H

Board of Zoning Adjustment
District of Columbia
CASE NO. 17232
EXHIBIT NO. 37A6

DEVELOPMENT-RELATED RIDERSHIP SURVEY II

Washington Metropolitan
Area Transit Authority

DECEMBER 1989

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Washington Metropolitan
Area Transit Authority

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Washington Metropolitan Area Transit Authority

600 Fifth Street, N.W., Washington, D.C. 20001
(202) 962-1234



May 15, 1990

Dear Sir or Madam:

Enclosed for your information is a copy of the "Development-Related Ridership Survey (II)" which examines relationships among (a) major land uses; (b) distances to and from Metrorail stations; and (c) transit ridership. The Survey is being forwarded to you because you have previously indicated an interest to WMATA's Office of Planning in this subject or perhaps have been kind enough to participate to some extent in the Survey.

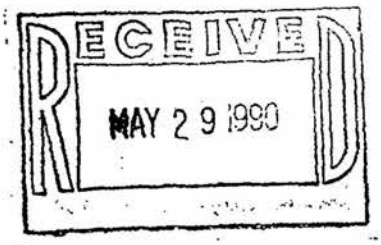
I would welcome any observations or questions you might have regarding this Survey. If you choose to offer either, kindly write to me at the address listed below.

Sincerely,

Alvin R. McNeal

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Manager, Joint Development and
Facilities Planning Branch
WMATA Office of Planning
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Enclosure



DEVELOPMENT-RELATED RIDERSHIP SURVEY II

Prepared for

Washington Metropolitan Area Transit Authority

Prepared by

JHK & Associates

December 1989

ACKNOWLEDGEMENTS

The study was sponsored by the Washington Metropolitan Area Transit Authority (WMATA). The project managers for WMATA were Mr. Richard Miller and Mr. John Green. The project manager for JHK & Associates (JHK) was Mr. James Curren. Mr. Dan Hardy served as JHK's project engineer, Ms. Joan Jenkins served as Field Supervisor, and Mr. Morris Rothenberg was the Responsible Officer.

JHK & Associates and WMATA would like to acknowledge and thank the many individuals and organizations that contributed to this study. This especially includes the building owners and managers who assisted JHK in granting permission for and setting up the surveys. A listing of the sites studied can be found in the text of the report. Thanks are also expressed to other WMATA staff.

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EXECUTIVE SUMMARY

This study, the Development - Related Ridership Survey II, is the second in a series sponsored by the Washington Metropolitan Area Transit Authority (WMATA). The first study conducted by JHK & Associates was completed in March 1987. The data collection for this study was collected during March and April 1989. The purposes of the studies were to study travel behavior of persons travelling to and from residential and commercial developments around Metrorail stations and to establish relationships among travel characteristics, distance, and the nature of development at each site. The studies consisted of surveys of persons travelling to and from office buildings, residential developments, retail sites and hotels near Metrorail stations. The first study surveyed 34 building sites, this study surveyed 38 buildings, 13 of which were repeated from the first study.

This executive summary highlights the key findings and conclusions from the Development-Related Ridership Surveys. The details of the procedures and results are discussed in the body of the report. A summary of observations is presented below, beginning first with general observations, followed by conclusions relating to each of the land use types.

General Observations

The choice of mode for trips to and from any type of land use is influenced by many factors. This study confirmed the findings of the first study, that the most significant and readily used factors for planning purposes are:

- The location of the site within Metropolitan Washington.
- The proximity of a building to a Metrorail station entrance.

Significant transit mode shares were recorded for all land uses.

Transit users reported almost as many linked trips as auto users.

Origin destination pairs heavily influence the propensity to take transit. Poor transit accessibility at either end of the trip results in poor transit ridership between those pairs.

Based on the response to attitudinal questions an average of 28% of all respondents hold the perception that information regarding the transit system (rail and bus) and schedules is not readily available.

Observations on Office Development

Transit mode share for offices ranged from under 10% in some suburban settings to over 50% in the downtown. In general it was found that the residences of employees was spread throughout the region, with employees who cross jurisdictional lines more inclined to use transit than those who live and work within the same jurisdiction.

Residential Buildings

The transit mode share for residential buildings surveyed in this study ranged from 30 to over 70%. The sites surveyed included both rented and owner occupied. Auto ownership was found to be significantly lower at all sites surveyed as compared to the regional average, which is 1.93 autos per household.

Retail Uses

All of the retail sites surveyed had significant transit mode share. In general, it appears that transit mode share to retail sites has increased over the two year period between studies. In contrast to the first study, this study found that transit mode share to retail sites was often higher at a given metrorail station than the transit mode share to office buildings at that station.

Hotels

Like retail sites, hotels showed a significant increase in the transit mode share when compared to the first study. Hotel trip generation rates vary from day to day more so than other land uses.

Conclusions

Several land use and transportation factors are critical to making the best possible use of the transit system. These include:

- Locating the types of uses that tend to generate the most transit trips in the Metrorail station areas.

- Locating these land uses in close proximity to stations with good access to the station portals.
- Providing high density land development around Metrorail stations, including suburban stations.
- Providing convenient walk and feeder bus access to the stations to expand the transit market.

In general mixed development at each station area is the most desirable in terms of reducing overall vehicle trips. However, the development in a corridor as a whole should be considered, as well as development at individual stations. Variations from station to station along a rail line appear to maximize ridership on a daily basis. The study also found that in general sensitivity to the distance from the station portal varies by land use, office developments being the most sensitive and residential developments the least sensitive. This suggests that office development is best suited to areas immediately adjacent to the station. However, exceptions to this may occur for specific uses such as destination retail.

Development of the station areas is only one component of overall planning that is required in order to maximize transit ridership. Transit service and station access to and from lower density development is also critical.

Adequate road networks must be constructed in conjunction with the development of station areas. Poor road networks not only create a negative image of station areas but also restrict the transit market to relatively tight areas surrounding the station. People will not use Metrorail if they must fight congestion to reach the station.

Marketing must be targeted at individual station areas to provide those who live, work, or shop in these areas specific information about the system and how they can use it.

Development of any type tends to be controversial. There are pros and cons that must be weighed. It is clear, however, that the limited supply of developable land and the fixed nature of the Metrorail system make development decisions around rail stations particulary critical. These decisions must be lived with for years to come and therefore must be made with a long-term view. One locational benefit, for example, is that a 200,000 square foot office being considered for development in the suburbs could achieve an annual reduction of some 500,000 vehicle miles of travel by locating near a Metrorail Station.

It is inevitable that the Washington area will grow. Careful attention to how it grows, particulary in areas served by Metrorail, will reap major benefits in optimizing

the use of the existing and future regional transportation system.

INTRODUCTION

This is the Final Report for the Development-Related Ridership Survey II, prepared for the Washington Metropolitan Area Transit Authority (WMATA). Like the first Ridership Survey completed in March 1987[1], the purpose was to study the travel behavior of persons travelling to and from residential and commercial developments around Metrorail stations. The data collected was used to establish relationships between travel characteristics and the nature of development at each site. The sites chosen for this survey were carefully selected to provide expansion of the existing database, and to permit long-term trend analysis. In addition, a more extensive examination of mid-day travel characteristics was conducted in this survey than in the original effort. This information will provide WMATA and other local agencies with better information on the accessibility benefits of locating buildings near Metrorail stations.

The purpose of this study is to present findings from the survey data, mathematical relationships developed between travel characteristics and site development factors, and trip generation characteristics and site development factors.

STUDY APPROACH

The basic approach to the study involved the development of data on a building by building basis. Each building was considered to constitute an observation with which a distinct set of travel characteristics could be associated. The travel characteristics were expected to vary among buildings based on a number of factors including, type of land use, location within the metropolitan area, proximity to Metrorail stations, type of employers within a building, cost and availability of parking. Also, factors not directly related to sites also influence travel characteristics. Examples of these include average income, auto ownership, and the quality of Metrorail service at each end of the trip.

Data on travel characteristics was collected through a series of questionnaires, interviews, and "cordon counts" conducted at each of the 38 buildings surveyed. The type of survey conducted depended primarily on the type of land use. The four land use types and associated survey approach were as follows:

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[1] Development-Related Ridership, JHK & Associates, March 1987.

- Office Buildings - several techniques were employed including self-administered questionnaires for employees, pedestrian intercept surveys for visitors, and cordon counts of persons entering the office for specified periods.

- Residential Buildings - self-administered surveys were distributed to each unit and cordon counts were conducted at all sites to determine actual trip generation rates for each site.

- Retail Establishments - personal interviews were conducted at the store entrances or within the store itself depending on the characteristics of the site. In addition cordon counts were conducted at most sites.

- Hotels - as with the retail sites, personal interviews were conducted combined with cordon counts of the site.

Chapter 2 of this study discusses the specific approach and survey procedures for each land use type as well as unique characteristics of specific sites, the analysis procedure, and a summary of results. Important considerations in the design of the data collection program were the development of unbiased sampling techniques, the ability to cross-check data, and compatibility with the previous surveys. Although any survey is subject to sampling error, careful design of the data collection program can reduce the chances of any biasing of the results. For example, no direct reference was made to WMATA in the self administered surveys. The surveys were cast as general transportation surveys, thereby providing the best chance of obtaining unbiased estimates of mode choice. The ability to detect any bias that may occur is also important. For example, cordon counts can provide the actual trip generation rate and in many cases the mode split, thus acting as a cross-check. Where interviews were conducted, counts allow sample size by entrance to be determined. The total number of survey responses for all land uses studied exceeded 6,600, plus cordon counts for all but three sites. A summary of response rates for mail-back surveys is given in the appendix.

Chapter 3 focuses on quantitative relationships between travel characteristics at the buildings surveyed and the factors that influence travel behavior. This includes the development of regression equations that can be used to predict transit[1] mode share for newly planned development. These equations are compared to previous findings in other studies and their limitations discussed. When properly applied within the context of their limitations, the equations provide an excellent planning tool for developments being considered in close proximity to an urban rail station.

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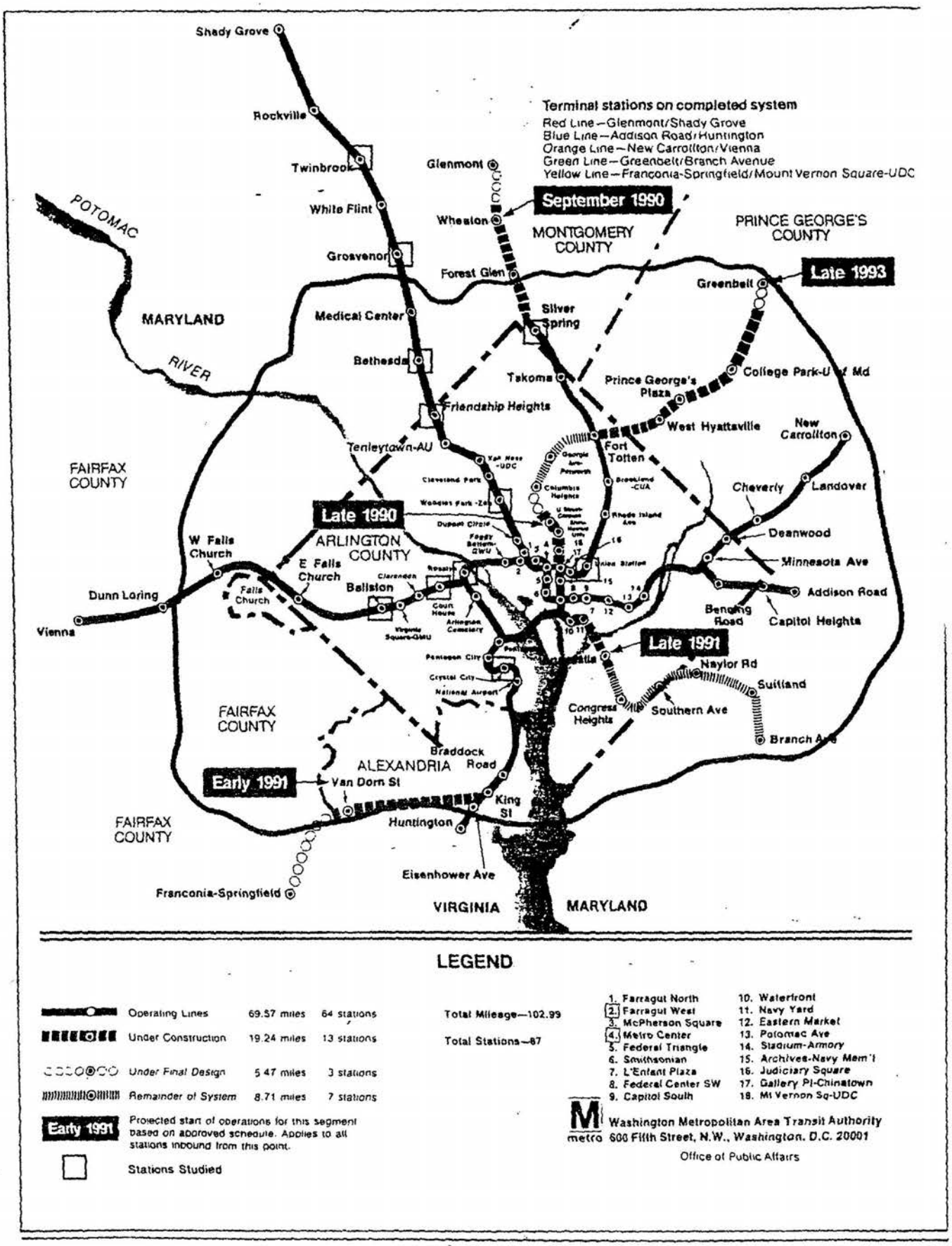
[1] The term "transit" is used in this report to refer to rail and bus services unless otherwise specified.

Finally, Chapter 4 presents a summary of our conclusions and recommendations. Techniques and strategies to improve transit ridership are suggested based on the findings of the study.

SITE SELECTION

Site selection procedures considered the location of the Metrorail station, the location and type of building, and the previous study (Figure 1 shows the station areas selected and Table 1 the number of land uses surveyed at each station). The surveyed sites were selected from an initial list of candidate Metrorail stations and sites by the following criteria:

- A range of stations reflecting different development patterns and varying locations within the metropolitan area. (i.e. inside the Beltway vs. outside the Beltway):
- Station areas had to have building developments that were constructed, rehabilitated or converted within more recent years. Unlike the first study, individual sites that were older were selected in order to broaden the database.
- The expansion of the database was an important consideration. A similar study " Development Related Ridership Survey" was completed for WMATA by JHK & Associates in March of 1987. Additional station areas and sites were added while at the same time a deliberate effort was made to repeat a significant number of sites in order to begin the development of time series data.
- The developments were to be of the following minimum sizes; office buildings - 100,000 square feet, residential buildings - 75 dwelling units, hotels - 200 rooms, retail - no minimum square footage or number of establishments.
- Another major criterion involved the nature of the building tenants. In an effort to develop a data base that covers the full range of tenants, buildings were chosen to include both public and private employers. Government agencies tend to be large employers and have operational characteristics that significantly impact travel habits of employees. For example, the large employment base and fairly regular work hours enable extensive participation in ridesharing programs. Building sites with public employers were not chosen in the first study as it was felt that the data base was not large enough to allow the isolation of other factors. With the growing data base it was felt that government agencies should now be included. As well, there is a growing trend for government employers to locate adjacent to a Metrorail station, therefore it is important to include the trip making characteristics of public agencies in the data base.



LEGEND

Operating Lines	69.57 miles	64 stations	
Under Construction	19.24 miles	13 stations	
Under Final Design	5.47 miles	3 stations	
Remainder of System	8.71 miles	7 stations	
Total Mileage—102.99			
Total Stations—87			

Early 1991 — Projected start of operations for this segment based on approved schedule. Applies to all stations inbound from this point.

Stations Studied

1. Farragut North
2. Farragut West
3. McPherson Square
4. Metro Center
5. Federal Triangle
6. Smithsonian
7. L'Enfant Plaza
8. Federal Center SW
9. Capitol South
10. Waterfront
11. Navy Yard
12. Eastern Market
13. Potomac Ave
14. Stadium-Armory
15. Archives-Navy Mem'l
16. Judiciary Square
17. Gallery Pl-Chinatown
18. Mt Vernon Sq-UDC

Washington Metropolitan Area Transit Authority
600 Fifth Street, N.W., Washington, D.C. 20001
Office of Public Affairs

Figure 1. Metrorail System Map and Stations Studied

Table 1. Site Survey
Building Inventory Summary

	Office	Retail	Residential	Hotel	TOTAL
Metro Center		2		2	4
Farragut West	1				1
Crystal City	1	2	3	2	8
Courthouse	1				1
Silver Spring	1		2	1	4
Ballston	1	1	1		3
Bethesda	3	1		1	5
Friendship Heights		1			1
Twinbrook	2		1	1	4
Grosvenor			3		3
Union Station		1		1	2
Rosslyn				1	1
Woodley Park/Zoo				1	1
TOTAL	10	8	10	10	38

The sites selected are illustrated in Figures 2 to 13. These maps illustrate the varying distances the selected sites are from the stations. In addition, tables containing brief descriptions of the selected sites, with the numbers corresponding to the numbers shown on each map are included with the discussion for each land use. Numbers were assigned sequentially based on initial selections.

Contacting the building managers or leasing agents was the next step in the survey process. During the initial site inventory, basic information on each site (e.g. an estimate of size, proximity to Metro, etc.) was collected. Occasionally, management companies were reluctant to grant permission, stating they would not like to inconvenience their tenants or patrons. However, a thorough explanation of the study stressing that participation was voluntary on the part of each tenant or patron usually satisfied most building managers. Some managers preferred to have the request to conduct the survey in writing. The letter developed to give those building managers who requested additional information is contained in the appendix.

Unfortunately, not all of the initially selected sites were willing to participate in the survey. Replacement sites were chosen on an individual basis to provide the necessary balance in site characteristics. These sites were chosen in conjunction with WMATA. All data was collected during March and April 1989.

Sites were not re-numbered when alternate sites were chosen. All sites are shown on the maps including those that were dropped.

