5.0 Results of the Phase II Field Evaluation

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This section presents the results of the Fall 2001 ramp metering field data collection conducted between September 10 and September 28, 2001. Evaluation data were collected for periods corresponding with the times when the corridors were metered. Table 5.1 summarizes the average travel time, travel time reliability, speed, mainline volume and ramp delay observed at the various study corridors for the Fall 2001 study period.

Table 5.1 Summary of Freeway and Ramp Evaluation Results – Fall 2001

	I-494		I-35W	I-94			I-35E	TH-10
	NB p.m.	SB a.m.	NB a.m.	EB p.m.	WB a.m.	WB p.m.	SB a.m.	EB a.m.
Corridor length (miles)	13	15	7	12	12	12	6	8
Freeway speed average (mph)	38.55	41.34	37.91	41.84	38.44	34.43	39.74	47.49
Freeway speed standard deviation[1] (mph)	12.45	16.13	18.70	13.56	10.27	10.44	11.16	14.64
Freeway travel time average (min)	20.2	21.5	11.1	17.2	18.7	20.9	8.3	10.1
Freeway travel time standard deviation[1] (min)	9.6	13.3	10.8	8.2	6.8	9.1	3.2	4.5
Freeway volume average	10,458	10,433	10,579	15,016	15,323	15,350	15,022	8,940
Ramp delay average (sec)	0	0	0	0	0	0	0	0

[1] Standard deviation is defined as the measure of distribution of travel time around an average value.

5.1 Freeway Travel Time and Travel Speed

Freeway mainline travel speeds were observed to range between 35 miles-per-hour (mph) and 47 mph during the three-hour peak period, with an average of 40.25 mph. Mainline travel time averaged 1.5 minutes per mile, ranging from 1.26 minutes to 1.74 minutes per mile. Travel time reliability averaged 48 seconds per mile, with TH-10 eastbound during the a.m. peak as the most time-reliable corridor at 34 seconds per mile, and I-35W northbound during the a.m. peak as the least time-reliable corridor (92 seconds per mile).

Figures 5.1 through 5.8 illustrate the travel speeds observed at the study corridors for all weekdays. The solid lines indicate average speeds, while the dashed lines represent the upper and lower ranges of the average speeds – the speed range is defined as one standard deviation above and below the average value, which covers approximately 70 percent of all observations. The larger the distance between a solid line and its corresponding dashed lines, the larger the speed variability observed (i.e., travel time is less reliable). Conversely, tighter sets of lines indicate that the speeds do not deviate as greatly from the average, and travel speed is more predictable.

