QuickRide Usage Analysis

Technical Report 1
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TECHNICAL REPORT 1: QUICKRIDE USAGE ANALYSIS

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THE HOUSTON QUICKRIDE PROGRAM

In 1984 a reversible high-occupancy vehicle (HOV) lane opened along the Katy Freeway in Houston to allow transit vehicles and vanpools to bypass congestion along the mainlanes. By 1988, occupancy requirements for lane use had been reduced to two people per vehicle. Over time, with this occupancy restriction, traffic volumes increased on the HOV lane to the point where volumes exceeded capacity during peak periods (6:45–8:00 a.m. and 5:00–6:00 p.m.) on weekdays. Occupancy requirements were then raised to three occupants during the peak periods, causing traffic on the HOV lane to return to free-flow conditions, but creating excess capacity.

The Houston QuickRide program was implemented in January of 1998 to allow vehicles with two passengers to utilize the HOV lane during peak periods for a fee of $2. This type of lane is known as a High Occupancy/Toll lane, or HOT lane. The objectives of the program were to increase overall person throughput along the Katy Freeway during peak periods, increase travel speeds on the mixed-flow lanes, and efficiently manage demand without adverse operating impacts on both the HOV lane and the mixed-flow lanes (*1*). The program has since expanded to the morning peak hour on US 290. Today, the QuickRide program is still in operation for all three movements (Katy AM Peak Hour, Katy PM Peak Hour, and US 290 AM Peak Hour).

Previous Studies

Previous studies have examined numerous aspects of the QuickRide program (*2,3,4*). These studies were based on 1998 usage of the QuickRide program and data from a survey conducted in mid-1998 of all QuickRide enrollees. The main findings from the studies were:

1. The total demand for HOV2 (high-occupancy vehicle with two or more passengers) value pricing on HOT lanes may be limited in major travel corridors despite large potential time savings.
2. Substantial shifts in mode and time are possible with HOV2 value pricing.

3. Household size and income are good indicators, but prior HOV lane use is a poor indicator, of the demand for HOV2 value pricing.
4. QuickRide users were typically familiar with the Houston HOV system prior to signing up for the program.

QUICKRIDE DATA

This report examines QuickRide usage, trends, enrollment, etc. from 1998 to 2002. The first set of data examined here is the QuickRide usage data for those five years. The time, date, transponder number, and reader number of each QuickRide use are listed in this data set. The transponder number is the unique number assigned to the transponder on each individual vehicle. The reader number is a unique identification number for the various transponder readers located along Houston freeways.

Several problems with the data set had to be resolved prior to analyzing the data. First, some transponder numbers were listed twice for the same QuickRide movement on the same day. Each QuickRide movement has two transponder readers that track QuickRide usage for billing purposes (Readers 12 and 15 for the Katy AM movement, readers 18 and 19 for the Katy PM movement, and readers 36 and 42 for the US 290 AM movement – see Figure 14). Many QuickRide users pass both transponder readers when using the QuickRide lane. The QuickRide software is designed to remove these duplicate readings prior to final billing. However, a total of 2659 duplicate entries remained in this data set. These duplicate entries were removed from the original 160,610 entries, leaving a data set containing 157,951 QuickRide uses for the five-year period.

Another problem with the data was the high number of days in which no uses were logged for a QuickRide movement. Some of these days corresponded to holidays (Figure 1) and were thus ignored in the analysis of the data. Other zero-usage days may be attributed to malfunctioning readers, construction in the area, or a malfunction in the QuickRide software. Researchers found that the five years of QuickRide usage data had 195 “zero days” that were not holidays or weekends.

QuickRide Holidays
New Years Day
Memorial Day
Independence Day
Labor Day
Thanksgiving (2 days)
Christmas Eve
Christmas Day
New Years Eve

Figure 1: QuickRide Holidays in which no uses are logged

Raw Transponder Read Data

To better examine the problem of zero days, the raw data of transponder reads on the HOT lanes were examined. The raw data included every transponder reading, both for QuickRide users and non-users who happen to own an electronic toll collection (ETC) transponder, from the QuickRide readers during the QuickRide times.

One concern with the large number of zero days in the QuickRide data was the possibility that not all QuickRide uses were counted and recorded by the QuickRide software. After visually examining the raw data and comparing the number of uses to the QuickRide data, it seemed that there could be QuickRide uses that went uncharged. However, after running the raw data for these days through the QuickRide software again, we received the same results as the original QuickRide data and therefore could not reduce the 195 days of zero recorded QuickRide uses.

ANALYSIS OF QUICKRIDE USAGE DATA

Daily QuickRide Usage

QuickRide usage refers to the number of times that the QuickRide enrollee's transponder was detected and charged for traveling on the HOT lane during the QuickRide period. It

does not include any trips where the transponder was not read but the driver used the lane nonetheless. Daily QuickRide usage was plotted for each QuickRide movement for each year (Figures 2–4) (a summary of this can be found later in this report in Table 1). Usage drops significantly from around the middle of May to the beginning of September for the AM QuickRide movements. (This trend is described in greater detail below.) The gaps in the plots represent periods where no data existed. In other words, at some times in the five-year analysis period there were long periods of zero days for a particular movement.