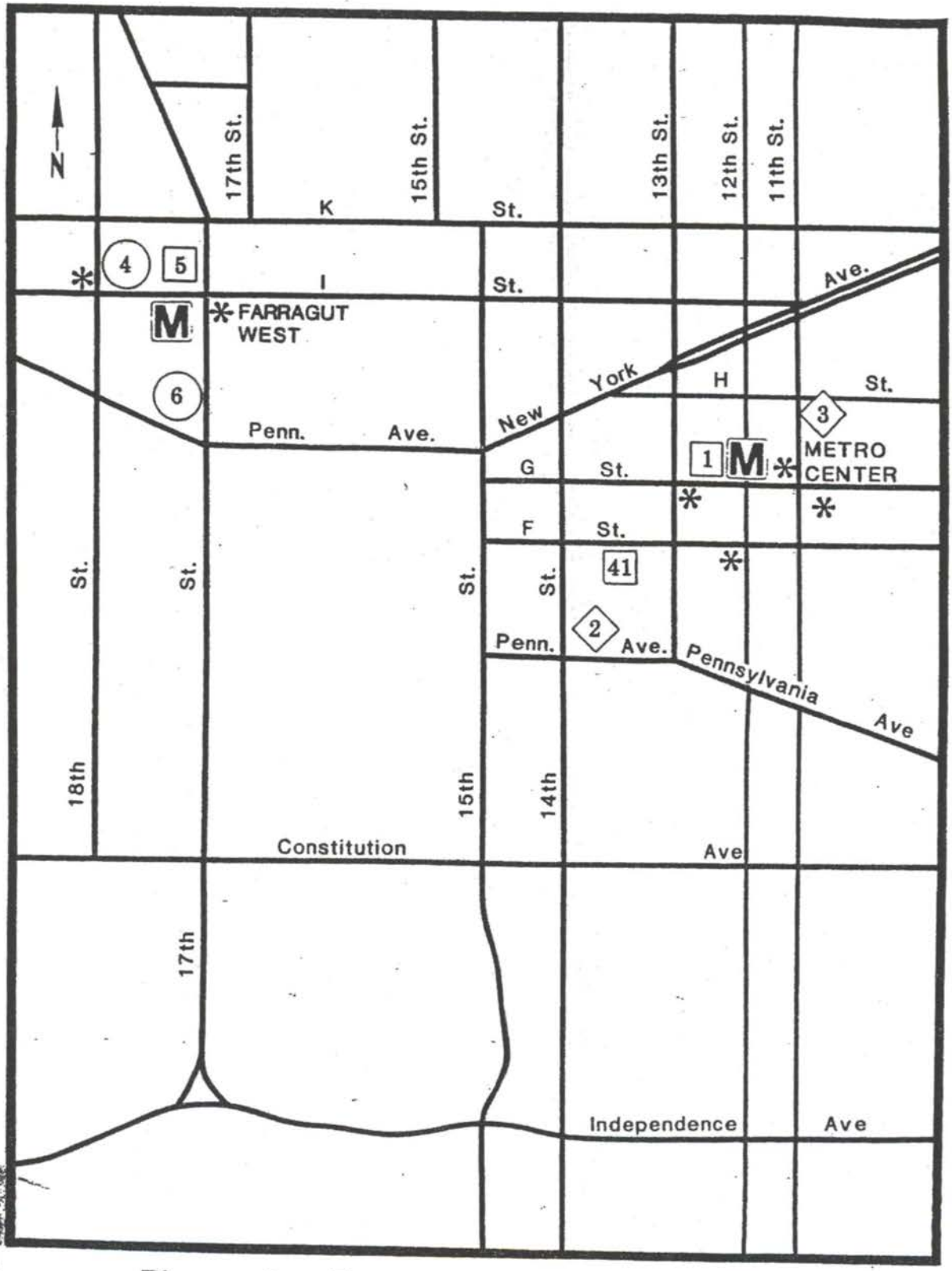


Figure 2. Farragut West/Metro Center

office
residential
retail
hotel
entrance location

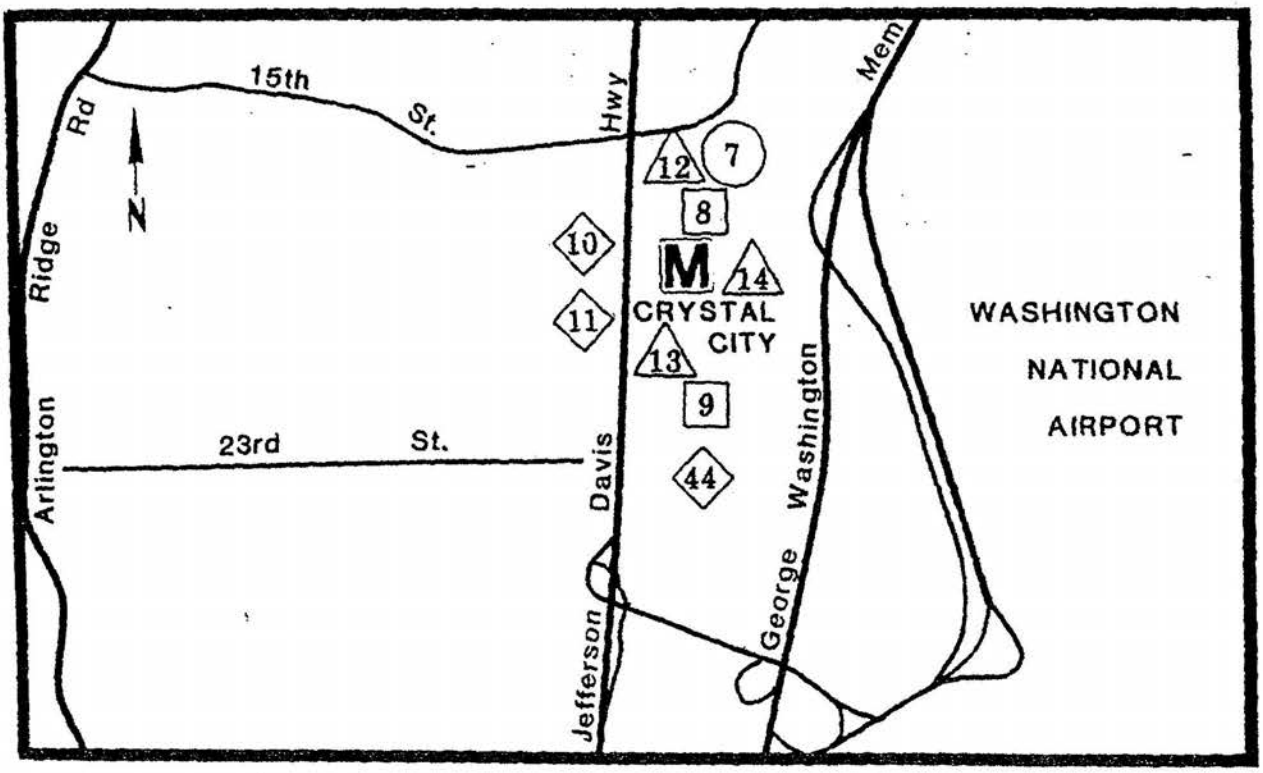


Figure 3. Crystal City

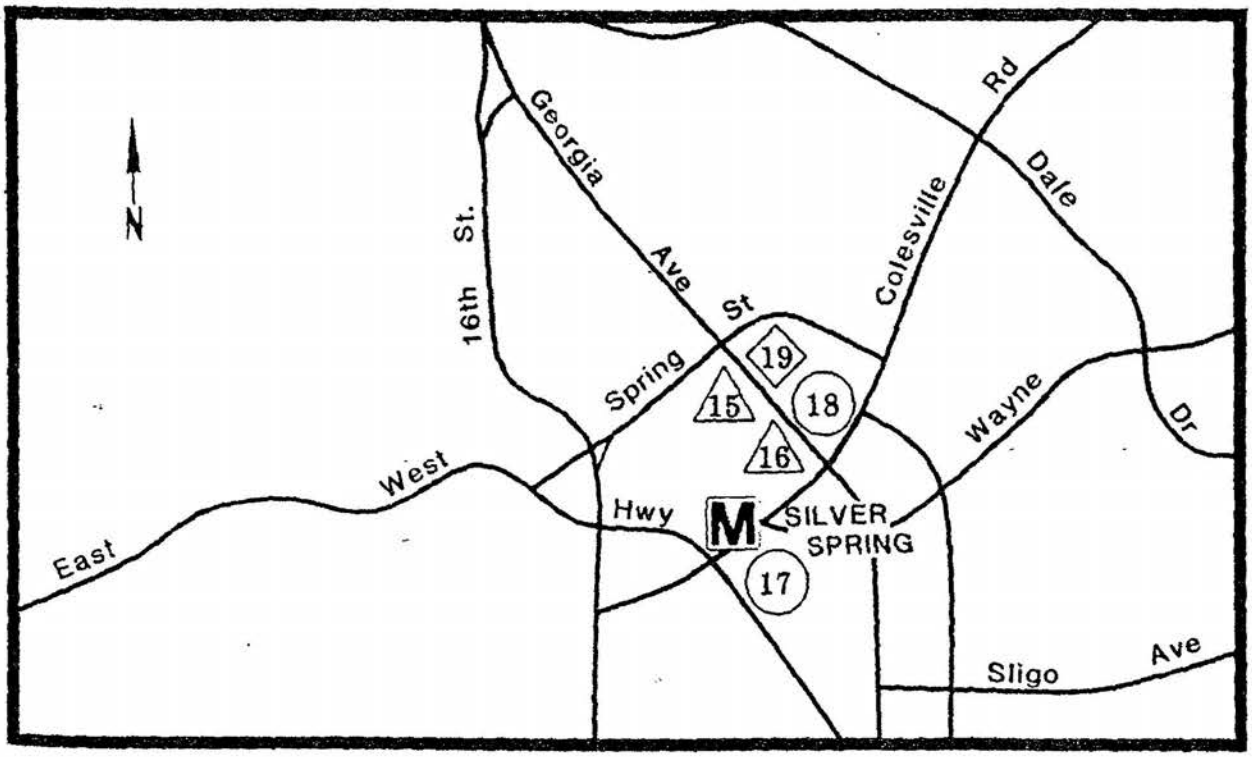


Figure 4. Silver Spring

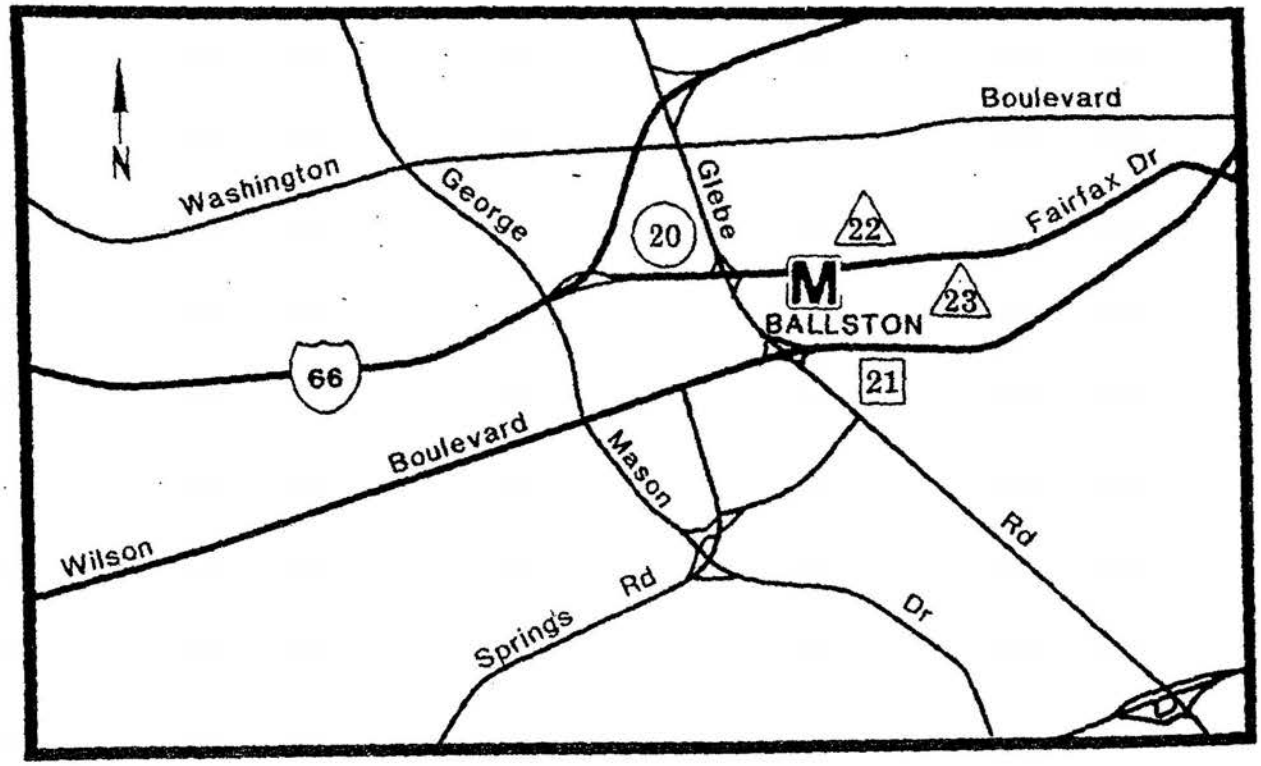


Figure 5. Ballston

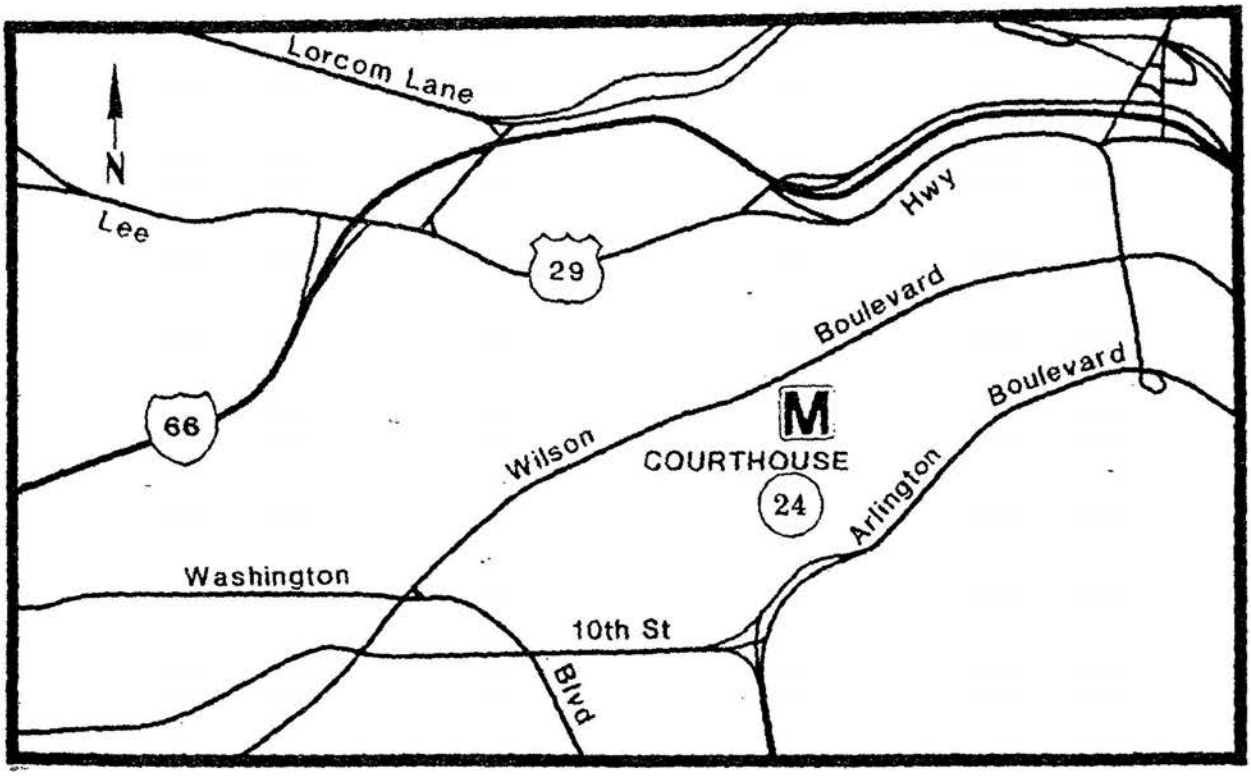


Figure 6. Courthouse

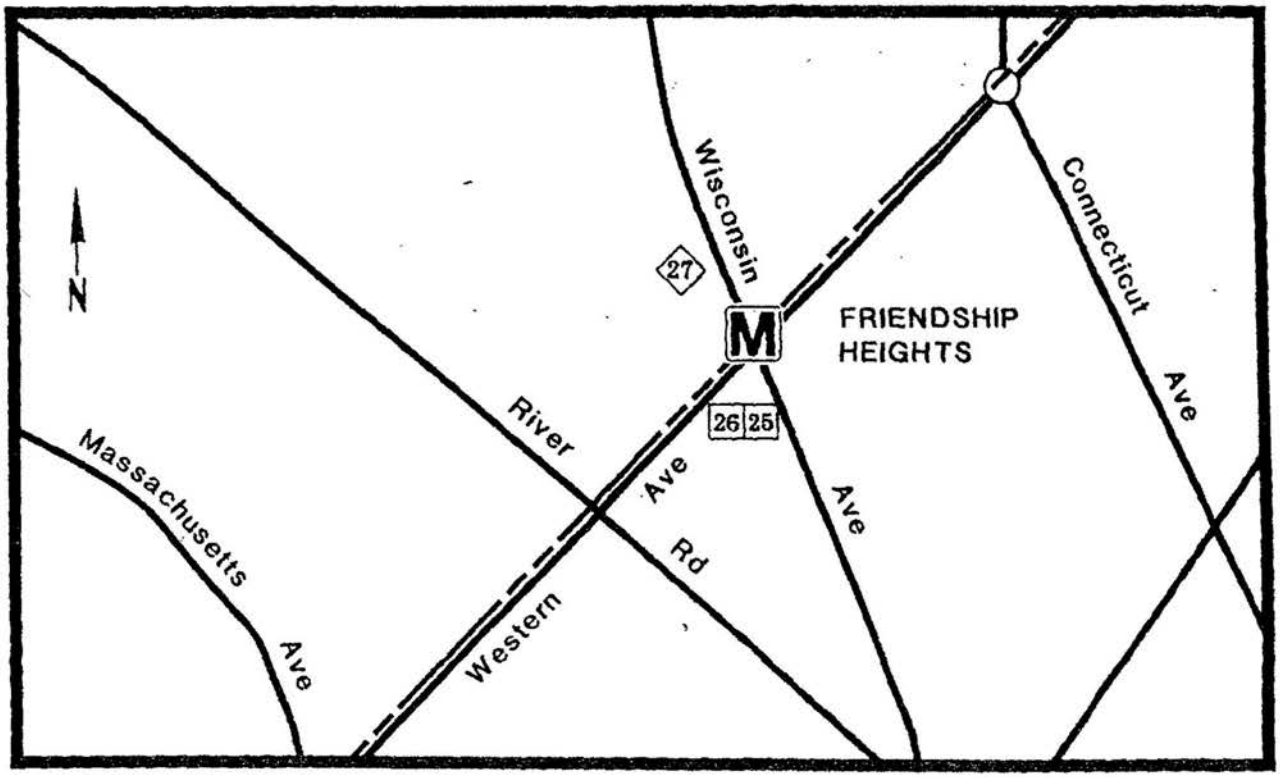


Figure 7. Friendship Heights

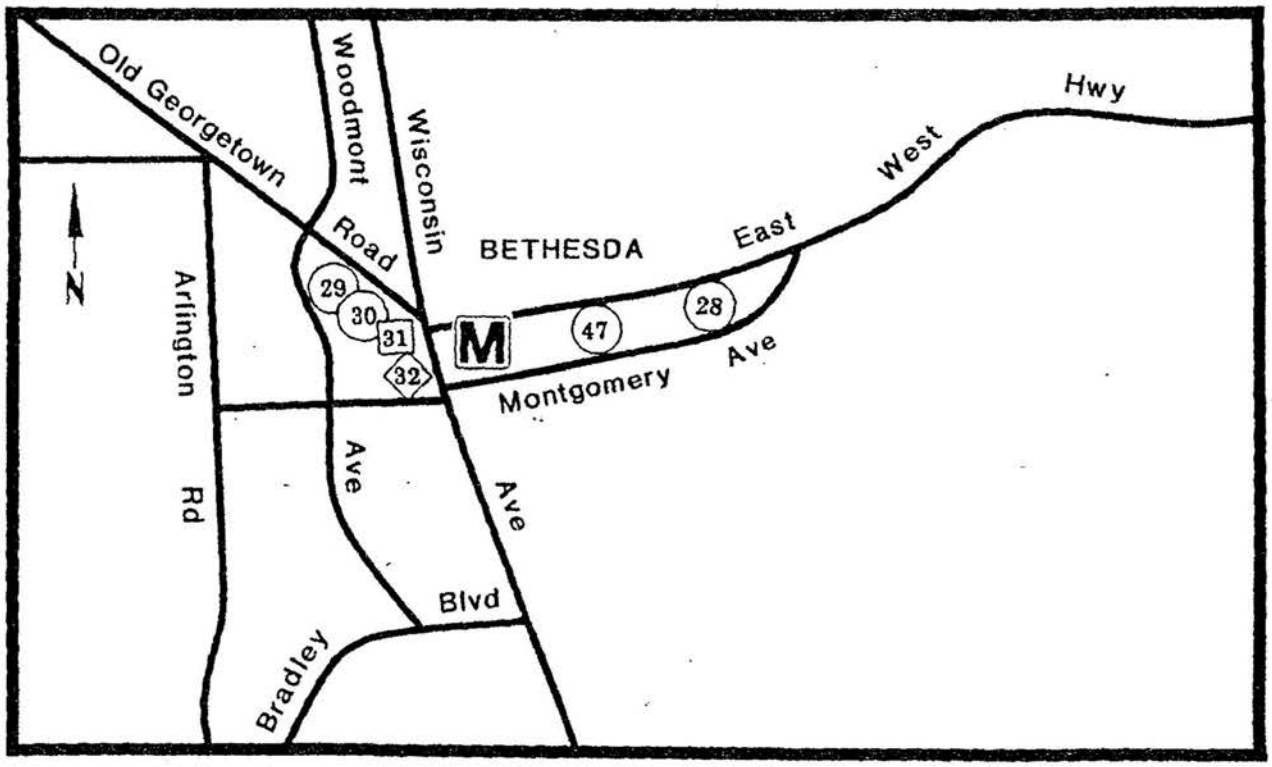


Figure 8. Bethesda

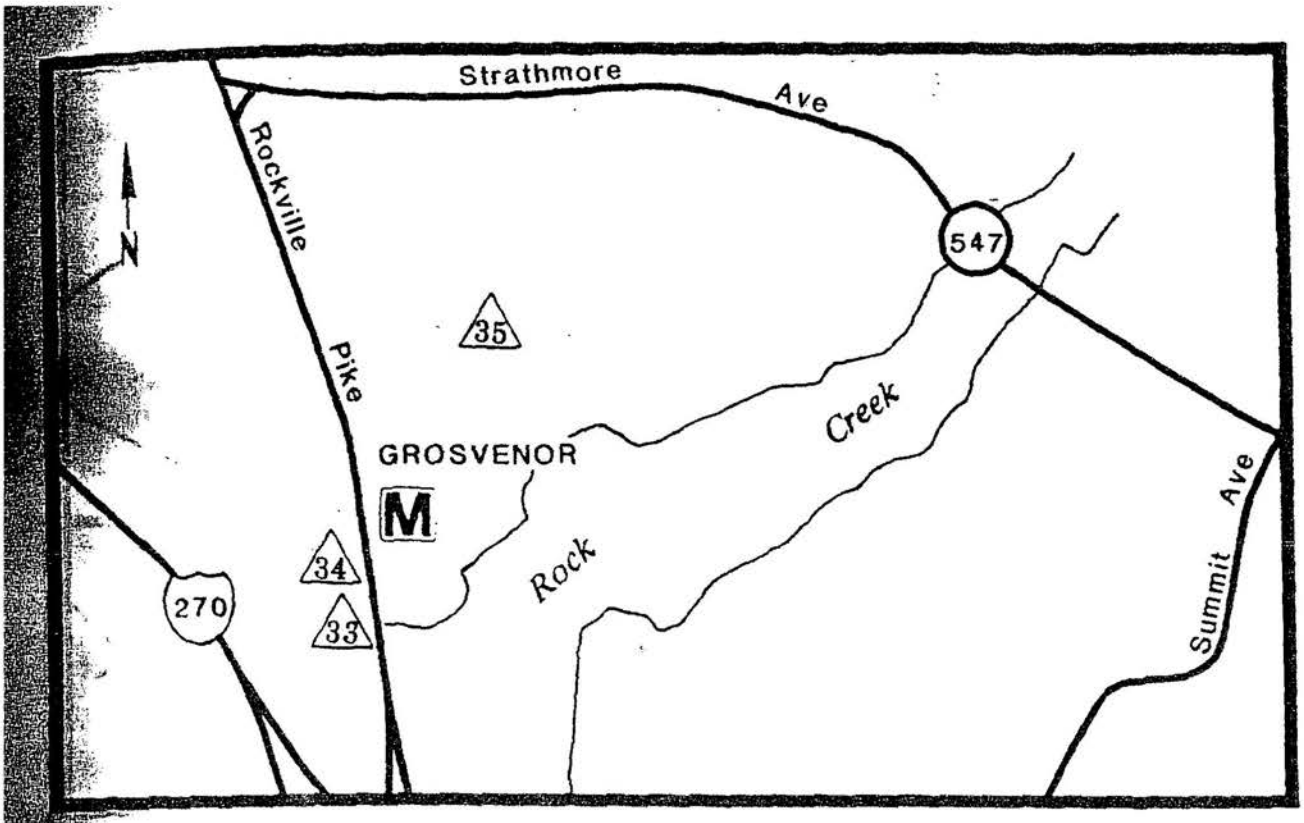


Figure 9. Grosvenor

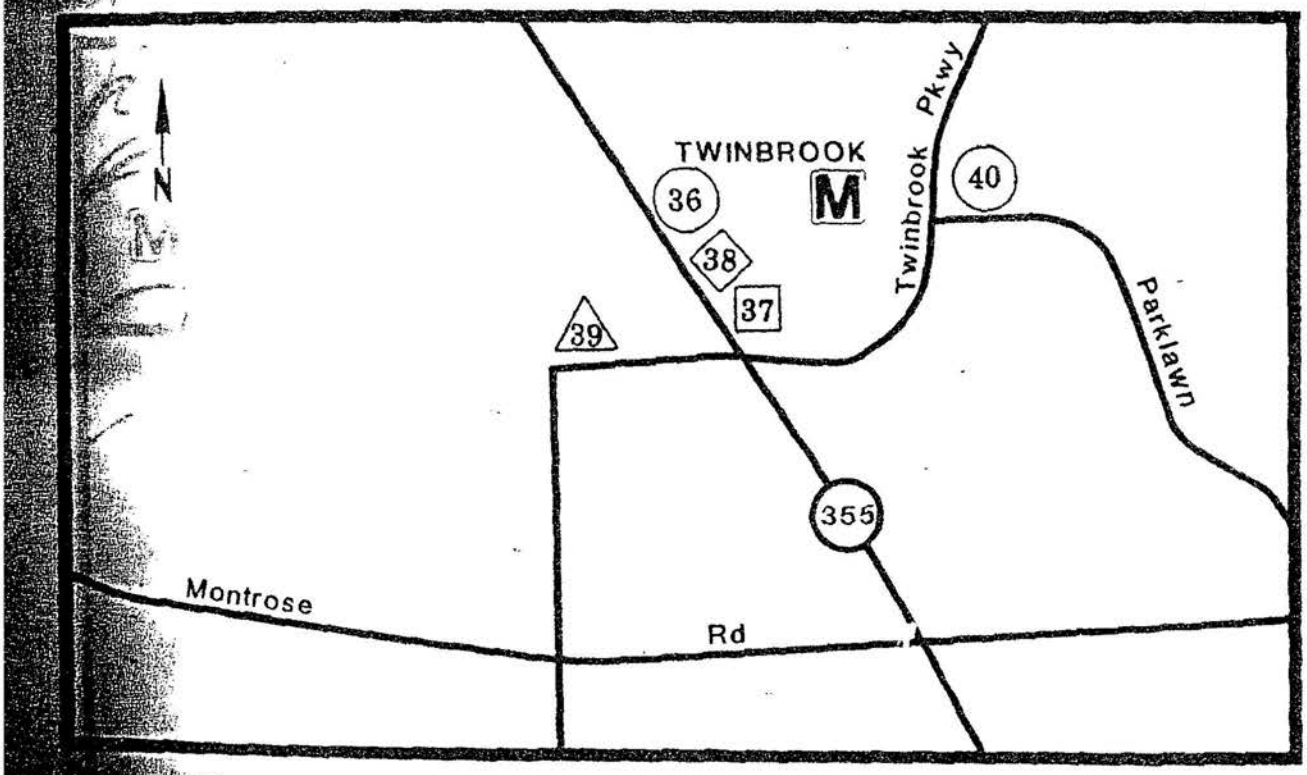


Figure 10. Twinbrook

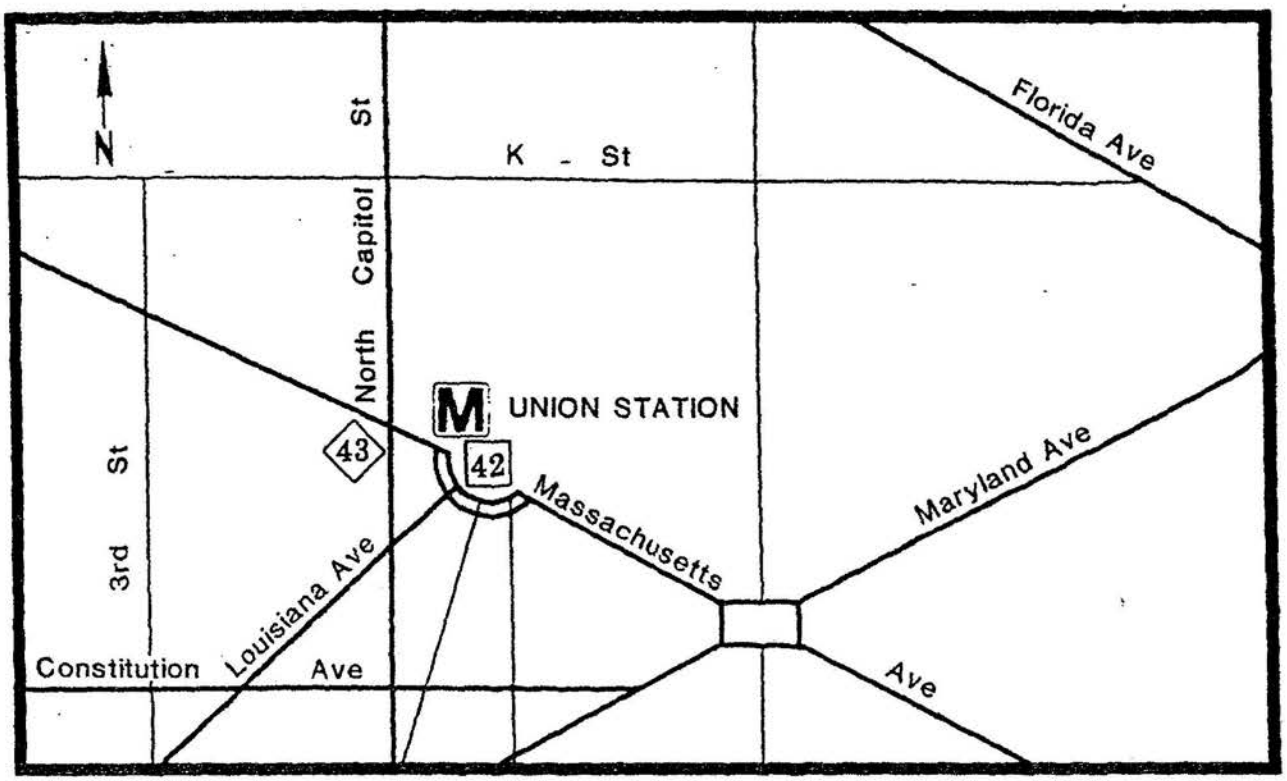


Figure 11. Union Station

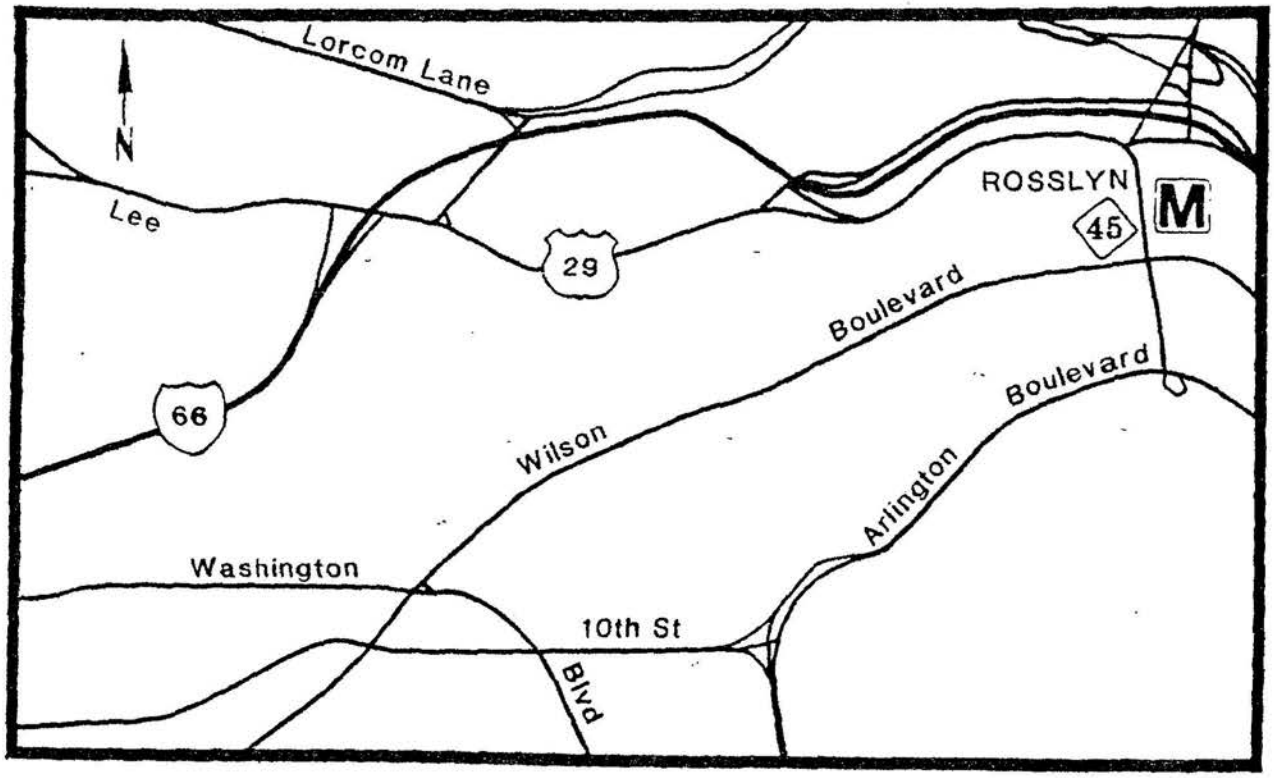


Figure 12. Rosslyn

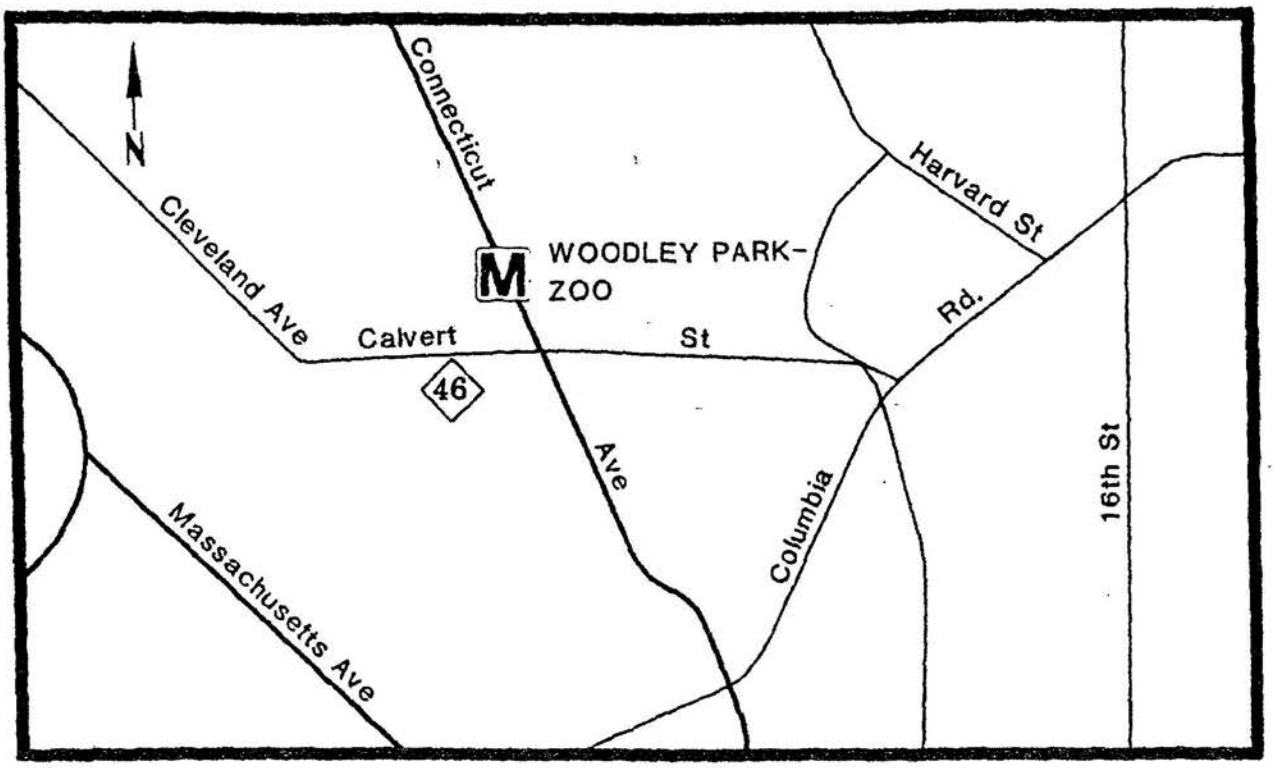


Figure 13. Woodley Park-Zoo

SURVEY PROCEDURES AND RESULTS

The survey procedures are described below for office, residential, retail, and hotel sites. A critical element of the study involved consistency with the first set of data in order that the testing and validity of the data could be accomplished without introducing any inconsistencies. The survey forms for this study were modified only slightly from those used in the 1987 study. The most significant additions in this survey were questions relating to linked trips (trips that have an indeterminate destination) and attitudes towards transit. Also, significantly more pedestrian counts were undertaken in this study with cordon counts completed at most sites.

OFFICE

Ten office buildings, varying from 100 to 2,000 feet in distance from the various Metrorail station entrances were selected for study. Table 2 provides the characteristics for each office building. At these offices, approximately 9,500 workplace surveys were distributed with slightly less than one third responding.

Data Collection

In order to determine the travel characteristics of office employees, a survey form was developed for distribution in the workplace. The objective of the survey was to determine the mode split and other travel characteristics of office employees. A sample workplace questionnaire is contained in the appendix. Demographic data were acquired first, followed by information on trips to and from the building, and then respondents' attitudes toward transit.

The questionnaires were delivered to individual employers by project staff. The staff personally visited each office to explain the survey procedure and distribute enough forms for each employee to respond. Also, a letter from WMATA explaining the purpose of the survey was left with the employer's contact person. A copy of the letter is contained in the appendix. In several cases, the building manager distributed a memo to inform tenants that the survey was to be conducted. After the surveys were distributed, the employees were asked to return them to the employer's contact person within two days. On approximately the third day the completed questionnaires were picked up by project staff. This procedure was altered at the Bell Atlantic and Parklawn buildings at the request of their management. At both buildings the survey

Table 3: Site Characteristics of Office Buildings