Figure 5.1 I-494 NB P.M. Peak Period Speed and Speed Variability

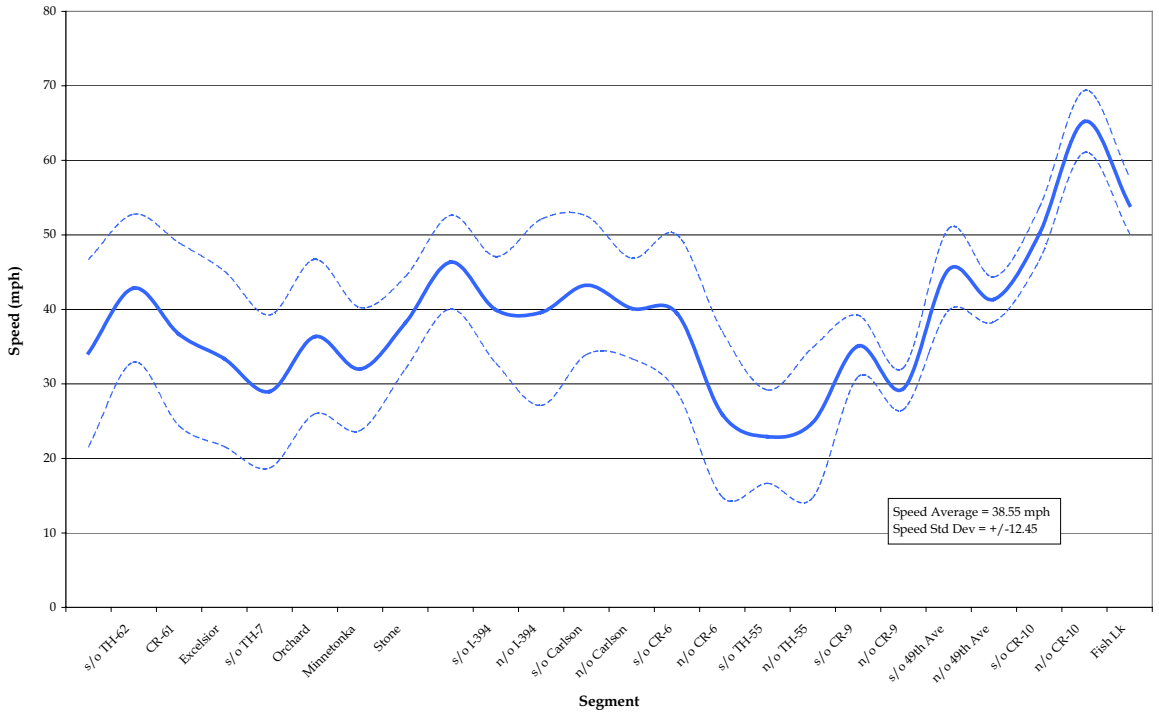


Figure 5.2 I-494 SB A.M. Peak Period Speed and Speed Variability

