U.S. Department of Transportation
Federal Transit Administration

Automated Parking Information System Operational Test Evaluation

WMATA Glenmont Parking Facility

December 15, 2010

http://www.fta.dot.gov/research

Report FTA-MD-26-7021.2010.01

REPORT DOCUMENTATION PAGE			*Form Approved* *OMB No. 0704-0188*
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE December 15, 2010		3. REPORT TYPE AND DATES COVERED Final Report August 25, 2004 – October 12, 2007
4. TITLE AND SUBTITLE Preparation and Presentation of a Final Technical Report: Elements, Organization and Design			5. FUNDING/GRANT NUMBER
6. AUTHOR			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) T3 Design, Inc 3927 Old Lee Highway – Suite 101C Fairfax, Virginia 22030			8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Federal Transit Administration U.S. Department of Transportation Website [http://www.fta.dot.gov/research] 1200 New Jersey Avenue, SE Washington, DC 20590			10. SPONSORING/MONITORING AGENCY REPORT NUMBER **FTA-DC-26-7008-2008.1**
11. SUPPLEMNTARY NOTES			
12a. DISTRIBUTION/AVAILABILITY STATEMENT Available From: National Technical Information Service (NTIS), Springfield, VA 22161. Phone 703.605.6000, Fax 703.605.6900, Email [orders@ntis.gov]			12b. DISTRIBUTION CODE TRI-30
13. ABSTRACT (Maximum 200 words) This report presents the evaluation of commuter responses to the Automated Parking Information System (APIS) at the Washington Metropolitan Area Transit Authority's (WMATA) Glenmont parking facility and the Maryland State Highway Administration (SHA) Park-and-Ride Lot on Norbeck Road, in Montgomery County, Maryland.			
14. SUBJECT TERMS			15. NUMBER OF PAGES 16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT

NSN 7540-01-280-5500 Prescribed by ANSI Std. 239-18298-102 Standard Form 298 (Rev. 2-89)

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FINAL REPORT
Report Number: MD-26-7021.2010.01

Sponsored by:
Federal Transit Administration
Office of Research, Demonstration, and Innovation
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, D.C. 20590

Available Online
[http://www.fta.dot.gov/research]

FOREWORD

In 2004 Montgomery County DOT began work on a demonstration project generously funded by the Federal Transit Administration to develop and test a system to alert commuters of parking availability in advance of their arrival at a transit parking garage. By giving the commuter this information before they arrive at a full parking garage, they commuter has the opportunity to take advantage of available parking at nearby park and ride lots with connecting bus service to the transit station. This project showed that it was possible to provide such a system.

DISCLAIMER NOTICE

ACKNOWLEDGMENT

This report, *Automated Parking Information System Operational Test Evaluation for Glenmont Parking Facility*, represents the final report submitted to the Federal Transit Administration.

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EXECUTIVE SUMMARY

This report presents the evaluation of commuter responses to the Automated Parking Information System (APIS) at the Washington Metropolitan Area Transit Authority's (WMATA) Glenmont parking facility and the Maryland State Highway Administration (SHA) Park-and-Ride Lot on Norbeck Road, in Montgomery County, Maryland. The report also describes the results of the "before-and-after" parking utilization study at both of the parking locations**.**

The purpose of Automated Parking Information Systems at this location is to:

- Provide real-time information to commuters about the availability of parking spaces at the Glenmont Metro Station and if spaces are not available to direct them to other lots with available spaces.
- Improve the usage of the underutilized parking resources at the Norbeck Road park-and-ride lot.

The following conclusions are drawn from the system evaluation from commuter responses to the new signs and the "before-and-after" parking utilization study:

- The Automated Parking Information System was effective in informing commuters using the Glenmont Metro Station about the availability of parking spaces at the Glenmont Metro parking facility and the Norbeck park-and-ride lot.
- Several commuters go directly to the Wheaton Metro Station after seeing the message sign for non-availability of parking spaces at the Glenmont Metro parking facility.
- The Norbeck park-and-ride lot remains underutilized even after the message sign informs commuters about the space availability at the lot. Also, count data of inbound vehicles collected at the lot before and after the message display does not show a significant difference.
- Some of the possible reasons for the underutilization of the Norbeck park-and-ride lot are:
    - its isolated location
    - low frequency of bus service between the Norbeck lot and the Glenmont Metro Station
    - commuter unfamiliarity with the bus service between the Norbeck lot and the Glenmont Metro Station
- No conclusion regarding the decline in number of inbound vehicles to the Glenmont Metro Station parking facility after the APIS can be drawn from the survey and count data.

CHAPTER 1

INTRODUCTION

This report presents the evaluation of commuter responses to the Automated Parking Information System (APIS) at the Washington Metropolitan Area Transit Authority's (WMATA) Glenmont Metro parking facility and the Maryland State Highway Administration (SHA) Park-and-Ride Lot on Norbeck Road, in Montgomery County, Maryland. The report also describes the results of the "before-and-after" parking utilization study at both of the parking locations**.**

Figure 1 shows the location of the Glenmont Metro Station parking facility and the Norbeck Road Park-and-Ride lot. Automatic Parking Information signs were installed on Georgia Avenue, Layhill Road and Norbeck Road to provide information to the commuters about parking availability at the Glenmont Metro Station. Alternative free parking is available at the Norbeck Road park-and-ride lot, which is located at the intersection of Georgia Avenue and Norbeck Road, where Ride On shuttle bus service connects the lot with the Glenmont Metro station. The Norkbeck Road park-and-ride lot has a total of 236 parking spaces.
The scope of this study included the following tasks:

- Conduct a parking inventory of the WMATA Glenmont parking facility and Maryland SHA Norbeck Road park-and-ride lot
- Conduct before-and-after utilization counts at both parking locations
- Design two survey questionnaires to capture commuter responses regarding the effectiveness of the new signs
- Survey the commuters during the PM peak hours on a typical weekday
- Analyze the resulting data from the before-and-after studies and the commuter surveys
- Report the results and conclusions in a written report

The Glenmont Metro Station is located along the WMATA Metro Red Line. The Metro Red Line parallels Georgia Avenue (MD 97), proceeding from the District of Columbia through the northern portion of Montgomery County and terminates at the Glenmont Metro Station. The Glenmont Metro Station, which was opened in July 1998, extended the rail service eight (8) miles into Montgomery County beyond the existing Wheaton Metro Station.