Metrorail Station	Office Building	Distance[1] to Station (ft.)	Gross Square Feet (1000)	Leasable Square Feet (1000)	Percent Occupied	Number of Employees	Number of Parking Spaces	Parking Cost per Month[2]	Year Constructed
Farragut West	1701 Pennsylvania (6)[3]	700	175	175	85	680	175	$120	1963
Crystal City	Crystal Square 2 (7)	1000	490[4]	414	98	1550	550	$40-70	1980
Bethesda	East-West Towers, North Building (28)	2000	180	180	100	700	1600	$75	1978
	Bethesda Office Ctr. (47)	800	168	168	98	600	--	--	1980
	Bethesda Metro Ctr. (30)	100	378	377	99	1500	1400[5]	--	1985
Ballston	Ballston One (20)	2000	240	238	78	1000	450	$60	1986
Courthouse	Bell Atlantic (24)	1500	353	--	100	1300	690	--	1982
Twinbrook	Parklawn (40)	2000	1035[6]	--	--	6800	362 in Bldg 2650 outside	--	1969
	Twinbrook Office Center (36)	800	165	--	75	700	--	--	1980
Silver Spring	Silver Spring Metro Center (17)	200	150	--	60	300	26	(7)	1986

[1] Distance to station is defined as the walking distance from the surveyed building to the nearest Metrorail station portal.

[2] Monthly parking cost refers to cost at garage.

[3] Numbers in parentheses refer to location maps in Figures 2 to 13.

[4] Based on LSF = 0.85 x GSF.

[5] Total parking for project.

[6] Government offices only -- does not include retail.

[7] $30/2 pers; $25/30--4; free-5 or more.

was distributed through the internal mail systems. At the Bell Atlantic building a mail back survey was used and at Parklawn, surveys were deposited in containers provided in the lobbies.

The surveys were distributed on Tuesdays, Wednesdays and Thursdays to maximize the chances of receiving responses for the most typical travel days.

Data on visitors to office buildings was collected by intercepting persons as they entered the building. If persons were employees no questions were asked; if persons were visitors, they were asked questions concerning their trip. This approach, combined with the cordon counts, allowed not only the trip characteristics of visitors to be determined but also the establishment of a relationship between the number of employees entering and the number of visitors. The number of persons intercepted was recorded to allow the percent of visitors to be determined and then factored by the total count to determine the percent of visitors interviewed.

Analysis

The workplace survey form was designed to request information about the respondent, trips to and from the building, parking or transit costs, linked trips,[1] and the respondent's attitude towards transit. The completed survey forms were keypunched on microcomputer diskettes using a database program (dBase III Plus). The microcomputer version of the statistical package, SPSS, was then used to compute frequencies and/or means for each variable and crosstabs of selected variables. Many frequencies and crosstabs were created and are available as an appendix, contained in a separate volume.

The following summary tables were derived from the dBase III and SPSS outputs:

Work trip mode shares[2]

Work trip mode share by location of residence

Mode share by gender

Mode share by age

Mode share for non-walk, mid-day trips by destination

---

[1] Linked trips refer to trips with intermediate destinations.

[2] Mode share refers to the percent of persons using that particular mode of travel for the trip in question.