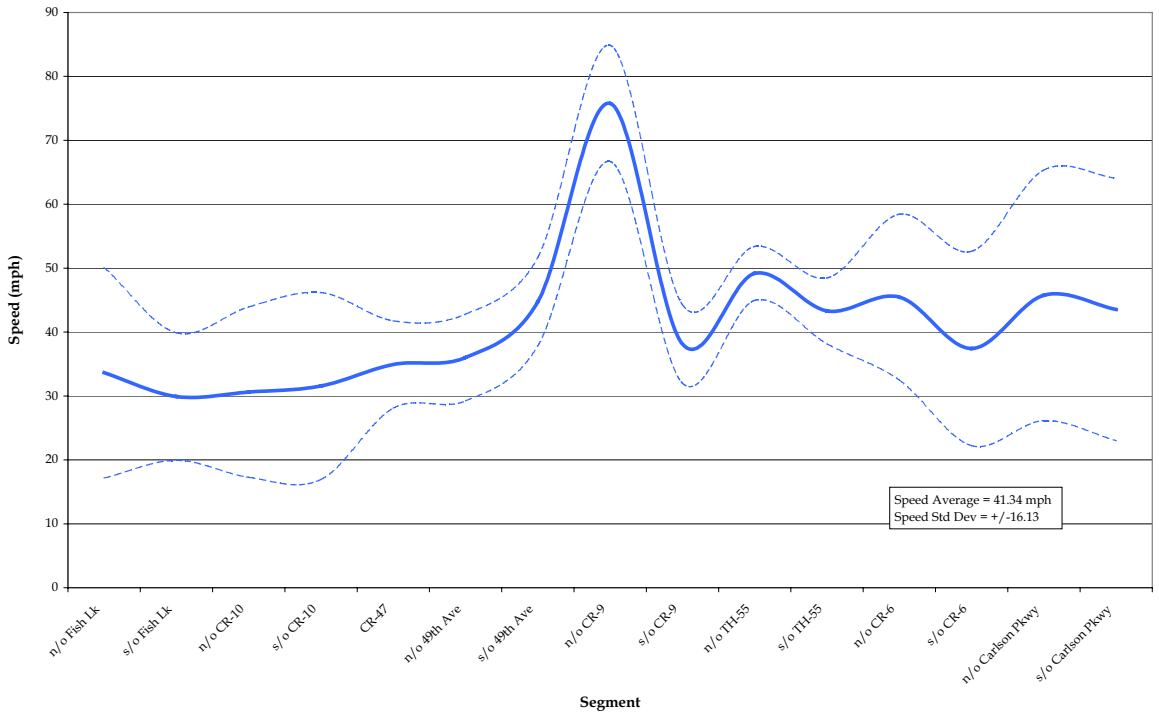


Figure 5.3 I-35W NB A.M. Peak Period Speed and Speed Variability

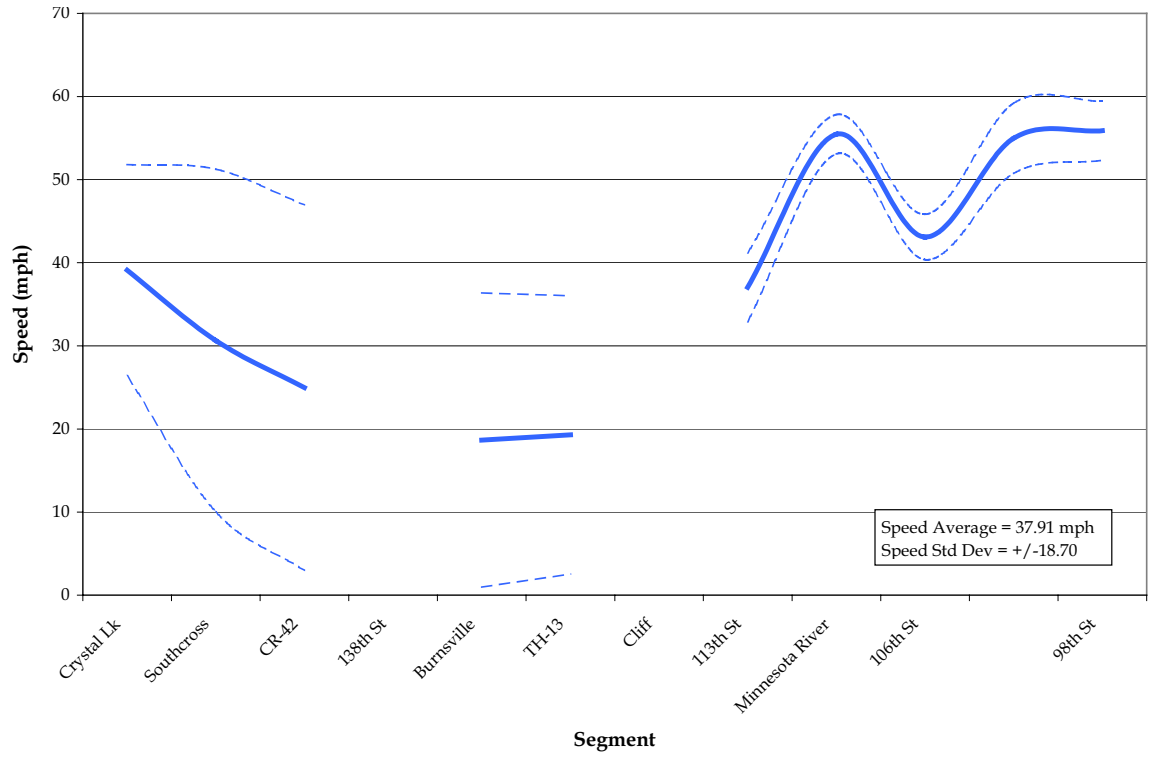