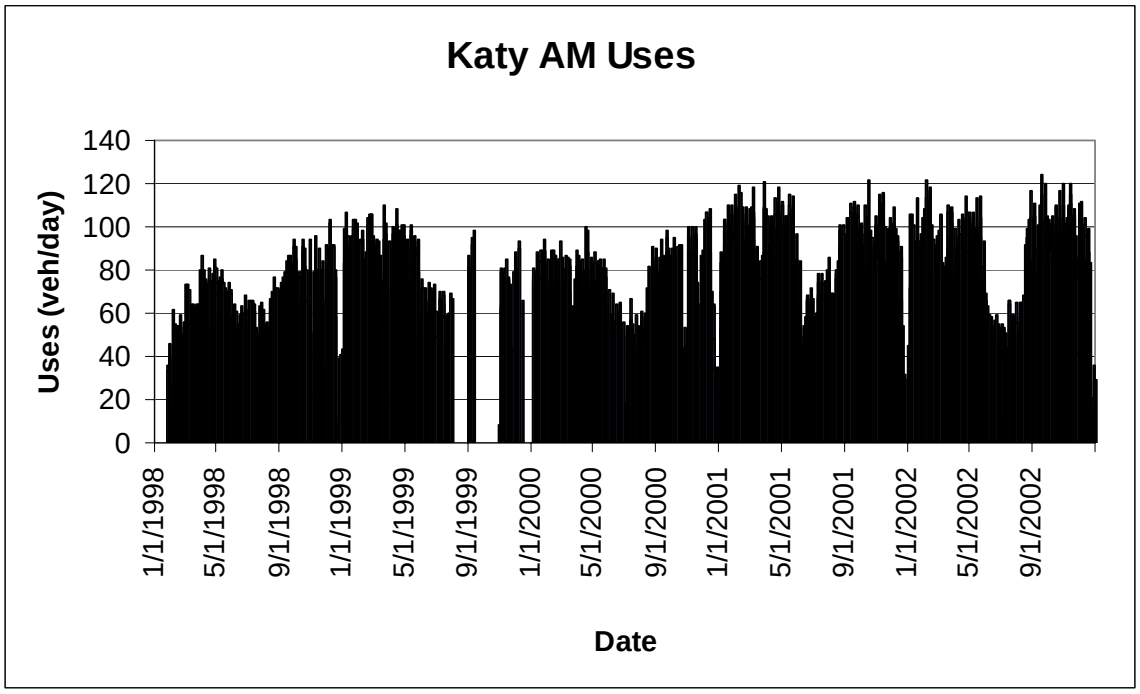

Figure 2: Daily QuickRide Uses for Katy AM Movement

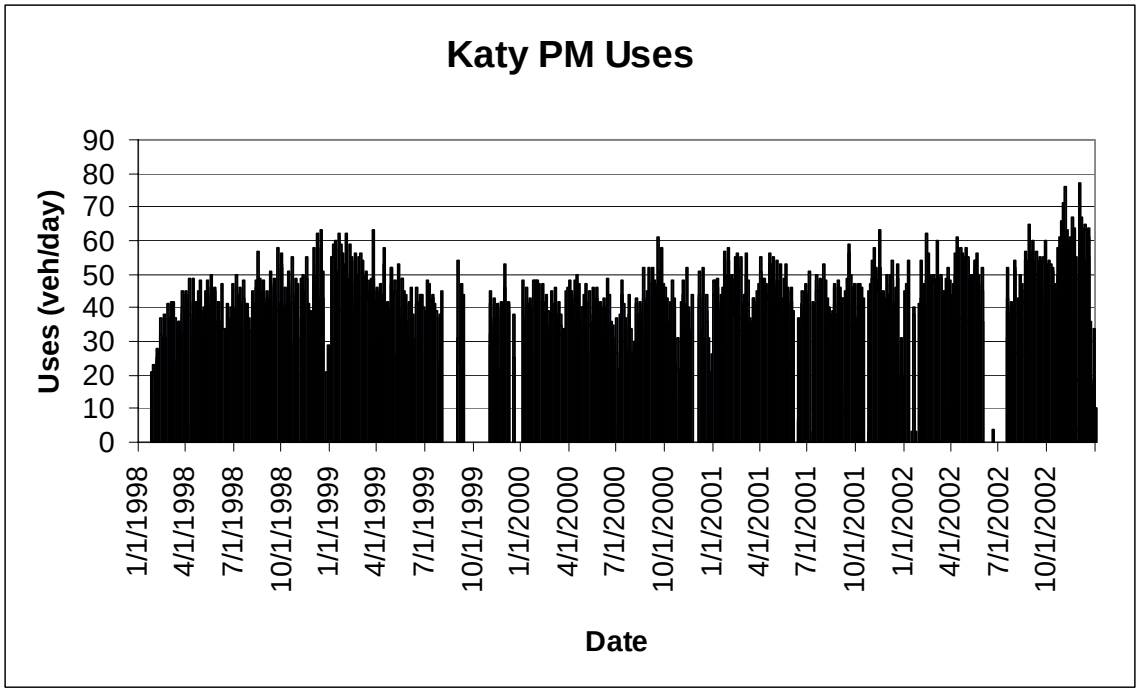

Figure 3: Daily QuickRide Uses for Katy PM Movement

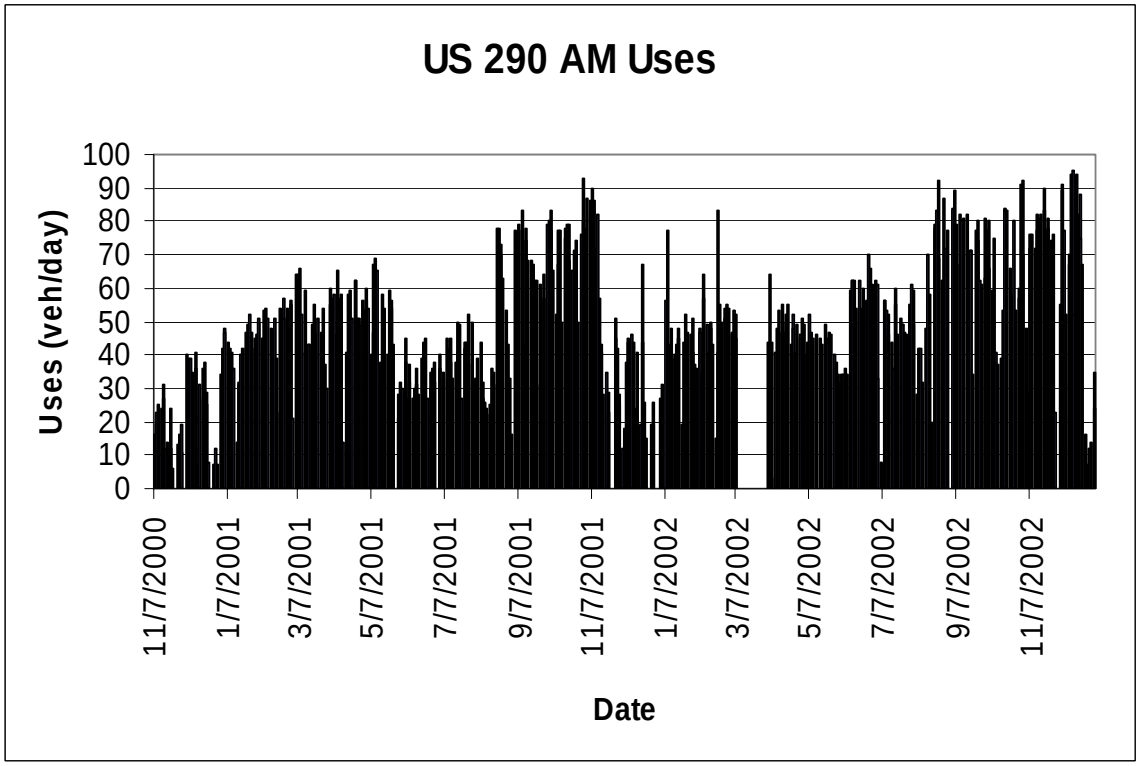

Figure 4: Daily QuickRide Uses for US 290 AM Movement

Average Monthly QuickRide Usage

The average uses per day are plotted for each month in all years QuickRide was operational (Figures 5–7). For the Katy AM and US 290 AM QuickRide movements, usage is lower in the summer than in the fall, winter, and spring. This is most likely due to the fact that students are not attending school in the summer. Many users surveyed said that they travel with family members while using QuickRide. If these family members were students going to school, then they would be unable to use the program in the summer. The AWTY International School is located near the intersection of US 290 and the Katy Freeway. This school can be accessed from either highway and may be an example of a QuickRide destination with a student as the passenger. Also, congestion on the mainlanes could be less during the summer (note that work is beginning on validating this theory using speed data from Katy and US 290 mainlanes). The summer trend is less obvious in the Katy PM data, likely because the school day generally ends before the PM QuickRide period and therefore picking up children at school was never a factor in PM QuickRide usage.