Mode share for non-walk, mid-day trips by purpose

Mode share for mid-day trips by destination

Mode share for mid-day trips by purpose

Mode share for visitors

It is important to understand the statistical limitations of the data prior to discussing the results. Because the surveys only represent a sample of all trips to and from a building, there is a degree of error associated with the results. Assuming a distribution of the data and knowing the sample size, estimates of this error can be made. Appendix A explains the statistical aspects in more detail and provides a table indicating the 95 percent confidence limits that can be placed on various values and sample size combinations. The smaller the sample, the wider the confidence. Particular caution is needed in interpreting cross-tabulated data as the number of responses for one variable may be very small. Sample size varies question by question since not all respondents answered every question.

Results

The first several questions on the survey form asked for information regarding the individual respondent. The tabulation of these questions reveals several factors that influence mode share although they are not the prime factors in determining ridership.

Table 3 summarizes mode share for trips to and from work by location of employee's residence. Examination of the residence locations indicate that at least a third of employees for an individual office come from outside the jurisdiction in which the office is located. Further study indicates that employees who cross jurisdictional lines are more likely to use transit than those who live and work within the same jurisdiction. This is illustrated in Figure 14 which shows the transit mode share at 11.4% within a jurisdiction and 23.6% when jurisdictional lines are crossed. As with the first study, the responses to this question imply that Metrorail accessibility opens up a substantial labor pool that might not otherwise be available.

Figure 15 shows the location of residence for Bell Atlantic employees, examination of these pie charts illustrates how employees are distributed throughout the metropolitan region. This widespread distribution of employees' residences throughout the metropolitan area is typical of most buildings surveyed.

Table 3. Mode by Location of Residence Trip to and from Work by Percents

Location	Mode	D.C.	Fairfax County	Arl.	Alex.	Va. Other	P.G. County	Montg. County	Md. Other	Other	Subtotal	Percent Auto	Percent Transit
1701 Penn	Auto	38.0%	61.3%	43.8%	23.5%	100.0%	60.9%	34.0%	60.0%	100.0%	44.6%		
	Transit	48.0	38.7	50.0	70.6	0.0	39.1	66.0	20.0	0.0	50.0		
	Other	14.0	0.0	6.3	5.9	0.0	0.0	0.0	20.0	0.0	5.4		
	Total	24.5	15.2	7.8	8.3	1.0	11.3	26.0	4.9	1.0	100.0	44.6%	50.0%
Silver Spring Metro Center	Auto	39.4	77.8	72.7	—	—	66.7	65.9	85.7	100.0	63.8		
	Transit	51.5	22.2	27.3	—	—	22.2	9.8	0.0	0.0	24.6		
	Other	9.1	0.0	0.0	—	—	11.1	24.4	14.3	0.0	11.5		
	Total	25.4	20.8	8.5	0.0	0.0	6.9	31.5	5.4	1.5	100.0	63.8	24.6
Ballston One	Auto	81.8	89.8	63.0	93.3	70.3	64.9	87.5	100.0	66.7	78.5		
	Transit	18.2	6.5	14.8	6.7	0.0	35.1	12.5	0.0	0.0	13.2		
	Other	0.0	3.7	22.2	0.0	29.7	0.0	0.0	0.0	33.3	8.3		
	Total	9.5	30.9	15.5	4.3	10.6	16.3	9.2	2.0	1.7	100.0	78.5	13.2
Bell Atlantic	Auto	66.7	83.1	78.9	94.7	82.9	92.3	93.2	100.0	100.0	85.2		
	Transit	26.7	14.8	11.3	5.3	4.9	7.7	6.8	0.0	0.0	11.4		
	Other	6.7	2.1	9.9	0.0	12.2	0.0	0.0	0.0	0.0	3.4		
	Total	5.4	43.4	12.7	3.4	7.3	11.6	10.5	5.2	0.5	100.0	85.2	11.4
East West Towers	Auto	66.7	100.0	—	—	—	100.0	77.8	100.0	—	83.3		
	Transit	0.0	0.0	—	—	—	0.0	22.2	0.0	—	13.3		
	Other	33.3	0.0	—	—	—	0.0	0.0	0.0	—	3.3		
	Total	10.0	6.7	0.0	0.0	0.0	10.0	60.0	13.3	0.0	100.0	83.3	13.3

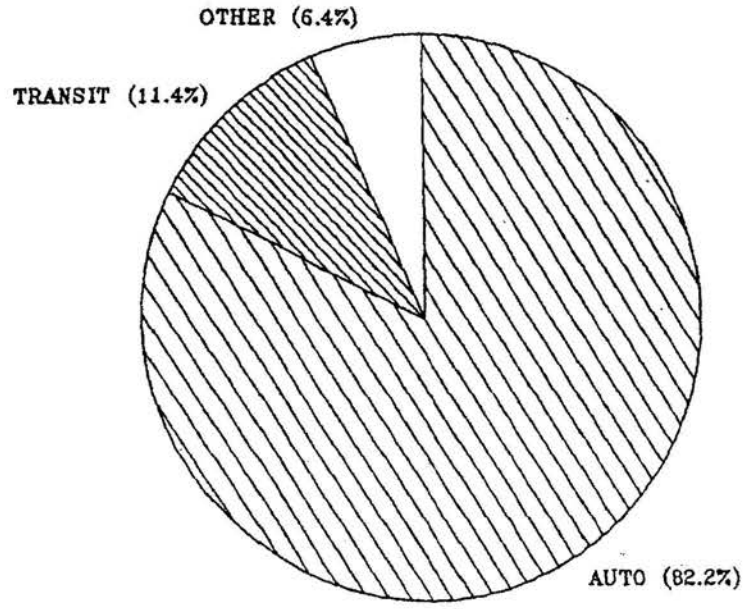
Table 3. Mode by Location of Residence Trip to and from Work by Percents
(Continued)

Location	Mode	D.C.	Fairfax County	Arl.	Alex.	Va. Other	P.G. County	Montg. County	Md. Other	Other	Subtotal	Percent Auto	Percent Transit
Bethesda Metro Center	Auto	70.6	88.9	100.0	100.0	100.0	70.4	84.4	81.0	33.3	82.3		
	Transit	29.4	11.1	0.0	0.0	0.0	29.6	12.3	4.8	66.7	14.6		
	Other	0.0	0.0	0.0	0.0	0.0	0.0	3.2	14.3	0.0	3.1		
	Total	6.7	7.1	2.4	2.0	1.2	10.6	60.6	8.3	1.2	100.0	82.3	14.6
Twinbrook	Auto	40.0	100.0	88.9	100.0	100.0	95.7	90.8	100.0	50.0	90.1		
	Transit	60.0	0.0	0.0	0.0	0.0	4.3	9.2	0.0	50.0	9.3		
	Other	0.0	0.0	11.1	0.0	0.0	0.0	0.0	0.0	0.0	0.5		
	Total	5.5	9.3	4.9	2.2	3.3	12.6	53.8	7.1	1.1	100.0	90.1	9.3
Parklawn	Auto	68.4	97.4	83.3	100.0	87.5	94.0	87.3	88.3	50.0	87.2		
	Transit	21.1	2.6	16.7	0.0	12.5	6.0	7.7	5.2	0.0	7.8		
	Other	10.5	0.0	0.0	0.0	0.0	0.0	4.9	6.5	50.0	4.9		
	Total	5.5	5.7	0.9	0.3	1.2	7.2	67.5	11.2	0.6	100.0	87.2	7.8
Crystal Square 2	Auto	100.0	73.4	37.5	77.3	94.6	94.1	68.2	88.2	—	75.8		
	Transit	0.0	21.5	37.5	13.6	0.0	5.9	31.8	11.8	—	17.8		
	Other	0.0	5.1	25.0	9.1	5.4	0.0	0.0	0.0	—	6.4		
	Total	0.5	36.1	11.0	10.0	16.9	7.8	10.0	7.8	0.0	100.0	75.8	17.8
Bethesda Office Center	Auto	56.3	100.0	66.7	50.0	—	87.5	79.7	77.8	—	79.3		
	Transit	43.8	0.0	33.3	50.0	—	12.5	12.2	0.0	—	14.3		
	Other	0.0	0.0	0.0	0.0	—	0.0	8.1	22.2	—	6.5		
	Total	7.4	8.3	2.8	1.8	0.0	7.4	68.2	4.1	0.0	100.0	79.3	14.3

Note: This table presents the mode share by jurisdiction for each office building and the distribution of employee residences by jurisdiction. For each jurisdiction, the percentage of trips by mode are indicated in the rows labeled "Auto," "transit," and "other." These three totaled vertically for each building equal 100%. For each office location, the row labeled "total" indicates the percentage of trips from each jurisdiction. Totaled horizontal this row equals 100%.

OFFICE COMMUTE BY JURISDICTION

TRIPS WITHIN JURISDICTION



OFFICE COMMUTE BY JURISDICTION

TRIPS BETWEEN JURISDICTIONS

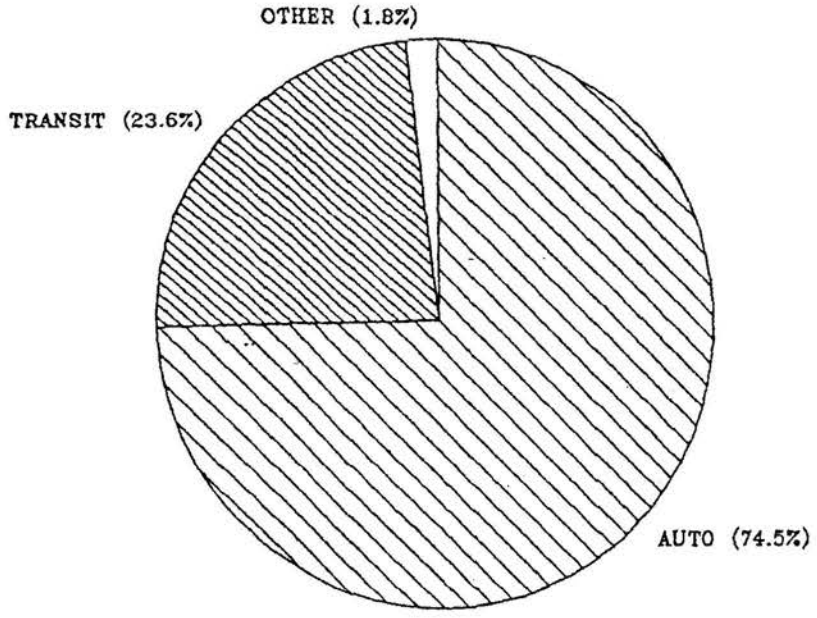
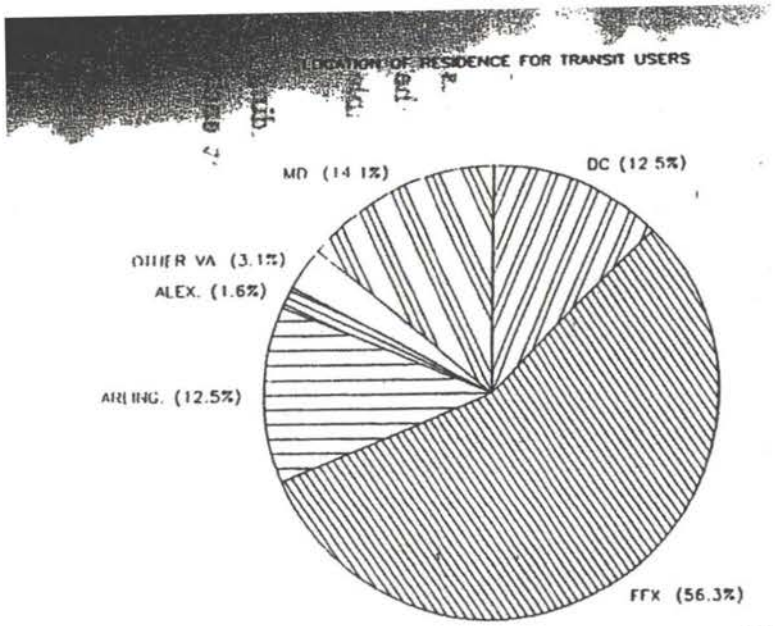
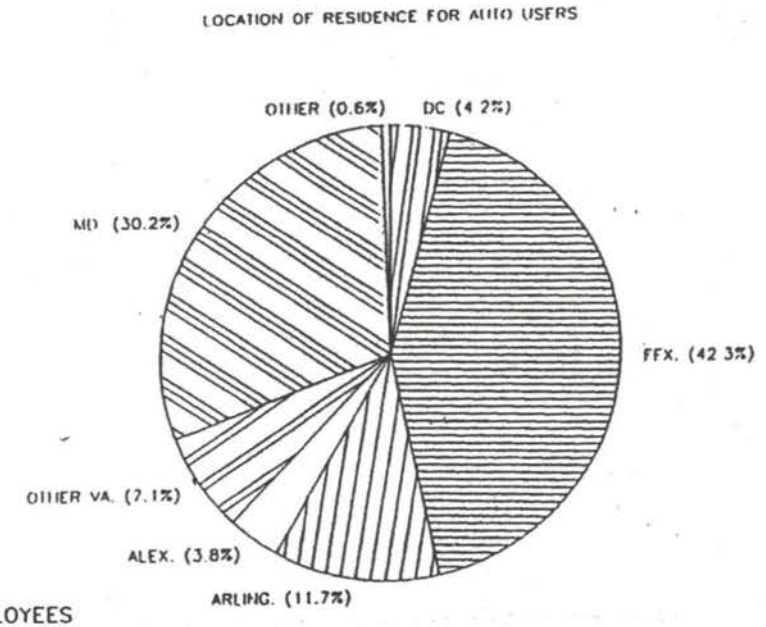


Figure 14.





LOCATION OF RESIDENCE FOR ALL EMPLOYEES

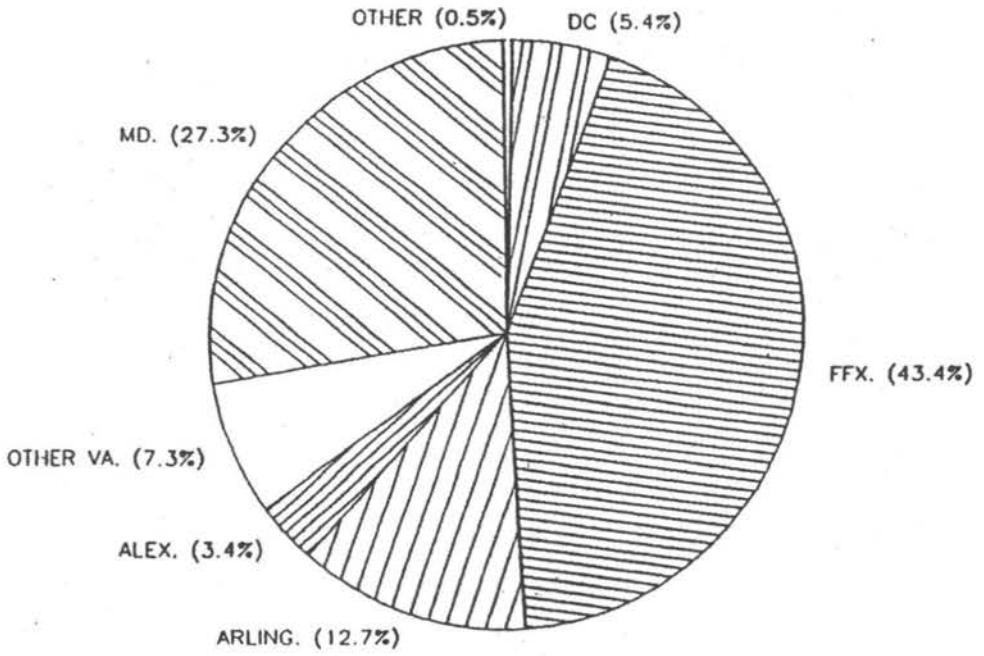


Figure 15.

Based on the responses to question 4 the auto ownership per household is 2.05. This is above the regional average of 1.93. Auto availability by building and mode of travel is shown in Table 4. The results confirm that auto users generally have more cars available.

Figure 16 summarizes the responses by gender. The result indicates that there is almost no difference in mode share by gender. This is in contrast to some previous studies which have indicated that women are more likely to use transit than men (studies in other cities have indicated that this is changing). The response rate to the survey by females was higher compared to males with approximately 57% of all replies made by women. The results of this analysis indicates the higher response by females does not bias the overall findings of this survey.

Examining the mode share by age indicates that transit usage declines with age from 27% by people in their twenties to approximately 15% for people in their forties and fifties (Table 5). This is probably a reflection of several factors: older people generally hold positions that require a greater use of their auto during the day; they perhaps have more disposable income and can afford more cars per household; parking provided by employers tends to be by rank thus more people in the older age groups have parking provided; and people in older age brackets developed their commuting practices before Metrorail was in place and old habits die hard.

While this relationship will probably hold true for some time to come, it does indicate that WMATA should consider strategies to expand the 35 and up market. This could become increasingly important as the average age of the work force increases.

The impact of occupation on mode share appears to be insignificant with the exception of clerical jobs which report greater transit usage. However, it should be kept in mind that the data base for this study is limited to primarily white collar office buildings and occupations are classified based on respondents information.

Based on the responses, the peak hour for the AM is between 7:30 and 8:30 and the PM is between 4:30 and 5:30. Examination of the data also reveals that in most cases the number of people arriving in the peak hour is not significantly greater than the hour immediately before and after. Instead there is a peak period that lasts for about 2 1/2 hours. This is true for all buildings, perhaps indicating that employees are taking advantage of flexible work hours allowed by their employers to avoid the peak hours. Over 50% of respondents reported that their employers allowed flexible working hours.

The mode share (auto vs transit) for the commute trip to each office building is given in Table 6 and illustrated in Figure 17. The cordon count conducted at each

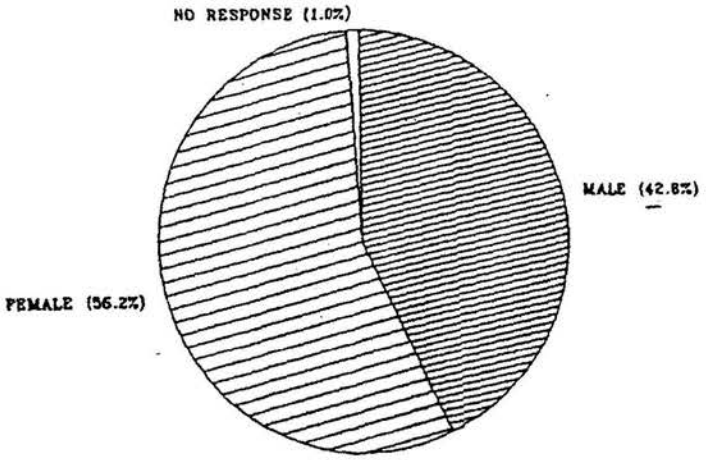
Table 4. Workplace Surveys

Number of Vehicles Available by Mode to Work

Average Number of Vehicles Per Household

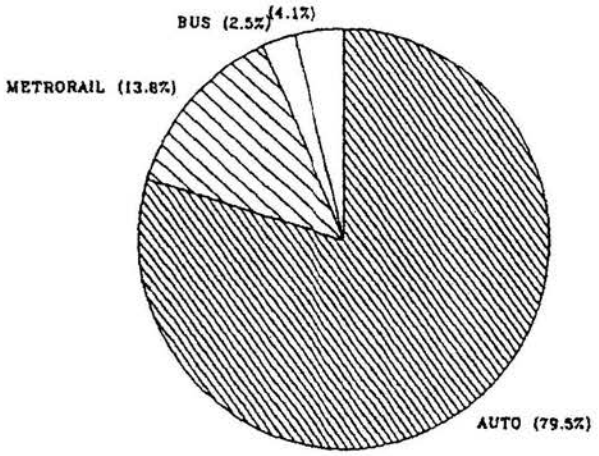
Building	MODE				All Modes	Transit Mode Shares
	Auto	Transit	Walk	Other		
Olmstead Building	2.04	1.51	0.80	NA	1.67	50.0%
Silver Spring Metro Center	2.01	1.53	1.00	1.78	1.83	24.6
Ballston One	2.11	1.18	1.50	2.17	1.95	13.2
Bell Atlantic	2.21	1.82	1.00	2.00	2.13	11.4
East West Towers	1.90	2.00	1.00	NA	1.88	16.7
Bethesda Metro Center	2.20	1.71	3.00	1.67	2.14	14.6
Twinbrook	2.18	0.92	NA	1.00	2.09	9.3
Parklawn	2.23	1.45	1.79	1.67	2.14	7.8
Crystal Square II	2.35	2.03	1.00	1.50	2.21	17.8
Bethesda Office Center	2.11	1.10	2.63	0.00	1.95	14.3
Averages	2.18	1.54	1.61	1.70	2.05	17.6

Note: This table shows the auto availability by building and by mode of travel. For example, at the Bell Atlantic building, the average number of vehicles per household among transit users is 1.82.