Currently, the Glenmont Metro Station includes a five-level parking structure containing 1,781 all-day parking spaces. Actual ridership at the Glenmont Metro Station reached 7,800 riders per day within three (3) months of its opening and the station facility reached 100% capacity by 10:00 AM on most weekdays. Since the Glenmont Metro Station is at one end of Metro's Red Line, the station draws riders from throughout the upper Georgia Avenue and New Hampshire Avenue corridors, both of which are experiencing rapid population growth.

With the opening of the Glenmont Metro Station, the daily facility usage at the Wheaton Metro Station dropped by almost 75%, but continued to offer usable capacity. The current parking utilization of the remote Norbeck Road park-and-ride lot is averaging between 5% and 10%. This data suggests that once the Glenmont Metro Station facility is full, commuters are not seeking alternative local parking lots such as the Norbeck Road park-and-ride lot and are not stopping at the Wheaton Metro Station, which is the next inbound station on the Red Line. Instead, commuters are apparently continuing to their ultimate destination via automobile. In order to inform and aid commuters with their travel plan decisions, so that they are aware of and benefit from the underutilized parking lots, the County in cooperation with the Federal Transit Authority (FTA) proposed to evaluate the use of an Automated Parking Information System.

This report documents the evaluation, analysis, and results of the operational test. The evaluation assesses the impact/effect of the automated parking information system on the commuter parking preferences at the Glenmont Metro station parking facility and the Norbeck Road park-and-ride lot.

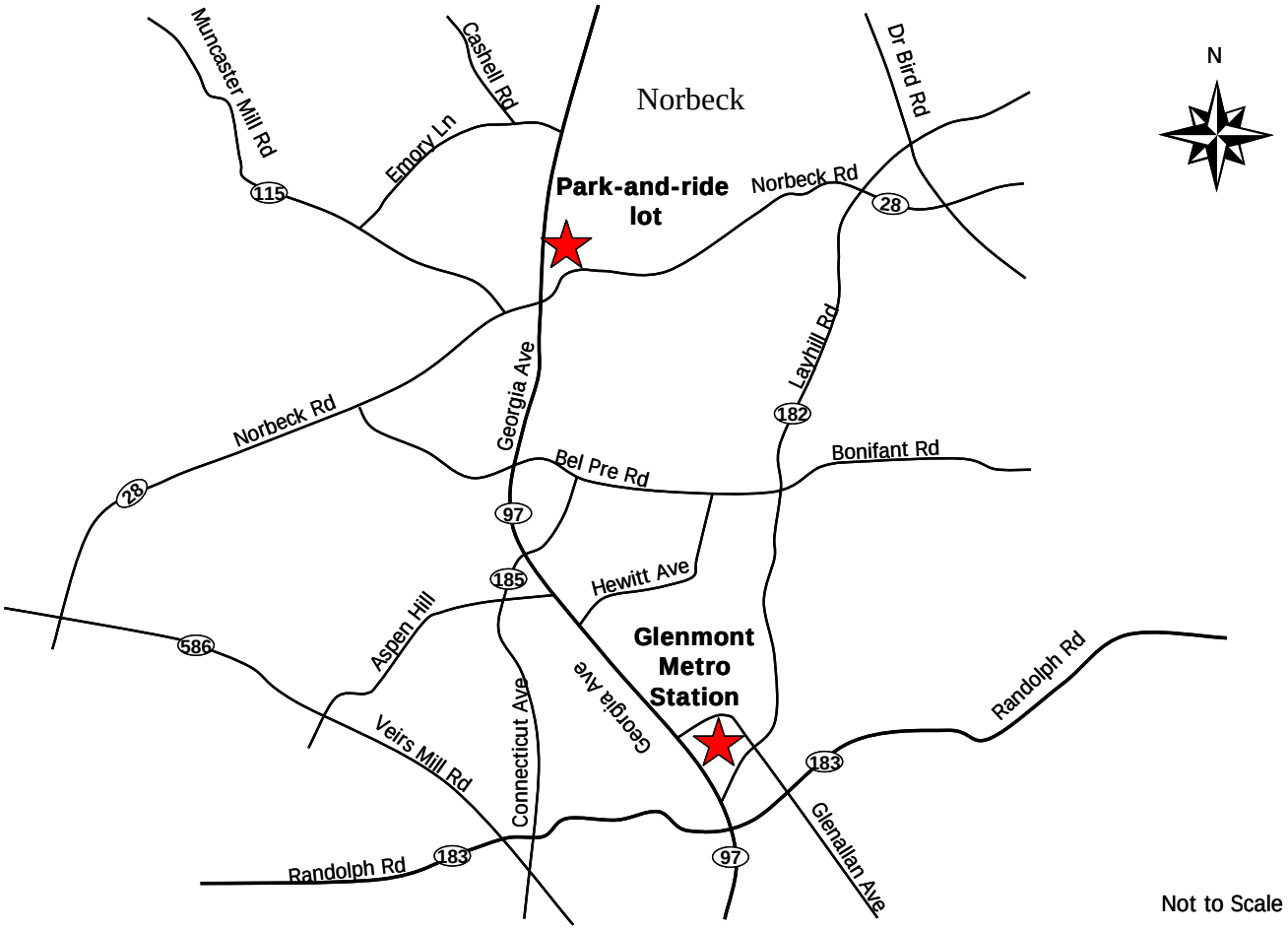

Figure 1: Location of Glenmont Metro Station and Norbeck Road Park and Ride Lot

1.1. EXISTING CONDITIONS

The existing five-level Glenmont Metro Station parking facility consists of 1,771 parking spaces. Table 1 shows the distribution of the spaces in each of the five levels of the parking facility. Level 3 of the parking structure has 280 reserved parking spaces that are permitted to use only with a reserved parking permit from 2:00 AM to 10:00 AM Monday through Friday. The Norbeck Road park-and-ride lot has a total of 236 parking spaces.

