: "After" Period 41

14. Impact Area Development Assessment in the Vicinity of the Addicks Park-and-Ride Lot: "Before" Period 43

15. Impact Area Development Assessment in the Vicinity of the Addicks Park-and-Ride Lot: "After" Period 43

16. Impact Area Development Assessment in the Vicinity of the Kingsland Park-and-Ride Lot: "Before" Period 44

17. Impact Area Development Assessment in the Vicinity of the Kingsland Park-and-Ride Lot: "After" Period 46

1. INTRODUCTION

1.1 BACKGROUND

The tremendous growth experienced in urban areas of Texas in recent years has caused concern by State and local transportation officials over the declining level of service being provided by the urban transportation system. Future growth and economic vitality in the Texas metropolitan regions are in jeopardy unless major improvements are implemented in the existing urban transportation system. It is generally not economically nor physically possible to provide sufficient additional highway capacity through major cross section expansion or to expand transit services to accommodate anticipated demand (1). Therefore, new and innovative means of freeway system management have been examined as possible remedies.

One alternative to increase roadway capacity is to provide high-occupancy vehicle (HOV) priority treatments. 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 commuter lanes. The fundamental differences between commuter lanes and transitways is the increased level of service provided.

The Houston Metropolitan area is implementing one of the most extensive HOV priority treatment networks in the nation. Over 36 miles of transitways are now operational. Another 59 miles are currently under construction or in the final planning and design stages. The ultimate commitment to transitways may result in nearly 100 miles of these facilities in operation with a total capital cost of approximately $700 million dollars (2). The location and status of the transitway elements being monitored as part of this study are shown in Figure 1.

In addition, Houston has 21 major, permanent park-and-ride facilities in operation throughout the metropolitan area; approximately one half were built through turnkey arrangements with the private sector. This arrangement achieved cost and time benefits

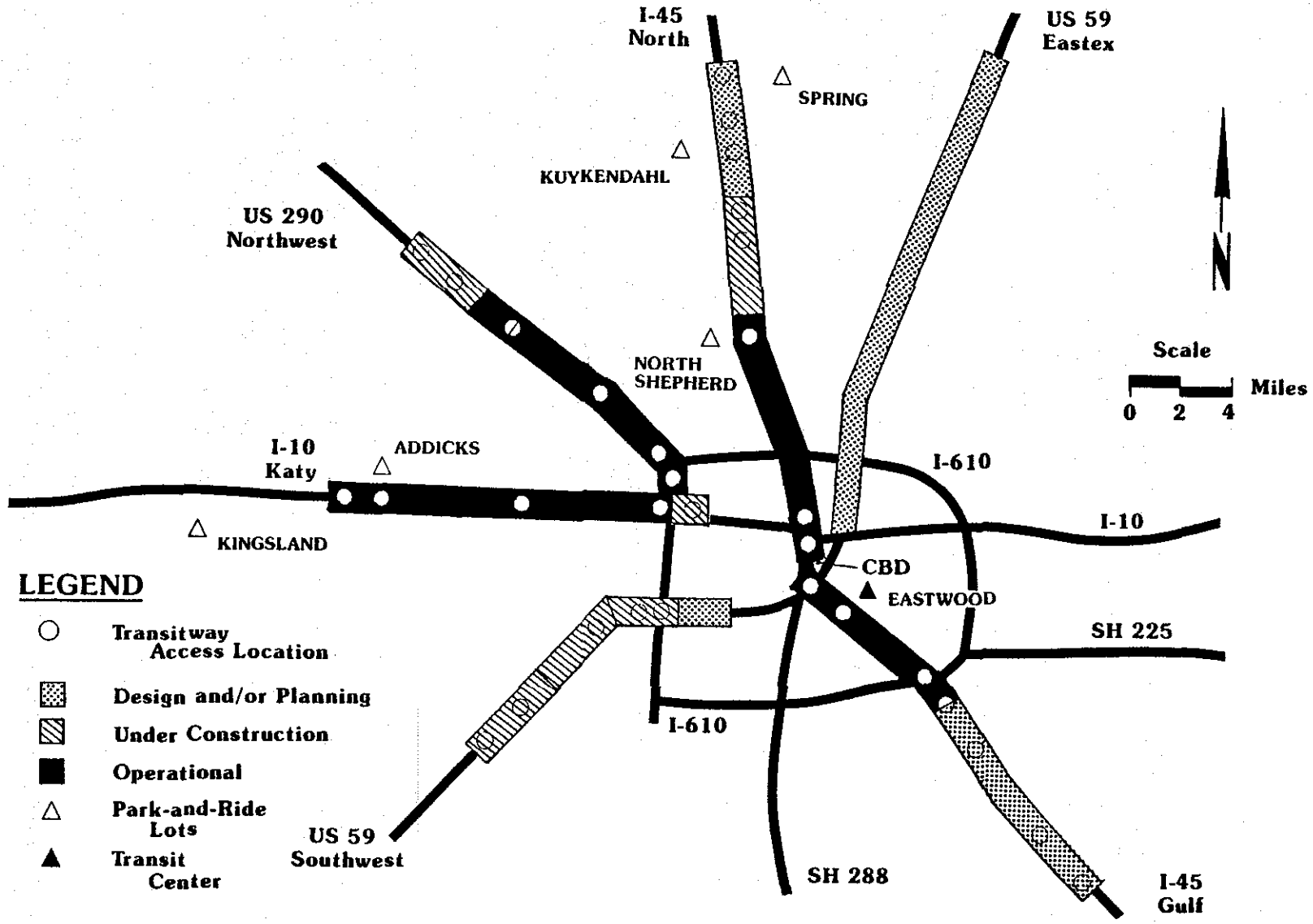


Figure 1. Elements of the Houston Transitway System Monitored For This Study

unprecedented in the public transit sector. This report summarizes the results of a 5 year study of the land use impacts of the Houston transitway system. Detailed discussions can be found in the following related project reports:

1. Land Use and Innovative Funding Impacts in a Permanent Busway/Park-and-Ride Transit System: An Annotated Bibliography, Technical Report 1086-1, December 1985.

2. Land Use and Innovative Funding Impacts in a Permanent Busway/Park-and-Ride Transit System: Work Program, Technical Report 1086-2, January 1986.

3. Survey of Transitway Projects in the United States and Canada, Technical Report 1086-3, November 1986.

4. 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, Technical Report 1086-4, January 1987.

5. Land Use and Innovative Funding Impacts in a Permanent Busway/Park-and-Ride Transit System: Land Use Data Base for Houston's Transitway Corridors and Second Year Summary, Technical Report 1086-5, March 1987.

6. Land Use Impacts of the Houston Transitway System: Third Year Update, Technical Report 1086-6, August 1987.

7. Land Use Impacts of the Houston Transitway System: Fourth Year Update, Technical Report 1086-7, August 1988.

1.2 STUDY OBJECTIVES

This five-year study has two primary objectives:

1. To measure, analyze, and evaluate the land use impacts resulting from the construction of permanent busways (transitways) and park-and-ride facilities in the Houston area; and,

2. To evaluate the "turnkey" procurement concept used by the Houston Metropolitan Transit Authority (METRO) and to determine its nationwide potential for park-and-ride facility development.

During the initial phase of the study, six secondary, supportive objectives were identified:

- To prepare a detailed work program compatible with other prior or ongoing impact evaluation studies;
- To conduct, based upon available data, case studies of transitway facilities in cities other than Houston for comparison of design and operational characteristics;
- To examine land use impacts of the contraflow lane in Houston's North (I-45N) Freeway corridor;
- To develop a "before" or pre-busway land use data base in Houston's North (I-45 North), Gulf (I-45 South) and Katy (I-10 West) Freeway corridors;
- To project anticipated land use impacts, in the three Houston freeway corridors, which are likely to occur from implementing permanent busways and park-and-ride facilities; and,
- To document the study data and findings in one or more reports.

The evaluation of turnkey development for park-and-ride facilities by Houston METRO examined the key ingredients of the program. This portion, as well as the portion of the study dealing with the problems, opportunities and potential costs and benefits of the concept applied on a nationwide basis, is being conducted by Barry Goodman and Associates. A previous technical report (3) presents documentation of this research and the reader is referred to this earlier report for further background on the turnkey development process.

1.3 STUDY APPROACH

1.3.1 General

The methodology used in this study is referred to as the "before-after" study approach. Data from a time period prior to the transportation improvement are compared to similar data collected after the completion of the improvement in the affected area. Therefore, the effects of the transportation change are determined by comparing "before" period data to "after" period data which are collected and updated on an annual basis. The time frames and corridors included in the analysis are:

North (Contraflow)
- Before - 1973 to 1979 (6 yr)
- After - 1979 to 1985 (6 yr)

North (Transitway) - 1973 to 1989 (16 yr)
Gulf (Transitway) - 1979 to 1989 (10 yr)
Katy (Transitway) - 1979 to 1989 (10 yr)

To satisfy the study objectives, land use data were obtained from 1) aerial photographs of study areas, 2) site visits, 3) Cole's City Directory, and 4) developer interviews. In addition, a literature review and survey of existing transitways was conducted. The use of each of these is described in the following subsections.

1.3.2 Aerial Photographs/Site Visits

Aerial photographs of the study areas were examined to identify land use changes in the vicinity of the study sites. The process of identifying land use changes consisted of taking the earliest available photos (between 1973- 1975) and overlaying them with the next interval (time frame) photos. This procedure was repeated until the most current photos were examined.

Because the aerial photography analysis can identify only "new developments," changes in use of existing structures (prior to "before" time frame) had to be identified through the site visits and the city directory. Site visits were made to the study areas to verify and supplement the results obtained from the aerial photograph analysis. The visits were also used to assess the types of development and their approximate age.

1.3.3 City Directory

Cole's City Directory contains information on each occupied address in the Greater Houston Area. Land use changes were identified by reviewing the addresses listed within the study area on an annual basis. The addresses listed for the first year of observation (1973) were compared to those for the following year (1974) and so on until the most current year of the study period available. Also, any new addresses within the study area were listed and observed for the remainder of the study period.

1.3.4 Developer Interviews

As part of this research effort, it was decided that interviews with the developers of major office and commercial projects within the freeway corridors would be an expedient and direct method of assessing the actual interaction between the transitway and its support facilities and the developer's decision concerning where, when, what, why and how much to develop. The information obtained from the interviews, combined with the other data should provide as complete a picture as possible with regard to the transitway and transit facilities impacts on the freeway corridors.

The interviews were initially conducted with developers of various projects along the North (I-45N) Freeway corridor. The conclusion drawn from the interviews conducted with the development community in the area is that neither the transitway nor its support facilities have influenced land use or development decisions over the last six years.

1.3.5 Literature Review

The initial task in the study was to conduct a literature review to enable this study to benefit from other relevant work and studies. The results of the literature review are summarized in Section 2. A complete bibliography is presented at the conclusion of this report.

1.3.6 Survey of Existing Transitway Projects

A review of operational transitways in the U.S. and Canada was performed. The review focused on identifying the general design and operating characteristics of transitways and the development impacts these facilities have had on the urban areas in which they are located. The results of the review are summarized in Section 1.6.

1.4 ZONE OF INFLUENCE

The zone of influence or "impact area" is commonly an area of a specified dimension inside which may occur land use changes as a result of a transit improvement. For this study, a distance of one-quarter mile was chosen as the limit for the impact area of all study locations. This distance was chosen in order to maintain consistency with prior rail and rapid transit impact studies. The one-quarter mile distance has become somewhat of a standard delimitation of the zone of influence of transit locations and is consistent with the general approach used in impact studies outlined in Technical Report 1086-1 (4).

1.5 DATA PRESENTATION

For presentation purposes, both visual and tabular methods were developed for the data obtained through the analysis of aerial photos, the site visits and the city directory.

The tabular format was developed to further detail the land use changes presented in the maps. This tabular presentation includes data not only for the update period but for the study period years 1973 to 1986, and maintains consistency with the presentation format exhibited in prior reports. It is hoped that the presentation provides more insight into the "evolution" of uses around the various sites. For those sites with operational facilities, the tables are broken into "before" and "after" data based on the timing of the improvement.

1.6 SURVEY OF TRANSITWAY PROJECTS

A review of transitway projects in the United States and Canada was conducted as a supplement to the study approach described in the previous sections. The intent of the review was to develop a preliminary data base for assessing the transferability of the results to the study of the land use impacts of the Houston (Texas) transitway system. The following 15 urban areas were surveyed:

1. Atlanta, Georgia
2. Baltimore, Maryland
3. Denver, Colorado
4. Garden Grove (Orange County), California
5. Houston, Texas
6. Los Angeles, California
7. Miami, Florida
8. Minneapolis, Minnesota
9. Oakland, California
10. Ottawa, Canada
11. Phoenix, Arizona
12. Pittsburgh, Pennsylvania
13. San Francisco, California
14. Seattle, Washington
15. Washington, D.C.

The results of the review indicate that virtually no studies have been conducted on the land use impacts of transitways. Additionally, the majority of the transitway operators surveyed indicated that no such studies are being considered in the near future. The prevailing opinion among transitway operators is that given the exclusive, line-haul nature of transitways, their land use impacts are likely to be highly localized; occurring around station areas and major access points. A previous technical report (5) presents documentation of this survey and the reader is referred to this earlier report for further background on the survey of Transitway Projects in the United States and Canada.

2. LITERATURE REVIEW

2.1 GENERAL

Several past studies related to the land use impacts of new transportation facilities or improvements to existing facilities were reviewed. Most of these publications were prepared during the late 1970's and early 1980's, and cover all surface modes of transit with emphasis placed on light rail transit. For the purpose of this study these publications were grouped into the following three major categories: (1) relationship between land use and transportation; (2) impacts of public transportation on land uses and land values; and (3) recent actions to promote more coordinated land use and transportation planning.

2.2 RELATIONSHIP BETWEEN LAND USE AND TRANSPORTATION

The interrelationships between transportation and land use have long been recognized. Commercial, industrial and residential land development generate traffic and require transportation system improvements. When it is added, the additional transportation system capacity improves access to the surrounding area which increases the property value and fosters additional development. These fundamental economic principles clearly are evident in practice as well. Concentration of commercial development along freeway corridors and principal street intersections illustrates the effect of good access on property development (4).

The role of transportation in shaping urban form is a subject of diverse opinions. Ward (6) suggests that "Transportation does not cause development, it enables it." Additionally, Ward (6) notes that "Transportation is a tool for permitting development in a form deemed desirable; the location of potential development can be controlled by controlling points of access to the transportation network." Ward (6) also observes that "access is a necessary but not sufficient condition for development." Altshuler et al. (7) contend it only plays a supportive role in the development decisions of urban areas. Specifically, Altshuler et al. (7) point out that:

> There appear to be current circumstances in which transportation measures alone can have a significant impact on metropolitan patterns of land development. Highway access is already ubiquitous throughout and well beyond American urban areas. In this bountiful highway environment, even a total cessation of new highway construction would have virtually no impact on development for many years to come, and transit improvements can generally enhance the relative accessibility of locations served in only quite modest degrees. Where a considerable potential for core area development exists, and where numerous government policy instruments (including strong land use controls) are being deployed to help fulfill this potential, transit improvements will normally have a significant supporting role to play. To act on the premise that they can do more than perform such a supportive role in an otherwise favorable environment, however, is simply to invite disappointment.

Page and Demetsky (8) state that one of the principal objectives of a transit project is to stimulate economic development. Downs (9) shares this view and notes that:

> Major transportation arteries, particularly expressways and rapid transit lines, play crucial roles in the development of planned new cities throughout the world. One such role is helping to generate rising land values, the cornerstone on which the economic feasibility of new cities is built.

2.3 IMPACTS OF PUBLIC TRANSPORTATION ON LAND USE AND LAND VALUES

Numerous studies have been undertaken to analyze the zone of influence of transportation improvements. These zones range from Baerwald's (10) use of a quarter mile zone of influence for investigating land use change in suburban clusters and freeway corridors to Rollins et al. (11) use of a 3 block zone for investigating the effects of an improved urban arterial. Bain and Escudero (12) proposed an 1800 foot radius around BART stations to provide time series data for development and land use monitoring. In the evaluation of the land use impacts of a park-and-ride facility, one might expect less impact than that associated with rail. As a result, any impacts may be assumed to be extremely localized.

Several studies have been conducted reflecting various views on the impacts of the Bay Area Rapid Transit (BART) system on the San Francisco Bay Area. These impacts are categorized as being environmental, economic, social or political.

Graff and Knight (13), for example, conducted a study to determine the environmental impacts of BART. The study consisted of a detailed assessment of BART's current environmental impacts, including direct (i.e., wayside) impacts as well as indirect impacts (resulting from development in BART station area) and effects on the system's patrons. Assessment was made using both technical impact evaluations (e.g. noise measurements) and surveys of the responses of those affected.

The results of this study indicate that (13).

> BART has not had much impact on its environment. In view of the system's large size, the intensive local activity generated at stations, its variety of configuration, and the diversity of environments through which it passes, this conclusion is particularly significant. Moreover, it (BART) was planned and largely completed before environmental concerns had attained their present importance in public policy. There are exceptions to this conclusion in that impacts vary throughout the system, both in degree and nature, depending on variations in BART itself and in its surroundings. However, the system's environmental impacts--both during construction and through its early operations--have been small enough in most places to require careful study even to detect.

This "low profile" of impact is confirmed by surveys of BART users and nearby residents.

The Federal Highway Administration (14) reported in its study on the influence of central city radial freeways on manufacturing decisions that "No major negative environmental impacts were identified beyond those normally associated with urban development or beyond the scope of contemporary performance standards." However, the report notes that (14):

> Radial freeway influence is found to be positive in (1) revitalizing existing, declining central city industrial area; (2) strengthening existing, stable industrial areas; and, (3) developing new industrial areas. The 264 manufacturing firms located in the study areas employed more than 36,700 workers, generated nearly $6.8 million in local tax revenues and an estimated $231 million in annual wages.

Rollins et al. (11) report similar conclusions by noting that "The effect of improving existing urban roadways on surrounding land use is an important consideration in highway agency decisions regarding roadway improvements. Such decisions should consider the economic impact of proposed improvements."

In many instances economic and development impacts are included as positive objectives of major transit investments. For example, Berechman and Paaswell (15), in their study of a $450 million light rapid rail transit (LRRT) system currently under construction in Buffalo, New York, report that "this project represents a large public investment for a transportation system for which user benefits are not the sole or even a major consideration. Anticipated increases in service employment, retail activity and land development, mainly in the declining CBD area, are viewed as the major benefits."