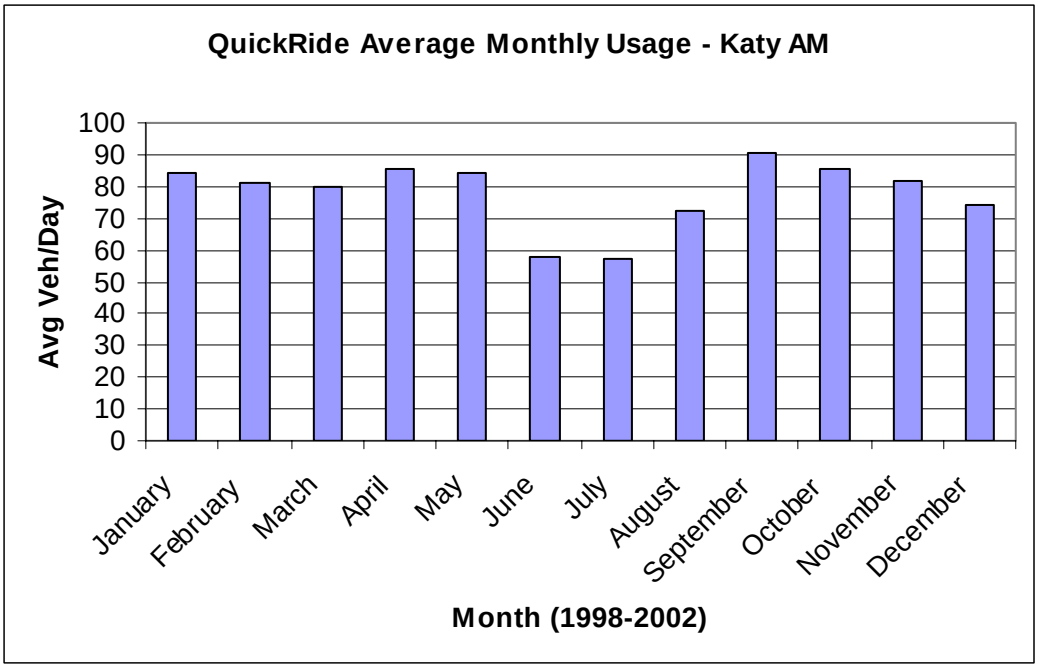

Figure 5: Average Monthly QuickRide Use for Katy AM Movement

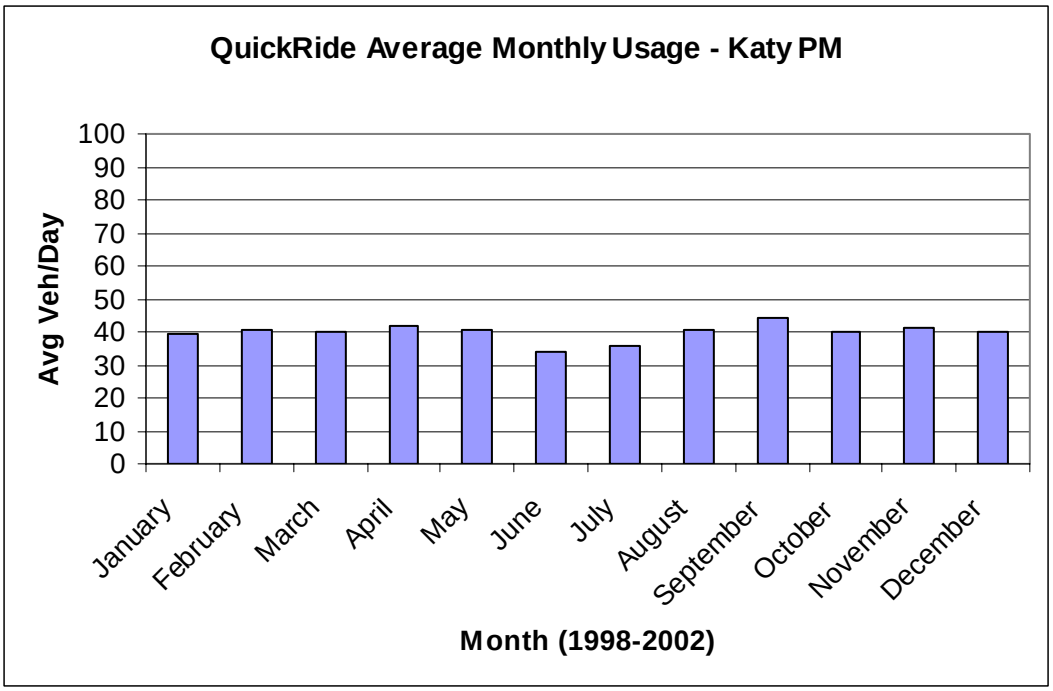

Figure 6: Average Monthly QuickRide Use for Katy PM Movement

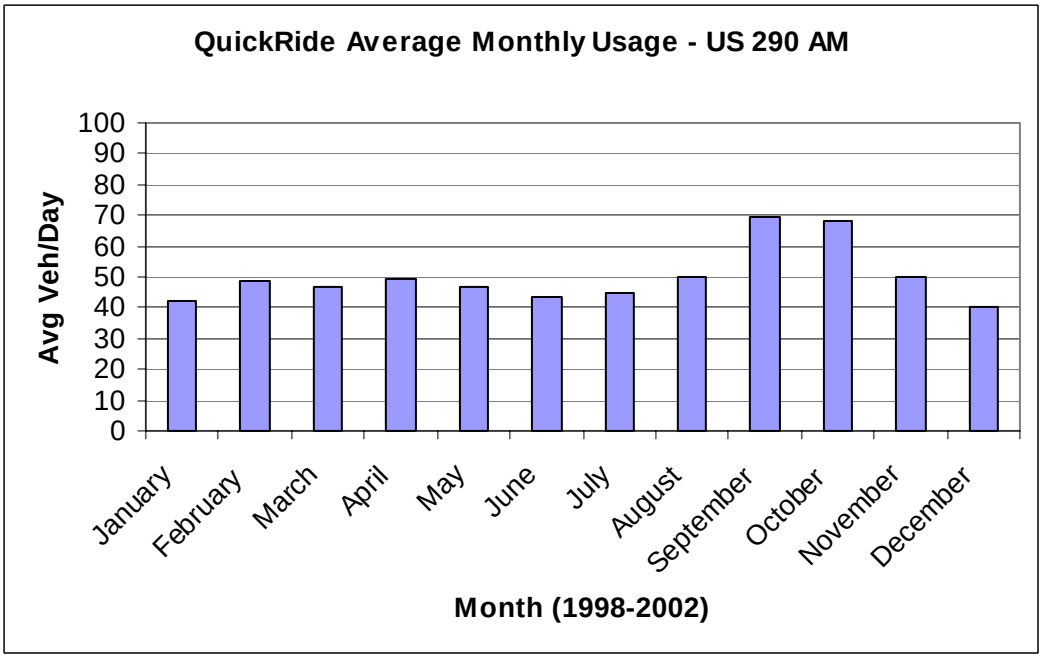

Figure 7: Average Monthly QuickRide Use for US 290 AM Movement

Average Weekday QuickRide Usage

Average QuickRide uses per day for each QuickRide movement were plotted for each year. Daily usage is quite consistent through the week, with a small decrease on Friday (Figures 8–10).