Table 1: Available Parking Spaces in the Glenmont Parking Facility

Parking Facility Spaces at Glenmont				
Level	Regular	Handicapped	Reserved	Total
1	248	0	0	248
2	416	10	0	426
3	136	11	280	427
4	354	11	0	365
5	305	0	0	305
	1459	32	280	1771

To estimate the utilization counts for the Glenmont Metro station parking structure, nine-hour, 15-minute utilization counts were conducted on Tuesday, December 2, 2004 during the hours of 5:30 AM to 2:30 PM. Table 2 shows the results of the utilization counts for the Glenmont Metro Station parking facility. The utilization counts in Table 2 show that the Glenmont Metro Station parking facility reaches 100% capacity by 8:15 AM on a typical weekday.
Utilization counts of the Norbeck Road park-and-ride Lot, before the automated signs were placed, in the field were conducted using the automatic traffic recorder (ATR) counters at the entrance and exit to the lot. The counts were conducted from October 19-21, 2004. Figure 2 shows three days average inbound and outbound vehicles to and from the park-and-ride lot. Figure 2 shows a very low volume of incoming vehicles to the park-and-ride lot in the morning peak hours; this suggests an underutilization of the lot capacity. A slightly higher numbers of incoming vehicles are however observed in the evening peak hours. This could be due to the utilization of the lot as a "kiss and ride" facility, where vehicles enter the lot for picking up the passengers taking the bus to Glenmont Metro Station.

Table 1-2: Utilization Counts for Glenmont Metro Station Parking Facility

	Garage Level								
	1	2		3			4		5
	Regular	Regular	ADA	Regular	ADA	Reserved	Regular	ADA	Regular
Total Spaces	248	416	10	136	11	280	354	11	305
Time									
5:30	30	98	1	10	1	1	1	0	1
5:45	40	127	2	21	1	1	1	0	1
6:00	55	159	4	24	1	1	5	1	1
6:15	71	199	4	37	1	2	7	1	1
6:30	101	283	5	66	3	5	43	1	1
6:45	148	338	9	105	1	10	46	1	1
7:00	200	368	10	119	5	25	190	1	34
7:15	213	416	10	133	11	45	282	2	61
7:30	248	416	10	136	11	68	330	3	207
7:45	248	416	10	136	11	97	351	6	215
8:00	248	416	10	136	11	108	353	11	234
8:15	248	416	10	136	11	142	353	11	305
8:30	248	416	10	136	11	157	353	11	305
8:45	248	416	10	136	11	178	353	11	305
9:00	248	416	10	136	11	185	353	11	305
9:15	248	416	10	136	11	195	353	11	305
9:30	248	416	10	136	11	204	353	11	305
9:45	248	416	10	136	11	211	353	11	305
10:00	248	416	10	136	11	231	353	11	305
10:15	248	416	10	135	11	240	353	11	305
10:30	248	416	10	136	11	240	353	11	305
10:45	248	415	10	136	11	248	353	11	305
11:00	248	415	10	136	11	249	350	11	303
11:15	248	416	10	136	11	251	353	11	304
11:30	247	416	10	136	11	254	353	11	302
11:45	248	416	10	136	11	256	353	11	305
12:00	248	416	10	135	11	256	352	11	305
12:15	248	416	10	135	11	258	350	11	305
12:30	248	416	10	135	11	257	351	11	304
12:45	247	416	10	135	11	257	353	11	304
1:00	248	415	10	136	11	263	353	11	304
1:15	248	416	10	136	11	261	353	11	304
1:30	244	416	10	136	11	261	352	11	304
1:45	245	411	10	136	11	261	350	11	304
2:00	248	416	10	136	11	260	350	11	305
2:15	248	416	10	136	11	261	351	11	305