The U.S. House of Representatives (16) reported in its assessment of Metrorail impacts on Washington area land values that:

> A sample of the land value increases generated by the opening of Metro leads to the finding that a minimum of $2 billion in land values has already been added to the existing land value base. This amount does not count any of the values being added to land adjacent to stations that are not yet in operation, all of which are the scenes of rapidly rising site values. Also, the $2 billion amount does not count any of the downtown D.C. blocks that are more than two blocks from Metro, though most observers agree that the Metro impact zone includes land three or four blocks (an easy walk) from the nearest station.

Baker (17) supported this contention by stating that Washington's Metrorail has had an impressive impact on development. He reports that:

> A recent study by the Metropolitan Washington Council of Governments (COG) found that more than half of the dollar value and almost half of the square footage of new, nonresidential construction in the Washington metropolitan area during the last four years has been concentrated within seven-tenths of a mile (a 15-minute walk) from a Metro station.

The station areas attracted several types of high-density development between 1979 and 1982 (the period COG studied). For example, 45 percent of the metro area's mixed-use projects, 40 percent of its office buildings, 54 percent of the new hotels, and 42 percent of the office buildings constructed for state and local governments occurred during this period (17). Further, the COG estimates that, of the $8.5 billion in construction starts predicted for the region during the next 20 years, 64 percent, or $5.4 billion, will be near Metro stations (17).

Boyce (18) provides further evidence of transit facilities providing an economic stimulus. The author states that analysis of the Philadelphia-Linderwold High Speed Rail Line indicates a modest, positive impact on suburban residential property values which is proportional to user's travel cost and time savings. This conclusion is based on two statistical models of residential property values estimated with data on about 20,000 residential property transactions during 1964-1971 in Camden and Gloucester Counties, New Jersey.

Gaegler et al. (19), in their evaluation of the economic impacts of the Connecticut Turnpike, reported that changes in population, manufacturing employment, retail sales, and assessed property values were related to increases in accessibility afforded by the Connecticut Turnpike. Findings from the study indicate that the Connecticut Turnpike has had a continuing influence on the level and distribution of population and economic activity in the eastern Connecticut region. Specifically, the study reported that:

> During the first 6 years the turnpike was in operation, only the eastern Connecticut towns located directly on the turnpike grew faster in population than the state as a whole. Since then, towns throughout the entire eastern Connecticut region have grown faster than the rest of the state. Although increases in population were widespread throughout the region, increases in manufacturing employment, retail sales, and land values were concentrated in towns along the turnpike. Moreover, among the turnpike towns significant differences in impact were found. The study concluded that the Connecticut Turnpike has had a significant long-term impact on the eastern Connecticut region, but that not all towns in the region have shared equally in that growth.

Empirical analysis of economic and development impacts from a study of major transit investment for the Seattle, Washington, area reveals (20):

> Economic impacts are found to be quite sensitive to assumptions on financing local shares of transit investment, although project financial planning and economic impact analysis have rarely been considered together. Development impacts, in terms of both job and household locations, are modest overall and are concentrated in the vicinity of the central business district that was to be the focus of the transit service, despite the magnitude of the investment involved.

Dyett (21) reported that BART has influenced land use and urban development in the Bay Area both directly (through its service and its local physical effects) and indirectly (by affecting zoning regulations, redevelopment financing, and civic improvements). Dyett (21) notes that to date, the effects have been small, relative to expectations, but not inconsequential. To a limited extent, both office and housing construction have been influenced by BART, and the BART system is becoming a common, though not highly ranked, factor in the location decisions of households and employers. BART has been less influential in the sphere of retail activity. Retailers almost completely disregard BART in their location decisions. Sales data show no advantages for stores near BART locations.

Baerwald (10) addresses the social implications associated with transportation and land uses. The author states that the following four general factors affect cluster and corridor development: (1) variations in the locational tendencies of different land uses, which lead comparison goods stores and higher-value residences to locate in clusters, while automobile dealers, industrial plants, and warehouses are more likely to be in corridors; (2) characteristics of the transportation system, including metropolitan freeway configuration, local characteristics within a concentration, and proximity and access to other modes; (3) historical factors and the timing of development; and (4) other factors, including social and demographic patterns, local governmental impacts, and entrepreneurial prerogative.

2.4 RECENT ACTIONS TO PROMOTE COORDINATED LAND USE AND TRANSPORTATION PLANNING

Major studies in this area include research conducted on various forms of pooling arrangements, joint development activities, and other attempts aimed at the integration of land use and transportation planning. Misch (22) summarizes the general intent and effect of these efforts when she notes that:

> A fundamental strategy of transportation system management is to encourage more efficient use of highway and roadway vehicles and space through higher vehicle occupancies. Although highways and transportation departments, transit authorities, and other public agencies can and do encourage increased commuter use of carpools and vanpools in large and small urban areas in a variety of ways (computer matching, purchase of vans for vanpooling, parking incentive programs, preferential highway treatment, etc.), many people fail to take advantage of, or even resist, these opportunities when offered.

Voorhees and Associates Inc. (23) support this contention by noting that: "The goal of a carpool/buspool program is to satisfy travel requirements more efficiently by increasing passenger occupancy in autos and buses, thereby reducing the number of vehicles using the streets and highways. Achievement of that goal calls for coordination among many institutions within a metropolitan region including public agencies and citizen and business groups. TenHoor and Smith (24) investigated the parking-requirement reduction process for ridersharing and report that:

> Due to rising land costs and local government's desire to reduce the economic, environmental, and energy problems associated with single-occupant vehicle commuting, both the public and the private sectors have sought methods of mitigating these problems. Concern about these high costs has resulted in the emergence of transportation system management (TSM) actions. TSM advocates short-term, low-capital-cost efforts to improve transportation system capacity. Parking management and ridesharing are two key, mutually complementary TSM actions.

There are many competing objectives that come into play in the development process. Certain transportation objectives (i.e., promoting more efficient modes of travel) cannot be isolated from others. The desires and impacts on the many groups with an

interest in land development, parking, and transportation must be considered and all such parties should be involved in the process. Participants should included developers, citizens, employers, attorneys, lenders, and public agency staff of various disciplines. There must be a keen awareness of how the development community views such actions (24).

Engelen (25) conducted a study on the coordination of transportation system management and land use management. The study consisted of a survey of current practice in the coordination of Transportation System Management (TSM) and Land Use Management (LUM). Emphasis was placed on the corridor-wide approach as opposed to the project level. Actions taken to meet the objectives of TSM/LUM generally fall into one of four categories: (1) control/develop land, (2) control access to transportation, (3) control physical features of transportation, and (4) control or influence transportation system use. The advantages of coordinating TSM and LUM are evident in the principles and concepts of zoning. However, a clear understanding of the economic benefits and the separation of funds used for transportation and land development remain as obstacles to the coordination effort.

Efforts to evaluate the relationship between land use, transportation and energy planning have surfaced since the energy crisis of the mid 1970's. Potter (26), for example, indicates that:

> The transport sector, seems remarkably inflexible to changes in fuel prices and energy measures. The suggestion is made that the long-term land use and social effects of cheap motorized travel has produced a land use and transport system that is dangerously inflexible to changing needs and that planning and transport investment methods tend to unnecessarily heighten such problems.

Kihl and Flathers (27) report that federal highway project funding assisted in the suburbanization process that led to increased automobile dependency but suggested that revised land use plans jointly administered by local government and the private sector might increase the energy efficiency of environments. The key elements which forge the links between land use, transportation, and energy are a positive political climate, and clearly defined planning objectives.

Another program intended to facilitate a coordination of land use and transportation planning is joint development. The Urban Land Institute (28) concluded that the prospects appear bright for future joint development providing that:

- o Public officials implement land use and transit planning decisions which exploit transit as a development tool;

- o Private developers and public officials are willing and able to work together to consummate the necessary deals; and

- o Joint development, with its synergistic qualities, offers excellent opportunities to combine public and private efforts in order to contribute to the well-being of our major metropolitan areas.

Padron (29) contends that public-private joint development projects do influence the development patterns of cities. A major reason for this is the declining availability of federal funds for rail transit construction and operating subsidies. The shared use of property to benefit both the private and public sectors has a long history dating back to the mid-to-late 1800's when the federal government issued large land grants to private railroad companies. Historically, joint development projects have not always been managed in such a manner to generate an optimum profit. Station area development should not be confused with joint development because station area planning may or may not be coordinated with the transit agency owning the parcel. Joint development is but one of many value capture mechanisms. Other techniques include station cost sharing, connector fees, lease of advertising space, concession rights and special transit tax districts.

The Atlanta Regional Commission (30) suggests the benefits of the Atlanta system covered much more than just the reduction of traffic congestion and time expended on commuter travel. Other benefits included: (1) fostering central Atlanta's growth, (2) the generation of highly accessible development modes, (3) increased property values, and (4) a reduction of future land area devoted to transportation facilities. The integration of rapid transit and land development is essential in order to achieve many of these other benefits.

2.5 SUMMARY

A review of the literature demonstrates the relationship between land use and transportation. This relationship is often viewed as being cyclical in nature. Commercial, industrial and residential land development generate traffic and require improvements in the transportation system. When it is added, the additional transportation system capacity improves access to the surrounding area which increases the property value and fosters additional development (4).

The impacts of transportation in shaping urban form is a subject of diverse opinions. These opinions range from Ward's (6) contention that "transportation does not cause development but merely permits it in a desirable form by controlling points of access to the transportation network" and Altshuler et al. (7) contention that it only impacts development in a supportive manner. Downs offers an opinion at the opposite end of the spectrum by arguing that "major transportation arteries, particularly expressways and rapid transit lines, play crucial roles in the development of planned new cities throughout the world."

The impacts of public transportation on land use and land values were reviewed in four categories: environmental, economical, social and political or policy. Given the relative newness of transitways in the nation, very little data have been collected or experience gained with land use impacts resulting from these types of transportation improvements. As a result, most research and evaluations have concentrated on rail development impacts. According to studies by Graff and Knight (13) BART has not had much impact on its environment. The FHWA (14) reported in its study on the influence of central city radial freeways on manufacturing decisions that no major negative environmental impacts were identified beyond those normally associated with urban development or beyond the scope of contemporary performance standards.

In many instances economic and development impacts are included as positive objectives of major transit investments. This contention is supported by Rollins, Memmott and Buffington (11). The authors state "the effect of improving existing urban roadways on surrounding land use is an important consideration in highway agency decisions

regarding roadway improvements. Such decisions should consider the economic impact of proposed improvements." Also, Berechman and Paaswell (15) report that anticipated increases in service employment, retail activity and land development, mainly in the declining CBD area, are viewed as the major benefits of Buffalo, New York's, light rapid rail transit system.

Another function of transportation improvements is helping to increase land values. This is evident in the Washington Metropolitan Area Transit Authority (WMATA) System of Washington, D.C. where a sample of land value increases generated by the opening of METRO led to the finding that a minimum of $2 billion in land values has already been added to the existing land value base (16).

The social implications associated with transportation improvements and land use indicate that the effects have been small, relative to expectations. When assessing BART, however, it is becoming a highly ranked factor in the location decisions of households and employers. Also, characteristics of the transportation system such as freeway configuration and proximity and access to other modes affect cluster and corridor development.

Recent actions aimed at the promotion and coordination of land use and transportation planning concentrates on pooling arrangements and joint development activities. These measures are usually administered under Transportation System Management (TSM) programs and emphasize more efficient use of existing facilities. Although many people fail to take advantage of, or even resist, these opportunities when offered, the future remains bright for the coordination of land use management and transportation planning.

This review did not locate any direct literature assessing the land use impacts of transitways. Therefore, this study effort is new to the research community and to the literature.

3. HOUSTON'S TRANSITWAY CORRIDORS

3.1 NORTH (I-45N)

The I-45 North Freeway is a major north-south highway serving travel demands in north Houston and Harris County and central Montgomery County (Figure 1, p. 2). Extensive residential and commercial development and population growth have led to increasing levels of traffic volume on I-45N. In 1987 the facility was carrying nearly 160,000 vehicles in an 8-lane section near I-610. Peak direction freeway speeds averaged less than 30 MPH during both the morning and afternoon peak hours. The North Freeway has been one of Houston's more congested freeways for many years.

The North Freeway had a highly successfully HOV contraflow lane for more than five years. Increases in traffic demands in the off-peak direction precluded the continued operation of the contraflow lane beyond the mid 1980's, without increasing off-peak direction congestion to unacceptable levels (31). Although the continuation of the contraflow project was no longer desirable, it was neither economically nor physically feasible to provide enough additional freeway lanes to satisfy even existing peak period travel demand, much less serve projected demand levels. The need for a transitway was clear. 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.)

The I-45N Transitway opened for operation in November 1984 replacing the contraflow lane that had operated in the corridor since 1979. The transitway was constructed as part of an overall freeway improvement that is being implemented in four phases (Figure 2). Phase I construction extended from downtown Houston to North Shepherd Drive, essentially replacing the contraflow lane with a 16 foot wide, barrier-

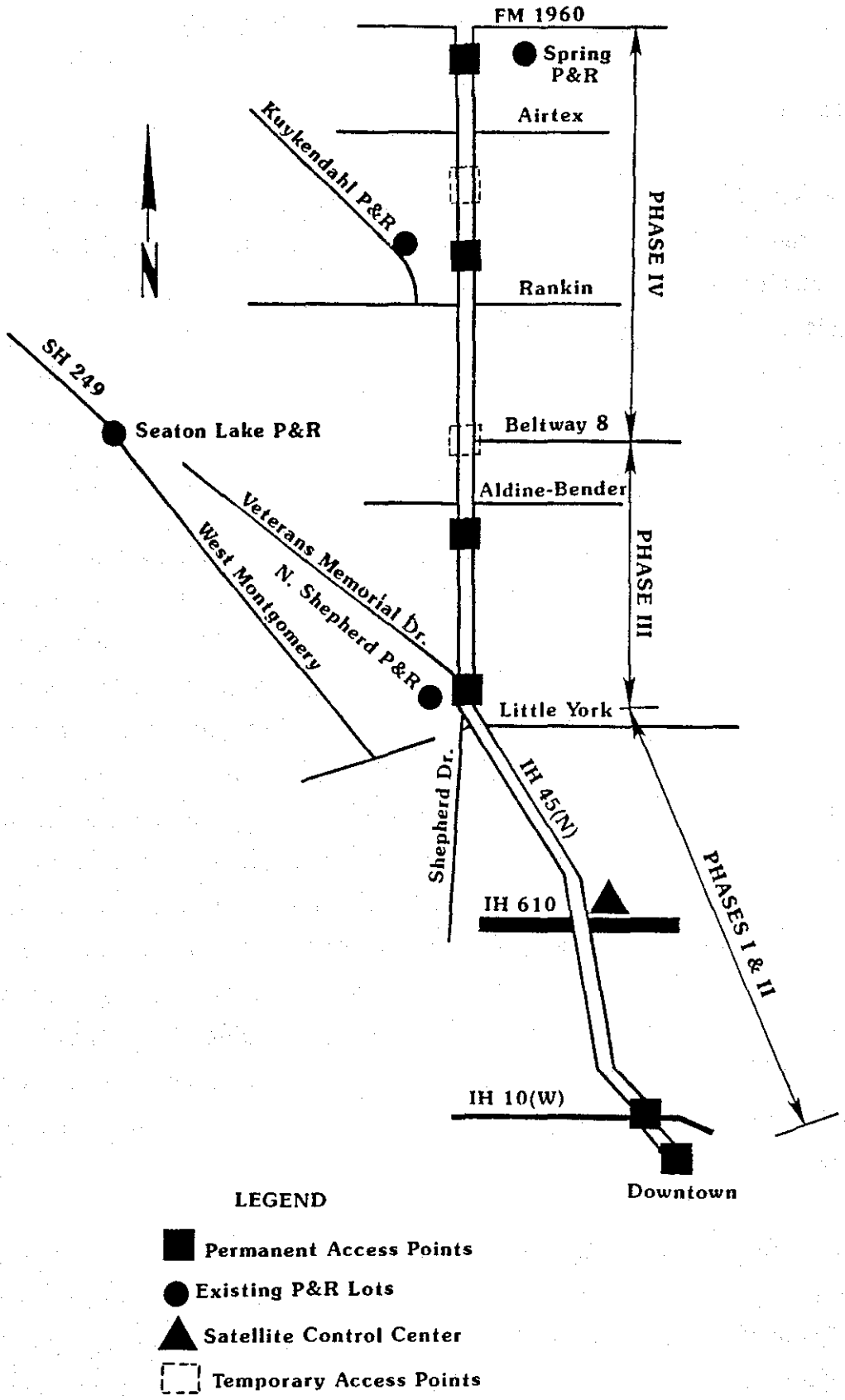


Figure 2. I-45 North Freeway Transitway

separated, reversible HOV lane in the freeway median (this narrow transitway width existed only until freeway construction was completed). Phase II construction, which began in March 1985, included freeway widening, shoulder replacement, construction of u-turn lanes, and widening of the transitway to its final width. The limits of this project were from North Shepherd to near downtown (Quitman Street). The project was completed in May 1987. Phases I and II are currently operational. The Phase III construction, which will extend the transitway from North Shepherd to Beltway 8, began in April 1986. The project, which also includes freeway rehabilitation and widening, replacement of bridge structures, intersection improvements, and transitway construction (including an elevated transitway interchange), is scheduled for completion in January 1990. The transitway became operational in this section in a temporary configuration in February 1989. The Phase IV segment is undergoing conceptual design and is scheduled to become operational by 1997.

The priority lane is open for use by authorized buses and vanpools. The transitway operates in the Southbound direction (toward downtown) from 5:45 to 8:45 A.M., and operates Northbound from 3:30 to 7:00 P.M.

Five park-and-ride facilities exist in the corridor, however, only three are being monitored as part of this research effort. The Kuykendahl lot has 2246 spaces, the Spring lot has 1280 spaces and approximately 1600 spaces are available at the North Shepherd lot. The five lots have a combined capacity of over 7000 vehicles. With the exception of the Woodlands Lot, which was developed by the Woodlands Corporation with a mixture of public and private funds, all the park-and-ride lots in the corridor are owned and operated by the Metropolitan Transit Authority of Harris County (METRO).