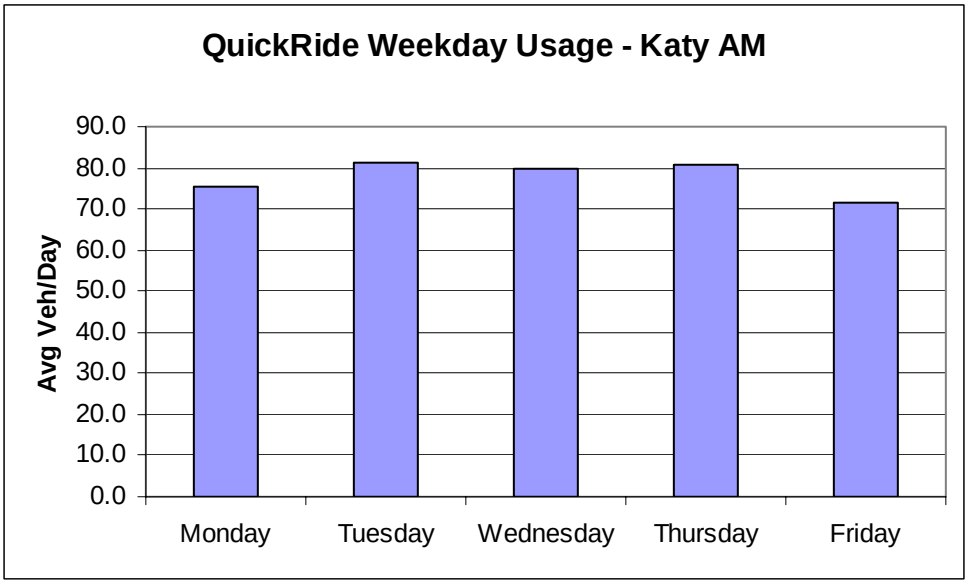

Figure 8: Average Weekday QuickRide Uses for Katy AM Movement

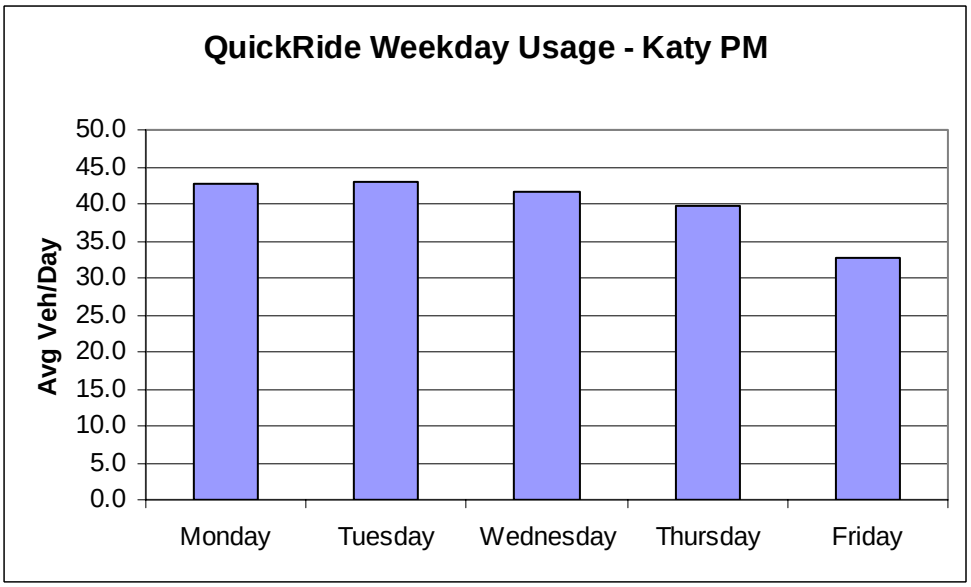

Figure 9: Average Weekday QuickRide Uses for Katy PM Movement

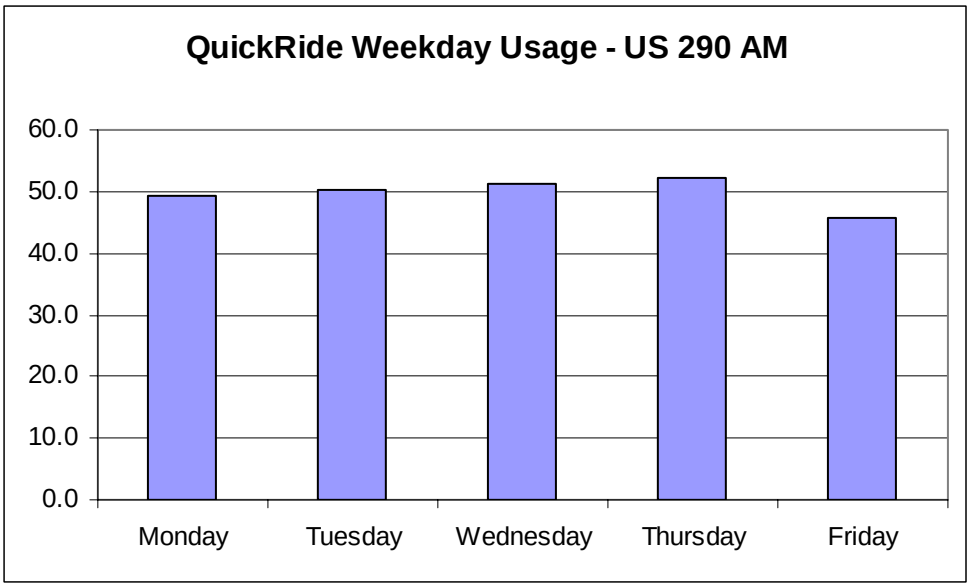

Figure 10: Average Weekday QuickRide Uses for US 290 AM Movement

Temporal Distribution of QuickRide Usage

The distribution of QuickRide uses throughout the QuickRide periods were examined and plotted in 5-minute increments. Figures 11–13 show the three distributions for 2002. There are a number of concerns with this approach of determining the distribution. The official QuickRide times of 6:45–8:00a.m. and 5:00–6:00 p.m. have remained the same throughout the five-year period. However, the QuickRide software uses slightly different times for charging purposes to account for the distance (and thus travel time) between the HOT lane entrance and the transponder reader. The times shown in these graphs are based on the time each user passes the first reader. Also, there are two readers associated with each QuickRide movement located at different points along the HOV lane (see Figure 14). This distribution analysis did not take into account the reader associated with each reading.

By observing the usage distribution graphs, it is apparent that fewer users enter the QuickRide lane near the beginning and end of the QuickRide periods. The largest group of users enter the QuickRide lane in the middle of the QuickRide period. One possible reason for this is that QuickRide enrollees with a preferred time of travel near the start of

the Quick Period attempt to reach the HOT lane before the QuickRide time so they do not get charged. Other enrollees with a preferred time of travel near the end of the QuickRide period may delay their trip in order to enter the HOT lane after the QuickRide charge. Drivers who prefer to travel during the middle of the QuickRide times would have to alter their trip up to 35 minutes to avoid the charge. Therefore, it is less likely those drivers would alter their time of travel to outside of the QuickRide period.