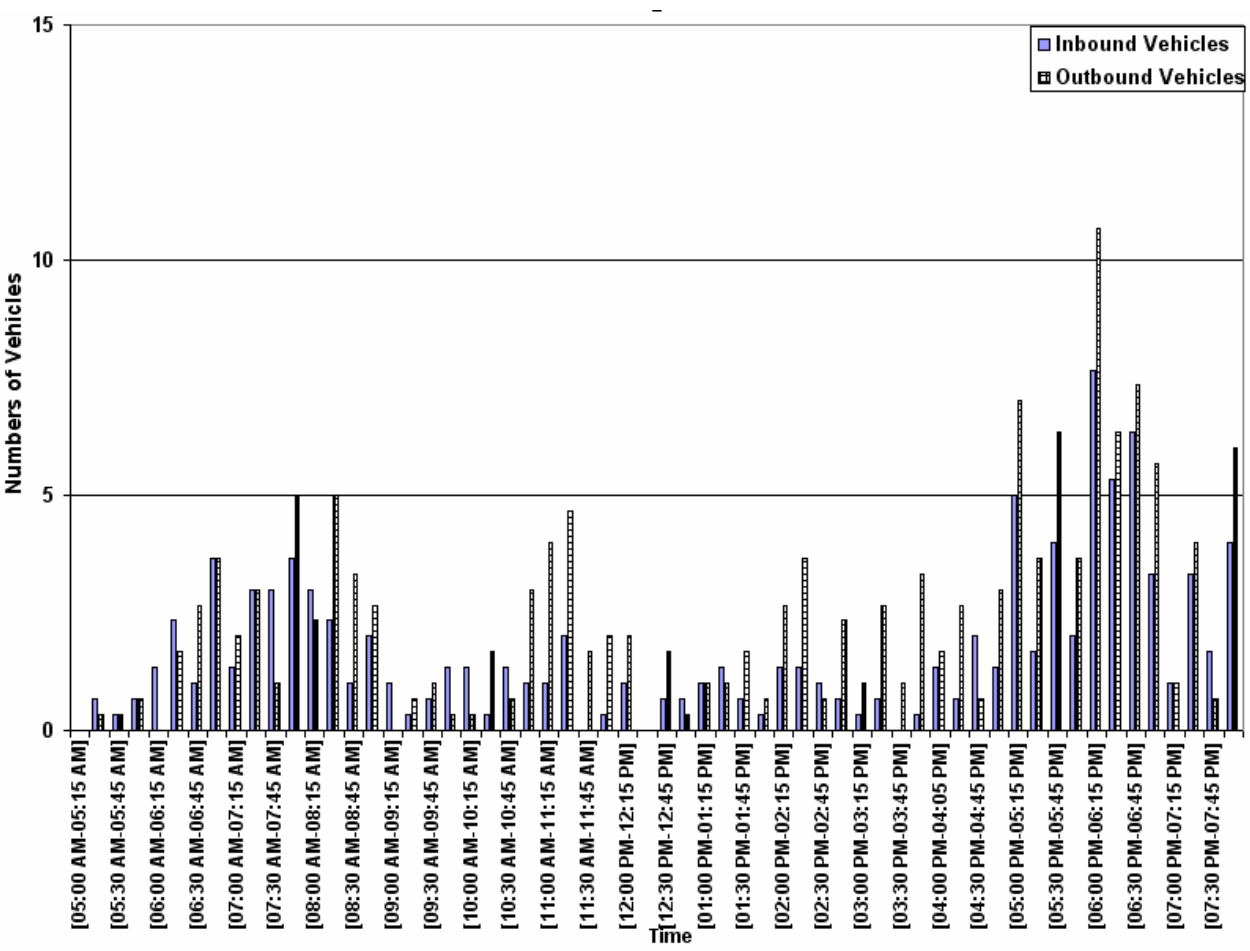

Figure 1-2: Inbound and Outbound Vehicles at Norbeck Road Park and Ride Lot

CHAPTER 2.
OPERATIONAL TEST

2.1. Test Statement

Montgomery County Advanced Transportation Management System (ATMS) teamed with the Federal Transit Authority (FTA) to perform the Automated Parking Information System Operational Test for WMATA's Glenmont Metro Station parking facility and MD SHA's Norbeck Road park-and-ride lot. The test consisted of the implementation and operation of electronic signs displaying real-time parking availability information at the Glenmont Metro Station parking facility and the Norbeck Road park-and-ride lot.

The purpose of this Automated Parking Information System operational test is to determine the ability of the automated, real-time parking information and guidance system to:

- Provide efficient and user-friendly access to parking at the Glenmont metro station parking facility and the Norbeck Road park-and-ride lot.
- Improve management and utilization of the underutilized parking resources at the Norbeck Road park-and-ride lot lot.

2.2. Automated Parking Information Signs Test Conditions

To inform and assist commuters with parking availability at the Glenmont Metro Station parking facility and guide them to alternative available parking space at the Norbeck park-and-ride lot, automated parking information signs were constructed on Georgia Avenue (MD 97), Norbeck Road and Layhill Road (MD 182) on April 23, 2007. Figure 3 shows the location of the signs. One sign is located on southbound Georgia Avenue, south of Emory lane. A second sign is located on westbound Norbeck Road, just east of Norbeck Road and the third sign is placed on south of Layhill Road, south of Briggs Road. Figures 4 (a) and (b), 5 (a) and (b), and 6 (a) and (b) show the signs displaying messages to the commuters on Georgia Avenue, Norbeck park-and-ride lot, and Layhill Road

respectively

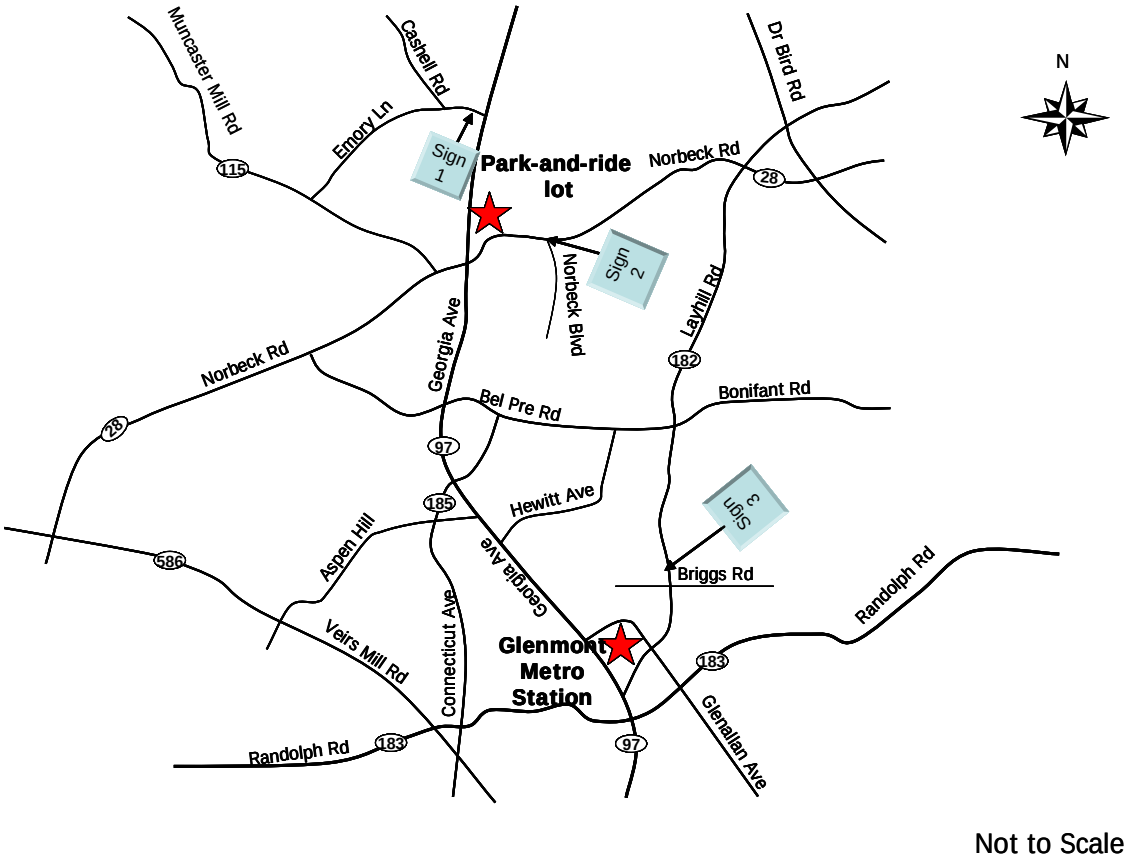

Figure 2: Automated Parking Information Sign Locations

Figure 2-1: Automated Parking Information Signs at Georgia Avenue

Figure 2-2: Automated Parking Information Signs at Georgia Avenue

Figure 2-3: Automated Parking Information Signs at Norbeck Road

Figure 2-4: Automated Parking Information Signs at Norbeck Road

Figure2-5: Automated Parking Information Sign at Layhill Road

Figure 2-6: Automated Parking Information Sign at Layhill Road

2.3. Automated Parking Information System Effectiveness

In order to evaluate the effectiveness of the automated parking information signs, commuters' response surveys were conducted at the Glenmont Metro station parking structure and the Norbeck Road park-and-ride lot.