The transitway is currently carrying nearly 13,000 passenger trips and over 500 vehicle trips per day. In terms of total daily volume, buses transport approximately 83% of transitway users in 58% of the vehicles and vanpools move 17% of the persons in 42% of the vehicles. Both passenger and vehicle volumes are rather evenly split between the A.M. and P.M. peak periods (Table 1).

Table 1. North Transitway Operational Summary, December 1988

Vehicle Type	Peak Period Passenger Volumes			Peak Period Vehicular Volumes		
	AM	PM	Total	AM	PM	Total
Buses	5,440	5,335	10,775	146	159	305
Vanpools	1,200	971	2,171	118	103	221
Total HOV	6,640	6,306	12,946	264	262	526

Source: (2).

3.2 GULF (I-45S)

The I-45 Gulf Freeway is a major north-south highway serving travel demands in South Houston and Harris county and Galveston county (Figure 1, p. 2). Currently, the Gulf freeway serves some 184,000 vehicles on a typical weekday with traffic in the peak period exceeding 1,900 vehicles per hour per lane (32). The transitway is being built and operated in three phases as part of the freeway reconstruction began in 1982 and extends 4 miles from Lockwood Drive to Broadway (Figure 3). The second phase extends the lane 2.5 miles from Lockwood to downtown; this section was opened as an interim facility in the spring of 1988. The nine-mile third phase is currently under construction with a summer 1992 projected completion date. When completed, phase three will extend the lane from Broadway South to Choate Road near Ellington Air Force Base. This phase may be built in segments as traffic demands dictate. The total Gulf (I-45S) Transitway will be 15.5 miles long when completed and will extend from downtown Houston to the vicinity of Ellington Air Force Base (32).

The transitway is currently carrying over 5,000 passenger trips and nearly 1,400 vehicle trips per day. In the context of daily volume, buses transport approximately 46% of transitway users in 8% of the vehicles, vanpools transport 5% of the users in 3% of the vehicles and carpools transport 49% of the users in 89% of the vehicles. Both passenger and vehicular volumes are fairly evenly split between the A.M. and P.M. peak periods (Table 2).

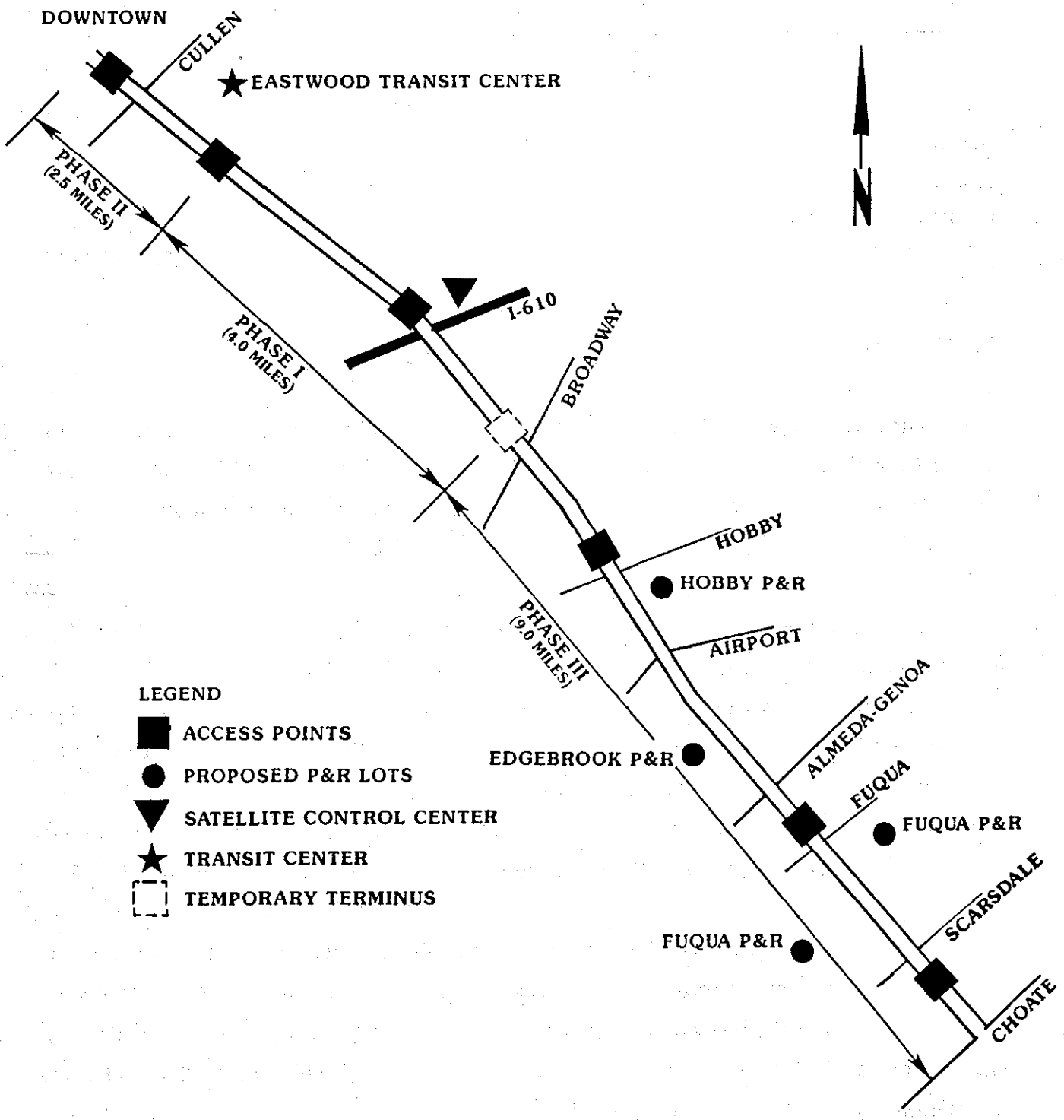


Figure 3. I-45 Gulf Freeway Transitway

Table 2. Gulf Transitway Operational Summary, December 1988

Vehicle Type	Peak Period Passenger Volumes			Peak Period Vehicular Volumes		
	AM	PM	Total	AM	PM	Total
Buses	1,267	1,173	2,440	48	56	104
Vanpools	139	116	255	23	19	42
Carpools	1,375	1,183	2,558	648	557	1,205
Total HOV	2,781	2,472	5,253	719	632	1,351

Source: (2).

3.3 KATY (I-10W)

The Katy Freeway (I-10W) is a major Interstate highway serving travel demands from Western Harris county to various parts of Houston. The Katy Freeway is primarily a six lane freeway, with a section of 8 lane facility near I-610. In 1987, the highest average daily traffic (ADT) on the Katy Freeway was approximately 175,000.

The Katy Freeway Transitway was implemented in 3 phases; the first phase (4.7 miles) opened October 29, 1984 between Post Oak and Gessner (Figure 4). On May 2, 1985, the transitway was extended from Gessner to West Belt, resulting in a total of 6.4 miles of transitway. On June 29, 1987, the third phase of the transitway opened; this phase extended the transitway to just west of SH 6, resulting in approximately 11.5 miles of transitway. At present, the Katy transitway operates inbound toward downtown from 4:00 A.M. to 1:00 P.M.; it operates outbound in the afternoon from 2:00 P.M. to 10:00 P.M.

The transitway is currently carrying nearly 16,000 passenger trips per day during the peak periods. In terms of total volume, buses transport approximately 34% of transitway users in 4% of the vehicles; vanpools transport 5% of the users in 2% of the vehicles and carpools move 61% of the persons in 94% of the vehicles. P.M. volumes on the transitway are slightly higher than A.M. volumes (Table 3).

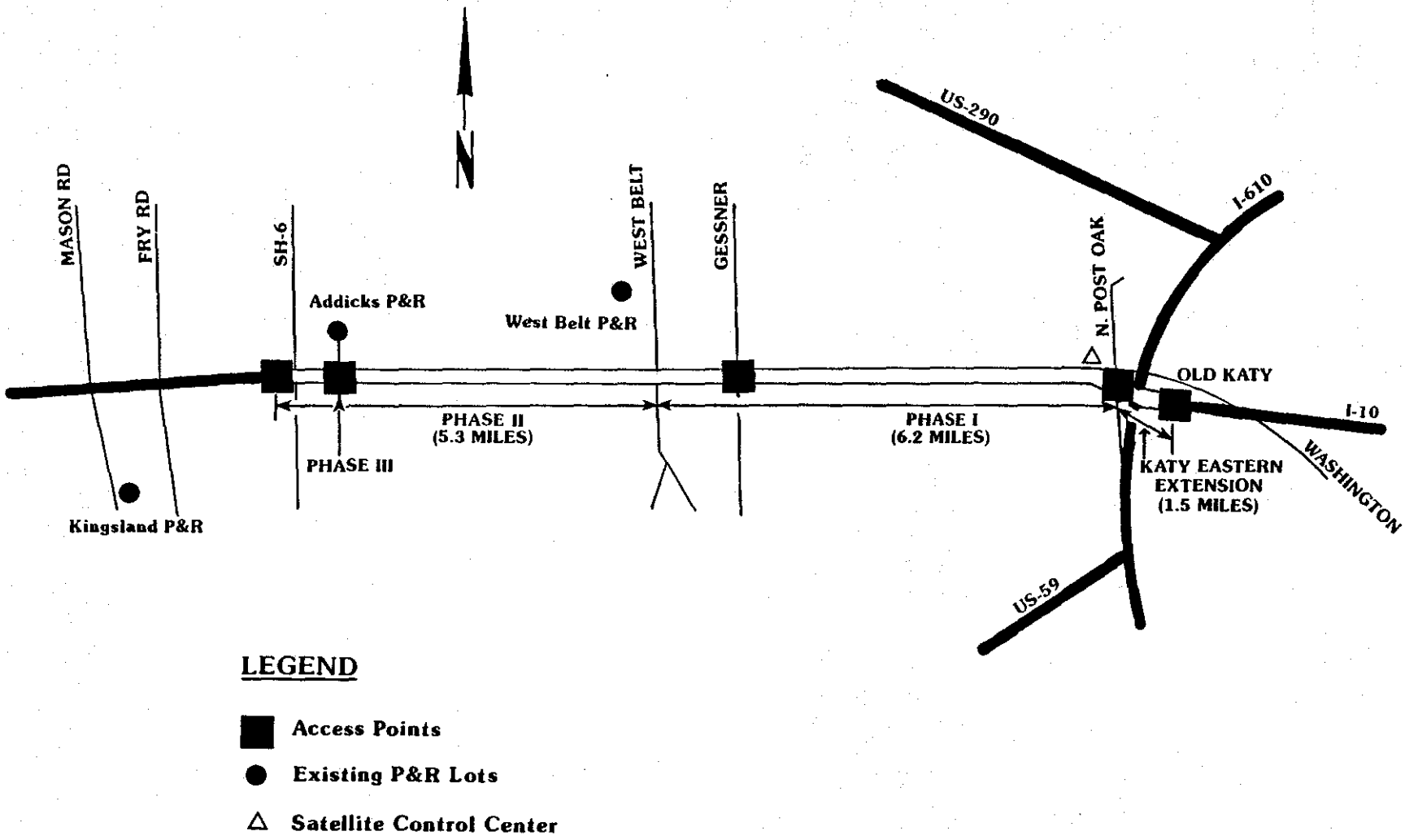


Figure 4. I-10 Katy Freeway Transitway

Table 3. Katy Transitway Operational Summary, December 1988

Vehicle Type	Peak Period Passenger Volumes			Peak Period Vehicular Volumes		
	AM	PM	Total	AM	PM	Total
Buses	2,915	2,545	5,460	87	78	165
Vanpools	276	343	619	39	47	86
Carpools	4,128	5,541	9,669	1,736	2,598	4,334
Total HOV	7,319	8,429	15,748	1,862	2,723	4,585

Source: (2).

Three major park-and-ride facilities exist in the corridor, however, only two are being monitored as part of this research effort. The Kingsland lot has 1326 spaces and approximately 850 spaces are available at the Addicks lot. Additionally, 3 carpool formation lots exist to the west of the Western terminus of the transitway. All of these lots have between 375 and 410 parking spaces, are paved and lighted.

4. LAND USE IMPACTS

4.1 NORTH (I-45N) TRANSITWAY CORRIDOR

As set forth in the study work program (33), the North (I-45N) Transitway Corridor was used as a pilot for land use analyses resulting from the implementation of permanent transit facilities (i.e., busways and park-and-ride lots). The results of this initial effort were fully documented in a previous report (34).

The results of the 1988 update of land use changes at the four study sites along the North Transitway Corridor are presented in the following sections. Analyses of each area's changes in previous years are more fully documented in earlier reports (35, 36).

4.1.1 Aldine-Bender Transitway Interchange

The only land use changes in the vicinity of the transitway interchange have been the closing of twelve commercial establishments and the vacating of three residential units. The commercial establishments that experienced closings were in the strip center developments in the vicinity.

Figure 5 shows that no new land uses have appeared in the last year and that land uses in the area continue to be generally of the type that one might expect in the vicinity of a major transportation facility access point with numerous apartment and office complexes, as well as a few commercial developments in the impact area. Table 4 indicates in detail the types and numbers of land use changes that have occurred in the vicinity of the interchange.

The data in Tables 4 and 5 appear to show a stabilization of land use patterns in terms of the relative number of commercial and residential uses. The data for 1987 indicate that the dominance of commercial uses over residential uses continues.

The closing of the twelve commercial establishments appears to have occurred not because of any transitway impact but more likely because of the continued poor local

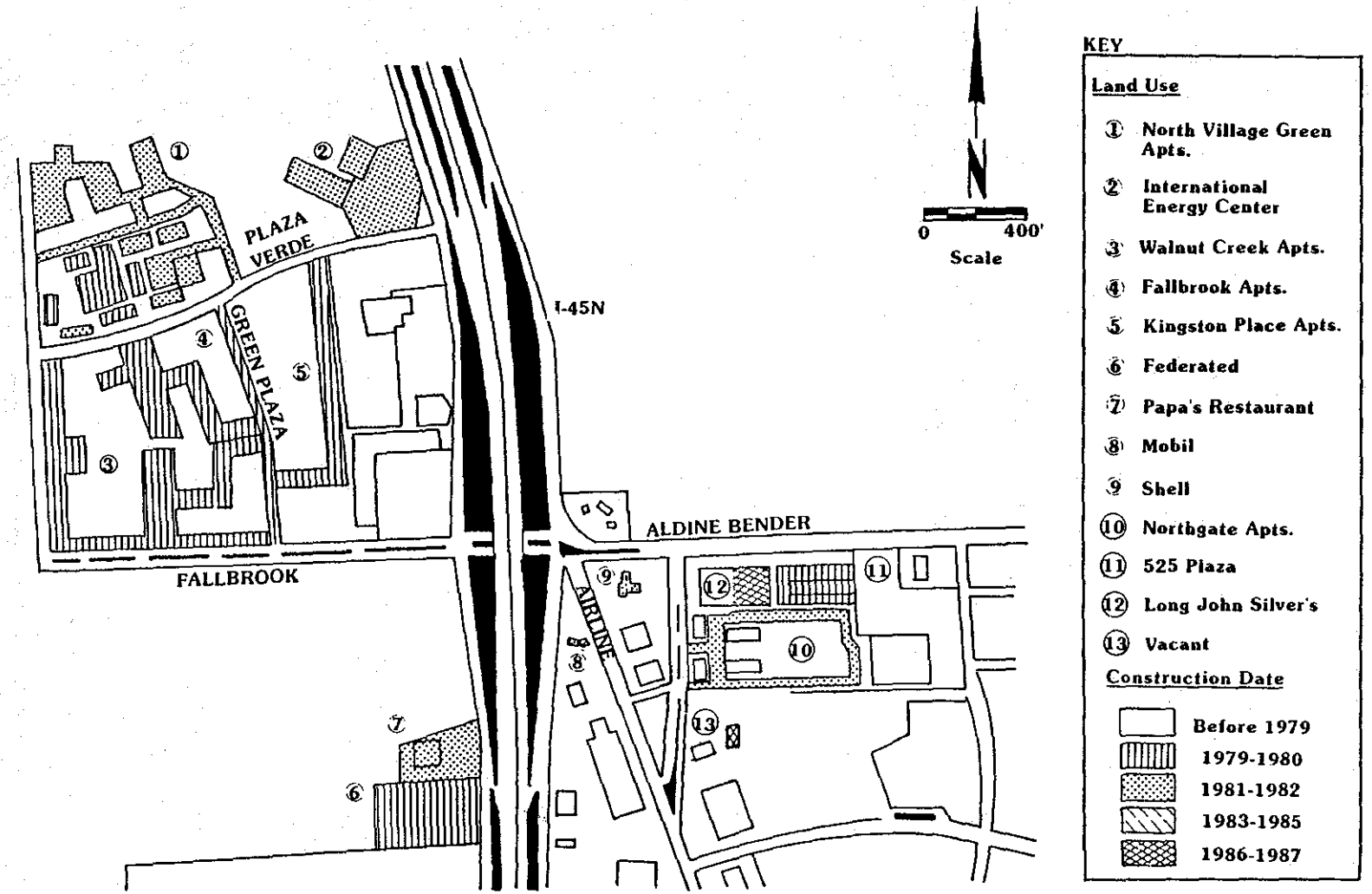


Figure 5. Land Use Trends in the Vicinity of the Proposed Aldine-Bender Transitway Interchange (1979-1988)

Table 4. Impact Area Development Assessment in the Vicinity of the Aldine-Bender Transitway Interchange: "Before" Period (1973-1980)

	Year															
	1973		1974		1975		1976		1977		1978		1979		1980	
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial	22	76	29	76	27	90	28	90	34	92	49	91	58	95	75	88
Residential	7	24	6	17	3	10	3	8	3	8	5	9	3	5	10	12
Total	29	100	35	100	30	100	37	100	54	100	54	100	1	100	85	100

No. = Number of Addresses
Source: Cole's City Directory

Table 5. Impact Area Development Assessment in the Vicinity of the Aldine-Bender Transitway Interchange: "Before" Period (1981-1987)

	Year															
	1981		1982		1983		1984		1985		1986		1987			
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Commercial	76	84	88	83	93	82	83	80	79	64	80	64	68	62		
Residential	15	16	18	17	21	18	21	20	44	36	44	36	41	38		
Total	91	100	106	100	114	100	104	100	123	100	124	100	109	100		

No. = Number of Addresses
Source: Cole's City Directory

economic situation. In addition, the transitway interchange is still under construction and any land use impacts probably will not be evident for several years.