Figure 5.4 I-94 EB P.M. Peak Period Speed and Speed Variability

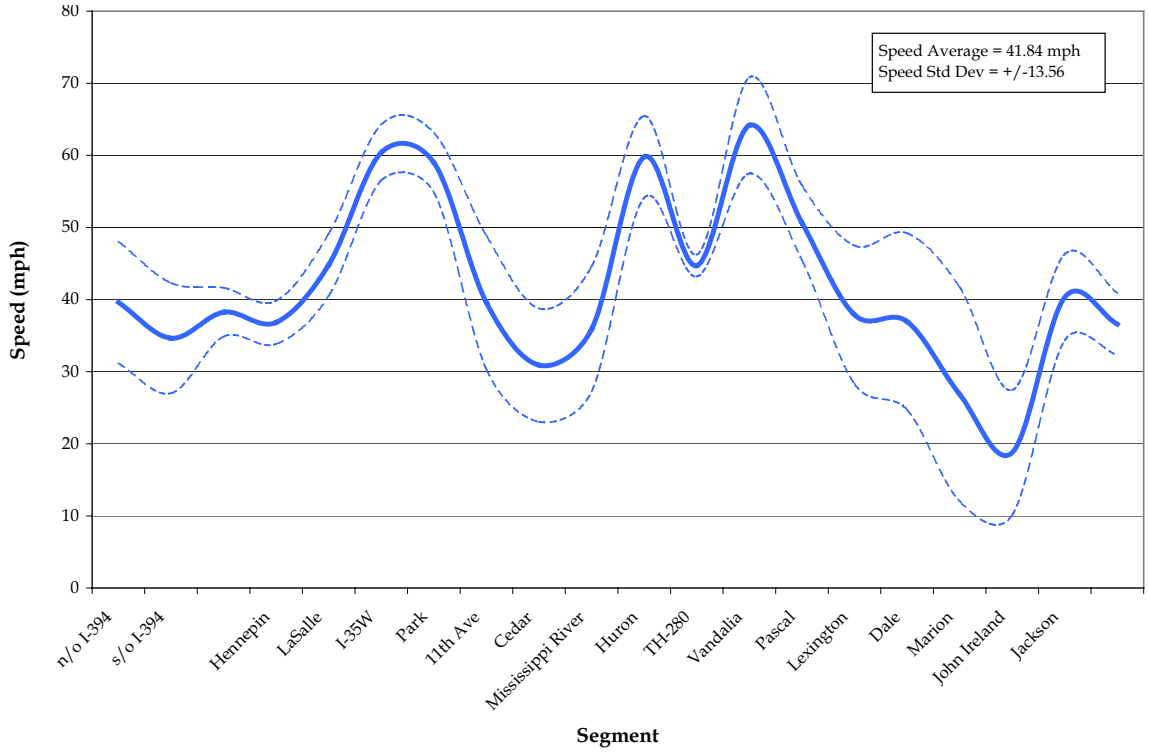


Figure 5.5 I-94 WB A.M. Peak Period Speed and Speed Variability