MODE SPLIT FOR OFFICE BUILDINGS

MALE EMPLOYEES



MODE SPLIT FOR OFFICE BUILDINGS

FEMALE EMPLOYEES

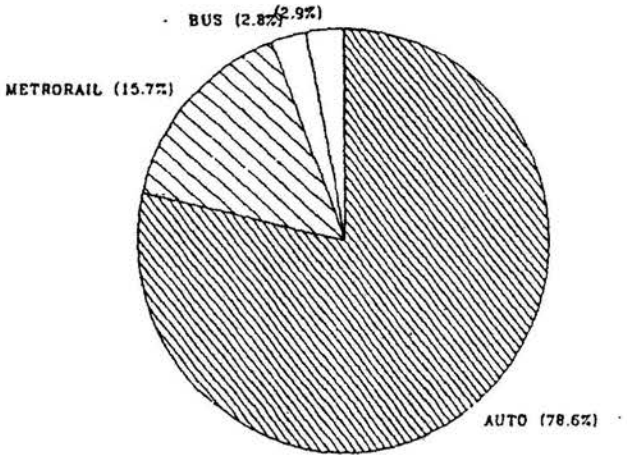


Figure 16.

Table 5. Workplace Surveys

Age By Mode By Office

Sites 1 - 10: All Surveyed Offices

	Auto	Transit	Walk	Other	Total
<18	5	3	0	0	8
19 - 24	158	65	5	2	230
25 - 34	498	134	20	7	659
35 - 44	563	91	12	11	677
45 - 54	404	84	9	4	501
55 - 64	158	25	4	3	190
>65	24	3	1	0	28
Missing Values	19	3	0	1	23
Totals	1829	408	51	28	2316

Note: "Missing Values" refer to people who answered the question but did not specify their mode of travel.

Table 6. Mode Share for Trips to and from Work

Location	Mode						Summary	
	Auto	Rail	Bus	Walk	Other	Subtotal	% Auto	% Transit
Olmstead Building	44.0%	43.5%	7.2%	3.9%	1.4%	100.0%	44.0%	50.7%
Silver Spring Metro Center	64.4	19.7	4.5	5.3	6.1	100.0	64.4	24.2
Ballston One	78.6	12.0	1.1	3.1	5.1	100.0	78.6	13.1
Bell Atlantic	85.1	11.0	0.5	1.9	1.4	100.0	85.1	11.5
East Wet Towers	83.3	13.3	3.3	0.0	0.0	100.0	83.3	16.7
Bethesda Metro Center	82.4	14.5	0.0	1.6	1.6	100.0	82.4	14.5
Twinbrook	90.3	7.6	1.1	0.5	0.5	100.0	90.3	8.6
Parklawn	87.4	4.7	3.0	3.4	1.4	100.0	87.4	7.8
Crystal Square II	75.8	16.4	1.4	2.7	3.7	100.0	75.8	17.8
Bethesda Office Center	79.5	10.0	4.1	5.0	1.4	100.0	79.5	14.2

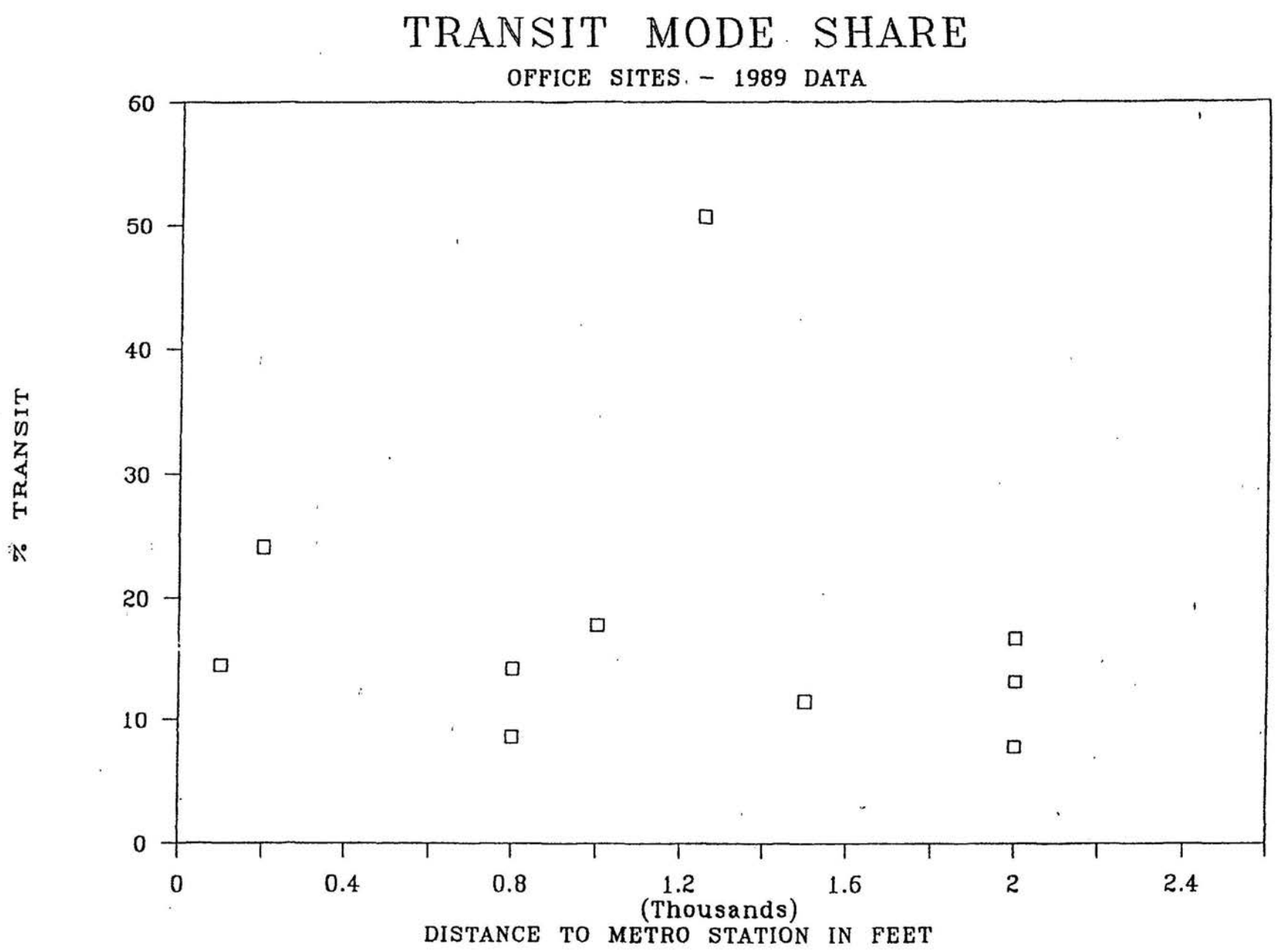

TRANSIT MODE SHARE
OFFICE SITES - 1989 DATA
% TRANSIT
60
50
40
30
20
10
0
0
0.4
0.8
1.2
1.6
2
2.4
(Thousands)
DISTANCE TO METRO STATION IN FEET

Figure 17.

building allowed the actual trip generation rate to be determined, this was then compared to predicted trip generation rates estimated from the survey responses. This comparison helped to determine and adjust for the presence of bias in the survey responses. At five of the buildings it was possible to conduct occupancy counts at the entrance(s) as the parking for the building was restricted to the building as opposed to shared parking for two or more buildings. At these sites then the mode share as determined by the survey responses could be compared for reasonableness to the mode share for the site.

As was the case with the first study, distance from a Metrorail station portal is one of the main dependent variables for determining the mode share for transit. In general, the data confirmed the findings of the first study, namely that the offices closer to the Metrorail station portals exhibit a higher percent of transit users than those located further from the station portals and that the percent of transit users is a function of the location within the metropolitan area. For instance, sites located outside the Beltway exhibit different trends than those inside the Beltway. Table 7 summarizes the findings of this study. These relationships are examined in more detail in Chapter 3.

Transit users can be classified as either "captive" or "choice" users. A choice user, as the term implies, is one who actively chooses to use public transit rather than other modes that are available to him or her. The typical choice rider lives in the suburbs, works in the central business district (CBD) and, faced with peak period congestion on the roads, limited and expensive parking and relatively high levels of transit service to the downtown, chooses to leave his or her auto at home and use public transit.

Conversely, a captive rider is one who effectively has no alternative mode of travel. Typically he or she does not have the use of an automobile available. The majority of transit trips throughout the day in many urban areas is typically made by captive riders and this provides the core ridership. Additional ridership is developed by attracting choice users, particularly from the segment of work related commute trips. In this study 67.6% of Metrorail riders and 60.3% of transit riders in general reported that they did have a car available. This is illustrated in Figure 18 and summarized by building in Table 8. Captive vs choice user is a measure of a systems perceived competitiveness vs other modes within a region. Thus, the results indicate that transit is perceived as being competitive by more people in the Washington metropolitan area than in many urban areas. The higher the percent of choice users, the better in terms of achieving a reduction in auto traffic. Expansion of ridership, for the most part, must

Table 7. Summary of Transit Mode Share - Office

	Number of Sites	Percent Transit Range	Percent Transit Average
CBD Locations	1	50.0%	50.0%
Suburban Locations Inside Beltway	7	11.4% - 24.6%	15.6%
Suburban Locations Outside Beltway	2	7.8% - 9.3%	8.5%
All Office Locations	10	7.8% - 50.0%	17.6%

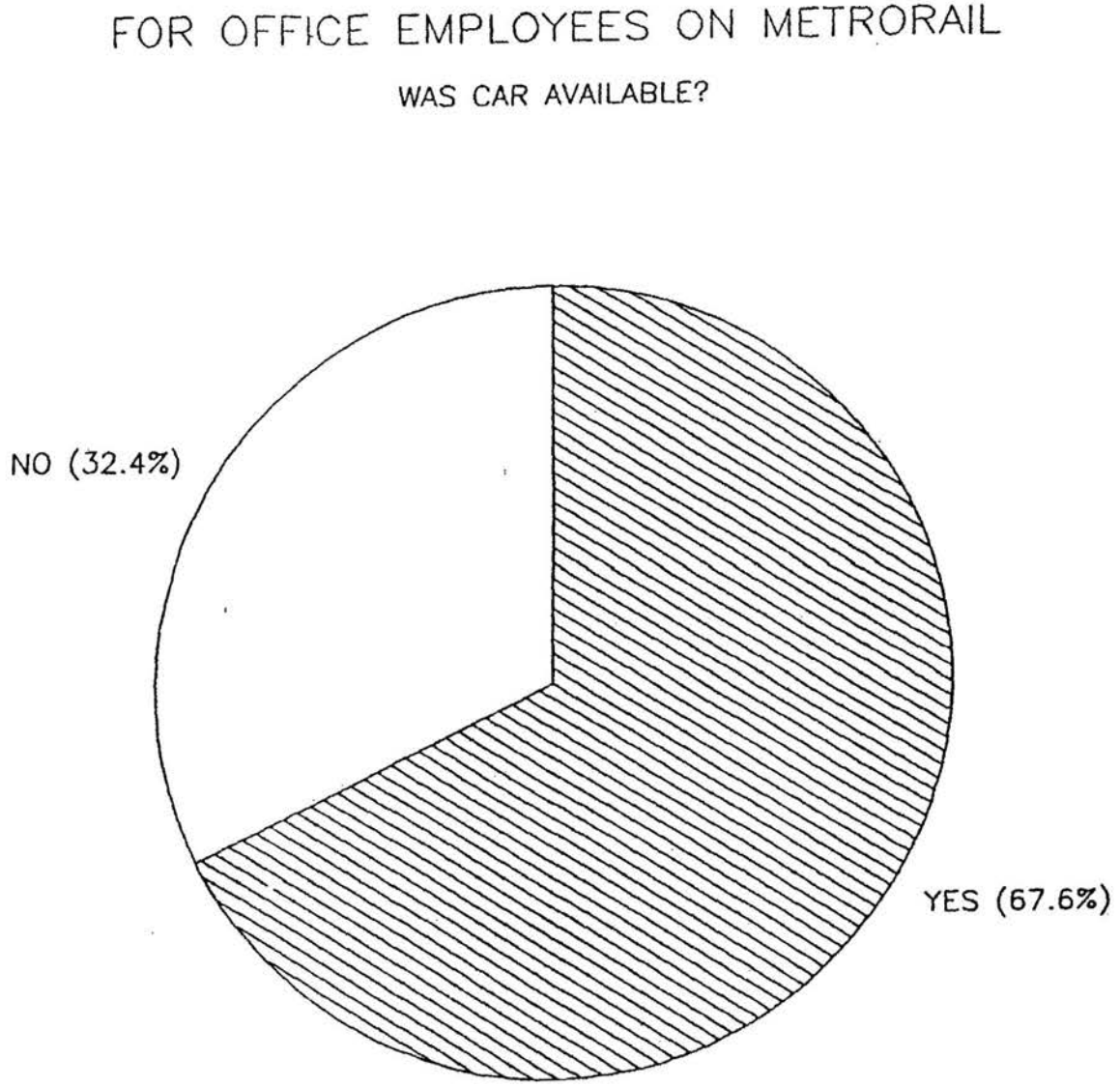

FOR OFFICE EMPLOYEES ON METRORAIL
WAS CAR AVAILABLE?
NO (32.4%)
YES (67.6%)

Figure 18.

Table 8. Workplace Surveys
Auto Availability

If you took transit, was a car available?

Building	Yes	No	Not Answered	Total	Percent Available
1701 Pennsylvania	62	17	4	83	74.7%
Silver Spring Metro Center	22	14	2	38	57.9
Ballston One	16	25	5	46	34.8
Bell Atlantic	53	18	3	74	71.6
East West Towers	2	4	1	7	28.5
Bethesda Metro Center	19	8	3	30	63.3
Twinbrook	7	7	0	14	50.0
Parklawn	28	25	3	56	50.0
Crystal Square II	20	11	0	31	64.5
Bethesda Office Center	17	10	2	29	58.6
TOTALS	246	139	23	408	60.3

come from segments of the population who would be classified as choice users. Despite the fact that a large percentage of patrons are choice users, only 11.8% of all respondents who have a car available use transit. Another statistic generated from the data, is that transit is perceived as a viable option by approximately 48% of employees at the sites surveyed. If transit mode share is expressed as a percent of those who have acceptable connections it rises from 17.6% to 36.7% -- more than double. This implies that lack of access is perceived as a major obstacle by a large segment of potential choice users.

Another factor that influences transit ridership is the cost of travel. Parking costs varied somewhat for each site, however at most sites there was significant off-site parking available. No relationship to parking cost could be determined.

Travel times for both auto and transit users are summarized in Table 9. Transit mode share tends to increase for longer distance trips. This is to be expected as it is difficult for transit to be competitive on shorter trips as waiting times account for a bigger percentage of an individual's trip resulting in a poor travel time relative to auto travel. On longer trips this is overcome. For instance, a short trip may take 10 minutes by car and 15 to 20 minutes by transit including wait time while a 30 minute trip by car could be accomplished in 35 to 40 minutes by transit.

Table 10 summarizes the responses to the attitudinal questions. As expected transit users have a better perception of transit than auto users. The most significant difference is in opinions concerning the availability of schedule information. Approximately 48% of auto users believe that schedule information is readily available while approximately 63% of transit users believe schedule information is readily available. Of the total respondents only 49.4% believe schedule information is readily available. This suggests that a marketing strategy that distributes information to employees may be beneficial. Targeted information could be distributed to offices within each station area.

The final set of questions pertained to trip making characteristics for all trips throughout the day. Respondents were asked the purpose, mode and destination for all trips to and from their office building for the day in question. Also, information concerning stop overs was collected for each trip.

Table 11 summarizes the mode share by location of employees' residences for the commute trips to and from work. Figure 19 illustrates the percent of linked trips that are made for each time period during the day; linked trips are most prevalent during the mid-day period. Table 12 summarizes mid-day trips by trip purpose and mode share.

Table 9. Average Travel Times

Auto Users	(Minutes)
Drive from home to office parking	31.6
Walk from office parking to office	3.2
Total trip time, home to office	36.2
Transit Users	
Trip from home to transit	9.6
Time on transit vehicle(s)	31.3
Trip from last transit vehicle to office	7.0
Total trip time, home to office	43.9

Table 10. Workplace Surveys
Respondents Opinions By Mode of Travel

Q12A: People should be encouraged to use transit.

	Mode of Travel															
Question	Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	1385	(75.8%)	331	(81.1%)	42	(82.4%)	23	(82.1%)	1781	(76.9%)	28	(66.7%)	1809	(76.7%)
Disagree	112	(6.1)	17	(4.2)	2	(3.9)	0	(0.0)	131	(5.7)	3	(7.2)	134	(5.7)
No Opinion	297	(16.2)	46	(11.3)	7	(13.7)	5	(17.9)	355	(15.3)	8	(19.0)	363	(15.4)
Not Answered	35	(1.9)	14	(3.4)	0	(0.0)	0	(0.0)	49	(2.1)	3	(7.2)	52	(2.2)
Total	1829	(100.0)	408	(100.0)	51	(100.0)	28	(100.0)	2316	(100.0)	42	(100.0)	2358	(100.0)

Q12B: Schedule information for transit is readily available.

	Mode of Travel															
Question	Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	874	(47.8%)	257	(63.0%)	22	(43.1%)	12	(42.9%)	1165	(50.3%)	16	(38.1%)	1181	(50.1%)
Disagree	576	(31.5)	99	(24.3)	21	(41.2)	7	(25.0)	703	(30.4)	8	(19.0)	711	(30.2)
No Opinion	348	(19.0)	37	(9.1)	8	(15.7)	7	(25.0)	400	(17.3)	14	(33.3)	414	(17.6)
Not Answered	31	(1.7)	15	(3.7)	0	(0.0)	2	(7.1)	48	(2.1)	4	(9.5)	52	(2.2)
Total	1829	(100.0)	408	(100.0)	51	(100.0)	28	(100.0)	2316	(100.0)	42	(100.0)	2358	(100.0)

Table 10. Workplace Surveys
Respondents Opinions By Mode of Travel
(Continued)

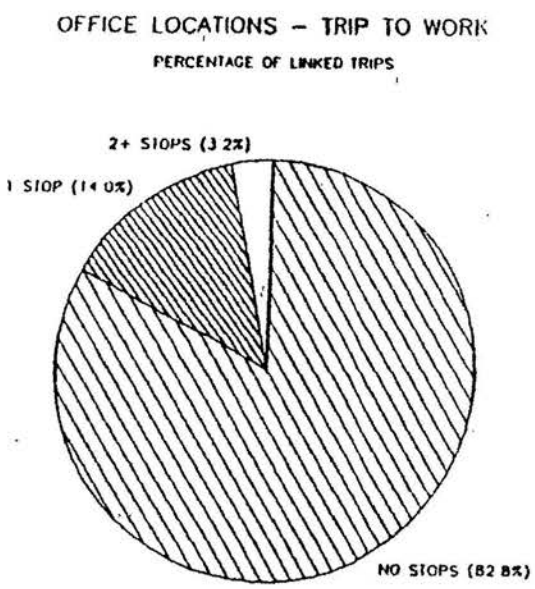
Q12C: Metrorail is clean and reliable.