4.1.2 Kuykendahl Park-and-Ride

Figure 6 shows land use changes in the vicinity of the Kuykendahl Park-and-Ride Lot. Within the past year, two commercial establishments have closed in the area, while one commercial establishment, a new car dealership, has opened in the vicinity of the park-and-ride lot. This new land use continues the trend of previous land use changes in the

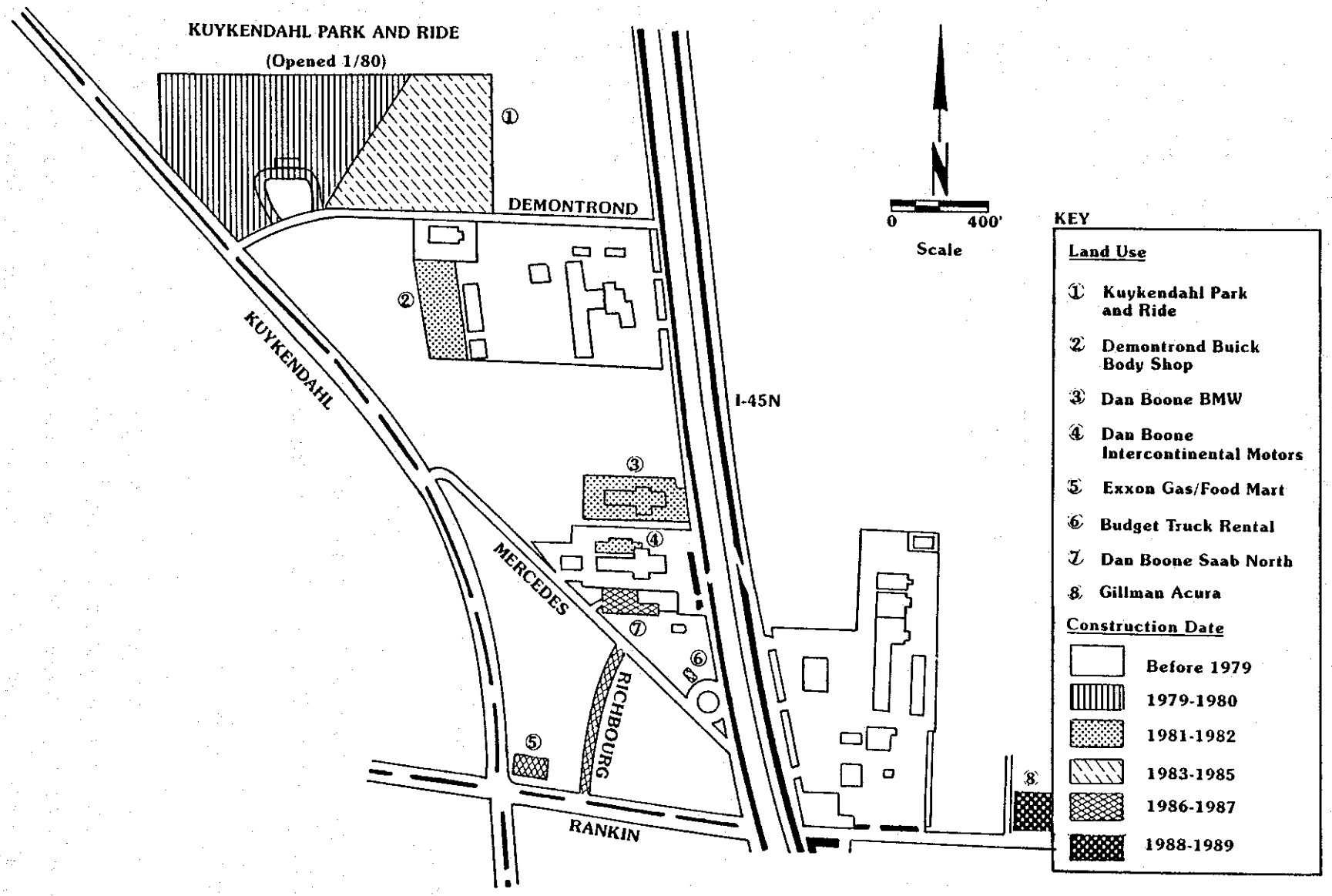


Figure 6. Land Use Trends in the Vicinity of the Kuykendahl Park-and-Ride Lot (1979-1988)

area which have almost exclusively involved auto sales establishments. However, the location of the park-and-ride lot does not appear to be an important factor in the location of the car sales businesses as they are not the type of business which would benefit from locating in the vicinity of a transitway facility.

As Tables 6 and 7 show, there has been a change in the dominant type of land use in the vicinity of the Kuykendahl Park-and-Ride Lot. The apparent reversal in share of uses between residential and commercial must be tempered by pointing out that there was originally such a relatively small amount of developed land, that any change results in a dramatic percentage change.

Table 6. Impact Area Development Assessment in the Vicinity of Kuykendahl Park-and-Ride: "Before" Period

	Year													
	1973		1974		1975		1976		1977		1978		1979		1980	
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial	3	30	5	42	6	40	7	50	10	62	10	62	13	76	14	82
Residential	7	70	7	58	9	60	7	50	6	38	4	24	4	24	3	18
Total	10	100	12	100	15	100	14	100	16	100	16	100	17	100	17	100

No. = Number of Addresses
Source: Cole's City Directory

Table 7. Impact Area Development Assessment in the Vicinity of Kuykendahl Park-and-Ride Lot: "After" Period

	Year													
	1981		1982		1983		1984		1985		1986		1987	
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial	16	89	18	100	20	95	22	92	20	87	20	87	19	86
Residential	2	11	0	0	1	5	1	4	2	9	2	9	2	10
Public/Quasi-Public	-	-	-	-	-	-	1	4	1	4	1	4		
Total	18	100	18	100	21	100	24	100	23	100	23	100	22	100

No. = Number of Addresses
Source: Cole's City Directory

The latest year's data (1987) seem to indicate that the relative amounts of commercial and residential uses have stabilized somewhat. The past three year's data have essentially identical relative quantities of commercial and residential uses. However, there does not appear to be any connection between either the transitway or the park-and-ride lot and these or any other trend of land use changes within the study period. The fact that there is such a small amount of developed land in the impact area indicates that, like the situation at the Aldine-Bender Interchange, the area surrounding the park-and-ride lot should continue to be an ideal site for monitoring land use impacts of the park-and-ride lot and the North Freeway Transitway.

4.1.3 North Shepherd Park-and-Ride

Figure 7 shows that there have been no new land uses established in the vicinity of the North Shepherd Park-and-Ride Lot. Land use changes in the past year have involved the closing of one auto repair establishment and the addition of three residences. The auto repair establishment, which closed during the past year, was one of those identified in a previous year's report (36) as representing a potential land use impact of the park-and-ride lot due to its location immediately adjacent to the park-and-ride lot and the nature of the business it conducted (auto repair service). The events of the past year regarding this establishment do not prove the assumption of potential influence incorrect, but may more correctly represent and reinforce the fact that local economic conditions play or have played a role in terms of influence of land use development patterns. As can be seen from Figure 7, two of the three auto repair establishments located adjacent to the park-and-ride lot remain in operation.

Tables 8 and 9 present land use data for the entire study period. The data show that the area surrounding the North Shepherd Park-and-Ride Lot has become dominated by commercial land uses. The data also suggest that over the length of the study period, particularly after 1980, the character of the area began to change, resulting in large numbers of residential uses becoming vacant and commercial uses appearing in areas that had previously been vacant. The new data for the update year show the trend of dominant commercial land uses to be continuing. However, other than the two auto repair establishments there is little direct evidence of any land use impacts that can be attributed either to the North Shepherd Park-and-Ride Lot or the North Freeway Transitway.

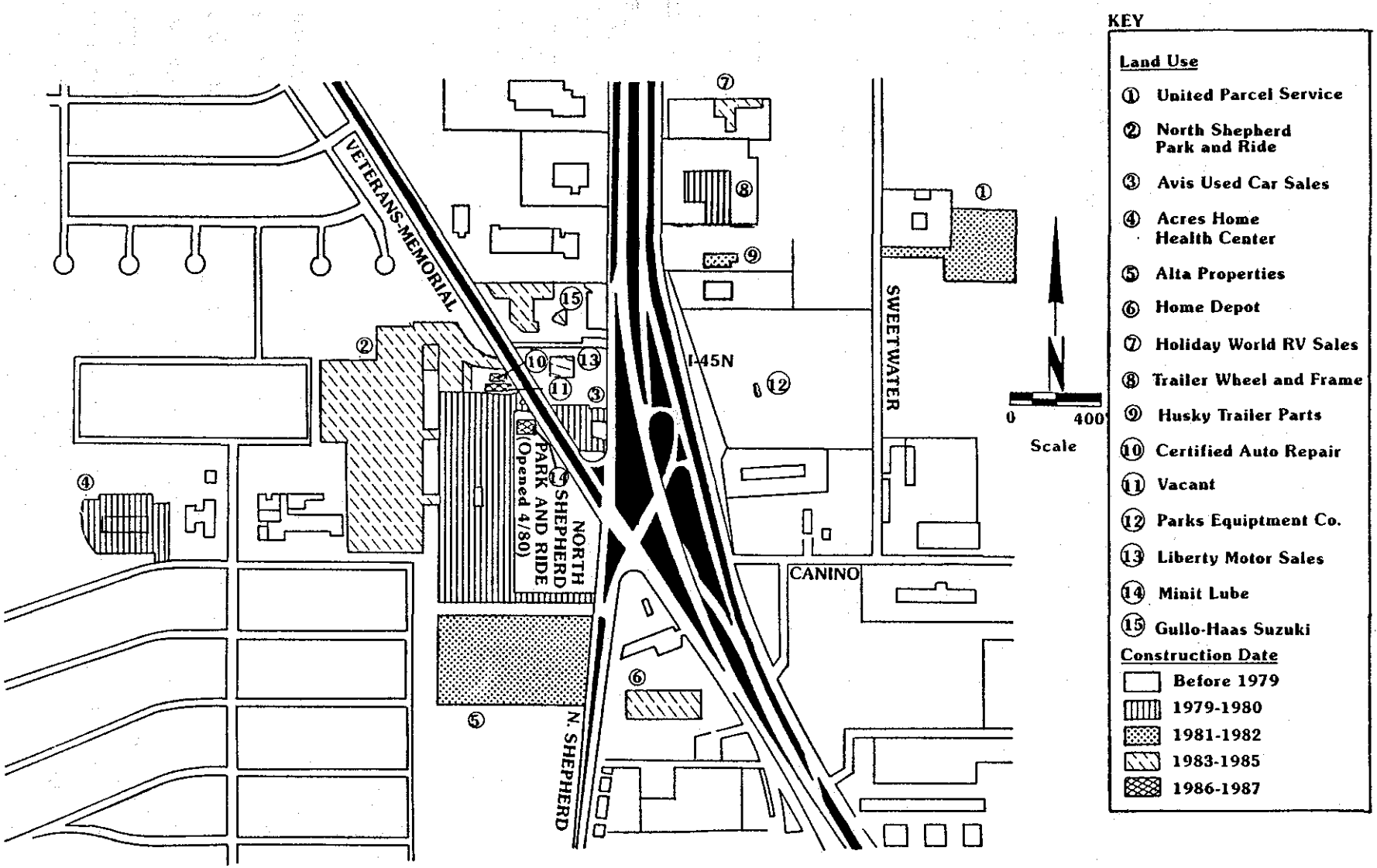


Figure 7. Land Use Trends in the Vicinity of the North Shepherd Park-and-Ride Lots (1979-1988)

Table 8. Impact Area Development in the Vicinity of North Shepherd Park-and-Ride Lot: "Before" Period

	Year													
	1973		1974		1975		1976		1977		1978		1979		1980	
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial	59	63	60	62	63	64	67	63	79	72	80	72	88	75	94	75
Residential	35	37	36	38	36	36	39	37	30	28	31	28	30	25	31	25
Total	94	100	96	100	99	100	106	100	109	100	111	100	118	100	125	100

No. = Number of Addresses
Source: Cole's City Directory

Table 9. Impact Area Development in the Vicinity of North Shepherd Park-and-Ride Lot: "After" Period

	Year													
	1981		1982		1983		1984		1985		1986		1987	
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial	93	83	98	82	98	84	109	86	104	87	109	89	106	87
Residential	19	17	21	18	19	16	17	14	16	13	13	11	16	13
Total	112	100	119	100	117	100	126	100	120	100	122	100	122	100

No. = Number of Addresses
Source: Cole's City Directory

4.1.4 Spring Park-and-Ride

Recent land use changes in the vicinity of the Spring Park-and-Ride Lot are shown in Figure 8. The land use changes that have occurred in the past year are the opening of a gas station and a mini-storage business on FM 1960. The presence of the park-and-ride lot does not appear to have had any influence on the location of the mini-storage business. However, because of its proximity to the park-and-ride lot and the type of the business being conducted, the location of the gasoline station may have been slightly influenced by the park-and-ride lot.

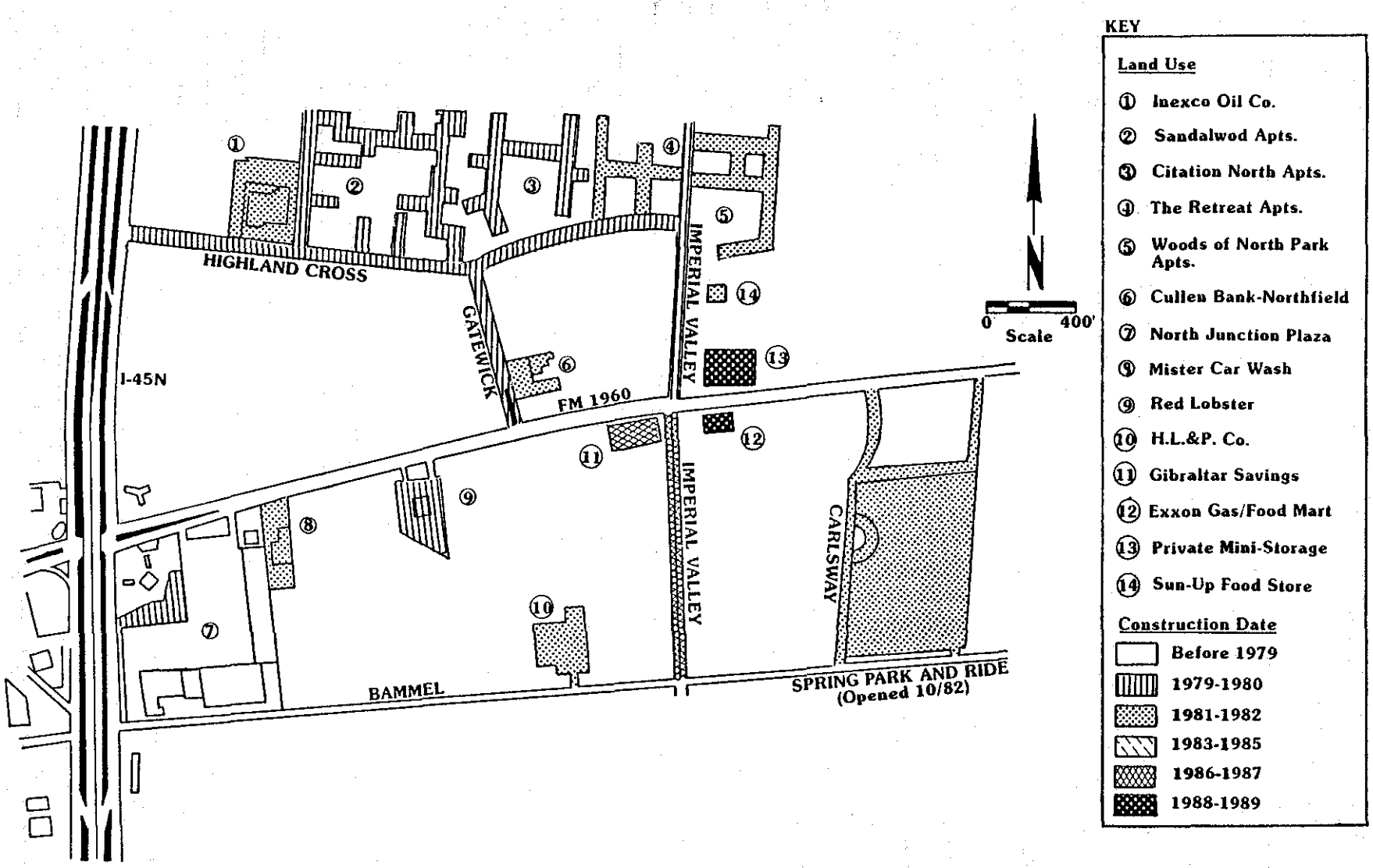


Figure 8. Land Use Trends in the Vicinity of the Spring Park-and-Ride Lot (1979-1988)

Tables 10 and 11 present the land use data from the entire study period. The data show that both residential and commercial uses experienced little change from 1973 to 1979. However, beginning in 1980, both residential and commercial land uses began to increase in number. In 1982, with the opening of a major strip mall development, the number of commercial uses grew rapidly while residential uses stabilized. The latest data show that this trend appears to be continuing. Excluding the newest commercial developments as well as the savings and loan and two apartment complexes, all changes occurred prior to the construction of the park-and-ride lot and thus could not have been influenced by the location of the park-and-ride lot. Of those developments constructed after the park-and-ride lot opened, only the recent opening of the gasoline station can be considered a potential land use impact. Most of the land use changes in this area are probably tied to the general economic growth experienced in the FM 1960 area in the early and mid-1980's.