2.4. Survey Methodology

The survey format was oriented around the premise of the Glenmont parking structure and Norbeck park-and-ride lot with a surveyor asking the questions to the commuter, which allowed for the survey to not intrude on the commuters' daily commute. The surveys were conducted on June 12 and 13, 2006. At the Glenmont Metro Station, the questions were asked to the commuters when they departed the trains during the PM peak period. The PM peak hours were selected by the evaluation team because it required less time to capture a sufficient number of patrons than during the AM peak hours when the commuters were waiting for the train. The reason for this discrepancy is because the train headways during the morning peak period are very small (around 6 minutes), so the commuters do not wait long for trains. Also, the survey team screened only those commuters who drove and parked at the Glenmont Metro Station facility that day. The surveys were comprised solely of multiple choice check box questions.

At the Norbeck park-and-ride lot, the survey was conducted during the AM peak period (7:00AM – 9:00 AM). Since at Norbeck, the buses depart on average at 10 to 15 minutes during the AM peak, so morning provided a good opportunity to administer surveys while patrons were waiting for the bus. Further, the surveyors screened Norbeck Road park-and-ride lot patrons to survey only those who were taking the bus to the Glenmont Station that day (Parking Management Evaluation: Montgomery County Survey Overview, September, 2006).

2.5. Target Number of Survey Participants

2.5.1. Glenmont Metro Station

The surveyors' goal was to obtain a total of 300 intercept surveys during two consecutive 3-hour mid-week (i.e., Tuesday, Wednesday, or Thursday) PM peak periods. The evaluation team arrived at this goal of 300 surveys based on a confidence level of 95 percent, a confidence interval of +/- 5%, and an estimated population of 1,800[1] surveys, which resulted in a required sample size of 317 surveys[2]. Based on the sample size target, a total of 322 surveys were

[1] This estimate is based on the fact that there are 1,800 parking spaces in the Glenmont Garage and based on the assumption that the garage is at full capacity on an average weekday and the assumption that most vehicles are single occupancy vehicles.

[2] Calculation performed using Sample Size Calculator at: http://www.surveysystem.com/sscalc.htm

conducted at the Glenmont Metro Station (Parking Management Evaluation: Montgomery County Survey Overview, September, 2006).

2.5.2. Norbeck Park-and-Ride Lot

The surveyors' goal was to obtain 100 completed surveys. The evaluation team arrived at this goal of 100 surveys based on a confidence level of 95 percent, a confidence interval of +/- 7.5%, and an estimated population of 250[3] surveys, which resulted in a required sample size of 102 surveys[4]. It was anticipated before the survey that the goal of 102 surveys at the Norbeck Road park-and-ride lot may not be achievable simply due to the smaller number of patrons using the lot. With that said, the team tried to obtain as many surveys as possible during the allotted time. As expected, the evaluation team was able to conduct the survey from only eleven (11) patrons (Parking Management Evaluation: Montgomery County Survey Overview, September, 2006).

Sample parking survey questionnaires both at the Glenmont Metro Station and the Norbeck Park-and-Ride lot are included in the Appendix as A-1 and A-2, respectively.

2.6. System Evaluation

The automated parking information system was evaluated based on commuter responses to the survey questions. The effectiveness of these responses is based on the frequency of a commuter's ridership on the Red Line from the Glenmont Metro Station. Figure 7 illustrates the number of times that respondents commute to the Glenmont Metro Station to ride the Red Line. The figure shows that 87% of the commuters use the station 4-5 times a week.
In response to a question regarding the availability of parking spaces at the Glenmont Metro Station parking facility, 213 out of 332 (66%) of the respondents replied that they often do not find available parking at the Glenmont Metro Station parking facility. After they do not find a parking space at the facility, 5.6% drive directly to their destinations, 46% park at the Wheaton Metro Station, 12.2% park somewhere near the Glenmont Metro Station, and less than one percent go to the Norbeck Road park-and-ride lot. Some of the commuters make different decisions on different day/times. For example, 3.75% of the commuters sometimes drive directly to their final destination and sometimes park their vehicles at the Wheaton Metro Station. The other options for commuters include parking at the Silver Spring or Twin Brook Metro Station, going back home to get dropped off at work, or parking illegally in the parking facility or on the surrounding streets around the parking facility.

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[3] This estimate is based on the fact that there are 250 parking spaces in the Norbeck lot, and based on the assumption that the lot will be at full capacity on an average weekday after the system is in place, that most vehicles are single occupancy vehicles, and that the majority of these vehicles represent individuals taking the bus to Glenmont.

[4] Calculation performed using Sample Size Calculator at: http://www.surveysystem.com/sscalc.htm