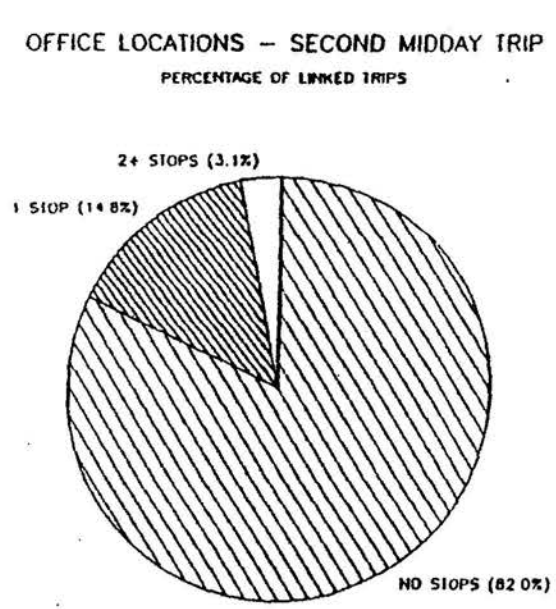
Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	1543	(84.4%)	379	(92.9%)	51	(100.0%)	23	(82.1%)	1996	(86.2%)	30	(71.4%)	2026	(85.9%)
Disagree	58	(3.2)	9	(2.2)	0	(0.0)	1	(3.6)	68	(2.9)	3	(7.1)	71	(3.0)
No Opinion	202	(11.0)	6	(1.5)	0	(0.0)	1	(3.6)	209	(9.0)	6	(14.3)	215	(9.1)
Not Answered	26	(1.4)	14	(3.4)	0	(0.0)	3	(10.7)	43	(1.9)	3	(7.1)	46	(2.0)
Total	1829	(100.0)	408	(100.0)	51	(100.0)	28	(100.0)	2316	(100.0)	42	(100.0)	2358	(100.0)

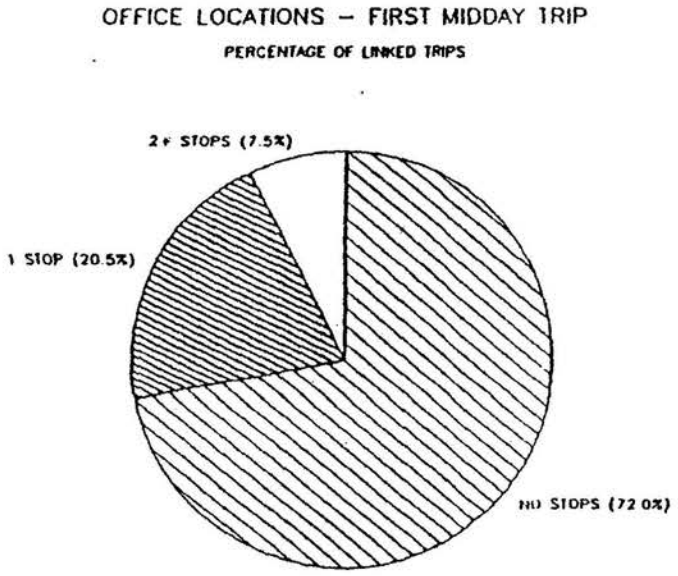
Q12D: Metrobus is clean and reliable.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	521	(28.5%)	142	(34.8%)	15	(29.4%)	3	(10.7%)	681	(29.4%)	10	(23.8%)	691	(29.3%)
Disagree	358	(19.6)	93	(22.8)	9	(17.6)	11	(39.3)	471	(20.3)	7	(16.7)	478	(20.3)
No Opinion	917	(50.1)	154	(37.7)	27	(52.9)	11	(39.3)	1109	(47.9)	22	(52.4)	1131	(48.0)
Not Answered	33	(1.8)	19	(4.7)	0	(0.0)	3	(10.7)	55	(2.4)	3	(7.1)	58	(2.5)
Total	1829	(100.0)	408	(100.0)	51	(100.0)	28	(100.0)	2316	(100.0)	42	(100.0)	2358	(100.0)

Note: Not answered refers to people who specified their mode of travel but do not answer the question. Missing values refer to people who answered the question but did not specify their mode of travel.


OFFICE LOCATIONS – TRIP TO WORK
PERCENTAGE OF LINKED TRIPS
2+ STOPS (3.2%)
1 STOP (14.0%)
NO STOPS (82.8%)


OFFICE LOCATIONS – SECOND MIDDAY TRIP
PERCENTAGE OF LINKED TRIPS
2+ STOPS (3.1%)
1 STOP (14.8%)
NO STOPS (82.0%)


OFFICE LOCATIONS – FIRST MIDDAY TRIP
PERCENTAGE OF LINKED TRIPS
2+ STOPS (7.5%)
1 STOP (20.5%)
NO STOPS (72.0%)

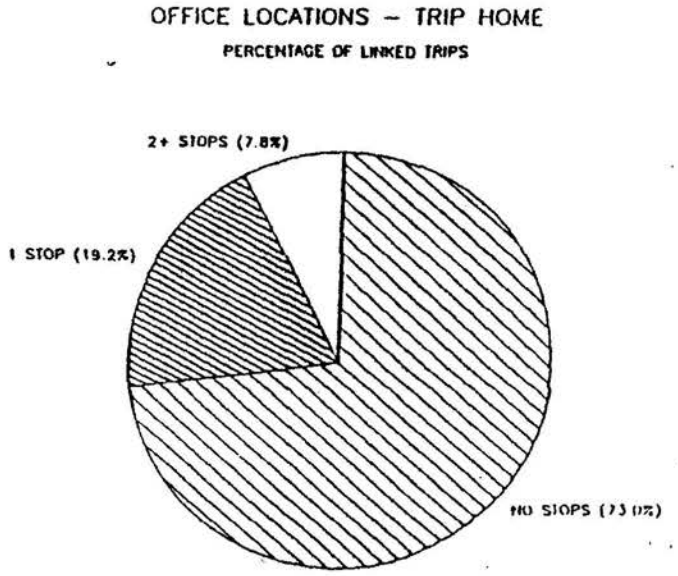

OFFICE LOCATIONS – TRIP HOME
PERCENTAGE OF LINKED TRIPS
2+ STOPS (7.8%)
1 STOP (19.2%)
NO STOPS (73.0%)

Figure 19.

Table 11. Mode by Location of Residence Trip to and from Work by Percent

Location	Mode	D.C.	Fairfax County	Arl.	Alex.	Va. Other	P.G. County	Montg. County	Md. Other	Other	Subtotal	Percent Auto	Percent Transit
1701 Penn	Auto	38.0%	61.3%	43.8%	23.5%	100.0%	60.9%	34.0%	60.0%	100.0%	44.6%		
	Transit	48.0	38.7	50.0	70.6	0.0	39.1	66.0	20.0	0.0	50.0		
	Other	14.0	0.0	6.3	5.9	0.0	0.0	0.0	20.0	0.0	5.4		
	Total	24.5	15.2	7.8	8.3	1.0	11.3	26.0	4.9	1.0	100.0	44.6%	50.0%
Silver Spring Metro Center	Auto	39.4	77.8	72.7	—	—	66.7	65.9	85.7	100.0	63.8		
	Transit	51.5	22.2	27.3	—	—	22.2	9.8	0.0	0.0	24.6		
	Other	9.1	0.0	0.0	—	—	11.1	24.4	14.3	0.0	11.5		
	Total	25.4	20.8	8.5	0.0	0.0	6.9	31.5	5.4	1.5	100.0	63.8	24.6
Ballston One	Auto	81.8	89.8	63.0	93.3	70.3	64.9	87.5	100.0	66.7	78.5		
	Transit	18.2	6.5	14.8	6.7	0.0	35.1	12.5	0.0	0.0	13.2		
	Other	0.0	3.7	22.2	0.0	29.7	0.0	0.0	0.0	33.3	8.3		
	Total	9.5	30.9	15.5	4.3	10.6	16.3	9.2	2.0	1.7	100.0	78.5	13.2
Bell Atlantic	Auto	66.7	83.1	78.9	94.7	82.9	92.3	93.2	100.0	100.0	85.2		
	Transit	26.7	14.8	11.3	5.3	4.9	7.7	6.8	0.0	0.0	11.4		
	Other	6.7	2.1	9.9	0.0	12.2	0.0	0.0	0.0	0.0	3.4		
	Total	5.4	43.4	12.7	3.4	7.3	11.6	10.5	5.2	0.5	100.0	85.2	11.4
East West Towers	Auto	66.7	100.0	—	—	—	100.0	77.8	100.0	—	83.3		
	Transit	0.0	0.0	—	—	—	0.0	22.2	0.0	—	13.3		
	Other	33.3	0.0	—	—	—	0.0	0.0	0.0	—	3.3		
	Total	10.0	6.7	0.0	0.0	0.0	10.0	60.0	13.3	0.0	100.0	83.3	13.3

Note: This table presents the mode share by jurisdiction for each office building and the distribution of employee residences by jurisdiction. For each jurisdiction, the percentage of trips by mode are indicated in the rows labeled "Auto," "transit," and "other." These three totaled vertically for each building equal 100%. For each office location, the row labeled "total" indicates the percentage of trips from each jurisdiction. Totaled horizontal this row equals 100%.

Table 11. Mode by Location of Residence Trip to and from Work by Percent
(Continued)

Location	Mode	D.C.	Fairfax County	Arl.	Alex.	Va. Other	P.G. County	Montg. County	Md. Other	Other	Subtotal	Percent Auto	Percent Transit
Bethesda Metro Center	Auto	70.6	88.9	100.0	100.0	100.0	70.4	84.4	81.0	33.3	82.3		
	Transit	29.4	11.1	0.0	0.0	0.0	29.6	12.3	4.8	66.7	14.6		
	Other	0.0	0.0	0.0	0.0	0.0	0.0	3.2	14.3	0.0	3.1		
	Total	6.7	7.1	2.4	2.0	1.2	10.6	60.6	8.3	1.2	100.0	82.3	14.6
Twinbrook	Auto	40.0	100.0	88.9	100.0	100.0	95.7	90.8	100.0	50.0	90.1		
	Transit	60.0	0.0	0.0	0.0	0.0	4.3	9.2	0.0	50.0	9.3		
	Other	0.0	0.0	11.1	0.0	0.0	0.0	0.0	0.0	0.0	0.5		
	Total	5.5	9.3	4.9	2.2	3.3	12.6	53.8	7.1	1.1	100.0	90.1	9.3
Parklawn	Auto	68.4	97.4	83.3	100.0	87.5	94.0	87.3	88.3	50.0	87.2		
	Transit	21.1	2.6	16.7	0.0	12.5	6.0	7.7	5.2	0.0	7.8		
	Other	10.5	0.0	0.0	0.0	0.0	0.0	4.9	6.5	50.0	4.9		
	Total	5.5	5.7	0.9	0.3	1.2	7.2	67.5	11.2	0.6	100.0	87.2	7.8
Crystal Square 2	Auto	100.0	73.4	37.5	77.3	94.6	94.1	68.2	88.2	—	75.8		
	Transit	0.0	21.5	37.5	13.6	0.0	5.9	31.8	11.8	—	17.8		
	Other	0.0	5.1	25.0	9.1	5.4	0.0	0.0	0.0	—	6.4		
	Total	0.5	36.1	11.0	10.0	16.9	7.8	10.0	7.8	0.0	100.0	75.8	17.8
Bethesda Office Center	Auto	56.3	100.0	66.7	50.0	—	87.5	79.7	77.8	—	79.3		
	Transit	43.8	0.0	33.3	50.0	—	12.5	12.2	0.0	—	14.3		
	Other	0.0	0.0	0.0	0.0	—	0.0	8.1	22.2	—	6.5		
	Total	7.4	8.3	2.8	1.8	0.0	7.4	68.2	4.1	0.0	100.0	79.3	14.3

Note: This table presents the mode share by jurisdiction for each office building and the distribution of employee residences by jurisdiction. For each jurisdiction, the percentage of trips by mode are indicated in the rows labeled "Auto," "transit," and "other." These three totaled vertically for each building equal 100%. For each office location, the row labeled "total" indicates the percentage of trips from each jurisdiction. Totaled horizontal this row equals 100%.

Table 12. Mode Share for Midday Trips by Purpose

Location	Mode	Work Related	Personal Business	Meal/ Snack	Shopping	Educational	Recreational	Other	Total	Summary: Percent Auto	Summary: Percent Transit
1701	Auto	22.2%	0.0%	0.0%	0.0%	—%	33.3%	—%	8.6%		
Penn	Transit	11.1	20.0	0.0	25.0	—	33.3	—	14.3		
	Other	66.7	80.0	100.0	75.0	—	33.3	—	77.1		
	Total	25.7	28.6	25.7	11.4	0.0	8.6	0.0	100.0	8.6%	14.3%
Silver	Auto	45.5	33.3	44.4	100.0	—	—	—	44.4		
Spring	Transit	54.5	0.0	0.0	0.0	—	—	—	22.2		
Metro	Other	0.0	66.7	55.6	0.0	—	—	—	33.3		
Center	Total	40.7	22.2	33.3	3.7	0.0	0.0	0.0	100.0	44.4	22.2
Ballston	Auto	81.3	90.0	78.3	85.7	100.0	100.0	0.0	81.7		
One	Transit	12.5	10.0	0.0	0.0	0.0	0.0	0.0	5.0		
	Other	6.3	0.0	21.7	14.3	0.0	0.0	100.0	13.3		
	Total	26.7	16.7	38.3	11.7	1.7	3.3	1.7	100.0	81.7	5.0
Bell	Auto	73.1	78.3	64.4	83.3	50.0	40.0	83.3	71.9		
Atlantic	Transit	15.4	4.3	5.1	3.3	33.3	0.0	0.0	6.7		
	Other	11.5	17.4	30.5	13.3	16.7	60.0	16.7	21.3		
	Total	14.6	25.8	33.1	16.9	3.4	2.8	3.4	100.0	71.9	6.7
East	Auto	25.0	0.0	—	—	—	—	—	20.0		
West	Transit	50.0	100.0	—	—	—	—	—	60.0		
Towers	Other	25.0	0.0	—	—	—	—	—	20.0		
	Total	80.0	20.0	0.0	0.0	0.0	0.0	0.0	100.0	20.0	60.0

Note: For each purpose, the percentage of trips by mode are indicated in the rows labeled "auto", "transit", and "other". These vertically total to 100% for each purpose. For each office location the row labeled "total" indicates the percentages of trips by purpose. This row totals horizontally to 100%.

Table 12. Mode Share for Midday Trips by Purpose

(Continued)

Location	Mode	Work Related	Personal Business	Meal/ Snack	Shopping	Educational	Recreational	Other	Total	Summary: Percent Auto	Summary: Percent Transit
Bethesda	Auto	76.7	63.0	61.5	100.0	—	50.0	—	71.3		
Metro	Transit	20.0	7.4	0.0	0.0	—	0.0	—	10.0		
Center	Other	3.3	29.6	38.5	0.0	—	50.0	—	18.8		
	Total	37.5	33.8	16.3	10.0	0.0	2.5	0.0	100.0	71.3	10.0
Twinbrook	Auto	92.9	92.9	62.5	85.7	100.0	0.0	100.0	81.8		
	Transit	7.1	7.1	0.0	0.0	0.0	0.0	0.0	3.6		
	Other	0.0	0.0	37.5	14.3	0.0	100.0	0.0	14.5		
	Total	25.5	25.5	29.1	12.7	3.6	1.8	1.8	100.0	81.8	3.6
Parklawn	Auto	62.1	91.8	85.0	97.2	100.0	75.0	85.7	86.2		
	Transit	34.5	4.1	0.0	0.0	0.0	0.0	0.0	5.6		
	Other	3.4	4.1	15.0	2.8	0.0	25.0	14.3	8.2		
	Total	12.5	31.5	34.5	15.5	1.3	1.7	3.0	100.0	86.2	5.6
Crystal	Auto	66.7	76.2	40.0	—	0.0	—	100.0	63.9		
Square 2	Transit	33.3	14.3	6.7	—	100.0	—	0.0	22.2		
	Other	0.0	9.5	53.5	—	0.0	—	0.0	13.9		
	Total	45.8	29.2	20.8	0.0	1.4	0.0	2.8	100.0	63.9	22.2
Bethesda	Auto	77.8	53.3	18.2	66.7	—	33.3	—	54.7		
Office	Transit	5.6	13.3	0.0	16.7	—	33.3	—	9.4		
Center	Other	16.7	33.3	81.8	16.7	—	33.3	—	35.8		
	Total	34.0	28.3	20.8	11.3	0.0	5.7	0.0	100.0	54.7	9.4

Note: For each purpose, the percentage of trips by mode are indicated in the rows labeled "auto", "transit", and "other". These vertically total to 100% for each purpose. For each office location the row labeled "total" indicates the percentages of trips by purpose. This row totals horizontally to 100%.

The results for this study were very similar to the first study. Approximately two thirds of the mid-day trips were made for job-related business or for a meal or snack. Job-related business accounted for approximately one third of the total mid-day trips. The actual percentages varied considerably. The Parklawn Building was at the low end with 12.5% reporting a mid-day trip, while East-West Towers was at the high end with 80% of respondents reporting a mid-day trip.

In contrast to the first study, office buildings were located in areas with varying density. For the meal or snack category, transit ridership was low. Transit ridership ranged from 0 to 6.7% and the percentage for auto usage ranged from 0 to 85%, with the higher auto use at the Parklawn Building (see Table 12). Transit mode share for non-walk mid-day trips by purpose is shown in Table 13.

The job-related business trip percentage increases when walk trips are removed from the data base while the percent of meal snack decreases significantly. One implication is that work related business is the least likely to be by transit. It should be noted that the sample sizes for the non-walk mid-day trips become very small in some cases and may not be representative of what actually happens.

Table 14 contains information on the percent of mid-day trips to each destination by office building and the mode share for each destination. Table 15 was prepared utilizing only non-walk mid-day trips. Eliminating these walk trips essentially removed the short localized trips. For example, a large percentage of the trips from 1701 Pennsylvania Avenue were walk trips. Removing the walk trips dramatically increased the percentage of trips to Virginia or Maryland. Generally trips from the offices outside the CBD to other offices in Maryland or Virginia exhibit a very low transit mode share. However, trips to or from the District of Columbia, where Metrorail access is the greatest, are expected to exhibit a larger transit ridership percentage. It is interesting to note that Silver Spring Metro Center and Crystal Square 2 both have a significant transit mode share. The implication is that a high percentage of mid-day office to office trips will take place on Metrorail as long as rail access is good at both ends. Locating office buildings at suburban stations should have the effect of increasing mid-day transit ridership through job-related interchange between that location and other Metrorail stations. An indirect effect of making mid-day job-related trips accessible by transit is the greater possibility of suburban employees commuting to their offices by transit, since their car would be needed less frequently for mid-day travel.

Table 13. Mode Share for Midday Trips by Purpose Only Non-Walk Trips Included

Location	Mode	Work Related	Personal Business	Meal/ Snack	Shopping	Educational	Recreational	Other	Total	Summary Percent Auto	Summary Percent Transit
1701	Auto	33.3	0.0	—	0.0	—	50.0	—	27.3		
Penn	Transit	16.7	100.0	—	100.0	—	50.0	—	45.5		
	Other	50.0	0.0	—	0.0	—	0.0	—	27.3		
	Total	54.5	18.2	0.0	9.1	0.0	18.2	0.0	100.0	27.3	45.5
Silver	Auto	45.5	100.0	100.0	100.0	—	—	—	66.7		
Spring	Transit	54.5	0.0	0.0	0.0	—	—	—	33.3		
Metro	Other	0.0	0.0	0.0	0.0	—	—	—	0.0		
Center	Total	61.1	11.1	22.2	5.6	0.0	0.0	0.0	100.0	66.7	33.3
Ballston	Auto	86.7	90.0	100.0	100.0	100.0	100.0	—	94.2		
One	Transit	13.3	10.0	0.0	0.0	0.0	0.0	—	5.8		
	Other	0.0	0.0	0.0	0.0	0.0	0.0	—	0.0		
	Total	28.8	19.2	34.6	11.5	1.9	3.8	0.0	100.0	94.2	5.8
Bell	Auto	79.2	94.7	92.7	96.2	60.0	100.0	100.0	90.8		
Atlantic	Transit	16.7	5.3	7.3	3.8	40.0	0.0	0.0	8.5		
	Other	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.7		
	Total	17.0	27.0	29.1	18.4	3.5	1.4	3.5	100.0	90.8	8.5
East	Auto	33.3	0.0	—	—	—	—	—	25.0		
West	Transit	66.7	100.0	—	—	—	—	—	75.0		
Towers	Other	0.0	0.0	—	—	—	—	—	0.0		
	Total	75.0	25.0	0.0	0.0	0.0	0.0	0.0	100.0	25.0	75.0

Table 13. Mode Share for Midday Trips by Purpose
Only Non-Walk Trips Included
(Continued)

Location	Mode	Work Related	Personal Business	Meal/ Snack	Shopping	Educa- tional	Recrea- tional	Other	Total	Summary: Percent Auto	Summary: Percent Transit
Bethesda	Auto	79.3	89.5	100.0	100.0	—	100.0	—	87.7		
Metro	Transit	20.7	10.5	0.0	0.0	—	0.0	—	12.3		
Center	Other	0.0	0.0	0.0	0.0	—	0.0	—	0.0		
	Total	44.6	29.2	12.3	12.3	0.0	1.5	0.0	100.0	87.7	12.3
Twinbrook	Auto	92.9	92.9	100.0	100.0	100.0	—	100.0	95.7		
	Transit	7.1	7.1	0.0	0.0	0.0	—	0.0	4.3		
	Other	0.0	0.0	0.0	0.0	0.0	—	0.0	0.0		
	Total	29.8	29.8	21.3	12.8	4.3	0.0	2.1	100.0	95.7	4.3
Parklawn	Auto	64.3	95.7	100.0	100.0	100.0	100.0	100.0	93.9		
	Transit	35.7	4.3	0.0	0.0	0.0	0.0	0.0	6.1		
	Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	Total	13.1	32.9	31.9	16.4	1.4	1.4	2.8	100.0	93.9	6.1
Crystal	Auto	66.7	84.2	85.7	—	0.0	—	100.0	74.2		
Square 2	Transit	33.3	15.8	14.3	—	100.0	—	0.0	25.8		
	Other	0.0	0.0	0.0	—	0.0	—	0.0	0.0		
	Total	53.2	30.6	11.3	0.0	1.6	0.0	3.2	100.0	74.2	25.8
Bethesda	Auto	93.3	80.0	100.0	80.0	—	50.0	—	85.3		
Office	Transit	6.7	20.0	0.0	20.0	—	50.0	—	14.7		
Center	Other	0.0	0.0	0.0	0.0	—	0.0	—	0.0		
	Total	44.1	29.4	5.9	14.7	0.0	5.9	0.0	100.0	85.3	14.7

Note: For each purpose, the percentage of trips by mode are indicated in the rows labeled "auto", "transit", and "other". These vertically total to 100% for each purpose. For each office location the row labeled "total" indicates the percentages of trips by purpose. This row totals horizontally to 100%.