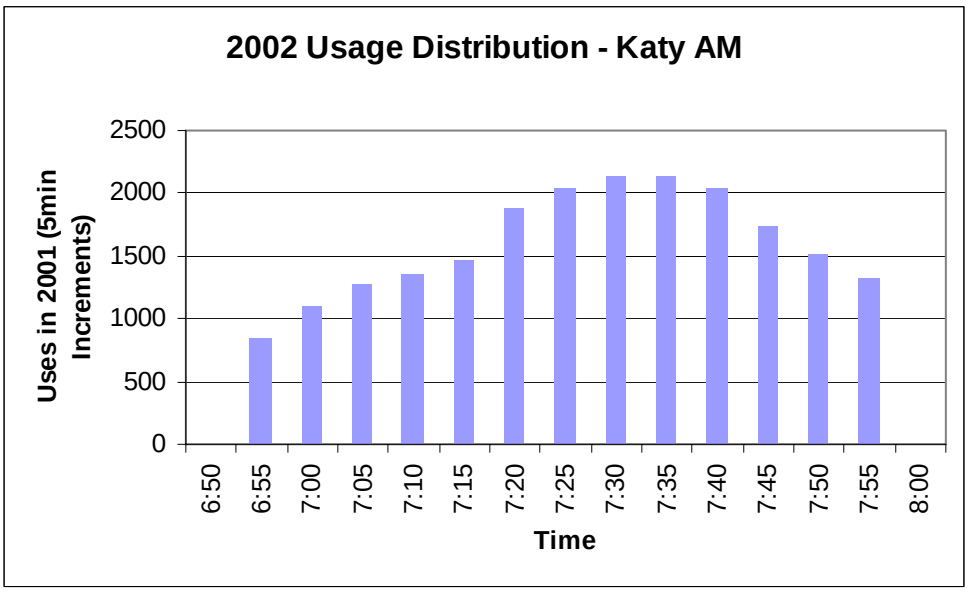

Figure 11: QuickRide Usage Distribution for Katy AM Movement in 2002

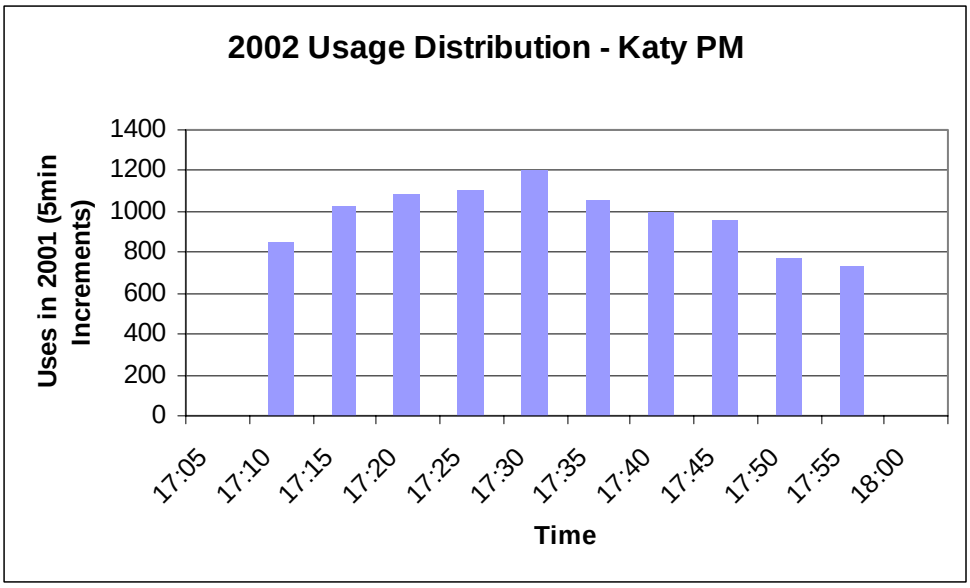

Figure 12: QuickRide Usage Distribution for Katy PM Movement in 2002

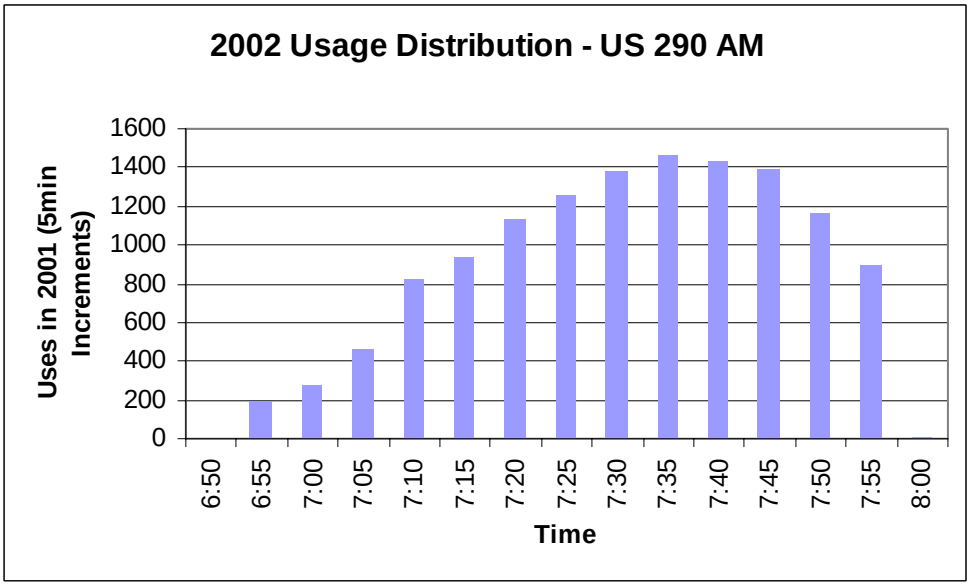

Figure 13: QuickRide Usage Distribution for US 290 AM Movement in 2002

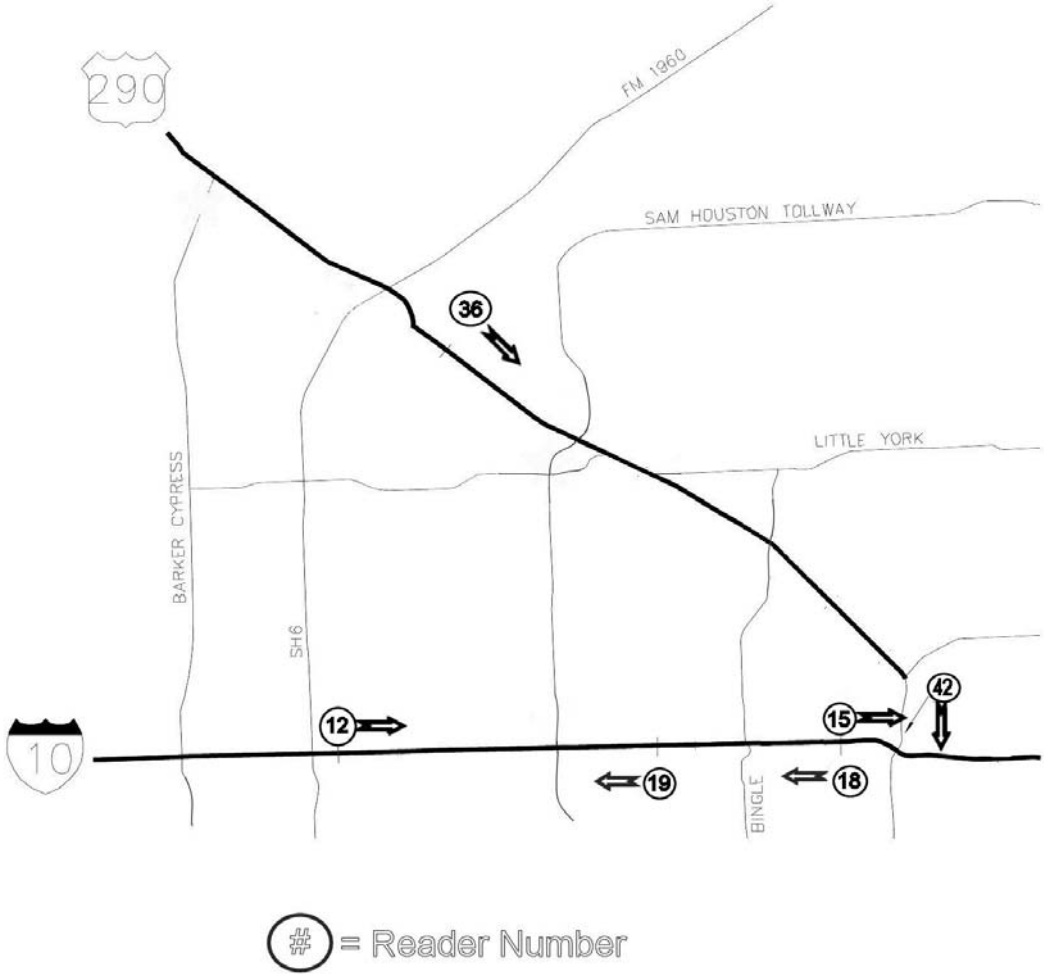

Figure 14: Location of QuickRide Billing Readers

QuickRide Uses per Day for Each Year

The average number of vehicles per day using the QuickRide lanes for each year in the five-year analysis period is shown in Table 1. US 290 AM does not have uses until late 2000, when the QuickRide program was implemented on that highway. Usage along the Katy AM movement saw an increase from 1998 to 1999, then a decrease in 2000, an increase in 2001, and another decrease in 2002. The US 290 AM movement has seen an

increase in uses per day for its two years of operation. Usage along the Katy PM movement has stayed fairly constant over the five-year period, with 2002 having the greatest number of uses (43.33 veh/day) and 2000 having the least number of uses (36.60 veh/day).