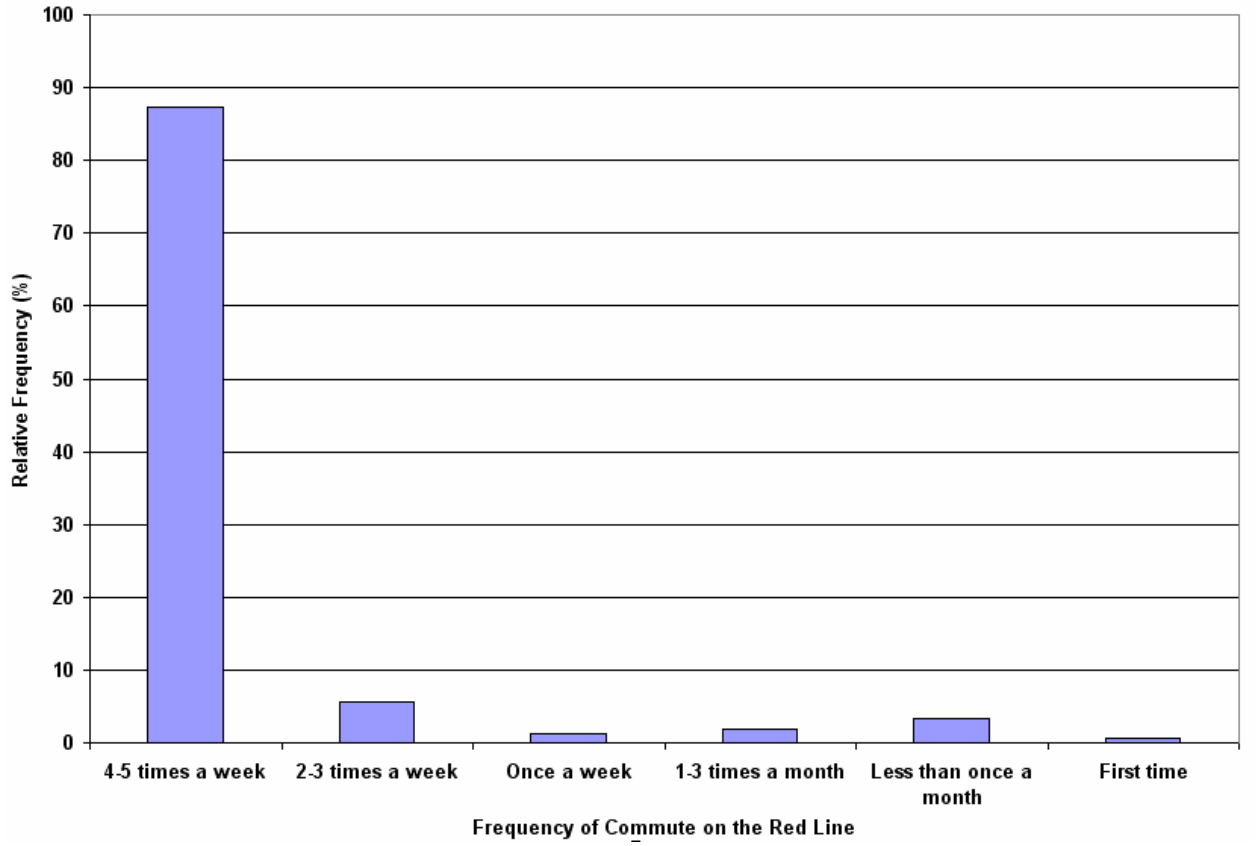

Figure 2-7: Frequency of Commuters Ridership on Red Line Metro

When the commuters at the Glenmont Metro Station and the Norbeck Road park-and-ride lot were asked about seeing the automated parking information sign during their morning commute to the Glenmont Metro Station, 196 (68%) replied in the affirmative and 126 (38%) replied in the negative. Table 3 shows the number of respondents who see the signs at different locations. The table shows that most of the respondents see the parking availability sign on Layhill Road, followed by the sign on Georgia Avenue, and lastly the sign on Norbeck Road.
The responses of the patrons regarding their decision after seeing the "facility full" sign are shown in Table 4. As shown in the table, thirty-one (31) respondents said that they go directly to the Wheaton Metro Station and four (4) go directly to the Norbeck Road park-and-ride lot. Nevertheless, a vast majority of the respondents neither go directly to Wheaton Metro Station nor to the Norbeck Road park-and-ride lot. A more detailed analysis of the data showed that 10 out of 148 respondents who do not go to the Wheaton Metro Station or the Norbeck Road park-and-ride lot had reserved parking spots at the parking facility. Also, there were a few respondents who doubt the accuracy of the signs.

Table 2: Locations of Automated Parking Information Signs

		Sign Location			
Survey Location	**Nos. of Replies**	**Georgia Ave, near Norbeck Park & Ride Lot**	**Norbeck Ave**	**Layhill Rd**	**Not Sure**
Glenmont Parking Structure	63				
	1				
	1				
	3				
	8				
	3				
	110				
	7				
Norbeck Park and Ride Lot	6				
	1				
	3				

When the respondents at Glenmont station were asked about the frequency of parking at the Norbeck park-and-ride lot, less than 1% replied they usually or sometimes park at the lot, 17 (5%) replied they rarely park at the lot, 4 (1%) replied they tried once but, would not try again, 152 (47%) replied they were aware of the parking lot but, never tried parking there, and 149 (46%) replied they were not aware of the lot. In case of Norbeck, 4 out of 11 respondents park at the lot usually, 3 park rarely and one respondent replied that it was his first time and would park there again.

Table 2-1: Respondents Decision after Seeing the Sign

Nos. of Replies	**Have ever decided to go straight to Wheaton Station because of the signs?**		**Have ever decided to go to Norbeck park & ride lot because of the signs?**	
	No	Yes	No	Yes
148				
4				
31				

In response to the reasons for not parking at Norbeck Road park-and-ride lot, 65 (20%) of the respondents at Glenmont Metro Station replied that the Norbeck Road park-and-ride lot was out of their way, 21 (6.5%) were unfamiliar with the bus schedule, 17 (5.3%) complained about the low frequency of the shuttle bus service from the Norbeck Road park-and-ride lot to the Glenmont Metro Station, and 34 (10.5%) they did not need to park at the Norbeck Road park-and-ride lot since they found parking at the Glenmont Metro Station. Some of the other reasons given by respondents for not parking at the Norbeck Road park-and-ride lot included

isolation of the parking lot, safety, and available parking at the Wheaton Metro Station. When the respondents at the Norbeck Road park-and-ride lot were asked about the reason to park at the lot, two out of eleven respondents replied that they saw the automated signs about the non-availability of the parking spaces at the Glenmont Metro Station parking facility.
The commuters at the Glenmont Metro Station and the Norbeck Road park-and-ride lot were also asked to rate on the scale of 1-5 (1 being strongly disagree and 5 being strongly agree) their level of satisfaction with the sign message and how has it affected their Metro ridership. Tables 5 and 6 show the commuters' responses from the Glenmont Metro Station and the Norbeck Road park-and-ride lot, respectively. The number of replies from 1 (strongly disagree) and 2 (disagree) were added together and were shown under the column titled "Disagree". Similarly, the replies from 4 (agree) and 5 (strongly agree) were added and were put into the column titled "Agree" and the replies from 3 (neutral) and 6 (N/A)were added and were shown in the column titled "N/A".

Table 5 shows a large numbers of respondents either remained neutral or the questions asked were not applicable to their case. The table also shows a higher number of commuters who agreed with the location of the signs, their accuracy, and whether or not they want to see similar signs at more locations, as compared to the respondents who did not agree with these statements. On the other hand, more commuters disagreed when asked if the sign display about availability of parking at the Glenmont Metro Station parking facility had increased the frequency of their ridership on Metro. When the data were analyzed it was found that most of the commuters who disagreed with an increase in the frequency of their Metro ridership already ride the Metro 4-5 times a week.