Table 14. Mode Share for Midday Trips by Destination

Location	Mode	Within 1/2 mi	D.C.	Ffx. County	Arl.	Alex.	Va Other	P.G. County	Mont. County	Md Other	Other	Subtotal	Summary Percent Auto	Summary Percent Transit
1701	Auto	0.0%	0.0%	—%	0.0%	0.0%	—%	—%	—%	—%	—%	0.0		
Penn	Transit	0.0	46.7	—	100.0	0.0	—	—	—	—	—	22.9		
	Other	100.0	53.3	—	0.0	100.0	—	—	—	—	—	77.1		
	Total	51.4	42.9	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	22.9
Silver	Auto	0.0	42.9	—	—	—	—	—	52.9	—	—	44.4		
Spring	Transit	0.0	57.1	—	—	—	—	—	11.8	—	—	22.2		
Metro	Other	100.0	0.0	—	—	—	—	—	35.3	—	—	33.3		
Center	Total	11.1	25.9	0.0	0.0	0.0	0.0	0.0	63.0	0.0	0.0	100.0	44.4	22.2
Ballston	Auto	25.0	80.0	90.9	84.6	100.0	100.0	—	100.0	100.0	100.0	80.0		
One	Transit	0.0	20.0	9.1	7.7	0.0	0.0	—	0.0	0.0	0.0	6.7		
	Other	75.0	0.0	0.0	7.7	0.0	0.0	—	0.0	0.0	0.0	13.3		
	Total	13.3	8.3	18.3	43.3	5.0	5.0	0.0	3.3	1.7	1.7	100.0	80.0	6.7
Bell	Auto	18.2	61.9	100.0	75.0	100.0	—	100.0	100.0	—	100.0	72.4		
Atlantic	Transit	0.0	33.3	0.0	5.7	0.0	—	0.0	0.0	—	0.0	6.9		
	Other	81.8	4.8	0.0	19.3	0.0	—	0.0	0.0	—	0.0	20.7		
	Total	12.6	12.1	14.4	50.6	5.2	0.0	1.1	3.4	0.0	0.6	100.0	72.4	6.9
East	Auto	0.0	—	—	—	—	—	—	33.3	—	—	20.0		
West	Transit	0.0	—	—	—	—	—	—	33.3	—	—	60.0		
Towers	Other	0.0	—	—	—	—	—	—	33.3	—	—	20.0		
	Total	40.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	0.0	0.0	100.0	20.0	60.0

Table 14. Mode Share for Midday Trips by Destination
(Continued)

Location	Mode	Within 1/2 mi	D.C.	Pfx. County	Arl.	Alex.	Va Other	P.G. County	Mont. County	Md Other	Other	Subtotal	Summary Percent Auto	Summary Percent Transit
Bethesda	Auto	38.5	44.4	100.0	50.0	—	—	100.0	77.5	100.0	100.0	70.1		
Metro	Transit	0.0	55.6	0.0	50.0	—	—	0.0	5.0	0.0	0.0	10.4		
Center	Other	61.5	0.0	0.0	0.0	—	—	0.0	17.5	0.0	0.0	19.5		
	Total	16.9	11.7	6.5	2.6	0.0	0.0	3.9	51.9	5.2	1.3	100.0	70.1	10.4
Twinbrook	Auto	72.7	100.0	—	—	100.0	—	100.0	78.1	100.0	100.0	81.8		
	Transit	0.0	0.0	—	—	0.0	—	0.0	6.3	0.0	0.0	3.6		
	Other	27.3	0.0	—	—	0.0	—	0.0	15.6	0.0	0.0	14.5		
	Total	20.0	9.1	0.0	0.0	3.6	0.0	3.6	58.2	3.6	1.8	100.0	81.8	3.6
Parklawn	Auto	61.5	50.0	100.0	100.0	—	—	100.0	91.8	100.0	—	86.0		
	Transit	0.0	50.0	0.0	0.0	—	—	0.0	3.3	0.0	—	5.7		
	Other	38.5	0.0	0.0	0.0	—	—	0.0	4.9	0.0	—	8.3		
	Total	11.4	6.1	0.4	0.4	0.0	0.0	0.9	79.5	1.3	0.0	100.0	86.0	5.7
Crystal	Auto	0.0	35.7	93.3	71.4	100.0	100.0	100.0	—	100.0	100.0	63.9		
Square 2	Transit	20.0	64.3	6.7	19.0	0.0	0.0	0.0	—	0.0	0.0	22.2		
	Other	80.0	0.0	0.0	9.5	0.0	0.0	0.0	—	0.0	0.0	13.9		
	Total	13.9	19.4	20.8	29.2	2.8	2.8	5.6	0.0	4.2	1.4	100.0	63.9	22.2
Bethesda	Auto	9.1	50.0	100.0	—	—	100.0	100.0	65.5	100.0	—	54.7		
Office	Transit	0.0	50.0	0.0	—	—	0.0	0.0	3.4	0.0	—	9.4		
Center	Other	90.9	0.0	0.0	—	—	0.0	0.0	31.0	0.0	—	35.8		
	Total	20.8	15.1	1.9	0.0	0.0	3.8	1.9	54.7	1.9	0.0	100.0	54.7	9.4

Note: For each destination, the percentage of trips of trips by mode are indicated in the rows labeled "auto", "transit", and "other". These total vertically to 100%. For office location, the row labeled "total" indicates the percentage of trips made to each destination. This row totals horizontally to 100%.

Table 15. Mode Share for Midday Trips by Destination
Only Non-Walk Trips Included

Location	Mode	Within 1/2 mi	D.C.	Ffx. County	Arl.	Alex.	Va Other	P.G. County	Mont. County	Md Other	Other	Subtotal	Summary Percent Auto	Summary Percent Transit
1701	Auto	—%	0.0%	—%	0.0%	0.0%	—%	—%	—%	—%	—%	0.0%		
Penn	Transit	—	77.8	—	100.0	0.0	—	—	—	—	—	72.7		
	Other	—	22.2	—	0.0	100.0	—	—	—	—	—	27.3		
	Total	0.0	81.8	0.0	9.1	9.1	0.0	0.0	0.0	0.0	0.0	100.0	0.0	72.7
Silver	Auto	—	42.9	—	—	—	—	—	81.8	—	—	66.7		
Spring	Transit	—	57.1	—	—	—	—	—	18.2	—	—	33.3		
Metro	Other	—	0.0	—	—	—	—	—	0.0	—	—	0.0		
Center	Total	0.0	38.9	0.0	0.0	0.0	0.0	0.0	61.1	0.0	0.0	100.0	66.7	33.3
Ballston	Auto	100.0	80.0	90.9	91.7	100.0	100.0	—	100.0	100.0	100.0	92.3		
One	Transit	0.0	20.0	9.1	8.3	0.0	0.0	—	0.0	0.0	0.0	7.7		
	Other	0.0	0.0	0.0	0.0	0.0	0.0	—	0.0	0.0	0.0	0.0		
	Total	3.8	9.6	21.2	46.2	5.8	5.8	0.0	3.8	1.9	1.9	100.0	92.3	7.7
Bell	Auto	100.0	61.9	100.0	93.0	100.0	—	100.0	100.0	—	100.0	90.6		
Atlantic	Transit	0.0	33.3	0.0	7.0	0.0	—	0.0	0.0	—	0.0	8.6		
	Other	0.0	4.8	0.0	0.0	0.0	—	0.0	0.0	—	0.0	0.7		
	Total	2.9	15.1	18.0	51.1	6.5	0.0	1.4	4.3	0.0	0.7	100.0	90.6	8.6
East	Auto	0.0	—	—	—	—	—	—	50.0	—	—	25.0		
West	Transit	100.0	—	—	—	—	—	—	50.0	—	—	75.0		
Towers	Other	0.0	—	—	—	—	—	—	0.0	—	—	0.0		
	Total	50.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	100.0	25.0	75.0

Table 15. Mode Share for Midday Trips by Destination
Only Non-Walk Trips Included
(Continued)

Location	Mode	Within 1/2 mi	D.C.	Ffx. County	Arl.	Alex.	Va Other	P.G. County	Mont. County	Md Other	Other	Subtotal	Summary Percent Auto	Summary Percent Transit
Bethesda	Auto	100.0	44.4	100.0	50.0	—	—	100.0	93.9	100.0	100.0	87.1		
Metro	Transit	0.0	55.6	0.0	50.0	—	—	0.0	6.1	0.0	0.0	12.9		
Center	Other	0.0	0.0	0.0	0.0	—	—	0.0	0.0	0.0	0.0	0.0		
	Total	8.1	14.5	8.1	3.2	0.0	0.0	4.8	53.2	6.5	1.6	100.0	87.1	12.9
Twinbrook	Auto	100.0	100.0	—	—	100.0	—	100.0	92.6	100.0	100.0	95.7		
	Transit	0.0	0.0	—	—	0.0	—	0.0	7.4	0.0	0.0	4.3		
	Other	0.0	0.0	—	—	0.0	—	0.0	0.0	0.0	0.0	0.0		
	Total	17.0	10.6	0.0	0.0	4.3	0.0	4.3	57.4	4.3	2.1	100.0	95.7	4.3
Parklawn	Auto	100.0	50.0	100.0	100.0	—	—	100.0	96.5	100.0	—	93.8		
	Transit	0.0	50.0	0.0	0.0	—	—	0.0	3.5	0.0	—	6.2		
	Other	0.0	0.0	0.0	0.0	—	—	0.0	0.0	0.0	—	0.0		
	Total	7.6	6.7	0.5	0.5	0.0	0.0	1.0	82.4	1.4	0.0	100.0	93.8	6.2
Crystal	Auto	0.0	35.7	93.3	78.9	100.0	100.0	100.0	—	100.0	100.0	74.2		
Square 2	Transit	100.0	64.3	6.7	21.1	0.0	0.0	0.0	—	0.0	0.0	25.8		
	Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	—	0.0	0.0	0.0		
	Total	3.2	22.6	24.2	30.6	3.2	3.2	6.5	0.0	4.8	1.6	100.0	74.2	25.8
Bethesda	Auto	100.0	50.0	100.0	—	—	100.0	100.0	95.0	100.0	—	85.3		
Office	Transit	0.0	50.0	0.0	—	—	0.0	0.0	5.0	0.0	—	14.7		
Center	Other	0.0	0.0	0.0	—	—	0.0	0.0	0.0	0.0	—	0.0		
	Total	2.9	23.5	2.9	0.0	0.0	5.9	2.9	58.8	2.9	0.0	100.0	85.3	14.7

Note: For each destination, the percentage of trips of trips by mode are indicated in the rows labeled "auto", "transit", and "other". These total vertically to 100%. For office location, the row labeled "total" indicates the percentage of trips made to each destination. This row totals horizontall 100%.

Office Visitors

Office visitors were interviewed rather than given a self administered survey. This resulted in a higher response rate than was achieved in the first study. When conducting the interviews each person approached was asked if they were a visitor or an employee. If they were an employee, no further questions were asked; if they were a visitor the questions concerning their trip were asked. The number of each (employee or visitor) approached was recorded by time period. This allowed the percent of visitors to be determined at each office by time of day. For the most part visitors accounted for about 10% to 15% of all persons entering an office. The mode share for visitors is shown in Table 16. No relationship to distance from the station could be determined. Most buildings averaged about a 10% transit mode share. This agrees with the findings of the office surveys in relation to the mid-day trip information.

RESIDENTIAL

Ten residential sites were chosen for study. Data was collected via a self-administered mail-back survey forms and by conducting cordon counts at each site for selected hours during the day. The primary objective was to determine the trip making characteristics for residential developments in close proximity of a Metrorail station. A variety of housing types were chosen that included both rental accommodations and owner occupied units. Site characteristics of each building are contained in Table 17. The average response rate for the home-based surveys was 12.6%.

Data Collection

The primary objective of the home-based survey was to obtain information on the trip making characteristics of residents. A sample home-based survey is contained in the appendix. The primary changes to the survey as compared to the first study were an attempt to gather information concerning linked trips and the addition of questions to determine residents' attitude towards transit. Mail-back surveys were mailed to each unit of a building on a Monday or Tuesday in an attempt to have residents receive the survey on a Tuesday, Wednesday, or Thursday.

In addition to the surveys, cordon counts were conducted at all ten sites and in most cases occupancy counts were conducted for vehicles leaving the buildings during the peak periods.

Table 16. Mode Share of Office Visitors

Office Site	Mode						Summary	
	Auto	Rail	Bus	Walk	Taxi	Other	Subtotal	% Auto	% Transit
1701 Penn	61.0%	11.0%	0.0%	19.5%	0.0%	8.5%	100.0%	61.0%	11.0%
Silver Spring Metro Center	79.3	13.8	0.0	6.9	0.0	0.0	100.0	79.3	13.8
Ballston One	61.2	5.0	0.0	24.0	0.0	9.9	100.0	61.2	5.0
Bell Atlantic	52.8	10.4	0.0	29.6	4.8	2.4	100.0	52.8	10.4
East West Towers	83.8	10.3	0.0	5.9	0.0	0.0	100.0	83.8	10.3
Bethesda Metro Center	34.0	33.3	4.1	27.9	0.0	0.7	100.0	34.0	37.4
Twinbrook	84.6	7.7	0.0	7.7	0.0	0.0	100.0	84.6	7.7
Parklawn	75.5	9.1	2.1	11.2	1.4	0.7	100.0	75.5	11.2
Crystal Square II	11.1	8.9	1.6	78.4	0.0	0.0	100.0	11.1	10.5
Bethesda Office Center	80.0	6.3	0.0	13.8	0.0	0.0	100.0	80.0	6.3

Table 17. Site Characteristics of Residential Developments

	Residential	Distance to Station (ft)	No. Units	Effi-ciencies	One Bdrm.	Two Bdrm.	Three Bdrm.	Percent Occupied	Number Parking Spaces	Parking Cost per Month	Year Constructed
Crystal City	Crystal Square Apts. (12)[1]	500	378	58	247	58	15	99	(*)	1 space included in rent, additional space $45	1976
	Crystal Plaza Apts. (13)	1500	540	94	184	214	48	100	570[3]	1 space included in rent, additional space $45	1966
	Crystal Park Condos (14)	2000	180	–	–	–	–	–	–	–	–
Silver Spring	Twin Towers (16)	900	315	–	–	–	–	99	320[4]	$50	1965
	Georgian Towers (15)	1400	858	–	–	–	–	99	550	$55 reserved $40 unreserved	1969
Ballston	Randolph Towers (23)	500	507	–	–	–	–	–	–	–	–
Twinbrook	Bethany House (39)	2400	276	–	–	–	–	100	69	$12	1968
Grosvenor	Grosvenor House Apts. (33)	2300	404	–	–	–	–	–	–	–	–
	Grosvenor Park I (34)	1850	399	–	–	–	–	–	–	–	–
	Stoneybrook (35)	2000	109	–	–	–	–	–	–	N/A	–

[1] Numbers in parentheses refer to location maps in Figures 2 to 13.

[2] Shared parking with entire Crystal Square complex, tenants are guaranteed one space/dwelling unit, no waiting list at present time.

[3] Approximately 218 spaces rented out to area workers on a monthly basis, these employees must be out of garage by 5:30-6:00 PM.

[4] Includes parking for 50 hotel rooms.

Analysis

Residential surveys were designed to obtain socioeconomic, demographic, and trip making characteristics. As with previous studies the response rate was not as good as with the workplace surveys, therefore caution must be exercised when interpreting the data at buildings with a small sample size. The data structure is included in the appendix. Crosstabs are also included in the appendix.

Similar to the office surveys, summary tables were produced based on the analysis. Mid-day trip information was found to be unreliable as a significant number of respondents reported on all trips they made during the day rather than just trips that began or ended at their building.

Results

Table 18 summarizes the socioeconomic and demographic data collected for each site. As with the office surveys more respondents were female and they tended to be older. Based on observation during site selection and while conducting the counts, it is felt that the average age as determined by the survey tends to be high although we are unable to verify this. Based on the cordon counts it appears that there is an under reporting of commute trips. This could be partially explained by the number of older retired respondents. Examining the counts (contained in the technical appendix) it appears that the transit mode share may be slightly higher than determined by the survey. The data suggests that the typical resident falls into three categories: single person households, couples without children and older people. Families tend to live in areas further away from the Metro station in lower density neighborhoods. The implication is that while families tend to generate more trips per household, the likelihood of this group increasing their transit usage cannot be influenced to a great degree by the nature of the development in the area of Metrorail stations. Increasing transit patronage by this segment of the population is influenced by access to the Metrorail station either by car or by feeder bus.

Table 19 presents mode share of each building by destination for the commute trips and a summary is presented in Table 20. Transit mode share ranges from 30.2% at Grosvenor Park I to 73.7% at Twin Towers with an overall average 46.2% Bethany House was excluded from the data base due to the small sample size. The trip generation from Bethany House was low as would be expected at a retirement home.

Table 18. Demographic Data for Residential Developments

Location	Mean Age	Mean Number of Vehicles per DU	Mean Number of Residents per DU	veh/ res.
Crystal Plaza	52.0	0.98	1.53	✓ 0.64
Crystal Park	44.9	1.20	1.57	0.76
Crystal Square West	48.1	1.05	1.63	✓ 0.64
Georgian Towers	39.4	0.76	1.27	✓ 0.60
Randolph Towers	43.0	0.97	1.58	✓ 0.61
Grosvenor House	41.1	1.19	1.44	0.83
Stoneybrook	43.7	1.56	2.06	0.76
~~Bethany House~~	~~72.7~~	~~0.25~~	~~1.09~~	
Twin Towers	43.3	0.50	1.30	✓ 0.38
Grosvenor Park I	59.3	1.24	1.35	0.92
Averages	**47.8**	**1.01**	**1.49**	

0.38 to 0.92
avg = 0.68
mean = 0.64

Table 19. Mode Share by Destination of Trip

Location	Mode	Within Half Mile	D.C.	Fairfax County	Arling. County	Alex.	Other Va.	Mont. County	P.G. County	Other Md.	Elsewhere	Total
Crystal Plaza	Auto	40.0	20.0	100.0	27.3	0.0	100.0	75.0	100.0	—	—	33.3%
	Transit	0.0	80.0	0.0	50.0	100.0	0.0	25.0	0.0	—	—	57.5
	Other	60.0	0.0	0.0	22.7	0.0	0.0	0.0	0.0	—	—	9.2
	Total	5.7	51.7	5.7	25.3	2.3	2.3	4.6	2.3	0.0	0.0	100.0
Crystal Park	Auto	0.0	9.1	100.0	14.3	50.0	—	50.0	100.0	—	—	24.2
	Transit	14.3	90.9	0.0	42.9	50.0	—	50.0	0.0	—	—	48.5
	Other	85.7	0.0	0.0	42.9	0.0	—	0.0	0.0	—	—	27.3
	Total	21.2	33.3	9.1	21.2	6.1	0.0	6.1	3.0	0.0	0.0	100.0
Crystal Square West	Auto	0.0	8.2	66.7	25.0	83.3	—	0.0	0.0	—	—	15.6
	Transit	16.7	91.8	33.3	41.7	16.7	—	100.0	0.0	—	—	62.2
	Other	83.3	0.0	0.0	33.3	0.0	—	0.0	100.0	—	—	22.2
	Total	20.0	54.4	3.3	13.3	6.7	0.0	1.1	1.1	0.0	0.0	100.0
Georg'n Towers	Auto	33.3	30.0	66.7	0.0	33.3	100.0	52.6	75.0	66.7	100.0	42.3
	Transit	33.3	70.0	33.3	100.0	66.7	0.0	31.6	25.0	33.3	0.0	52.6
	Other	33.3	0.0	0.0	0.0	0.0	0.0	15.8	0.0	0.0	0.0	5.1
	Total	3.8	51.3	3.8	1.3	3.8	1.3	24.4	5.1	3.8	1.3	100.0
Rand'ph Towers	Auto	0.0	9.8	50.0	9.1	100.0	100.0	80.0	—	—	—	20.6
	Transit	66.7	87.8	33.3	54.5	0.0	0.0	20.0	—	—	—	69.1
	Other	33.3	2.4	16.7	36.4	0.0	0.0	0.0	—	—	—	10.3
	Total	4.4	60.3	8.8	16.2	1.5	1.5	7.4	0.0	0.0	0.0	100.0

Note: For each jurisdiction, the percentage of trips by mode are indicated in the rows labeled "auto", "transit", and "other". The overall mode sha for each location is given in the column labeled "total". For each residential location, the row labeled "total" indicates the percentage of trips from each jurisdiction.