Table 10. Impact Area Development Assessment in the Vicinity of the Spring Park-and-Ride Lot: "Before" Period

	Year																			
	1973		1974		1975		1976		1977		1978		1979		1980		1981		1982	
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial	8	73	8	73	5	71	5	71	5	71	5	50	5	83	4	57	4	33	13	57
Residential	3	27	3	27	2	27	2	29	2	29	5	50	1	17	3	43	8	67	10	43
Total	11	100	11	100	7	100	7	100	7	100	10	100	6	100	7	100	12	100	23	100

No. = Number of Sources
Source: Cole's City Directory

Table 11. Impact Area Development Assessment in the Vicinity of Spring Park-and-Ride Lot: "After" Period

	Year									
	1983		1984		1985		1986		1987	
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial	21	70	26	72	30	77	31	77	37	82
Residential	9	30	10	28	9	23	9	23	8	18
Total	30	100	36	100	39	100	40	100	45	100

No. = Number of Addresses
Source: Cole's City Directory

4.2 GULF (I-45S) TRANSITWAY CORRIDOR

4.2.1 Eastwood Transit Center

There have been two land use changes of note in the vicinity of the Eastwood Transit Center since the previous update. These changes, which are shown in Figure 9, involve the opening of a used car sales establishment and a little league baseball facility. As Tables 12 and 13 indicate, the area surrounding the transit center remains a well-established predominantly residential area. There are areas of commercial activity, but these are located mostly along the Gulf (I-45S) Freeway. The most recent data show that while the total number of uses declined, the overall shares of each type of use remain essentially constant. The most plausible explanation for the decline in the total number of uses to a point that is below the level that existed in 1973 is that this area has been hard hit by the economic problems that exist in the Houston area.

As the transit center and the adjacent section of transitway have been in operation only since May 1988, it is doubtful that its presence had any influence on the overall decline in land uses or any particular land use changes, including the most recent ones. It appears that, similar to the situation at other study sites, economic influences may be the controlling factor in terms of land use changes.

Table 12. Impact Area Development Assessment in the Vicinity of the Eastwood Transit Center: "Before" Period (1973-1980)

	Year																			
	1973		1974		1975		1976		1977		1978		1979		1980		1981		1982	
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial	73	24	75	22	75	22	76	23	76	23	80	24	77	23	76	23	74	23	72	23
Residential	223	75	257	77	260	77	252	76	252	76	255	76	252	76	255	77	240	76	237	76
Public-Quasi-Public	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	0	1	1	1	1
Total	297	100	333	100	336	100	332	100	329	100	336	100	330	100	332	100	315	100	310	100

No. = Number of Sources
Source: Cole's City Directory

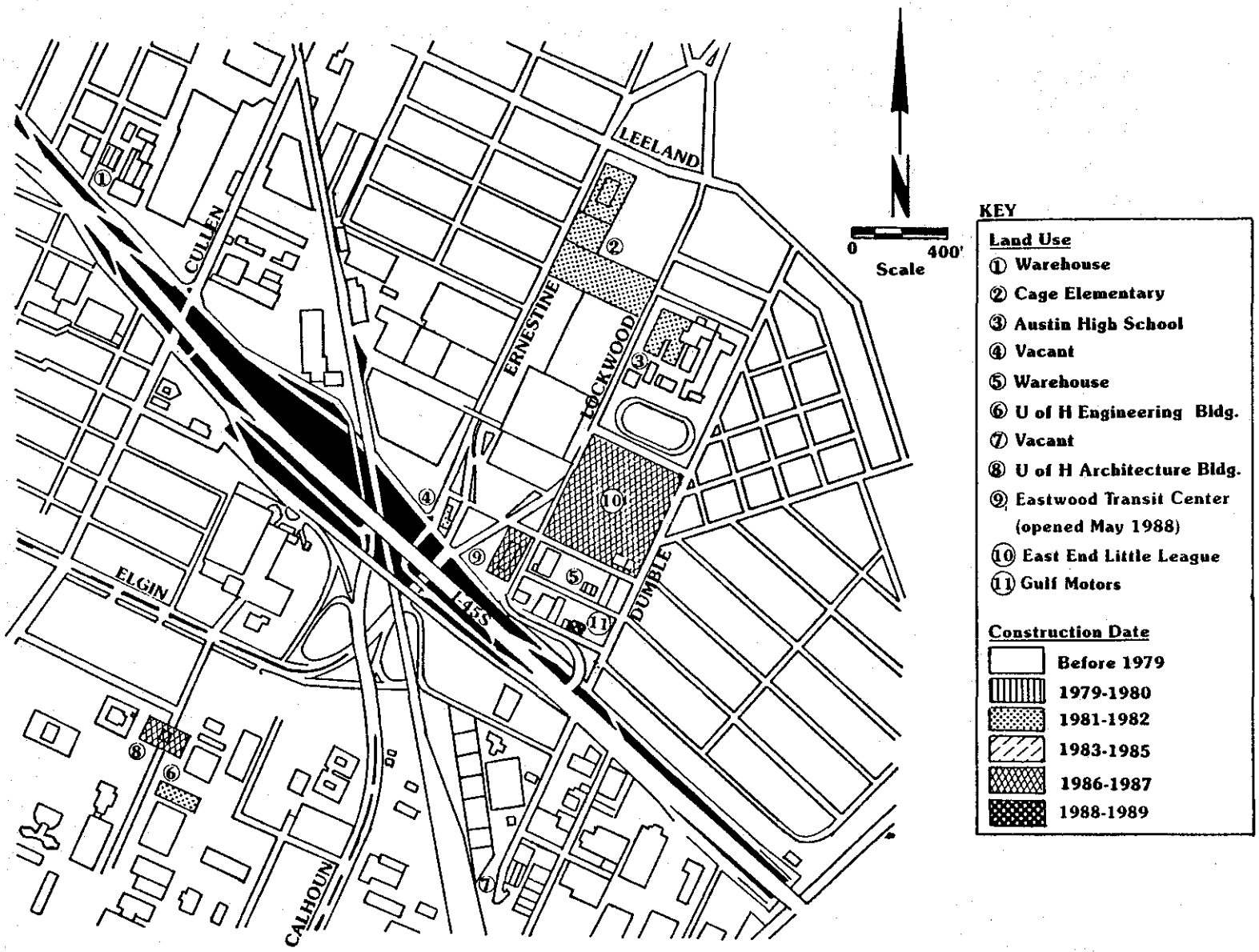


Figure 9. Land Use Trends in the Vicinity of the Eastwood Transit Center (1979-1988)

Table 13. Impact Area Development Assessment in the Vicinity of Spring Park-and-Ride Lot: "After" Period

	Year									
	1983		1984		1985		1986		1987	
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial	76	25	69	24	65	22	63	23	58	22
Residential	229	75	220	75	222	77	210	76	208	77
Public-Quasi-Public	1	0	2	1	2	1	2	1	3	1
Total	306	100	291	100	289	100	275	100	45	100

No. = Number of Addresses
Source: Cole's City Directory

4.3 KATY (I-10W) TRANSITWAY CORRIDOR

Two sites in the Katy Corridor were chosen to assess land use impacts of the park-and-ride lots and the Katy Transitway. The impacts on the area surrounding each site are summarized below.

4.3.1 Addicks Park-and-Ride

Figure 10 presents land use changes that have occurred in the area surrounding the Addicks Park-and-Ride Lot. The land use changes that have occurred most recently include the opening of two gasoline stations, one auto service establishment, as well as a truck and equipment rental business. All of these changes fit the general pattern of recent land use changes involving commercial and service uses on the south side of I-10W. However, there does not appear to have been any influence of either the transitway or the park-and-ride lot on these or any other land use changes.

The land use data, as shown in Tables 14 and 15, indicate that the trend of stabilization of commercial uses and slow but steady increases in residential uses has begun to change. The two most recent year's data show that a period of maintenance of each land uses' share of total land use may have begun.

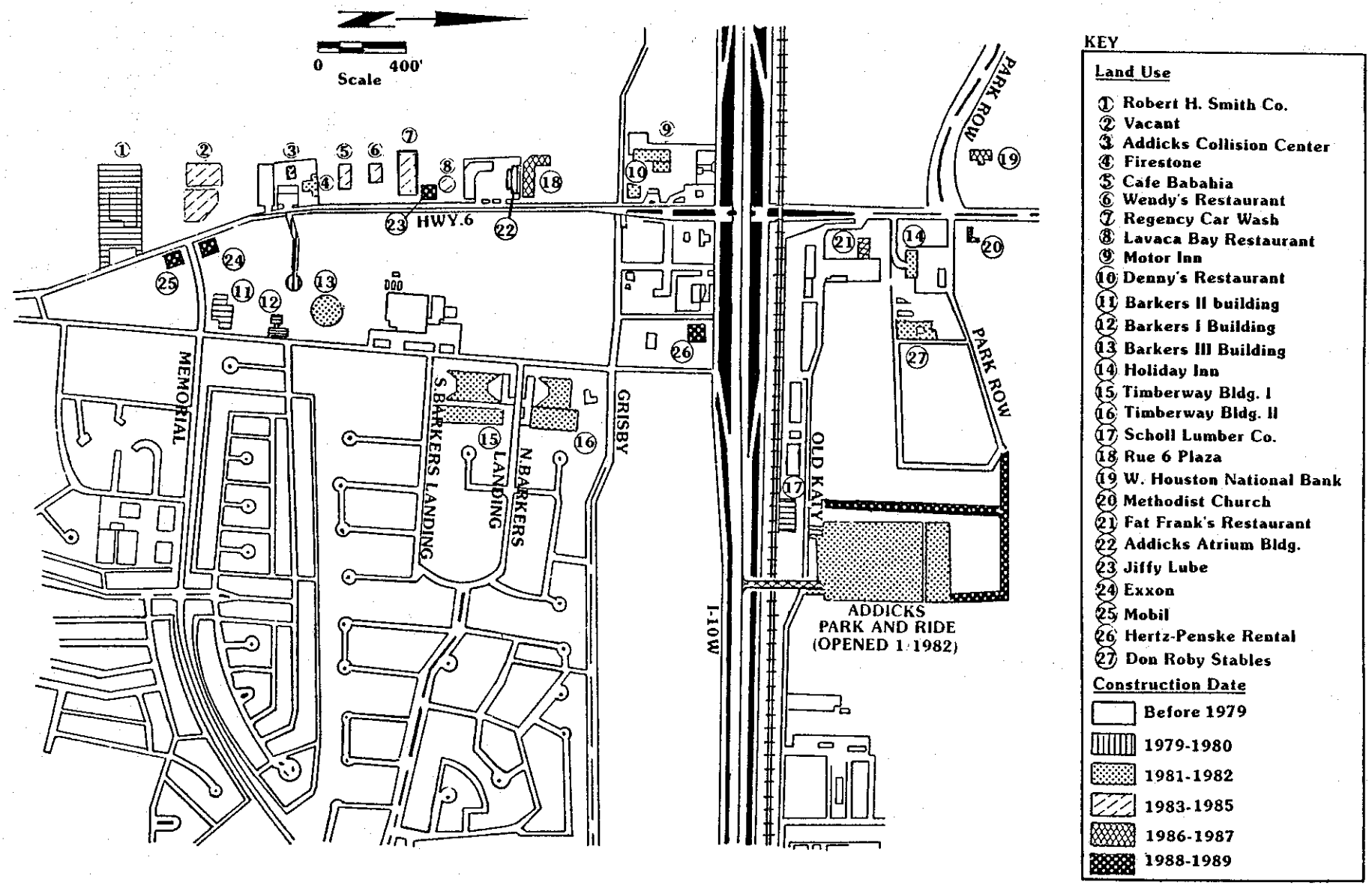


Figure 10. Land Use Trends in the Vicinity of the Addicks Park-and-Ride Lot (1979-1988)

Table 14. Impact Area Development Assessment in the Vicinity of the Addicks Park-and-Ride Lot: "Before" Period

	Year																			
	1973		1974		1975		1976		1977		1978		1979		1980		1981		1982	
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial	9	27	11	31	12	34	13	37	17	45	24	62	25	61	34	62	42	70	43	71
Residential	23	70	23	66	22	63	21	60	20	53	14	35	14	36	19	34	16	26	15	25
Public/Quasi-Public	1	3	1	3	1	3	1	3	1	2	1	2	1	2	1	2	1	2	1	2
Park or Recreational	-	-	-	-	-	-	-	-	-	-	-	-	1	2	1	2	1	2	1	2
Total	33	100	35	100	35	100	35	100	38	100	39	100	41	100	55	100	60	100	60	100

No. = Number of Sources
Source: Cole's City Directory

Table 15. Impact Area Development Assessment in the Vicinity of Addicks Park-and-Ride Lot: "After" Period

	Year									
	1983		1984		1985		1986		1987	
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial	52	74	46	69	55	69	53	65	54	64
Residential	17	24	20	30	24	30	28	34	30	35
Public/Quasi-Public	1	1	1	1	1	1	1	1	1	1
Park or Recreational	1	1	-	-	-	-	-	-	-	-
Total	71	100	67	100	80	100	82	100	85	100

No. = Number of Addresses
Source: Cole's City Directory

Figure 10 indicates that there are pockets of undeveloped land, particularly on the south side of I-10W. This combined with one aspect of the trend of land use changes described earlier (i.e., predominantly on the south side of I-10W) should make this area a site well suited for monitoring the land use impacts of the Katy Transitway and its park-and-ride lots.

4.3.2 Kingsland Park-and-Ride

Recent land use changes in the area surrounding the Kingsland Park-and-Ride Lot are presented in Figure 11. Land use changes identified in the past year include the opening of three fast food establishments and one auto service establishment. All three of the fast food establishments have opened in locations within a shopping center. Therefore, it appears that the overall trend of land use changes of a strip center or shopping center nature is continuing.

Details of the land use changes in the area around the Kingsland Park-and-Ride Lot are shown in Tables 16 and 17. Although there has been a park-and-ride facility in the area since 1980 (Mason Road Lot which was replaced by Kingsland Lot) there appears to have been no influence by these facilities on any land use changes that have occurred in the area thus far.

Table 16. Impact Area Development Assessment in the Vicinity of Kingsland Park-and-Ride: "Before" Period

	Year															
	1973		1974		1975		1976		1977		1978		1979		1980	
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial	-	-	-	-	-	-	1	25	0	0	8	12	33	35	49	43
Residential	-	-	2	100	2	100	3	75	38	95	55	87	60	64	63	56
Public/Quasi-Public	-	-	-	-	-	-	-	-	1	5	1	1	1	1	1	1
Total	-	-	2	100	2	100	4	100	39	100	64	100	94	100	113	100

No. = Number of Addresses
Source: Cole's City Directory

Of the four new land uses identified, only the auto service establishment location was previously a vacant tract of land. This probably does not mean that the previously identified trend of land use changes involving almost exclusively vacant tracts of land has ceased. It may merely be a result of recently established trends by fast food companies to locate outlets within or adjacent to developments which draw large concentrations of

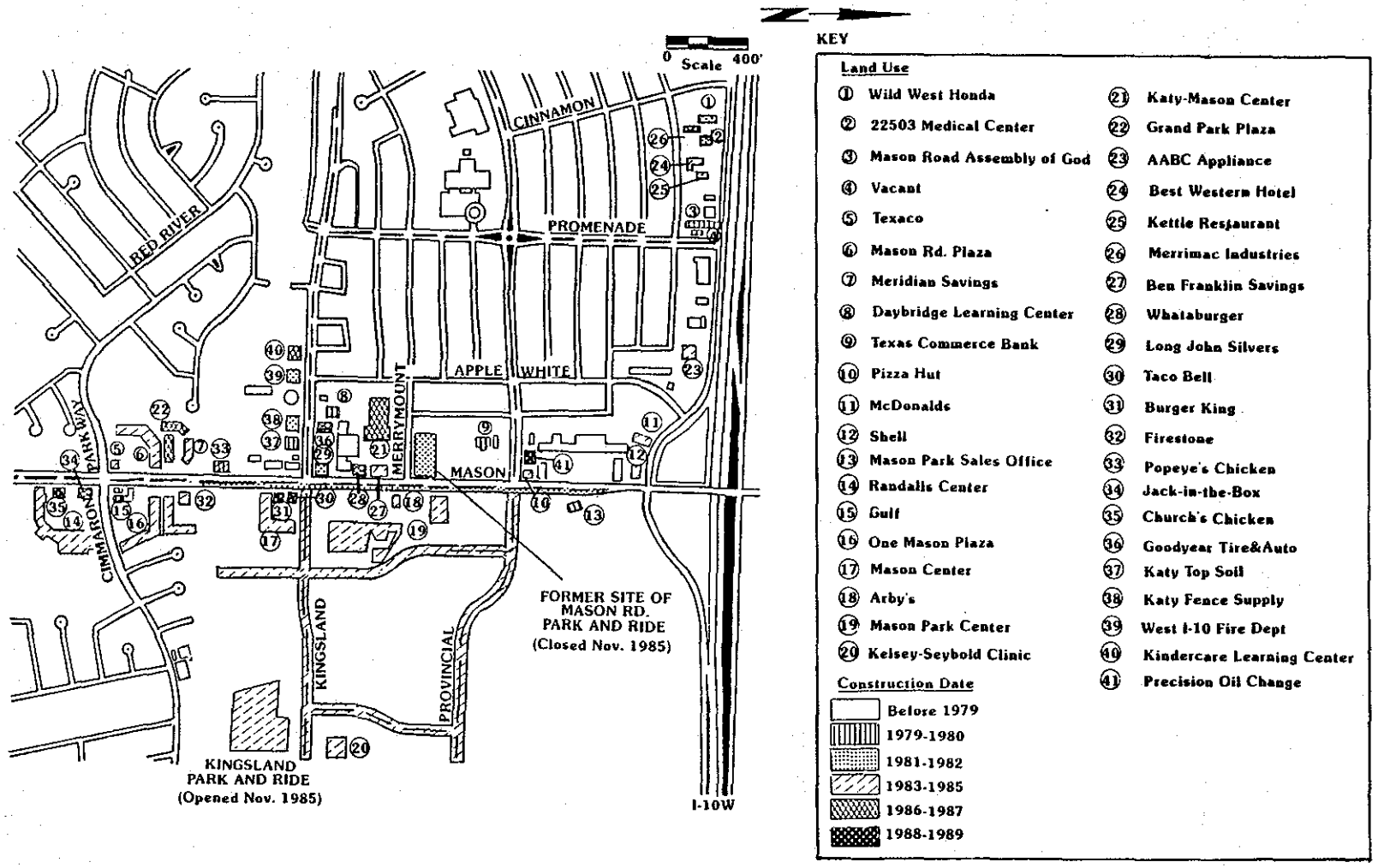


Figure 11. Land Use Trends in the Vicinity of the Kingsland Park-and-Ride Lot (1979-1988)

Table 17. Impact Area Development Assessment in the Vicinity of Kingsland Park-and-Ride Lot: "After" Period

	Year													
	1981		1982		1983		1984		1985		1986		1987	
Type of Use	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Commercial	57	46	63	152	67	51	62	52	92	61	101	61	105	62
Residential	65	53	55	47	61	47	54	46	57	38	63	38	62	37
Public/Quasi-Public	1	1	2	1	2	2	2	2	2	1	2	1		
Total	123	100	122	100	130	100	118	100	151	100	166	100	169	100

No. = Number of Addresses
Source: Cole's City Directory

customers. This, in combination with the economic slow-down in the Houston area has probably contributed to the fact that only one of the four land use changes in the past year involved a vacant tract of land.