Similar to commuters at the Glenmont Metro Station, a larger numbers of commuters at the Norbeck Road park-and-ride lot either provided neutral responses or the questions were not found to be applicable to their case. Nevertheless, more respondents agreed with the positive influence of the automated parking availability signs on their commuting pattern as compared to the respondents who did not agree.

In addition to multiple choice check box questions, the commuters were also encouraged to give comments about the system. The commuters had their own opinions about the shortage of parking spaces at the Glenmont Metro Station and empty reserved spaces, some of the respondents appreciated the new parking information system. Some of the commuters suggested different locations for the signs which they thought would be more helpful for them. For example, one of the commuters suggested the Georgia Avenue sign should be placed closer to the Glenmont Metro Station parking facility. The other proposed locations for the signs were and Randolph Road and Shady Grove Road.

Table 2-2: Opinions of Respondents at Glenmont about the APIS

Question	# of Replies		
	Don't Agree	**Agree**	**N/A**
The signs have reduced the amount of time I spend searching for an available parking space when riding the Red Line.	59 (18%)	45 (14%)	217 (67.4%)
The signs have not made any difference to me since I've never had trouble finding parking on the Red Line.	54 (16.7%)	66 (20.5%)	181 (62.4)
Before the signs, I often spent time circling in the Glenmont Garage looking for an available space.	43 (13.4%)	51 (15.9%)	185 (70%)
Overall, the message signs have improved my awareness of parking alternatives for the Red Line.	58 (18%)	53 (16%)	209 (65%)
I am satisfied with the location of the signs as they provide me with information at the right place in my trip.	30 (9%)	90 (28%)	172 (62%)
The information provided on the signs has not affected how often I ride Metro.	37 (11%)	98 (30%)	183 (57%)
I feel that the information on the signs is accurate.	30 (9%)	72 (22%)	214 (66%)
I've found myself riding Metro more now that the signs provide me with information about the availability of parking spaces.	78 (24%)	11 (3%)	232 (72%)
I feel that the information on the signs has improved my overall commuting experience.	44 (14)	45 (14%)	231 (72%)
I would like to see similar signs installed at other Metro Stations.	13 (4%)	95 (30%)	213 (66%)

Table 2-3: Opinions of Respondents at Norbeck Park & Ride Lot about the APIS

Question	**# of Replies**		
	Don't Agree	Agree	N/A
The signs have reduced the amount of time I spend searching for an available parking space when riding the Red Line.	1	3	7
The signs have not made any difference to me since I've never had trouble finding parking on the Red Line.	3	2	6
Before the signs, I often spent time circling in the Glenmont Facility looking for an available	1	4	5

space.			
Overall, the message signs have improved my awareness of parking alternatives for the Red Line.	1	3	7
I am satisfied with the location of the signs as they provide me with information at the right place in my trip.	1	4	5
The information provided on the signs has not affected how often I ride Metro.	2	5	4
I feel that the information on the signs is accurate.	0	4	7
I've found myself riding Metro more now that the signs provide me with information about the availability of parking spaces.	4	1	6
I feel that the information on the signs has improved my overall commuting experience.	0	3	8
I would like to see similar signs installed at other Metro Stations.	0	6	5

2.7. Conclusions and Observations Based on Evaluation Survey

The responses from the surveys conducted at the Glenmont Metro Station and the Norbeck Road park-and-ride lot for evaluating the automated parking information system, showed that the system was successful in informing the commuters about parking availability at the Glenmont Metro Station parking facility and guiding them to alternative parking facilities at Wheaton Metro Station and the Norbeck Road park-and-ride lot once the Glenmont Metro Station parking facility was full. The data showed that 31 commuters decided to go directly to the Wheaton Metro Station after seeing the new sign. Also, an acceptable number of commuters agreed that the signs have increased their awareness regarding the parking alternatives to the Red Line and have reduced the time they used to spend searching for a parking space at the Glenmont Metro Station parking facility. The data, however, also showed that very few commuters chose to go to the Norbeck Road park-and-ride lot. There were several reasons provided by the commuters for the underutilization of the Norbeck Road park-and-ride lot, including the lot being out of their way, they were unaware of the alternative mode of transportation from the lot to the Glenmont Metro Station, and the low frequency of bus services between the lot and the parking facility.

Based on commuter responses and comments, it is recommended that the sign on Georgia Avenue be placed closer to the metro station (south of Norbeck Road) as similar to the one on Layhill Road. Despite of the fact that the sign on Georgia Avenue is currently placed north of Norbeck Road, very few commuters traveling towards the Glenmont Metro Station go to the

Norbeck Road park-and-ride lot even after seeing the sign. However, if the sign is moved closer to the Glenmont Metro Station and the Wheaton Metro Station, it is anticipated that more commuters will choose to go to Wheaton Metro Station after seeing the sign about non-availability of parking spaces at the Glenmont Metro Station parking facility. This recommendation is based on the observation from the survey data which showed that 23 out of 31 commuters who decided to go directly to the Wheaton Metro Station saw the message sign on Layhill Road, which is placed closer to the Wheaton Metro Station.

2.8. Before-and-after Counts Evaluation

In addition to the evaluation survey about the system, counts for incoming and outgoing vehicles were also collected at the Glenmont Metro Station parking facility and the Norbeck Road park-and-ride lot before-and-after the sign system was operational. The counts were collected with the following hypotheses:

- There will be a decline in the number of inbound vehicles to the Glenmont Metro Station parking facility after it reaches its full capacity. This is based on the assumption that once the facility is full and the signs display information about non-availability of parking spaces at the facility, the commuters who do not have reserved parking spots, will not head towards the facility and will select other parking alternatives.
- There will be an increase in the number of inbound vehicles to the Norbeck Road park-and-ride lot once the signs will inform the commuters about non-availability of parking at the Glenmont Metro Station parking facility and parking availability at the Norbeck Road park-and-ride lot.

The count data at the Glenmont Metro Station parking facility and the Norbeck Road park-and-ride lot were collected using automatic traffic recorders (ATR). The parking utilization counts for the Glenmont Metro Station parking facility, before the new system was operational, were calculated based on 24-hour counts broken into 15-minute intervals. The counts were collected at all the entrances and exits to the Glenmont Metro Station parking facility on August 3-4, 2005 and May 23-25, 2006. Utilization counts after the signs were in place were calculated at the Glenmont Metro Station parking facility based on 24-hour counts collected at 15-minute intervals on August 21-23, 2007.