Table 19. Mode Share by Destination of Trip
(Continued)

Location	Mode	Within Half Mile	D.C.	Fairfax County	Arling. County	Alex.	Other Va.	Mont. County	P.G. County	Other Md.	Elsewhere	Total
Grosv'r	Auto	0.0	25.0	—	33.3	100.0	0.0	88.9	100.0	0.0	—	60.0%
House	Transit	0.0	75.0	—	33.3	0.0	100.0	11.1	0.0	100.0	—	35.0
	Other	100.0	0.0	—	33.3	0.0	0.0	0.0	0.0	0.0	—	5.0
	Total	2.5	30.0	0.0	7.5	2.5	2.5	45.0	7.5	2.5	0.0	100.0
Stoneybrook	Auto	—	30.0	100.0	0.0	—	0.0	66.7	100.0	100.0	—	57.6
	Transit	—	60.0	0.0	100.0	—	100.0	20.0	0.0	0.0	—	33.3
	Other	—	10.0	0.0	0.0	—	0.0	13.3	0.0	0.0	—	9.1
	Total	0.0	30.3	9.1	3.0	0.0	3.0	45.5	3.0	6.1	0.0	100.0
Beth'y	Auto	—	—	—	—	—	—	0.0	—	—	—	0.0
House	Transit	—	—	—	—	—	—	100.0	—	—	—	100.0
	Other	—	—	—	—	—	—	0.0	—	—	—	0.0
	Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Twin Towers	Auto	—	8.3	—	—	—	—	20.0	0.0	—	—	10.5
	Transit	—	91.7	—	—	—	—	40.0	50.0	—	—	73.7
	Other	—	0.0	—	—	—	—	40.0	50.0	—	—	15.8
	Total	0.0	63.2	0.0	0.0	0.0	0.0	26.3	10.5	0.0	0.0	100.0
Grosv'r	Auto	100.0	15.4	100.0	—	—	—	87.0	100.0	100.0	—	67.4
Park I	Transit	0.0	84.6	0.0	—	—	—	8.7	0.0	0.0	—	30.2
	Other	0.0	0.0	0.0	—	—	—	4.3	0.0	0.0	—	2.3
	Total	4.7	30.2	7.0	0.0	0.0	0.0	53.5	2.3	2.3	0.0	100.0

Note: For each jurisdiction, the percentage of trips by mode are indicated in the rows labeled "auto", "transit", and "other". The overall mode share for each location is given in the column labeled "total". For each residential location, the row labeled "total" indicates the percentage of trips from each jurisdiction.

Table 20. Summary of Transit Mode Share - Residential

	Number of Sites	Percent Transit Range	Percent Transit Average
CBD Locations	---	---	---
Suburban Locations Inside Beltway	6	48.5% - 73.7%	60.0%
Suburban Locations Outside Beltway	3	30.2% - 35.0%	32.8%
All Residential Locations	9	30.2% - 73.7%	46.2%

Note: Bethany House excluded from table because sample size = 1.

The transit mode share vs distance is plotted in Figure 20. The results were generally consistent, with higher transit ridership typically occurring at residential buildings closer to a rail station. Stoneybrook, an expensive ($250,000.00 per unit) town-home development near the Grosvenor station had a transit mode share of 33% indicating that even though higher income developments are more likely to have more autos available per household, substantial transit mode shares will be realized if convenient access to a rail station is available.

Average auto ownership for all residential sites was 1.01 per unit, less than half the average reported by respondents to the workplace survey which could be taken to represent the general population. It can be debated as to whether households without cars seek to locate near a rail station or whether their location influences their decision to buy a second or third car. In order to get some feel for this, the average auto ownership for areas with similar mid to high density development were examined. While auto ownership was found to be substantially lower, approximately 1.6 cars per household vs about 2.2 for single family neighborhoods, for mid to high density areas the building sites studied are well below comparable sites away from rail stations. The implication here is that locating residential developments near Metrorail stations has significant impact in terms of reducing auto ownership and hence vehicle trips. This has a greater impact than just replacing vehicle work trips with transit work trips. Second and third cars, once purchased, are usually used for more than just commuting, so if the proximity to a rail station tips the decision to buy or not to buy a car against buying, it reduces the auto availability for other trips as well, indirectly reducing the overall trip generation rate.

Table 21 presents the results of the attitudinal questions for the residential data base. In general the findings are similar to those for the office surveys. The most significant finding is the number of respondents who feel that adequate schedule information is not available for transit. This is further illustrated by Figure 21 which shows the results for Crystal Plaza apartments, where over 40% of respondents feel that they do not have adequate information. As mentioned earlier, this suggests that market strategies for station areas should be developed that provide residents, patrons, or office workers information concerning the transit options available.

The attempt to collect information on linked trips was not particularly successful as many respondents were confused and responded with information about all trips, whether or not they began or ended at the building.

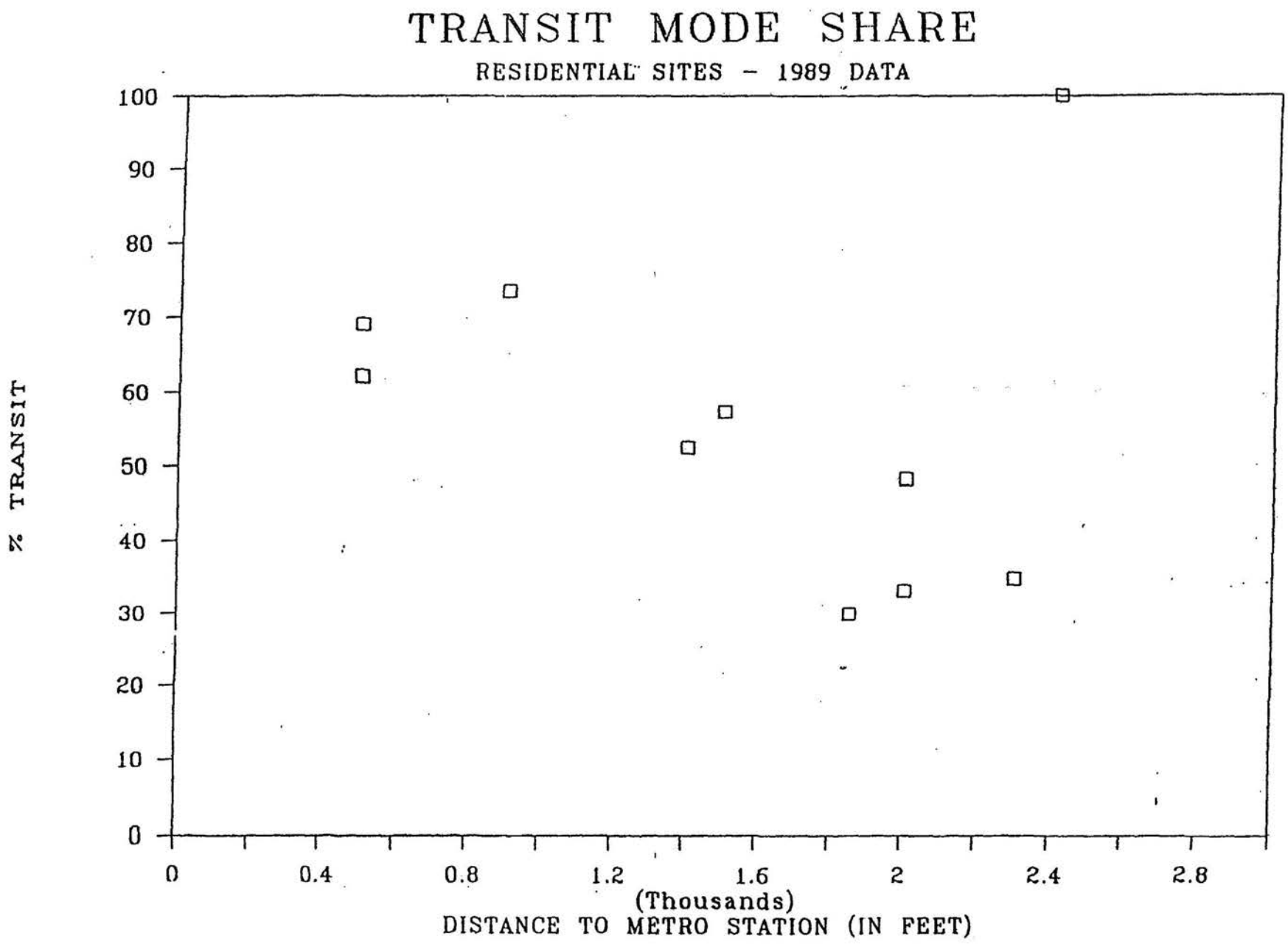

TRANSIT MODE SHARE
RESIDENTIAL SITES - 1989 DATA
% TRANSIT
100
90
80
70
60
50
40
30
20
10
0
0
0.4
0.8
1.2
1.6
2
2.4
2.8
(Thousands)
DISTANCE TO METRO STATION (IN FEET)

Figure 20.

Table 21. Residential Surveys
Respondents Opinions By Mode of Travel

Q8A: People should be encouraged to use transit.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	164	(88.6%)	274	(94.6%)	44	(84.6%)	2	(100.0%)	457	(91.4%)	158	(87.3%)	615	(90.3%)
Disagree	5	(2.7)	1	(0.4)	1	(1.9)	0	(0.0)	7	(1.4)	4	(2.2)	11	(1.6)
No Opinion	11	(5.9)	9	(3.4)	5	(9.6)	0	(0.0)	25	(5.0)	11	(6.1)	36	(5.3)
Not Answered	5	(2.7)	4	(1.5)	2	(3.8)	0	(0.0)	11	(2.2)	8	(4.4)	19	(2.8)
Total	185	(100.0)	261	(100.0)	52	(100.0)	2	(100.0)	500	(100.0)	181	(100.0)	681	(100.0)

Q8B: Schedule information for transit is readily available.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	88	(47.6%)	171	(65.5%)	31	(59.6%)	1	(50.0%)	291	(58.2%)	94	(51.9%)	385	(56.5%)
Disagree	75	(40.5)	66	(25.3)	13	(25.0)	0	(0.0)	154	(30.8)	49	(27.1)	203	(29.8)
No Opinion	18	(9.7)	21	(8.0)	6	(11.5)	1	(50.0)	46	(9.2)	26	(14.4)	72	(10.6)
Not Answered	4	(2.2)	3	(1.1)	2	(3.8)	0	(0.0)	9	(1.8)	12	(6.6)	21	(3.1)
Total	185	(100.0)	261	(100.0)	52	(100.0)	2	(100.0)	500	(100.0)	181	(100.0)	681	(100.0)

Table 21. Residential Surveys
Respondents Opinions By Mode of Travel
(Continued)

Q8C: Metrorail is clean and reliable.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	177	(95.7%)	257	(98.5%)	49	(94.2%)	2	(100.0%)	485	(97.0%)	160	(88.4%)	645	(94.7%)
Disagree	3	(1.6)	0	(0.0)	1	(1.9)	0	(0.0)	4	(0.8)	3	(1.7)	7	(1.0)
No Opinion	1	(0.5)	1	(0.4)	0	(0.0)	0	(0.0)	2	(0.4)	9	(5.0)	11	(1.6)
Not Answered	4	(2.2)	3	(1.1)	2	(3.8)	0	(0.0)	9	(1.8)	9	(5.0)	18	(2.6)
Total	185	(100.0)	261	(100.0)	52	(100.0)	2	(100.0)	500	(100.0)	181	(100.0)	681	(100.0)

Q8D: Metrobus is clean and reliable.

Question	Mode of Travel: Auto		Transit		Walk		Other		Subtotal		Missing Values		Total	
Agree	42	(22.7%)	62	(23.8%)	17	(32.7%)	1	(50.0%)	122	(24.4%)	68	(37.6%)	190	(27.9%)
Disagree	35	(18.9)	51	(19.5)	4	(7.7)	0	(0.0)	90	(18.0)	20	(11.0)	110	(16.2)
No Opinion	104	(56.2)	140	(53.6)	29	(55.8)	0	(0.0)	273	(54.6)	80	(44.2)	353	(51.8)
Not Answered	4	(2.2)	8	(3.1)	2	(3.8)	1	(50.0)	15	(3.0)	13	(7.2)	28	(4.1)
Total	185	(100.0)	261	(100.0)	52	(100.0)	2	(100.0)	500	(100.0)	181	(100.0)	681	(100.0)

Note: Not answered refers to people who specified their mode of travel but do not answer the question. Missing values refer to people who answered the question but did not specify their mode of travel.

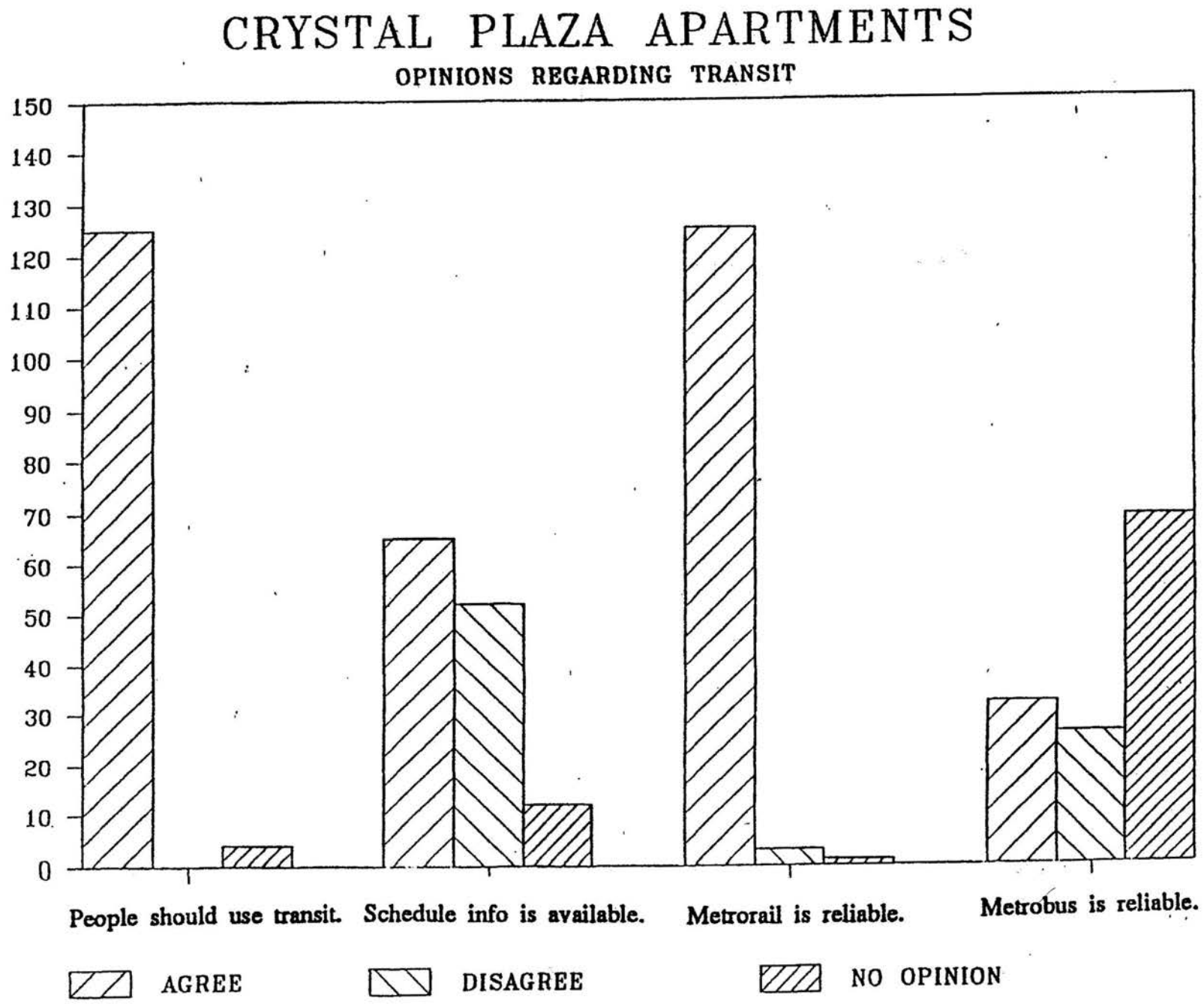

CRYSTAL PLAZA APARTMENTS
OPINIONS REGARDING TRANSIT
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
People should use transit.
Schedule info is available.
Metrorail is reliable.
Metrobus is reliable.
AGREE
DISAGREE
NO OPINION

Figure 21.

RETAIL

Eight retail sites were surveyed. Site characteristics are summarized in Table 22. These sites varied in the types of tenants, as well as in size, from 200,000 to 550,000 gross square feet (GSF) of floor area. For example, the Underground and Crystal Plaza in Crystal City both with direct access to the Metro station, cater primarily to the occupants of the office buildings adjacent to the retail centers. These locations are convenient for those who walk through the building to get to the Metrorail station, residence or parked car. Neither establishment has an anchor tenant. The second type of establishment surveyed was the single tenant building. This site, Hecht's at Metro Center was a repeat from the first survey. Ballston Common shopping mall, also a repeat site, has two large anchor tenants and Union Station represents a multi-mode transfer point, a shopping area, and a tourist attraction.

Data Collection

The pedestrian-based survey was designed to gather information on particular trip characteristics, such as trip purpose, trip mode, and trip origin-destination. A sample retail patron interview form is contained in the appendix. The interview was conducted in person by reading the questions from left to right and marking the answers in a single row for each respondent.

For most sites interviews were conducted at random throughout the common areas. At Hecht's Metro Center, The Shoppes and Mazza Gallerie, interviews were conducted at the entrances. Pedestrian counts were also conducted at these locations, as well as determining person trip generation. These counts also allowed for any bias to be detected and weighting factors to be developed for those sites where interviews were conducted at the entrances. For instance if a higher percentage of persons were interviewed at an entrance that is utilized by transit users, the results would be biased in favor of transit.

The interviews were conducted from the time the establishments opened until six o'clock PM on a Tuesday, Wednesday or Thursday. At Ballston Common and Mazza Gallerie interviews were conducted until nine o'clock PM.

Table 22. Site Characteristics of Retail Establishments

Metrorail Station	Retail Establishment	Distance to Station	Gross Square Feet (1000)	Selling Square Feet (1000)	No. Parking Spaces	Year Constructed
Metro Center	The Hecht Company (1)[1]	100	270	204	none	Oct. '85
	The Shops (41)	450	125			1984
Crystal City	The Underground (8)	100	150		200[2]	1979
	Crystal Plaza Shops (9)	2000	150			1985
Ballston Common	Ballston Common (21)	1000	530	530	2,900[3]	Oct.'86
Friendship Heights	Mazza Gallerie (25)	50	--	--	--	--
Bethesda	Bethesda Metro Center (31)	100	60	--	1400[4]	1985
Union Station	Union Station (42)	50	Total 750 Retail 210			Sept.'88

[1] Numbers in parentheses refer to location maps in Figures 2 to 13.

[2] 200 commercial parking spaces (at any one time not more than 50 percent are used by The Underground.

[3] Arlington County owns the parking structure.

[4] Total parking for project.