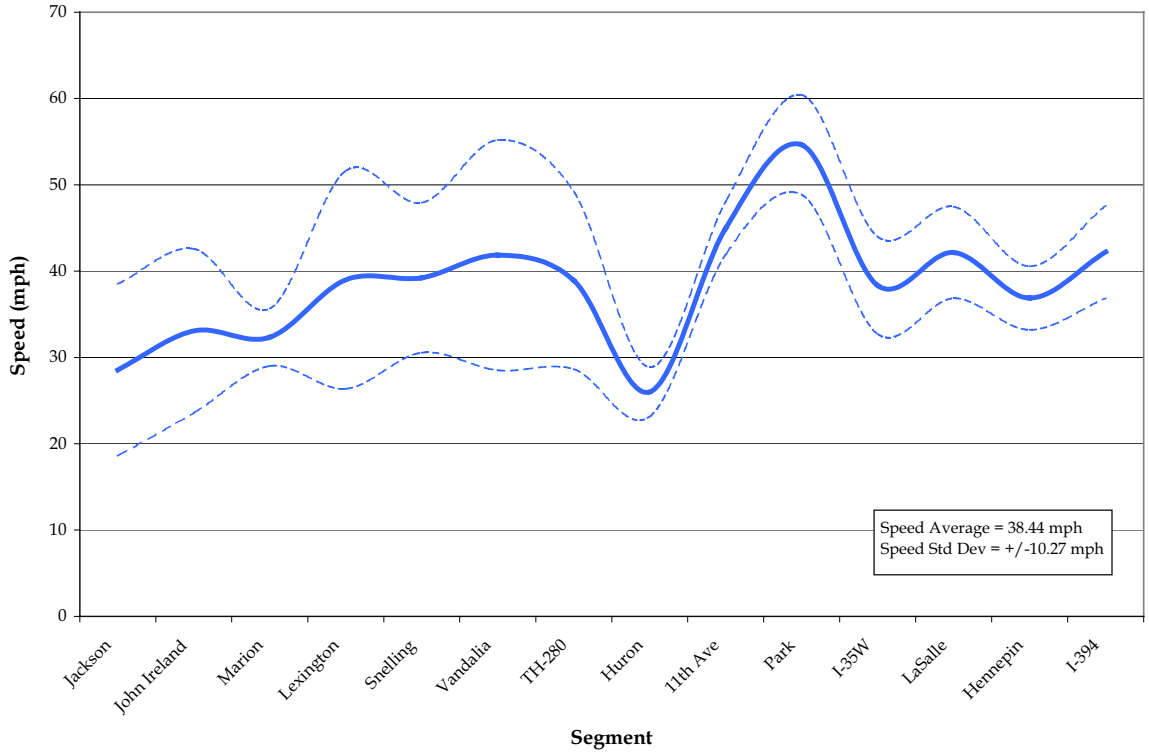


Figure 5.6 I-94 WB P.M. Peak Period Speed and Speed Variability

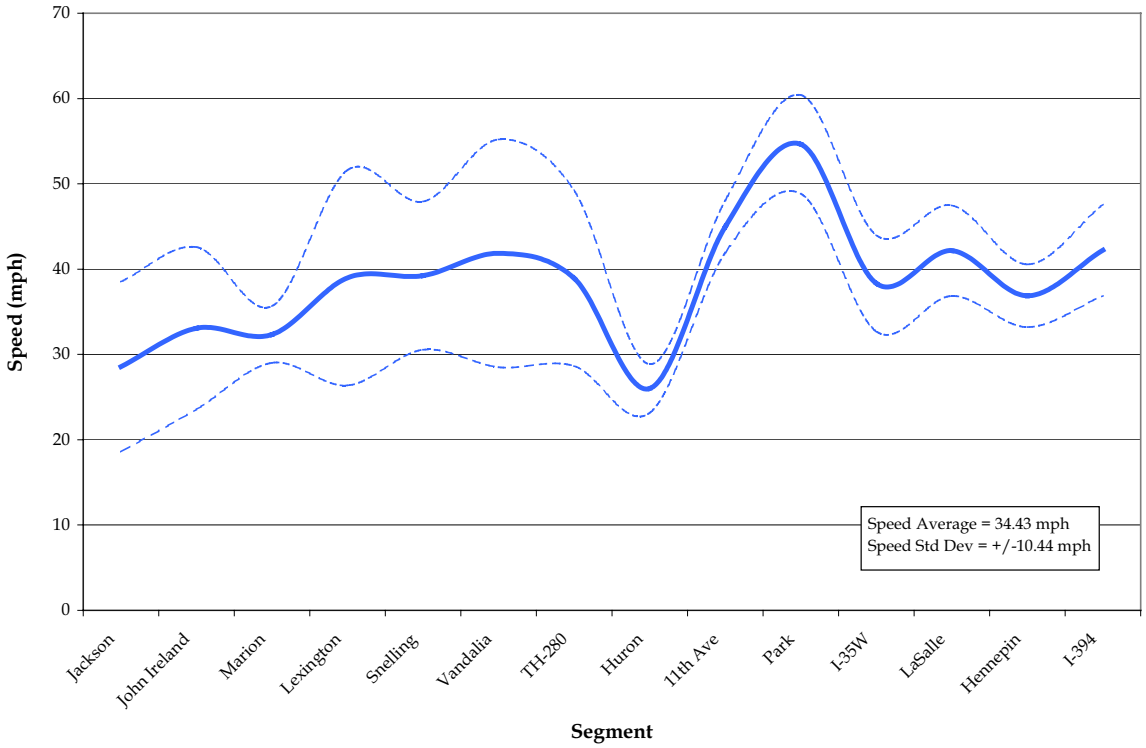