5. CONCLUSIONS

This study suggests that the land use impacts of the HOV treatments along the North Freeway (I-45N) and Katy Freeway (I-10W), as well as the Gulf Freeway (I-45S) remain relatively insignificant. Only one of the seven sites showed any change in land use that may have resulted from the HOV facilities. However, areas in two of the three corridors surveyed have substantial amounts of undeveloped land and it may prove necessary to wait until the transitways and associated support facilities become fully operational and a healthy economic solution exists 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 research should result in a reasonable assessment of the potential land use impacts of transitway systems.

Additionally, there are still several untried aspects of the Houston Transitway system which could significantly add to its influence on development. These include (3):

- Intermediate access points will give the same impression as a freeway interchange (i.e., that the access is convenient).

- Service which fans out from the transitway access points to provide local pickup in neighborhoods and at business locations would increase the reality and perception of accessibility. This is an approach which has often been mentioned in association with transitways but has not been tried in the METRO system to date.

- Provide two-way service on the transitways. With all current service originating at the park-and-ride lots in the morning and going to the CBD predominantly, there is no increase in accessibility to the outlying business centers. This becomes increasingly important as an activity center grows. While it initially draws from a narrow market area in the immediate vicinity, as buildings are added, the market area must necessarily expand proportionally. As the draw area expands, transit becomes more important to assist those living more than 20 or 30 minutes away from work.

Based on the results obtained from this limited study, several areas for further research can be identified. These are:

1) An extension of the study to include factors other than transit (e.g., economy, zoning) which may influence land use impacts and the development decision-making process.

2) An investigation should be undertaken to determine the feasibility of the utilization of joint development as a means of encouraging desired development patterns.

3) A similar examination should be conducted using another park-and-ride facility not connected with priority treatments as a control area.

The expected result of the integration of land use management and transportation planning is the encouragement and control of the development forms of our cities. Thus, with the optimization of land use management and transportation planning, the economic, social, and environmental bases of urban areas are enhanced. All of the information mentioned above is vital to a better understanding of the land use impacts of Houston's Transitway system.

REFERENCES

1. Kuo, N.M., R.L. Peterson and J.M. Mounce. Evaluation of High-Occupancy Vehicle Priority Treatment Projects: First Year's Analysis. Research Report 339-2, Texas Transportation Institute, College Station, TX, August 1984.

2. Christiansen, D.L. and D.E. Morris. The Status and Effectiveness of the Houston Transitway System, 1988. Research Report 1146-1, Texas Transportation Institute, College Station, TX, July 1989.

3. Goodman, B.M. and Associates. Land Use and Innovative Funding Impacts In A Permanent Busway/Park-and-Ride Transit System: Turnkey Park-and-Ride Facility Investigation (Draft). Technical Report 1085-1, Barry M. Goodman and Associates, Inc., Houston, TX. Unknown Date.

4. Peterson R.L. and R.W. Stokes. Land Use and Innovative Funding Impacts In A Permanent Busway/Park-and-Ride Transit System: An Annotated Bibliography. Technical Report 1086-1, Texas Transportation Institute, College Station, TX, Dec. 1985.

5. Stokes, R.W. and R.L. Peterson. Land Use and Innovative Funding Impacts In A Permanent Busway/Park-and-Ride Transit System: Survey of Transitway Projects in the United States and Canada. Technical Report 1086-3, Texas Transportation Institute, College Station, TX, April 1986.

6. Ward, J.D. " A Look Ahead," Public Transportation: Planning, Operations and Management. Englewood Cliffs, N.J. Prentice Hall Inc. 1979, pp. 697-717.

7. Altshuler, A., J.P. Womack and J.R. Pucher. The Urban Transportation System: Politics and Policy Innovation, Cambridge, MA. MIT Press, 1981.

8. Page, J.H. and M.J. Demetsky. "Planning Development with Transit Projects," Thornton Hall, Civil Engineering, University of Virginia, Charlottesville, VA, Sept. 1984.

9. Downs, A. "How Transportation Arteries Impact Land Value," Urban Transportation: Perspectives and Prospects, Westport, CT, ENO Foundation for Transportation, 1982.

10. Baerwald, T.J. "Land Use Change in Suburban Clusters and Corridors," Transportation Research Record 861. Transportation Research Board, Washington, DC, 1982, pp. 7-12.

11. Rollins, J.B., J.L. Memmott and J.L. Buffington. Effects of Roadway Improvements on Adjacent Land Use: An Aggregative Analysis and the Feasibility of Using Urban Development Models. Report No. FHWA-TX-81-226-22, State Department of Highways and Public Transportation, Austin, TX, May 1981.

12. Bain, H. and E. Escudero. Land Use and Urban Development Project Research Plan (Planning Document - Final). Report No. PDS-17-5-75, Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC, September 1975, (NTIS No. PB-247 767/7ST).

13. Graff, D.L. and R.L Knight. Environmental Impacts of BART: Final Report. Rept. No. DOT-P-30-79-05, U.S. Department of Transportation, Washington, DC, April 1979.

14. Federal Highway Administration. The Influence of Central City Radial Freeways on Manufacturing Location Decisions, Volume 1. Contract No. DOT-FH-11-7765, U.S. Department of Transportation, Washington, DC, Sept. 1973, (NTIS No. PB-265-474/7ST).

15. Berechman, J. and R.E. Paaswell. "Rail Rapid Transit Investment and CBD Revitalization: Methodology and Results," Urban Studies No. 20, Urban Transportation Center, University of Illinois, Chicago, IL, 1983.

16. "Metrorail Impacts on Washington Area Land Values." Subcommittee on the City; Committee on Banking, Finance, and Urban Affairs, U.S. House of Representatives, Washington, DC, Jan. 1981.

17. Baker, C.W. "The Uneven Impacts of Washington's Metro." Planning. Vol. 50, No. 6, American Planning Association, Chicago, IL, June 1984, pp. 11-14.

18. Boyce, D.E. et al. Impact of Rapid Transit on Suburban Residential Property Values and Land Development: Analysis of the Philadelphia - Linderwold High-Speed Line. Regional Science Department, University of Pennsylvania, Office of the Secretary, U.S. Department of Transportation, Washington, DC, Nov. 1972, (NTIS No. PB 220 69316).

19. Gaegler, A.M. et.al. "Dynamic Social and Economic Effects of the Connecticut Turnpike," Transportation Research Record 716. Transportation Research Board, Washington, DC, 1979, pp. 28-32.

20. Watterson, W.T. Estimating Economic and Development Impacts of Transit Investments. Paper for the 64th Annual TRB Meeting, Transportation Research Board, Washington, DC, January 1985.

21. Dyett, M.V., et al. Land Use and Urban Development Impacts of BART: Final Report. Report No. DOT-P-30-79-09, U.S. Department of Transportation, Washington, DC, April 1979.

22. Misch, M.R., et al. Guidelines for Using Vanpools and Carpools as a TSM Technique. NCHRP Report 241, Transportation Research Board, Washington, DC, Dec. 1981.

23. Voorhees and Associates, Inc. Transportation Pooling. Report No. UMTA-IT-06-0092-74-1, Urban Mass Transportation Administration, Washington, DC, Jan.1974.

24. TenHoor, S.J. and S.A. Smith. "Parking-Requirement Reduction Process for Ridesharing: Current Practices, Evolving Issues, and Future Directions," Transportation Research Record 940. Transportation Research Board, Washington, DC, 1983, pp. 44-51.

25. Engelen, R.E. Coordination of Transportation System Management and Land Use Management, NCHRP Synthesis No. 93, Transportation Research Board, Washington, DC, Sept. 1982.

26. Potter, S. "The Transport Versus Land Use Dilemma," Transportation Research Record 964. Transportation Research Board, Washington, DC, 1984, pp. 10-17.

27. Kihl, M. and T. Flathers. "Integration of Land Use, Transportation, and Energy Planning in Midsized Cities," Transportation Research Record 940. Transportation Research Board, Washington, DC, 1983, pp. 28-33.

28. Urban Land Institute. Joint Development: Making the Real Estate-Transit Connection, Executive Summary. Report No. DOT-I-79-13, Urban Mass Transportation Administration, Washington, DC, July 1979.

29. Padron, M. "Build Here: Transit's Rallying Cry," Planning. Vol. 50, No. 6, American Planning Association, Chicago, IL, June 1984, pp. 6-10.

30. Selected Value Capture Opportunities Related to the Rapid Transit System in Metropolitan Atlanta. Atlanta Regional Commission, Atlanta, GA, May 1978.

31. Christiansen, D.L., R.W. Stokes, J.M. Mounce and W.R. McCasland. The I-45N Contraflow Lane, Houston, Texas: Assessment of the Operational Life. Report No. 205-16, Texas Transportation Institute, College Station, TX, Jan 1982.

32. "Project Description and Justification Proposed Phase 4 Extension Gulf Transitways (Preliminary Analyses)." Technical Memorandum, Work Order 4D, Texas Transportation Institute, College Station, TX, June 1989.

33. Peterson R.L., R.W. Stokes and B.M. Goodman and Associates. Land Use and Innovative Funding Impacts In A Permanent Busway/Park-and-Ride Transit System: Work Program. Technical Report 1086-2, Texas Transportation Institute, College Station, TX, Jan. 1986.

34. Peterson R.L. and R.W. Stokes. 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 (Draft). Technical Report 1086-4, Texas Transportation Institute, College Station, TX, July 1986.

35. Peterson R.L. and R.W. Stokes. Land Use and Innovative Funding Impacts In A Permanent Busway/Park-and-Ride Transit System: Land Use Data Base for Houston's Transitway Corridors and Second Year Summary. Technical Report 1086-5, Texas Transportation Institute, College Station, TX, Aug. 1986.

36. Mullins, J.A., E.J. Washington and R.W. Stokes. Land Use and Innovative Funding Impacts In A Permanent Busway/Park-and-Ride Transit System: Third Year Update, Technical Report 1086-6, Texas Transportation Institute, College Station, TX, Aug. 1987.

BIBLIOGRAPHY

Aarts, J.A. and J. Hamm. "The Effect of Ridesharing Programs on Suburban Employment Center Parking Demand." Paper for the 63rd Annual TRB Meeting, Transportation Research Board, Washington, DC. Jan. 1984.

Alderson, S.R. and Y. Stephanedes. "Developing Compatible Land Uses - Transportation Relationships in a Changing Urban Economic Structure." Paper presented at the 1984 ASCE Annual Convention, Metropolitan Council of the Twin Cities Area, St. Paul, MN. Sept. 1984.

Altshuler, A., J.P. Womack and J.R. Pucher. The Urban Transportation System: Politics and Policy Innovation. Cambridge, MA. MIT Press, 1981.

Appleyard, D. BART-II: Pre-BART Studies of Environment, Land Use, Retail Sales - Control Strategies (Final Report). Contract No. DOT-OS-90023, U.S. Department of Transportation, Washington, DC. June 1973 (NTIS No. PB-236 729/OSL).

Arndt, J.C. "Turnkey Park-and-Ride Development," Transportation Research Record 877. Transportation Research Board, Washington, DC. 1982, pp. 103-110.

Atherton, T.J., G.J. Scheunernstuhl and D. Hawkins. "Transportation - Related Impacts of Compressed Workweek: The Denver Experiment." Transportation Research Record 845. Transportation Research Board, Washington, DC. 1982, pp. 22-30.

Atherton T.J. and E.S. Eder. "Impacts of CBD Fare-Free Transit on Retail Sales." Transportation Research Record 861. Transportation Research Board, Washington, DC. 1982, pp. 16-23.

Babcock, W.F. An Analysis of the Impact of Freeways on Urban Land Developments in North Carolina (Including Guidelines for Highway Planning and Design) - Final Report. Report No. ERSD-110-71-4, Federal Highway Administration, Washington, DC. June 1974, (NTIS No. PB-252 986/5ST).

Baerwald, T.J. "Land Use Change in Suburban Clusters and Corridors." Transportation Research Record 861, Transportation Research Board, Washington, DC. 1982, pp. 7-12.

Bain, H. and E. Escudero. Land Use and Urban Development Project Research Plan (Planning Document - Final). Report No. PD-17-5-75, Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. Sept. 1975. (NTIS No. PB-247 767/7ST).

Bain, H. and F. Lyons. BART Impact Program; Public Policy Project: Research Plan (Planning Document - Final). Report No. PD-22-8-76, Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. April 1976. (NTIS No. PB-251 697/9ST).

Baker, C.W. "The Uneven Impact of Washington's Metro." Planning. Vol. 50, No. 6, American Planning Association, Chicago, IL. June 1984, pp. 11-14.

Barrie, D.S. and G.L. Mulch. "The Professional CM Team Discovers Value Engineering." ASCE Journal of the Construction Division. Vol. 103, No. CO3, American Society of Civil Engineers, New York, NY. Sept. 1977, pp. 423-435.

BART Impact Program Data Catalog (Planning Document). Prepared by Metropolitan Transportation Commission, Berkeley, California, Contract No. DOT-OS-30176. U.S. Department of Transportation, Washington, DC. Dec. 1976. (NTIS No. PB-264 613/1ST).

Barton, R.M. "Revitalization of Downtown Areas Through Railroad Track Relocation and Consolidation." Paper for the 1984 ASCE Annual Convention, DeLeuw, Cather and Company, San Francisco, CA. Oct. 1984.

Bay Area Rapid Transit: (BART) in the San Francisco Bay Area. The Final Report of the BART Impact Program. Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. June 1979. (NTIS No. PB-81-107674).

Bay, P.N. "Working With the Private Sector." Paper Presented at APTA Western Conference in Sacramento, California, American Public Transit Association, Washington, DC. June 1979. (NTIS No. PB-81-107674).

Berechman J. and R.E. Paaswell. "Rail Rapid Transit Investment and CBD Revitalization: Methodology and Results." Urban Studies, No. 20, Urban Transportation Center, University of Illinois, Chicago, IL. 1983, pp. 471-486.

Bergsman, J. et al. Development of Methodology for the Assessment of BART's Impacts Upon Economics and Finance Research Plan (Planning Document). Report No. PD-22-7-76, Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. Mar. 1975. (NTIS No. PB-250 719/2ST).

Bernard, M.J. III. Applications of the New Alternative Futures Planning Concept. (Paper presented at the 57th Transportation Research Board Meeting on January 16, 1978), Contract No. W-31-109-ENG-38, U.S. Department of Energy, Washington, DC. 1978. (NTIS No. PB-250 719/2ST).

Black, J.T. and J.E. Hoben. Urban Land Markets: Price Indices, Supply Measures, and Public Policy Effects. Report No. 0-87420-593-X, Contract No. HUD-H-5131CA, U.S. Department of Housing and Urban Development, Washington, DC. 1980. (NTIS No. PB81-136939).

Box, P.C. and J.C. Oppenlander. Manual of Traffic Engineering Studies, Fourth Edition. Institute of Transportation Engineers, Washington, DC. 1976.

Boyce D.E. "Notes on the Methodology of Urban Transportation Impact Analysis." Highway Research Board Special Report No. 111. Highway Research Board, Washington, DC. 1970.

Boyce, D.E. et al. Impact of Rapid Transit on Suburban Residential Property Values and Land Development: Analysis of the Philadelphia-Linderwold High-Speed Line. Regional Science Department University of Pennsylvania, Office of the Secretary, U.S. Department of Transportation, Washington, DC. Nov. 1972. (NTIS No. PB220 693/6).

Briggs, R. The Impact of Interstate Highway System on Non-Metropolitan Growth (Final Report). Contract No. DOT-RC-92010, U.S. Department of Transportation, Washington, DC. Dec. 1980. (NTIS No. PB81-212987).

Brosch, G.L. et al. Non-Federal Funding For Transit System: State-of-the Art Case Analyses (Final Report). Report No. UMTA-TX-06-0045, Urban Mass Transportation Administration, Washington, DC. Mar. 1985.

Bucklin, L.P. BART-II: Pre-BART Studies of Environment, Land Use, Retail Sales - BART Impact on Retail Sales (Final Report). Contract No. DOT-OS-90023, U.S. Department of Transportation, Washington, DC. June 1973. (NTIS No. PB-236 747/2SL).

Buffington J.L., C.W. Herndon and M.E. Weiss. Non-User Impacts of Different Highway Designs as Measured by Land Use and Land Value Changes. Report No. FHWA-TX-77-225-2, State Department of Highways and Public Transportation, Austin, TX. March 1978.

Burgwald, B., W. Cole and C. Wagner. Investigating the Relationship Between Land Use Planning, Transportation and Energy Consumption. Contract No. DTOS59-80-C-0060, U.S. Department of Transportation, Washington, DC. Jan. 1981. (NTIS No. PB82-122185).

Burnett, B. "Traveler Response to Changes in Work Locations: The HHS/DOE Employees Post-Relocation Transportation Survey." Selected Papers on Major Issues Facing Public Transit-Productivity, Volume III. American Public Transit Association, Washington, DC. 1983, pp. 89-106.

Carp, F.M. Theory Background of Bart's Impacts on Human Perception and Response. Report No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. March 1976. (NTIS No. PB-258 368/SL).

Carter, M.M., et al. Transit Corridor Analysis - A Manual Sketch Planning Technique. Report No. UMTA-MD-06-0046-79-1, Urban Mass Transportation Administration, Washington, DC, April 1979.

Cervero, R. "Light Rail Transit and Urban Development." Journal of the American Planning Association. Volume 50, Number 2, American Planning Association, Chicago, IL. Spring 1984.

Charles River Associates, Inc. Predicting Travel Volumes for HOV Priority Techniques: Technical Report. Report No. FHWA/RD - 82/043, Federal Highway Administration, Washington, DC. April 1982.

Christiansen, D.L., R.W. Stokes, J.M. Mounce and W.R. McCasland. The I-45N Contraflow Lane, Houston, Texas: Assessment of the Operational Life. Report No. 205-16, Texas Transportation Institute, College Station, TX. Jan. 1982.

Christiansen, D.L. and D.E. Morris. The Status and Effectiveness of the Houston Transitway System, 1988. Research Report 1146-1, Texas Transportation Institute, College Station, TX. July 1989.