Movement	Time Period	1998		1999		2000		2001		2002	
		veh/day	veh/day	veh/day	veh/day	veh/day	veh/day	veh/day	veh/day	veh/day	veh/day
Katy AM	6:45 - 7:00	10.64	65.27	9.75	78.98	2.07	72.37	11.11	87.87	7.72	82.74
	7:00 - 7:15	14.28		16.72		14.78		19.48		16.23	
	7:15 - 7:30	15.75		19.22		17.92		23.61		24.01	
	7:30 - 7:45	13.62		18.49		20.22		23.49		23.47	
	7:45 - 8:00	10.99		14.80		17.38		10.18		11.31	
Katy PM	5:00 - 5:15	7.68	38.05	7.73	42.17	7.27	36.60	7.03	40.08	8.30	43.33
	5:15 - 5:30	11.46		11.58		11.86		14.15		15.04	
	5:30 - 5:45	9.92		12.09		9.95		12.18		13.33	
	5:45 - 6:00	8.99		10.77		7.52		6.71		6.66	
US 290 AM	6:45 - 7:00	0.00	0.00	0.00	0.00	1.46	22.40	2.83	48.26	2.04	55.58
	7:00 - 7:15	0.00		0.00		3.43		8.01		9.65	
	7:15 - 7:30	0.00		0.00		7.06		14.02		16.35	
	7:30 - 7:45	0.00		0.00		7.37		16.15		18.58	
	7:45 - 8:00	0.00		0.00		3.09		7.25		8.95	

Table 1: QuickRide uses per day by 15-minute period

When Enrollees Began and Ended QuickRide Use

In order to analyze any trends in QuickRide usage, it is important to study when users enrolled for QuickRide, when they began using the HOT lane, and when they quit. The primary data set is the QuickRide usage data mentioned earlier. In addition, a list of enrollees current as of December 2002, containing every transponder number registered with QuickRide throughout the duration of the program, is used. This list has some information on whether or not each transponder is still enrolled in the program. Finally, a list of when users enrolled for the QuickRide program has recently been obtained, current as of April 2003.

These three data sets were analyzed to find how many times each transponder was logged using QuickRide for each month between January 1998 and December 2002. From these data it could be observed when each transponder was first used and when each transponder was last used. It can also be observed when QuickRide users first enrolled for the program using the April 2003 data set. This analysis does not take into account each individual's frequency of QuickRide use, only when they first and last used the program.

It is possible that some users are using the QuickRide lanes but are avoiding the $2 charge. In order to not be charged, a QuickRide user would have to avoid having their transponder read by a reader along the HOT lane. This might be possible by placing the transponder in an electrostatic bag, disabling the transponder, or possibly placing it in the glove compartment. If a QuickRide user does this, his or her use of QuickRide does not appear in the data.

Figure 15 shows when QuickRide users first enrolled in the program. Many users enrolled in January of 1998 when the program was first implemented. Another large group enrolled in January of 2001, when the US 290 AM movement became part of the QuickRide program. Throughout the last five years, more new enrollees have enrolled for QuickRide than have dropped out of the program. However, daily usage has remained fairly constant. Thus, the number of (recorded) QuickRide trips per enrollee has dropped steadily.

Figure 16 indicates the month QuickRide users began using the QuickRide lanes. As expected, the trends are similar to when users enrolled for the QuickRide program (Figure 15).

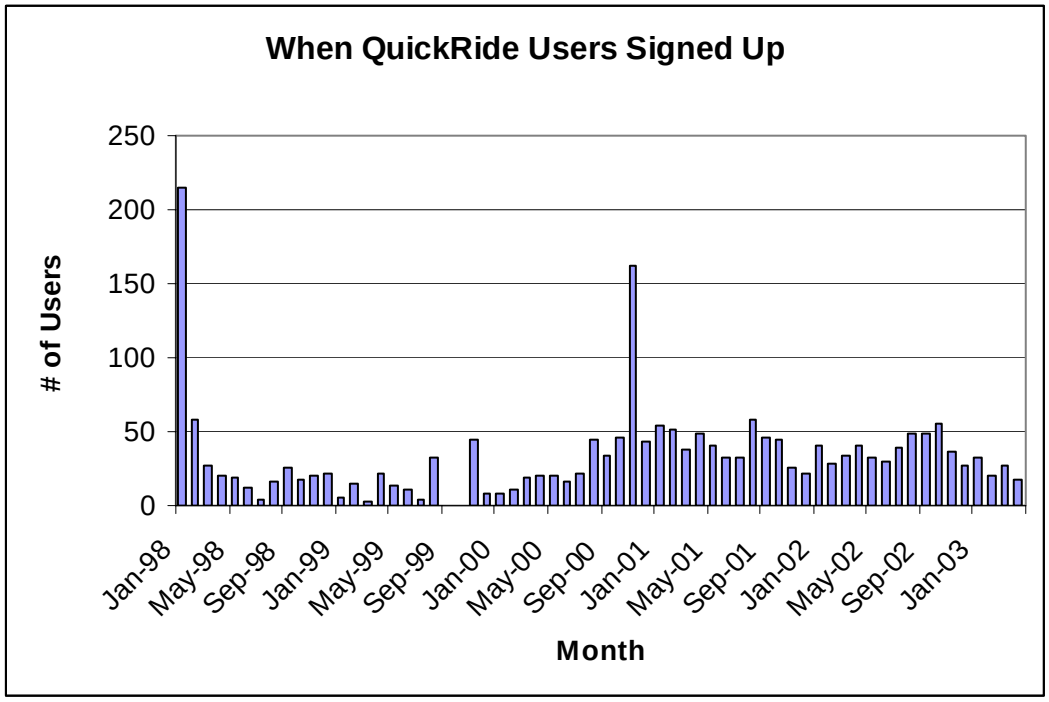

Figure 15: Signup Date for QuickRide Users

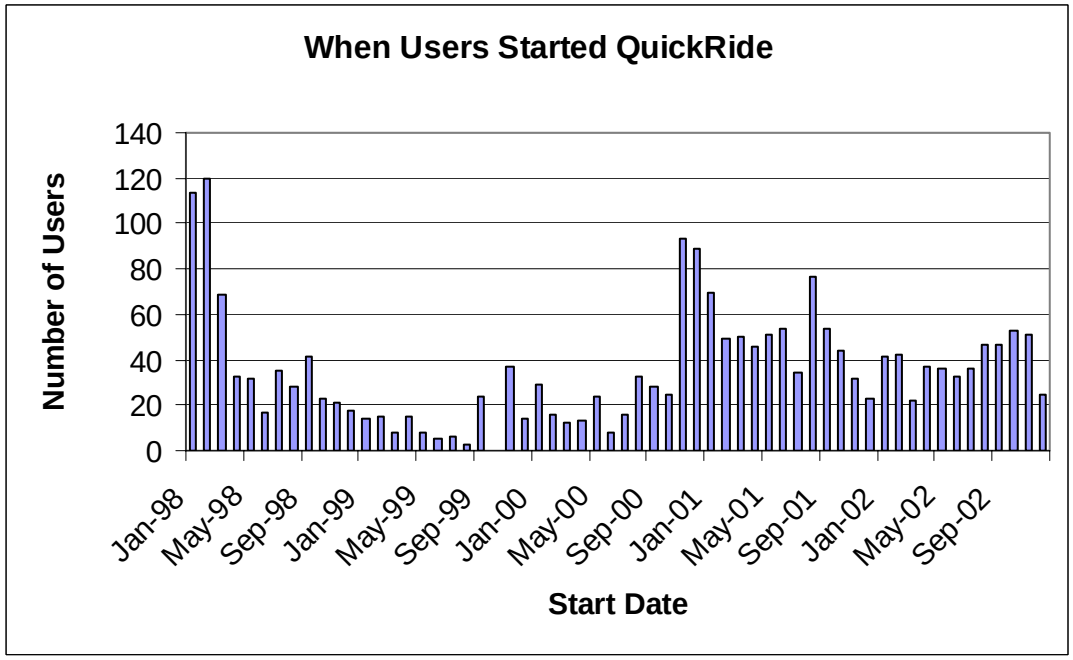

Figure 16: Start Date of QuickRide Users

Figure 17 indicates when QuickRide enrollees last used the QuickRide lanes. There appears to be a trend in increasing levels of enrollees not using the lanes. However, this graph represents when users last used the QuickRide program, not necessarily when (or if) they actually quit. Therefore, those that seemed to have stopped using QuickRide are likely still enrolled and could use the lane again.