Figure 5.7 I-35E SB A.M. Peak Period Speed and Speed Variability

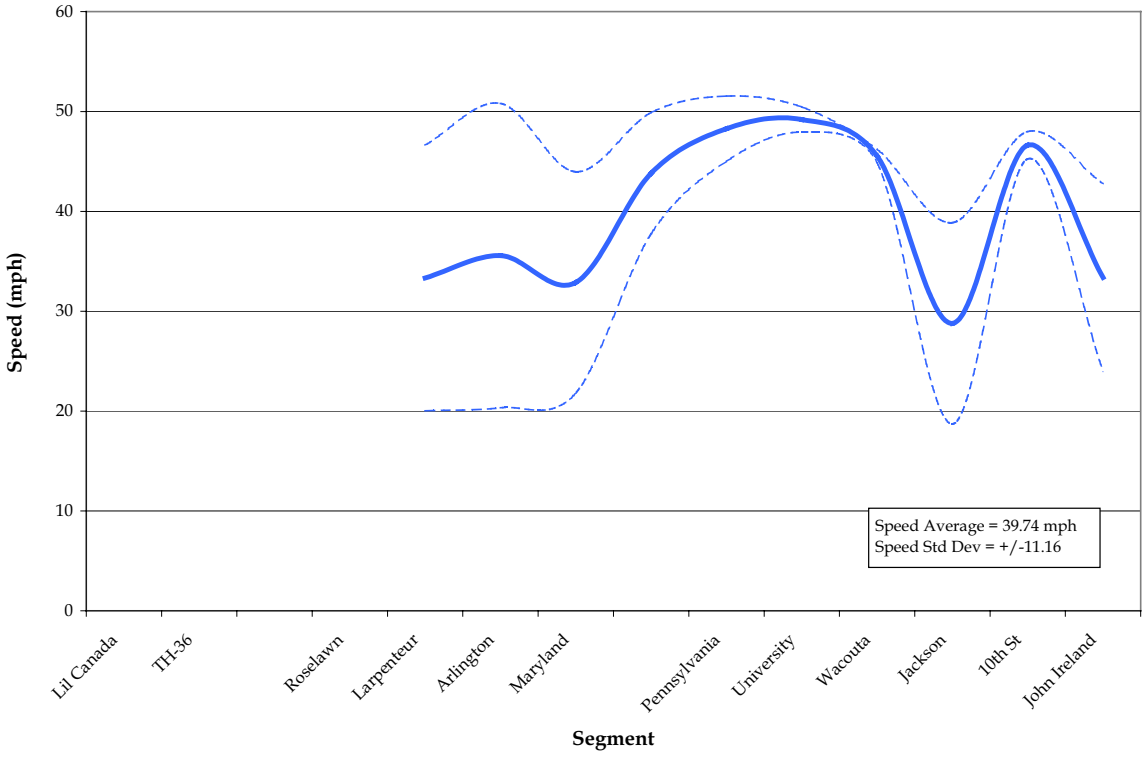
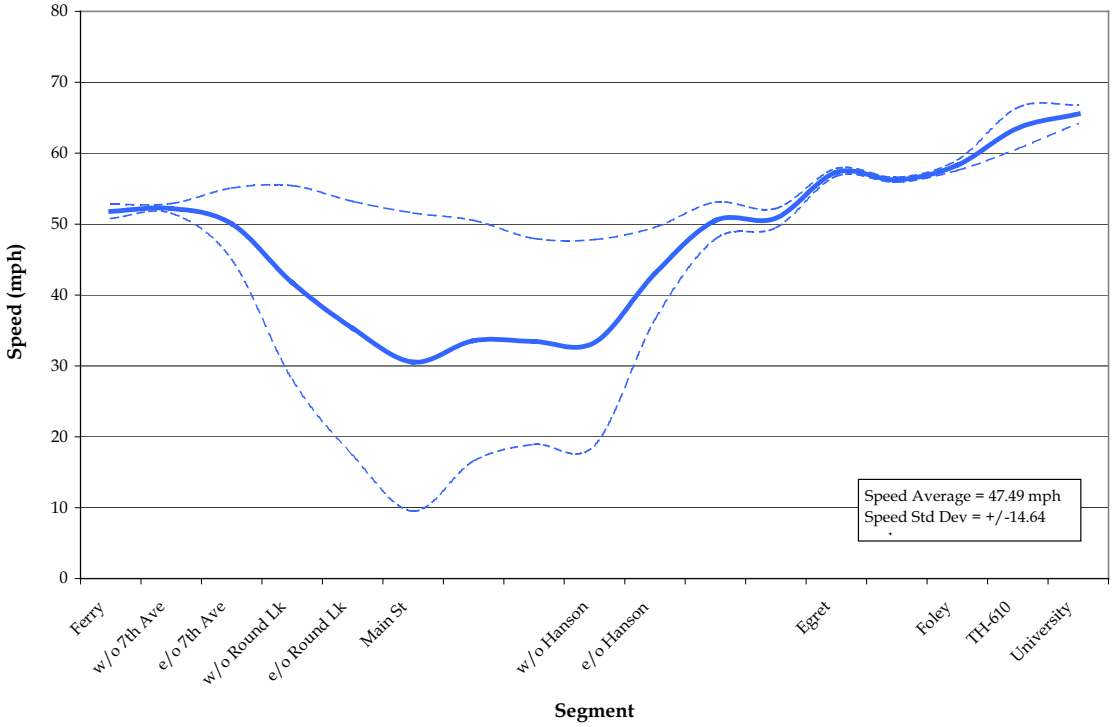