Christensen, D.L. Photo Survey of Development and Activities in the Vicinity of BART Stations - Users Guide (Final Report). Report No. FR-4-17-75, Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. July 1975. (NTIS No. PB-247 768/5ST).

Christensen, K. Social Impacts of Land Development: An Initial Approach for Estimating Impacts on Neighborhood Usages and Perceptions. The Urban Institute, Washington, DC. 1976.

Christoffel, T.J. Impacts: I-66 and Growth (Summary). U.S. Department of Housing and Community Development, Washington, DC. March 1980. (NTIS No. PB81-119497).

Chumak, A. and D. Bolger. "The Impact of LRT on Travel Behavior in Calgary." Paper for the 63rd Annual TRB Meeting, Transportation Research Board, Washington, DC. Jan. 1984.

Clemons, D. and J. Corpus. BART-II: Pre-Bart Studies of Environment, Land Use, Retail Sales - Appendix C, Data Documentation for the Land Use and Investment Study. Contract No. DOT-OS-90023, U.S. Department of Transportation, Washington, DC. June 1973. (NTIS No. PB-236 750/6SL).

Courage, K.G. et al. Report 2 - Effects of NW 7th Avenue Bus Priority Systems on Bus Travel Times and Schedule Variability. Report No. UMTA-FL-06-0006, U.S. Department of Transportation, Washington, DC. March 1977.

Daganzo, C.F. "Equilibrium Model for Carpools on an Urban Network." Transportation Research Record 835. Transportation Research Board, Washington, DC. 1981, pp. 74-79.

Dial, R., D. Levinsohn and G.S. Rutherford. "Integrated Transit -Network Model (INET): A New Urban Transportation Planning System Program." Transportation Research Record No. 761. Transportation Research Board, Washington, DC. 1980, pp. 33-40.

Donnelly, P. Rail Transit Impact Studies: Atlanta, Washington, San Diego. Report No. DOT-I-82-3, Urban Mass Transportation Administration, Washington, DC. March 1982.

Donnelly, R. and J. Arguelles. Implications of BART's Impacts for the Transportation Disadvantaged. Report No. DOT-P-30-79-12, Urban Mass Transportation Administration, Washington, DC. April 1979.

Downey, M.L. "Generating Private Sector Financing for Public Transportation," Selected Papers on Major Issues Facing Public Transit-Financing, Volume I. American Public Transit Association, Washington, DC. 1983, pp. 13-27.

Downer, J.P. "Transportation Means Business." Paper for the 1982 Mass Transit Show and Conference, Atlantic Richfield Company, Los Angeles, CA. April 5, 1982.

Downs, A. "How Transportation Arteries Impact Land Value." Urban Transportation: Perspectives and Prospects, Westport, CT, ENO Foundation for Transportation, 1982, pp. 105-109.

Dueker, K.J., P. Pendleton and P. Luder. The Portland Mall Impact Study. Report No. DOT-I-83-7, Urban Mass Transportation Administration, Washington, DC. Dec. 1982.

Dunphy, R.T. "The Impact of Metro Rail on Trip-Making by Nearby Residents: The Van Ness Case Study." Paper for the 63rd Annual TRB Meeting, Transportation Research Board, Washington, DC. Jan. 19, 1984.

Dunphy, R.T. Trends Before Metrorail. Metropolitan Washington Council of Governments, Washington, DC. July 1982.

Dunphy, R.T. and R.E. Griffiths. The First Four Years of Metrorail: Travel Changes. Metropolitan Washington Council of Governments, Washington, DC. Sept. 1981.

Duster, T and C. Fischer. Phase I- Research Plan: Institutions and Life Styles Project, BART Impact Program (Planning Document). Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. Jan. 1975. (NTIS No. PB-240 467/1st).

Dyett, M. et al. Land Use and Urban Development Impacts of BART: Final Report. Report No. DOT-P-30-79-09, U.S. Department of Transportation, Washington, DC. April 1979.

Dyett, M.V. Recommendations for Long-Term Monitoring (Working Paper on BART Study). Report No. DOT-BIP-WP-54-5-78, U.S. Department of Transportation, Washington, DC. July 1978. (NTIS No. PB-291 016/4ST).

Dyett, M.V. Station Area Land Use: BART Impact Program - Land Use and Urban Development Project. Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. Nov. 1977. (NTIS No. PB-282 996/8ST).

Ellis, R.H., R.D. Worrall and A. Sherret. Transportation Systems and Travel Behavior Project Research Plan (Planning Document). Report No. PD-14-3-75, Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. May 1975. (NTIS No. PB-242 439/8ST).

Employment Impacts of Transit Capital Investment and Operating Expenditures. American Public Transit Association, Washington, DC. April 1, 1983.

Engelen, R.E. Coordination of Transportation System Management and Land Use Management. NCHRP Synthesis No. 93, Transportation Research Board, Washington, DC. Sept. 1982.

Environment Project Research Plan (Planning Document on BART Study). Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. Jan. 1975. (NTIS No. PB-257 442/4ST).

Ercolano, J.M. "Utilizing Limited-Stop Bus Operations: An Evaluation." Paper for the 63rd Annual TRB Meeting, Transportation Research Board, Washington, DC. Jan. 1984.

European Conference of Ministers of Transport. Exchange of Information on Investment Criteria Applied to Transport Infrastructure Projects. Report ISBN 92-821-1070-2, Sale of Publications Department, Organization for Economic Cooperation and Development (OECD), Washington, DC. 1981.

Fajans, M.H. and M.V. Dyett. Program - Wide Case Studies; Land Use and Urban Development Project - BART Impact Program (Working Paper). Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. July 1978. (NTIS No. PB-291 388/7ST).

Falcke, C.O. Study of BART's Effects on Property Prices and Rents (Working Paper). Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. July 1978. (NTIS No. PB-292 401/7ST).

Fauth, G.R. and J.A. Gomez-Ibanez. "New Location Patterns and U.S. Transportation Policy (Abridgement)." Transportation Research Record 716. Transportation Research Board, Washington, DC. 1979, pp. 36-38.

Fondahl, J.W. and B.C. Paulson. Development of Research in the Construction of Transportation Facilities - A Study of Needs, Objectives, Resources, and Mechanisms for Implementation. Contract No. DOT-OS-60150, U.S. Department of Transportation, Washington, DC. Aug. 1979. (NTIS No. PB-301 389/3SL).

Fratessa, C. and W.Y. Lim. Systan's Macro-Analytic Regionwide Transportation Model: Applications Manual. Report No. DOT-I-83-57, Urban Mass Transportation Administration, Washington, DC. March 1983.

Gaegler, A.M., J.W. March and P. Weiner. "Dynamic Social and Economic Effects of the Connecticut Turnpike." Transportation Research Record 716. Transportation Research Board, Washington, DC. 1979, pp. 28-32.

Gersten, M.C. "I-395/I-66 Traffic Management System." Journal of Transportation Engineering. Vol. 110, No. 5, American Society of Civil Engineers, New York, NY. Sept. 1984, pp. 455-466.

Goepfert, C.W. "Turnkey Projects for Downtown People Movers." Transportation Engineering Journal. Vol. 108, No. TE4, American Society of Civil Engineers, New York, NY. July 1982, pp. 383-391.

Gomez-Ibanez, J.A. and D.B. Lee. "Economic Evaluation of Highway Investment Needs." Transportation Research Record 940. Transportation Research Board, Washington, DC. 1983, pp. 21-27.

Goodman B.M. and Associates. Land Use and Innovative Funding Impacts In A Permanent Busway/Park-and-Ride Transit System: Turney Park-and-Ride Facility Investigation (Draft). Technical Report 1085-1, Barry M. Goodman and Associates, Inc., Houston, TX. Unknown Date.

Graebner, L.S., T. Higgins and E. Curtis. The Impact of Bart on Local Transit Service and Financial Policy (Working Paper). Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. Sept. 1977, (NTIS No. PB-292 402/5ST).

Graebner, L.S., et al. The Impact of BART on Public Policy. (Report No. DOT-P-30-79-07), Urban Mass Transportation Administration, Washington, DC. April 1979.

Graebner, L.S., et al. The Local Implications of BART Development: Final Report. Report No. DOT-P-30-79-11, Urban Mass Transportation Administration, Washington, DC. April 1979.

Graff, D.L. and R.L. Knight. Environmental Impacts of BART: Final Report. Report No. DOT-P-30-79-05, U.S. Department of Transportation, Washington, DC. April 1979.

Grefe, R. and A.N. McDonald. The Economic and Financial Impacts of BART: Final Report. Report No. DOT-P-30-79-04, U.S. Department of Transportation, Washington, DC. April 1979.

Grefe, R. et al. The Impact of BART on the Competitive Advantage and Efficiency of Bay Area Business Operations. Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. Aug. 1977. (NTIS No. PB-273 485/3ST).

Grefe, R. and A.N. McDonald. The Impact of BART on Economics and Finance - Interpretive Summary of the Final Report. Report No. DOT-P-30-80-05, U.S. Department of Transportation, Washington, DC. Dec. 1979.

Grefe, R., A.N. McDonald and D. McLeod. Theoretical Framework for the Evaluation of Economic and Financial Impacts of BART (Working paper). Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. July 1976. (NTIS No. PB-261 362/8ST).

Gruver, J. and W. Reulein. "Estimating the Impact of Changing Highway Conditions." Transportation Research Record 940. Transportation Research Board, Washington, DC. 1983, pp. 1-7.

Hallam, C.E. and G. Pindor. "Prediction of Land Use Traffic Impact." Transportation Research Record 940. Transportation Research Board, Washington, DC. 1983, pp. 51-61.

Henke, C. "The Other Rapid Transit?" Metro. Volume 80, Number 4, Metropolitan, Redando Beach, CA. Aug. 1984, pp. 14-18.

Higgins, T.J. The Impact of BART on State Highway Plans and Policies. Report No. DOT-BIP-WP-30-8-77, U.S. Department of Transportation, Washington, DC. Oct. 1977.

Hoel, L.A. and L.G. Richards. Planning and Development of Public Transportation Terminals. Report No. DOT-RSPA-DPB-50- 81-19, U.S. Department of Transportation, Washington, DC. Jan. 1981.

Holden, A. and R.L. Peterson. Bus Priority Measures for The City of Fort Worth. Transportation Planning Division, City of Fort Worth, Fort Worth, TX. March 1978.

Hupp, R.C. "Vanpool travel Characteristics In Southeast Michigan (Abridgement)." Transportation Research Record No. 823. Transportation Research Board, Washington, DC. 1981, pp. 15-17.

Jarzab, J.T. "Use of Impact Models to Identify Economic Effects of Transportation Capital Projects." Paper presented at 1984 ASCE Annual Convention, Northeastern Illinois Planning Commission, Chicago, Illinois Planning Commission, Chicago, IL. Jan. 15, 1985.

Jonach, R.S. The Impact of BART on Land Use and Development Policy (Working Paper). Contract No. DOT-Os-30176, U.S. Department of Transportation, Washington, DC. Sept. 1977. (NTIS No. PB-291 957/9ST).

Kalauskas, C. et al. An Analysis of the I-93 Preferential Lane. Central Transportation Planning Staff, Contract No. MA-09-0051, Urban Mass Transportation Administration, Washington, DC. July 1981.

Kalanskas, C. et al. Southeast Expressway - Evaluation of the Downtown Express Lane. Central Transportation Planning Staff (CTPS) Technical Report #3, U.S. Department of Transportation, Washington, DC. Dec. 1977.

Karash, K.H. "The Effect of an Auto Restricted Zone in a Transit Oriented Downtown." Paper for the 1984 ASCE Annual Convention, Massachusetts Bay Transit Authority, Boston, MA. Aug. 1984.

Keefer, L.E. "An Interim Review of Nine UMTA Assisted Joint Development Projects." Paper for the 63rd Annual TRB Meeting, Transportation Research Board, Washington, DC. January 1984.

Keefer, L.E. An Interim Review of Nine UMTA-Assisted Joint Development Projects-Summary Report. Report No. DOT-I-83-46, Urban Mass Transportation Administration, Washington, DC. Oct. 1983.

Kenyon, K.L. "Increasing the Mode Split Through Parking Management: A Suburban Success Story." Seattle/King County Commuter Pool, Seattle, WA. Aug. 1983.

Kern, C. R. and S.R. Lerman. "Models for Predicting the Impact of Transportation Policies on Retail Activity." Transportation Research Record 677. Transportation Research Board, Washington, DC. 1978, pp.34-41.

Keyser Marston Associates, Inc. Long Beach-Los Angeles Rail System Transit Project: Economic Development Strategy. Los Angeles County Transportation Commission, Los Angeles, CA. April 1984.

Khisty, C.J. "Land-Use-Allocation Model for Small and Medium-Sized Cities." Transportation Research Record 730. Transportation Research Board, Washington, DC. 1979, pp. 34-38.

Kihl, M. and T. Flathers. "Integration of Land Use, Transportation, and Energy Planning in Midsized Cities." Transportation Research Record 940. Transportation Research Board, Washington, DC. 1983, pp. 28-33.

Kim, T.J. "Effects of Subways on Urban Form and Structure." Transportation Research. Vol. 12, University of Illinois, Urbana, IL. Aug. 1978, pp. 231-239.

Knight, R.L. and L.L. Trygg. Land Use Impacts of Rapid Transit: Implications of Recent Experiences. Contract No. DOT-OS-60181, U.S. Department of Transportation, Washington, DC. Aug. 1977. (NTIS No. PB-287 190/3ST).

Kulkarni, R., et al. Maintenance Levels-of-Service Guidelines. NCHRP Report 223, Transportation, Washington, DC. June 1980.

Kumer, A. and Y. Gur. "Consideration of Alternative Access, Egress, and Line-Haul Travel Choices WIthin UTPS Framework." Transportation Research Record No. 895. Transportation Research Board, Washington, DC. 1982, pp. 11-17.

Kuo, N.M., Peterson, R.L. and J.M. Mounce. Evaluation of High-Occupancy Vehicle Priority Treatment Projects: First Year's Analysis. Research Report 339-2, Texas Transportation Institute, College Station, TX. Aug. 1984.

Lee, D.B. BART-II: Pre-BART Studies of Environment, Land Use, Retail Sales -Impacts of BART on Prices of Single Family Residences (Final Report). Contract No. DOT-OS-90023, U.S. Department of Transportation, Washington, DC. June 1973. (NTIS No. PB-236 746/4SL).

Lee, D.B. "How to do a Transit Station Land-Use Impact Study." Transportation Research Record 677. Transportation Research Board, Washington, DC. 1978, pp. 28-33.

Levinson, H.S. "Urban Travel Characteristics." Transportation and Traffic Engineering Handbook, Second Edition. Institute of Transportation Engineers, Washington, DC. 1982, pp. 255-307.

Liew, C.K. and C.J. Liew. "Use of Multiregional Variable Input -Output Model to Analyze Economic Impacts of Transportation Costs." Transportation Research Record 747. Transportation Research Board, Washington, DC. 1980, pp. 5-12.

Liskamm, W.H. and R. Conradt. Serramonte Transit Center Study. Report No. DOT-I-83-45, Mass Transportation Administration, Washington, DC. June 1983.

Lundberg, B.D. and R. Conradt. "Joint Development in Cedar Rapids." Planning. Volume 50, No. 6, American Planning Association, Chicago, IL. June 1984, pp. 11-14.

Lutin, J.M. and B.P. Markowicz. "Interactive Model for Estimating Effects of Housing Policies on Transit Ridership." Transportation Research Record 835. Transportation Research Board, Washington, DC. 1981, pp. 47-52.

MacDonald, R. "Practical Solutions for the Financing and Construction of PRT Systems." International Conference on Personalized Rapid Transit, Vol. 1, Paper 7, University of Colorado, Center for Urban Transportation Studies, Boulder, CO. Sept. 1975.

May, A.D. "Demand-Supply Modeling for Transportation System Management." Transportation Research Record 835. Transportation Research Board, Washington, DC. 1981, pp. 80-86.

McQueen, J.T. et al. The Evaluation of the Shirley Highway Express-Bus-on-Freeway Demonstration Project. Urban Mass Transportation Administration, Washington, DC. Aug. 1975. (NTIS No. PB-247 637/2ST).

Merchant, J.P., V. Gussman and C.O. Falcke. Study of Retail Sales and Services (Working Paper on BART Study). Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. April 1978. (NTIX No. PB-291 44310ST).

Metropolitan Planning Organization. DPM Assessment Study Design: Miami Downtown People Mover. Metropolitan Dade County, Miami, FL. Sept. 1980.

Metropolitan Washington Council of Governments. Economic and Transportation Impact Analysis: Takoma Park Study Area. Washington, DC. Feb. 1968. (NTIS No. PB-184 235).

Metropolitan Washington Council of Governments. Metrorail Station Area Planning: A Metrorail Before-After Study Report. Report No. DOT-I-83-50, Urban Mass Transportation Administration, Washington, DC. Aug. 1983.

"Metrorail Impacts on Washington Area Land Values." Subcommittee on the City; Committee on Banking, Finance, and Urban Affairs. U.S. House of Representatives, Washington, DC. Jan. 2, 1981.

Minkus, D. and P.M. Gelb. Impacts of BART on Bay Area Health Care Institutions: BART Impact Program. Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. March 1977. (NTIS No. PB-266 614/7ST).

Misch, M.R., et al. Guidelines for Using Vanpools and Carpools as a TSM Technique. NCHRP Report 241, Transportation Research Board, Washington, DC. Dec. 1981.

Moore, C.T. Land Use Analysis In A Highway Corridor Area. Report No. HPR-13-B, Bureau of Public Roads, U.S. Department of Transportation, Washington, DC. Feb. 1968. (NTIS No. PB-179 583).

Mullins, J.A., E.J. Washington and R.W. Stokes. Land Use Impacts of the Houston Transitway System: Third Year Update. Technical Report 1086-6, Texas Transportation Institute, College Station, TX. Aug. 1987.

Muse, E.C. "Environmental Planning and Design for Rapid Transit Facilities." Transportation Research Record 716. Transportation Research Board, Washington, DC. 1979, pp. 1-8.

Nicholls, W.L. Sampling and Field Work Methods of 1973-74 BART Impact Travel Study (Working Paper). Report No. MTC-WP-1-3-74, Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. July 1974. (NTIS N0. PB-235 046/0).

1981 Transit Impact Monitoring Program Annual Report: Technical Appendix. Atlanta Regional Commission, Atlanta, GA. Jan. 1982.