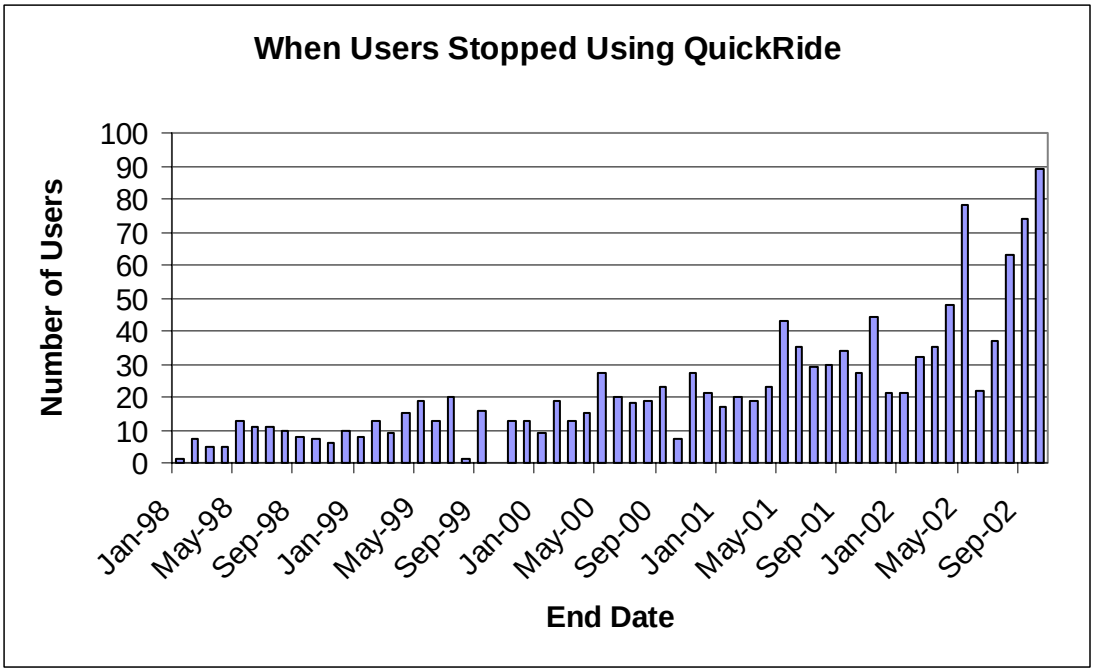

Figure 17: Date of Last QuickRide Use

In an attempt to combine the data in Figures 16 and 17, Figure 18 was constructed showing when individual enrollees both began and ended their use of the QuickRide lanes. All users are shown to have quit by December 2002 because the data set only contains information through that month.

It is difficult to determine any trends based on when users began and ended their use of QuickRide. In addition, some enrollees may be using the lane without being charged. Also, a large number of enrollees appeared to never have used the program, yet still paid the monthly QuickRide fee for some period of time. Of the 2140 transponders registered

with the QuickRide program, 344 never used (or, more accurately, never paid the $2 toll to use) the QuickRide lanes.

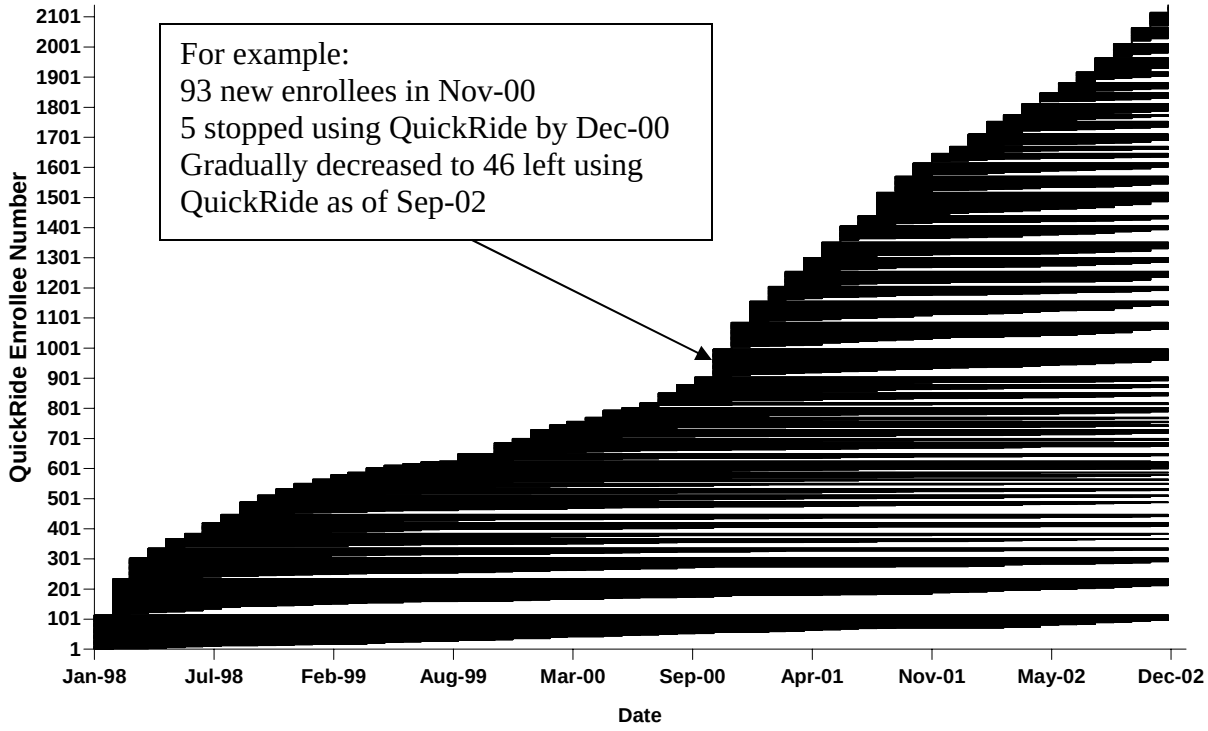

Figure 18: When Users Began and Ended Their Use of the QuickRide Lanes

Figure 19 shows the percent of QuickRide enrollees that were recorded as using QuickRide 12 months after they first began using QuickRide. The graph ends with December 2001 since usage data ended in December 2002. The percent that remain seems to have decreased slightly since the beginning of the program.