The before-and-after utilization counts at the Norbeck Road park-and-ride lot were calculated based on the counts collected on October 19-21, 2004 and September 26-28, 2007, respectively. In addition to the traffic recorder counts, manual counts for AM peak hours were also collected on September 26, 2007.

Figure 8 shows the before-and-after cumulative AM inbound traffic volume to the Glenmont Metro Station parking facility. The figure shows an increase in traffic volume to the facility in 2006 and 2007 as compared to 2005; however, there was no difference in inbound cumulative frequency curves observed between 2006 and 2007. Therefore, no conclusion regarding the decrease in traffic volume after the automated signs are displayed can be obtained from the count data.

Table 7 shows the AM inbound vehicles counts collected at the Norbeck Road park-and-ride lot before-and-after the signs were displayed. The table does not show any significant difference in the numbers of inbound vehicles at the Norbeck Road park-and-ride lot during the morning hours before-and-after the automated parking information system was in place.

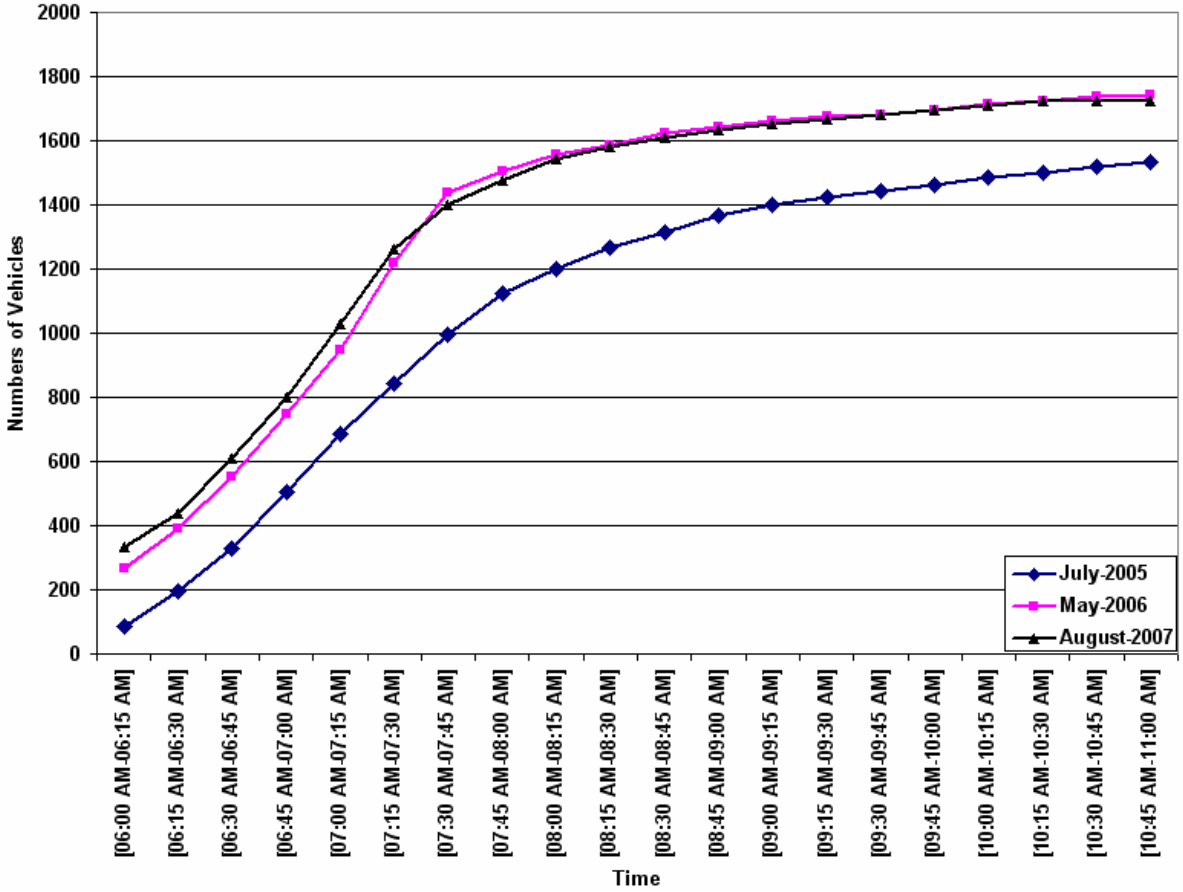

Figure 2-8: Cumulative Frequencies of Inbound Vehicles during AM Peak Period to Glenmont Parking Facility

Table 2-4: AM Count Data for Inbound Vehicles at Norbeck Park and Ride Lot

	Date	**Time**				
Counter Data	Counter Data	5:30AM-5:55 AM	6:00AM-6:55 AM	7:00AM-7:55 AM	8:00AM-8:55 AM	9:00Am-9:55 AM
	Counts Before Automated Parking Information System					
	10/19/04	2	8	15	9	3
	10/20/04	1	9	8	7	2
	10/21/04	0	8	10	9	5
	Counts After Automated Parking Information System					
	09/26/07	2	11	16	8	2
	09/27/07	1	6	13	11	4
	09/28/07	3	8	13	17	3
Manual Counts	Manual counts 09/26/07	3	6	8	2	2

CONCLUSIONS

An evaluation of automated parking information system at the WMATA Glenmont Metro parking facility and the Maryland SHA Park-and-Ride lot on Norbeck Road from commuter surveys had the following results:

- The signs displayed at Georgia Avenue, Norbeck Road, and Glenallen Avenue are an effective tool to inform commuters about the parking availability at the Glenmont Metro Station parking facility.
- The Norbeck Road park-and-ride lot remains underutilized despite the new signs informing commuters about the parking space availability at the lot. However, several commuters divert to the Wheaton Metro Station after seeing the sign about non-availability of parking spaces at the Glenmont Metro Station parking facility.
- Some of the several reasons mentioned by the commuters for the underutilization of the Norbeck Road park-and-ride lot are its isolation, commuter unfamiliarity about the availability of a shuttle bus schedule, and the lower frequency of shuttle buses from the park-and-ride lot to the metro station.
- Based on commuter feedback regarding the alternate parking lots after the Glenmont Metro Station parking facility reaches its capacity, it is recommended that the sign at Georgia Avenue be moved closer to Wheaton Metro Station.

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Report Number: MD-26-7021.2010.01