Noguchi, T. "Shaping a Suburban Activity Center Through Transit and Pedestrian Incentives: Bellevue CBD Planning Experience." Transportation Research Record 861. Transportation Research Board, Washington, DC. 1982, pp. 1-6.

O'Carroll, S.J. and G.S. Spivack. "Joint Development and the Los Angeles Metro Rail -- A Status Report." Paper for the 63rd Annual TRB Meeting, Transportation Research Board, Washington, DC. Jan. 1984.

OECD Road Research Group. Transport Choices for Urban Passengers - Measures and Models. Organization for Economic Cooperation and Development (OECD, Washington, DC. Sept. 1980.

OECD Road Research Group. Transport Choices for Urban Passengers - Measures and Models. Organization for Economic Cooperation and Development (OECD), Washington, DC. Oct. 1980.

Ou, F.L. and J. Rupe. "Use of IRPM for Transportation and Land-Use Planning in National Forests." Transportation Research Record 964. Transportation Research Board, Washington, DC. 1984, pp. 29-36.

Paaswell, R.E., et al. An Analysis of Rapid Transit Investments: The Buffalo Experience. Report No. DOT-I-81-32, Urban Mass Transportation Administration, Washington, DC. July 1981.

Padron, M., "Build Here: Transit's Rallying Cry." Planning. Vol. 50, No. 6, American Planning Association, Chicago, IL. June 1984, pp. 6-10.

Page, J.H. and M.J. Demetsky. "Planning Development with Transit Projects." Thornton Hall, Civil Engineering, University of Virginia, Charlottesville, VA. Sept. 1984.

Page, J.H., M.J. Demetsky and L.A. Hoel. A Methodology for Transit Station Impact Analysis. Paper for the 63rd Annual TRB Meeting, Transportation Research Board, Washington, DC. Jan. 1984.

Page, J.A. et al. Catalog of Transit Station Impact Case Studies. Report No. DOT-I-83-53, Research and Special Programs Administration, Washington, DC. Aug. 1983.

Page, J.H. et al. Impacts of Public Transportation Terminals on Land Use and Community Development. (Methodology for the Analysis of Transit Station Impacts). Contract No. DTRS 5681-C-00031, U.S. Department of Transportation, Washington, DC. Jan. 1984.

Parker, J.A. "Maximizing the Use of Private Credit Markets for Transit Investments." Transportation Research Record 967. Transportation Research Board, Washington, DC. 1984, pp. 37-42.

Parody, T.E. "Predicting Travel Volumes for High-Occupancy-Vehicle Strategies: A Quick-Response Approach." Transportation Research Record 976. Transportation Research Board, Washington, DC. 1984, pp. 49-56.

Parody, T.E. Predicting Travel Volumes for HOV Priority Techniques: User's Guide. Report No. FHWA/RD-82/042, Federal Highway Administration, Washington, DC. April 1982.

Partners for Livable Places. The Way to Go: The Benefits of Quality Design in Transportation. Technology Sharing Program, U.S. Department of Transportation, Washington, DC. April 1983.

Payne-Maxie Consultants and Blayney-Dyett, Urban and Regional Planners. The Land Use and Urban Development Impacts of Beltways - Final Report. Report No. DOT -P-30-80-39, U.S. Department of Transportation, Washington, DC. June 1980. (NTIS No. PB81-242141).

Payne-Maxie Consultants and Blayney-Dyett, Urban and Regional Planners. The Land Use and Urban Development Impacts of Beltways - Final Report. Report No. DOT-P-30-80-38, U.S. Department of Transportation, Washington, DC. Oct. 1980.

Payne-Maxie Consultants and Blayney-Dyett, Urban and Regional Planners. The Land Use and Urban Development Impacts of Beltways -Guidebook. Report No. DOT-P-30-80-39, U.S. Department of Transportation, Washington, DC. Oct. 1980

Payne-Maxie Consultants and Blayney-Dyett, Urban and Regional Planners. The Land Use and Urban Development Impacts of Beltways - Summary. Report No. DOT-P-30-80-40, U.S. Department of Transportation, Washington, DC. Oct. 1980.

Peterson, R.L. Exclusive Bus/Carpool Lanes for the Fort Worth Metropolitan Area. Traffic Engineering Department, City of Fort Worth, Fort Worth, TX. Feb. 1974.

Peterson, R.L. and R.W. Stokes. Land Use and Innovative Funding Impacts In A Permanent Busway/Park-and-Ride Transit System: An Annotated Bibliography. Technical Report 1086-1, Texas Transportation Institute, College Station, TX. Dec. 1985.

Peterson, R.L., R.W. Stokes and B.M. Goodman and Associates. Land Use and Innovative Funding Impacts In A Permanent Busway/Park-and-Ride Transit System: Work Program. Technical Report 1086-2, Texas Transportation Institute, College Station, TX. Jan. 1986.

Peterson, R.L. and R.W. Stokes. 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 (Draft). Technical Report 1086-4, Texas Transportation Institute, College Station, TX. July 1986.

Peterson, R.L. and R.W. Stokes. Land Use and Innovative Funding Impacts in a Permanent Busway/Park-and-Ride Transit System: Land Use Data Base for Houston's Transitway Corridors and Second Year Summary. Technical Report 1086-5, Texas Transportation Institute, College Station, TX. Aug. 1986.

Pincus, D. and J. Hodnett. "Public Transit and the Business Community." American Public Transit Association, Washington, DC. 1981.

Politano, A. "Urban Blight and Highways in the Central Cities: Theoretical and Practical Perspectives (Abridgement)." Transportation Research Record 747. Transportation Research Board, Washington, DC. 1980, pp. 63-66.

Pomeroy, L.H., J. Blyn and S. Burdick. "Land Donations as Local Match on Small Scale Transit Projects." Selected Papers on Major Issues Facing Public Transit - Financing, Volume I. American Public Transit Association, Washington, DC. 1983, pp. 29-38.

Potter, S. "The Transport Versus Land Use Dilemma." Transportation Research Record 964. Transportation Research Board, Washington, DC. 1984, pp. 10-17.

"Project Description and Justification Proposed Phase 4 Extension Gulf Transitway (Preliminary Analyses)." Technical Memorandum, Work Order 4D, Texas Transportation Institute, College Station, TX. June 1989.

Public Technology, Inc. Economic Impacts of Transportation Restraints. U.S. Department of Transportation, Washington, DC. Sept. 1980.

Public Technology, Inc. Joint Development: A Handbook for Local Government Officials. Report No. DOT-I-83-48, Urban Mass Transportation Administration, Washington, DC. Sept. 1983.

Public Technology, Inc. Proceedings of the Joint Development Marketplace '80. Report No. DOT-I-81-4, Urban Mass Transportation Administration, Washington, DC. June/July 1980.

Public Technology, Inc. "The Coordination of Parking with Public Transportation and Ridesharing." Information Bulletin No. DOT-I-82-29, U.S. Department of Transportation, Washington, DC. June 1982.

Pushkarev, B. and J. Zupan. Urban Rail In America: An Exploration of Criteria for Fixed - Guideway Transit. Report No. UMTA-NY-06-0061-80-1, Urban Mass Transportation Administration, Washington, DC. Nov. 1980.

Robert J. Harmon and Associates, Inc. Miami's Downtown Component of Metrorail: Public-Private Conventure Financing Using A Special Assessment District. Report No. DOT-I-84-16, Urban Mass Transportation Administration, Washington, DC. Feb. 1984.

Rollins, J.B., J.L. Memmott and J.L. Buffington. Effects of Roadway Improvements on Adjacent Land Use: An Aggregative Analysis and the Feasibility of Using Urban Development Models. Report No. FHWA-TX-81-226-22, State Department of Highways and Public Transportation, Austin, TX. May 1981.

Rouphail, N.M. "Operational Evaluation of Bus Priority Strategies." Paper for the 63rd Annual TRB Meeting, Transportation Research Board, Washington, DC. Jan. 1984.

Rowan, N.J., D.L. Woods and V.G. Stover. Alternatives for Improving Urban Transportation - A Management Overview. Technology Sharing Report 77-215, Federal Highway Administration, Washington, DC. Oct. 1977.

Sauerlender, O.H., et al. The Highway Corridor: Predicting the Consequences of Alternative Highway Locations (Final Report). Report No. TTSC-7214, Pennsylvania Department of Transportation, Harrisburg, PN. Nov. 1972. (NTIS No. PB-226 076/8).

Schaevitz, R.C. and M.I. Scheider. "Development of a Local Financing Strategy to Meet Multimodal Transportation Needs in Orange County, California." Selected Papers on Major Issues Facing Public Transit - Financing, Volume I, American Public Transit Association, Washington, DC. 1983, pp. 39-55.

Schneider, J.B. Transit and the Polycentric City. Report No. DOT-I-81-33, Urban Mass Transportation Administration, Washington, DC. Sept. 1981.

Schwart, G.G. Where's Main Street U.S.A.? Eno Foundation for Transportation, Inc., Westport, CT. 1984.

Selected Value Capture Opportunities Related to the Rapid Transit System In Metropolitan Atlanta. Atlanta Regional Commission, Atlanta, GA. May 1978.

Selsam, R.E. "Generating Private Contributions for Station Improvement Through Public Development, Incentives and Controls." Selected Papers on Major Issues Facing Public Transit - Financing, Volume I. American Public Transit Association, Washington, DC. 1983, pp. 69-77.

Sherret, A. BART's First Five Years: Transportation and Travel Impacts. Report No. DOT-BIP-FR-11-3-78, U.S. Department of Transportation, Washington, DC. May 1978.

Sherret, A. BART's Fist Five Years: Transportation and Travel Impacts. Report No. DOT-P-30-79-08, Urban Mass Transportation Administration, Washington, DC. April 1979.

Sherret, A. 1977 Work Travel Survey Methods and Findings - Bart Impact Program (Working Paper). Report No. DOT-BIP-WP 58-3-78, U.S. Department of Transportation, Washington, DC. Dec. 1978.

Siccardi, A.J. "Economic Effects of Transit and Highway Construction and Rehabilitation." Paper for the 1984 ASCE Annual Convention DMJM Phillips, Reister, Haley, Inc., Denver, CO. Oct. 1984.

Skaburskis, A. Survey of Data Sources for the Land Use and Urban Development Project (Working Paper). Report No. WP-13-5-75, Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. June 1975. (NTIS No. PB-242 440/6ST).

Skaburskis, A. The Impacts of BART on Property Values - A Case Study of the Rockridge Neighborhood. Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. Jan. 1976. (NTIS No. PB-258 367/2ST).

Skinner, R.E. and T.B. Deen. BART Impact Program: Federal Policy Implications. Report No. DOT-P-30-79-10, U.S. Department of Transportation, Washington, DC. April 1979. (NTIS No. PB82-163924).

Sosslau, A.B., A.B. Hassam, M.M. Carter and G.V. Wickstrom. Quick Response Urban Travel Estimation Techniques and Transferable Parameters: User's Guide. NCHRP Report 187, Transportation Research Board, Washington, DC. 1978.

"Status Report: Metrorail Before and After Study." Metropolitan Washington Council of Governments, Washington, DC. April 1, 1981.

Studholme, E.D. Metro Impact in Arlington County: A Case Study and Evaluation of a Transit Growth Model (Final Report). Report No. UTC-11, Contract No. DOT-UT-394, Urban Mass Transportation Administration, Washington, DC. June 1971. (NTIS No. PB-204 934).

Stokes, R.W. and R.L. Peterson. Land Use and Innovative Funding Impacts In A Permanent Busway/Park-and-Ride Transit System: Survey of Transitway Projects in the United States and Canada. Technical Report 1086-3, Texas Transportation Institute, College Station, TX. April 1986.

Taggart, R.E. Jr., N.S. Walker and M.M. Stein. "Estimating Socio-economic Impacts of Transportation Systems." Transportation Research Record 716. Transportation Research Board, Washington, DC. 1979, pp. 9-20.

Tenhoor, S.J. and S.A. Smith. "Parking-Requirement Reduction Process for Ridesharing: Current Practices, Evolving Issues, and Future Directions." Transportation Research Record 940. Transportation Research Board, Washington, DC. 1983, pp. 44-51.

Texas Urban Development Commission. Urban Texas: Policies for the Future. Institute of Urban Studies, The University of Texas at Arlington, Arlington, TX. Nov. 1971.

The Influence of Central City Radial Freeways on Manufacturing Location Decisions, Volume 1. Contract No. DOT-FH-11-7765, Federal Highway Administration, U.S. Department of Transportation, Washington, DC. Sept. 1973. (NTIS No. PB-265 474/7ST).

The Influence of Central City Radial Freeways on Manufacturing Location Decisions, Volume 2. Contract No. DOT-FH-11-7765, Federal Highway Administration, U.S. Department of Transportation, Washington, DC. Oct. 1973. (NTIS No. PB-265 475/7ST).

"The Location and Design of Bus Transfer Facilities-An Information Report." Technical Council Committee 5C-1, Institute of Transportation Engineers (ITE), Washington, DC. Jan. 1982.

Timoney, A. Bart Impact Program Report Catalog (Planning Document). Contract No. DOT-OS-30176, U.S. Department of Transportation, Washington, DC. July 1976. (NTIS No. PB-262 676/OST).

Toft, G.S. and H.S. Mahmassani. "Transportation and High Technology Economic Development." Paper for the 63rd Annual TRB Meeting, Transportation Research Board, Washington, DC. Jan. 1984.

Transit Impact Monitoring Program: A Preliminary Analysis of the Impact of MARTA's Omni Station on Omni International Atlanta. Atlanta Regional Commission, Atlanta, GA. Sept. 1981.

Transit Impact Monitoring Program Annual Report. Atlanta Regional Commission, Atlanta, GA. Dec. 1979.

Transit Impact Monitoring Program - Residential Attitudes Survey: MARTA East Line. Atlanta Regional Commission, Atlanta, GA. Dec. 1981.

Transit Impact Monitoring Program - Residential Attitude Survey: MARTA West Line (Hightower Station Area). Atlanta Regional Commission, Atlanta, GA. Oct. 1981.

Transit Impact Monitoring Program: Results of Station Area Studies. Atlanta Regional Commission, Atlanta, GA. Aug. 1981.

"Transit Station Access." Technical Council Committee 5C-6. Institute of Transportation Engineers (ITE), Washington, DC. Dec. 1980.

Transportation Research Board. Technical Aspects of Urban Transportation Alternative Analysis. Contract No. DOT-UT-70060, Urban Mass Transportation Administration, Washington, DC. July 1978.

University of Georgia. Mass Transit Management: Case Studies of the Metropolitan Atlanta Rapid Transit Authority. Report No. DOT-I-81-1, Urban Mass Transportation Administration, Washington, DC. March 1981.

Urban Land Institute. Joint Development: Making the Real Estate -Transit Connection, Executive Summary. Report No. DOT-I-79-13, Urban Mass Transportation Administration, Washington, DC. July 1979.

Valk, P.J. "Commuter Demand for Ridesharing Services (Abridgement)." Transportation Research Record No. 823. Transportation Research Board, Washington, DC. 1981, pp. 17-21.

Vlachos, E.C. Secondary Impacts and Consequences of Highway Projects (Final Report). Contract No. DOT-OS-50043, U.S. Department of Transportation, Washington, DC. Oct. 1976. (NTIS No. PB-267 294/7ST).

Voorhees and Associated, Inc. Transportation Pooling. Report No. UMTA-IT-06-0092-74-1, Urban Mass Transportation Administration, Washington, DC. Jan. 1974.

Vuchic, V.R. Urban Public Transportation - Systems and Technology. Prentice-Hall, Englewood Cliffs, NJ. 1981.

Ward, J.D. "A Look Ahead." Public Transportation: Planning, Operations and Management. Englewood Cliffs, NJ. Prentice-Hall Inc. 1979, pp. 697-717.

Watterson, W.T. "Estimating Economic and Development Impacts of Transit Investments." Paper for the 64th Annual TRB Meeting, Transportation Research Board, Washington, DC. Jan. 1985.

Wattleworth, J.A. et al. Report 1 - Evaluation of the NW 7th Avenue Express Bus and Bus Priority Systems. Report No. UMTA-FL-06-0006, U.S. Department of Transportation, Washington, DC. Sept. 1977.

Wattleworth, J.A. et al. Report 4 - Modal Shift Achieved on the NW 7th Avenue Express Bus System. Report No. UMTA-FL-06-0006, U.S. Department of Transportation, Washington, DC. Sept. 1977.

Wattleworth, J.A., C.E. Wallace and K.G. Courage. Report 5 - Effect of the Park-N-Ride Facility on Usage of the NW 7th Avenue Express Bus System. Report No. UMTA-FL-06-0006, U.S. Department of Transportation, Washington, DC. June 1977.

Wattleworth, J.A. et al. Report 6 - Effects of NW 7th Avenue Bus Priority Systems on NW 7th Avenue Traffic Stream Flow and Passenger Movements. Report No. UMTA-FL-06-0006, U.S. Department of Transportation, Washington, DC. Sept. 1977.

Wattleworth, J.A. et al. Report II-1: Evaluation of the I-95 Express Bus and High Occupancy Vehicle Priority System. Study No. UMTA-FL-06-0006, U.S. Department of Transportation, Washington, DC. Jan. 1978.

Wattleworth, J.A., K.G. Courage and C.E. Wallace. Report II-2: Evaluation of the Effects of the I-95 Exclusive Bus/Carpool Lane Priority System on Vehicular and Passenger Movement. Report No. UMTA-FL-06-0006, U.S. Department of Transportation, Washington, DC. Dec. 1977.

Wattleworth, J.A. et al. Report II-3: Evaluation of the Effects of the I-95 Exclusive Bus/Carpool Priority System on the Express Bus System. Report No. UMTA-FL-06-0006, U.S. Department of Transportation, Washington, DC. Dec. 1977.

Webber, M.M. "The BART Experience - What Have We Learned?" Monograph No. 26. Institute of Urban and Regional Development, University of California, Berkeley, CA. Oct. 1976.

Witheford, D.K. "Urban Transportation Planning." Transportation and Traffic Engineering Handbook, Second Edition. Institute of Transportation Engineers, Washington, DC. 1982, pp. 343-379.

Zumwalt, B.A. "Land Use Impacts of Fixed Guideway Transit Systems - Implications for Downtown People Mover Projects." Journal of Advanced Transportation. Vol. 13, (Research Supported by the U.S. Department of Transportation, Washington, DC). Spring 1979, pp. 67-79.