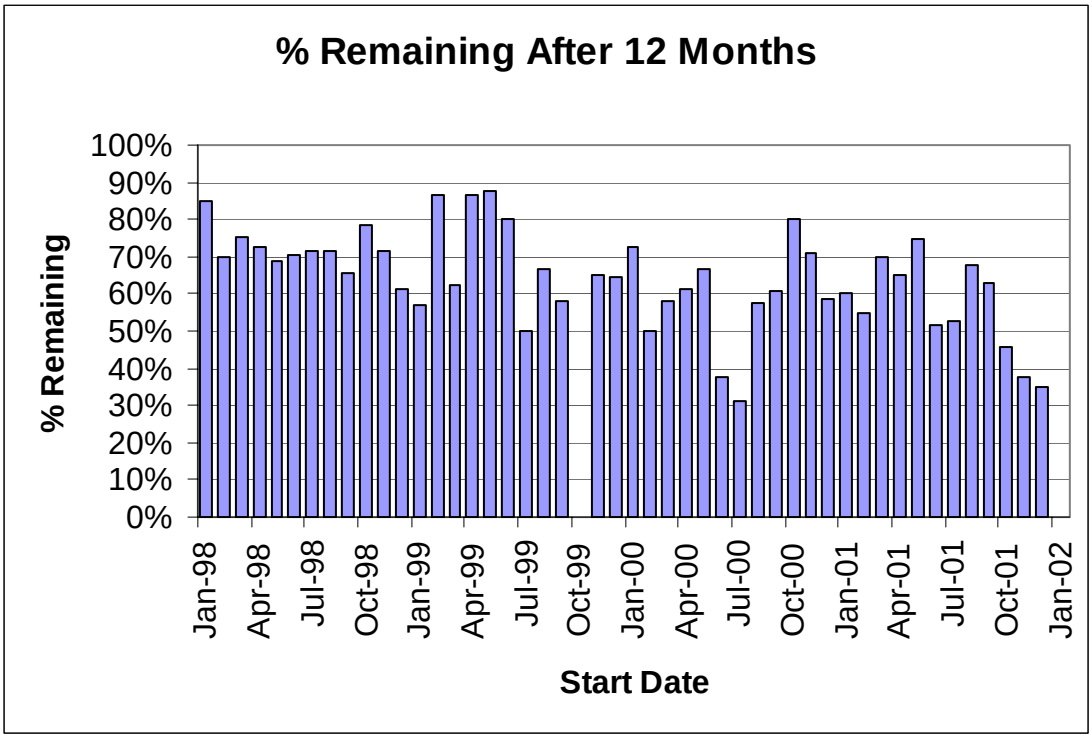

Figure 19: Percent of QuickRide Enrollees Remaining 12 Months after Their Start Date.

Frequency of QuickRide Usage

The previous graphs only take into account when users began and ended their use of QuickRide. They do not illustrate the frequency of use among QuickRide enrollees. Figure 20 indicates how many times per month, on average, a QuickRide user pays the $2 QuickRide toll during the five-year evaluation period. The largest group of enrollees paid the toll between 0 and 1 times per month during their duration of QuickRide use. Another large group never paid the QuickRide toll. This is surprising, given that they would have had to pay the $2.50 monthly service charge to be a member of the program. The most likely explanation appears to be that they are using the HOT lane but their transponder is not being read. Figure 20 also indicates that there are some QuickRide enrollees that average more than 10 QuickRide trips per month.

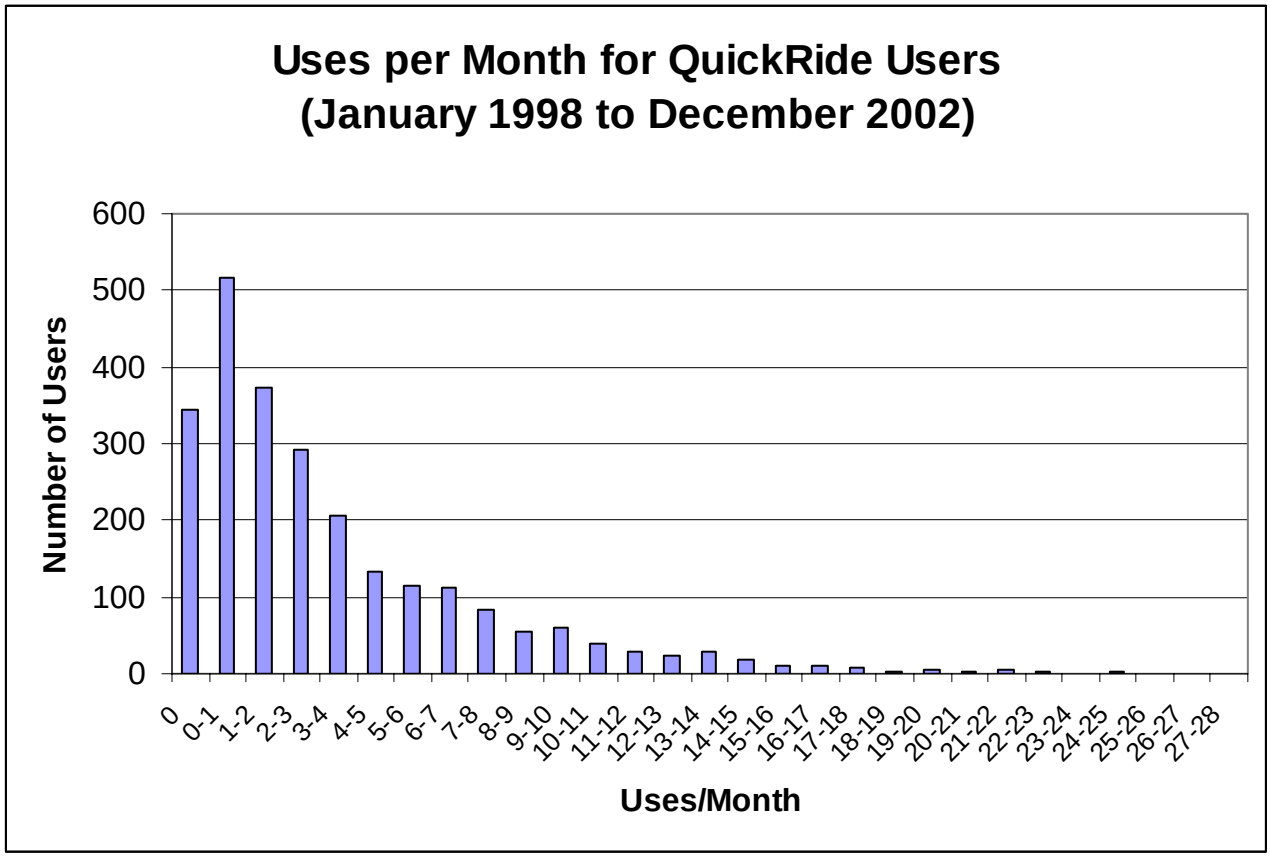

Figure 20: Number of Uses per Month for QuickRide Enrollees

CONCLUSIONS

The QuickRide program continues to gain new users, as it has done throughout the past five years. However, the number of recorded QuickRide trips per day has not kept pace with this increase in enrollment. One reason is that there are a significant number of users who are enrolled in the program but who rarely, or never, have been recorded using QuickRide.

A small number of trends in QuickRide usage are evident from this analysis. These include:

- During the AM periods, significantly fewer QuickRide trips are recorded from the middle of May to the beginning of September. These are likely due to fewer students attending schools during those months.

- QuickRide usage is relatively constant throughout the week except on Friday, when usage drops.
- QuickRide usage is limited at both the start and end of the QuickRide period and greatest during the middle of the QuickRide period.
- Typically, approximately 70 percent of new enrollees were recorded using QuickRide for at least one year. However, this percentage dropped in the latter half of 2001.

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