Figure 5.8 TH-10 EB A.M. Peak Period Speed and Speed Variability



5.2 Freeway Traffic Volume and Throughput

During the Fall 2001 study period, peak period vehicle volume averaged 12,640 vehicles across the corridors observed. Corridor TH-10 EB during the morning peak carried the least number of vehicles, averaging less than 9,000 vehicles, while corridor I-94 WB during each of the a.m. and p.m. peak periods carried over 15,000 vehicles. Figures 5.9 through 5.16 show the traffic volumes at various locations at the freeway corridors.

Figure 5.9 I-494 NB P.M. Traffic Volume

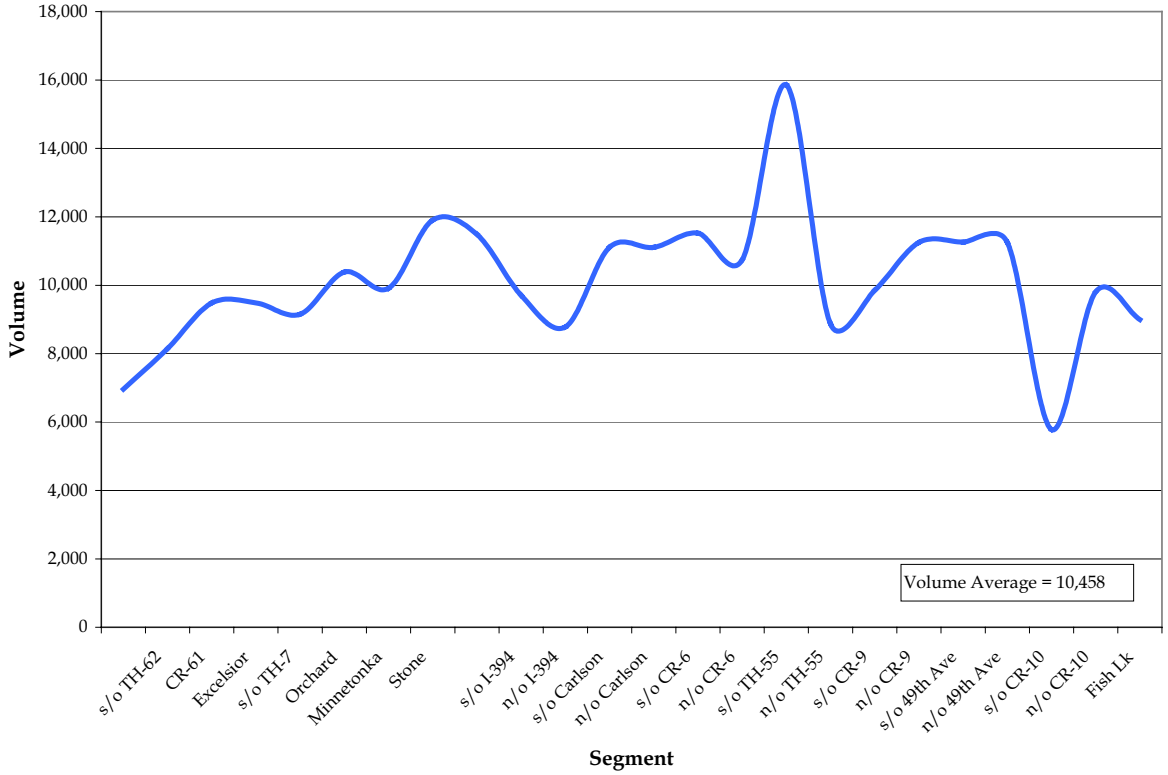


Figure 5.10 I-494 SB A.M. Traffic Volume

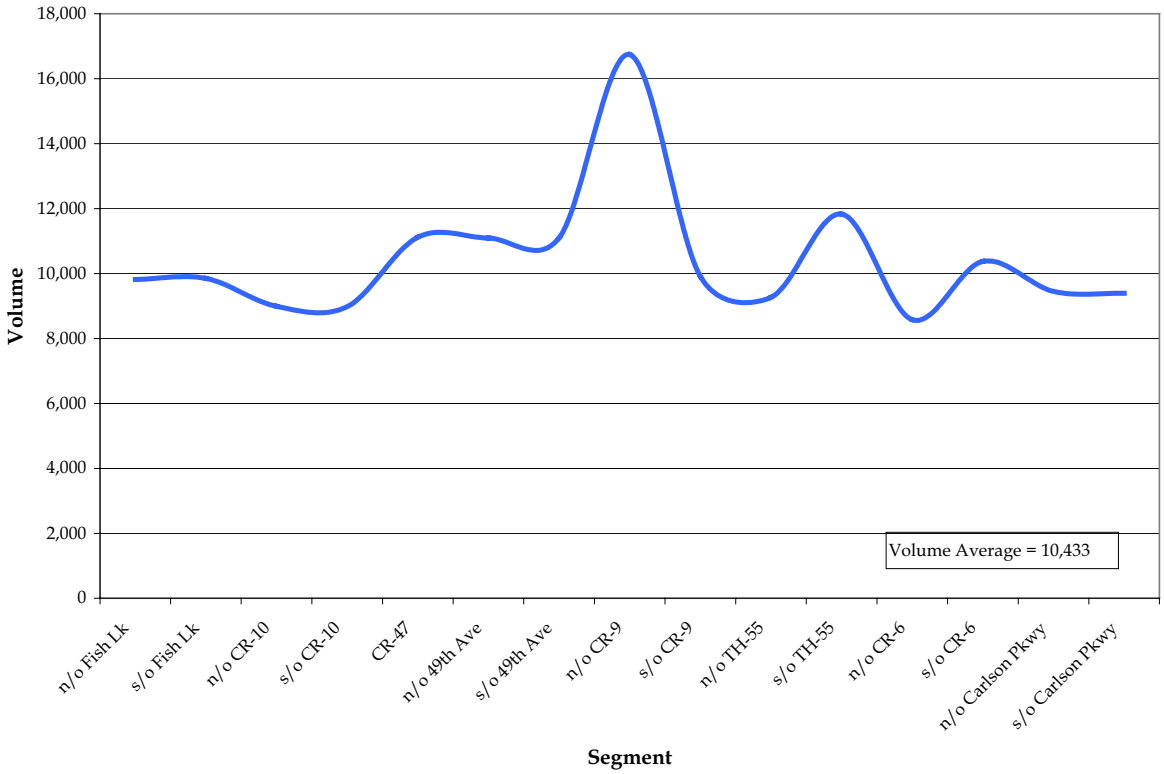


Figure 5.11 I-35W NB A.M. Traffic Volume

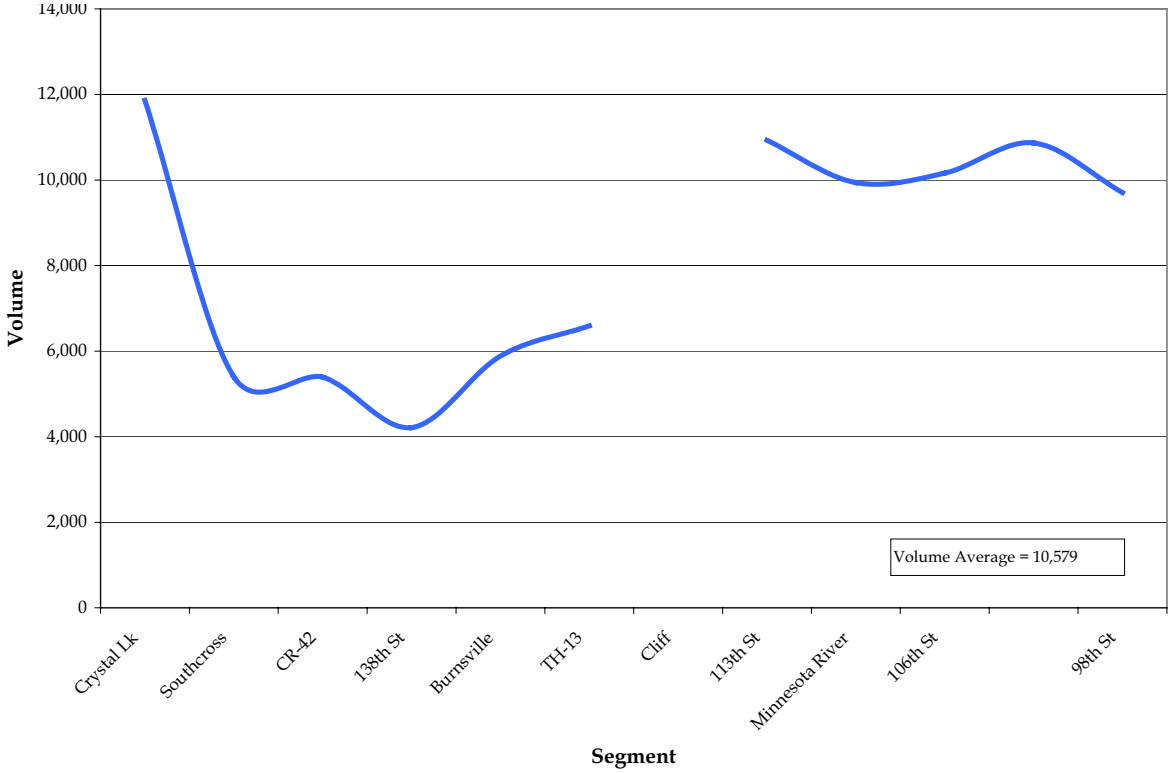


Figure 5.12 I-94 EB P.M. Traffic Volume

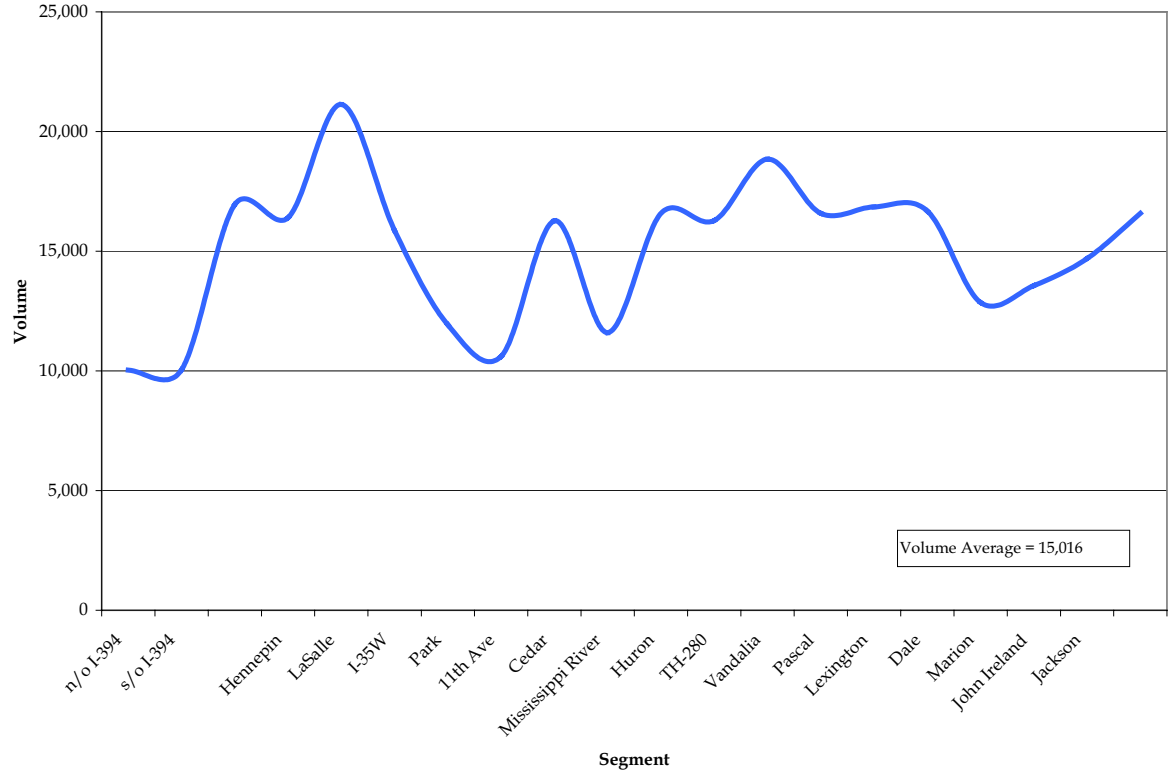


Figure 5.13 I-94 WB A.M. Traffic Volume

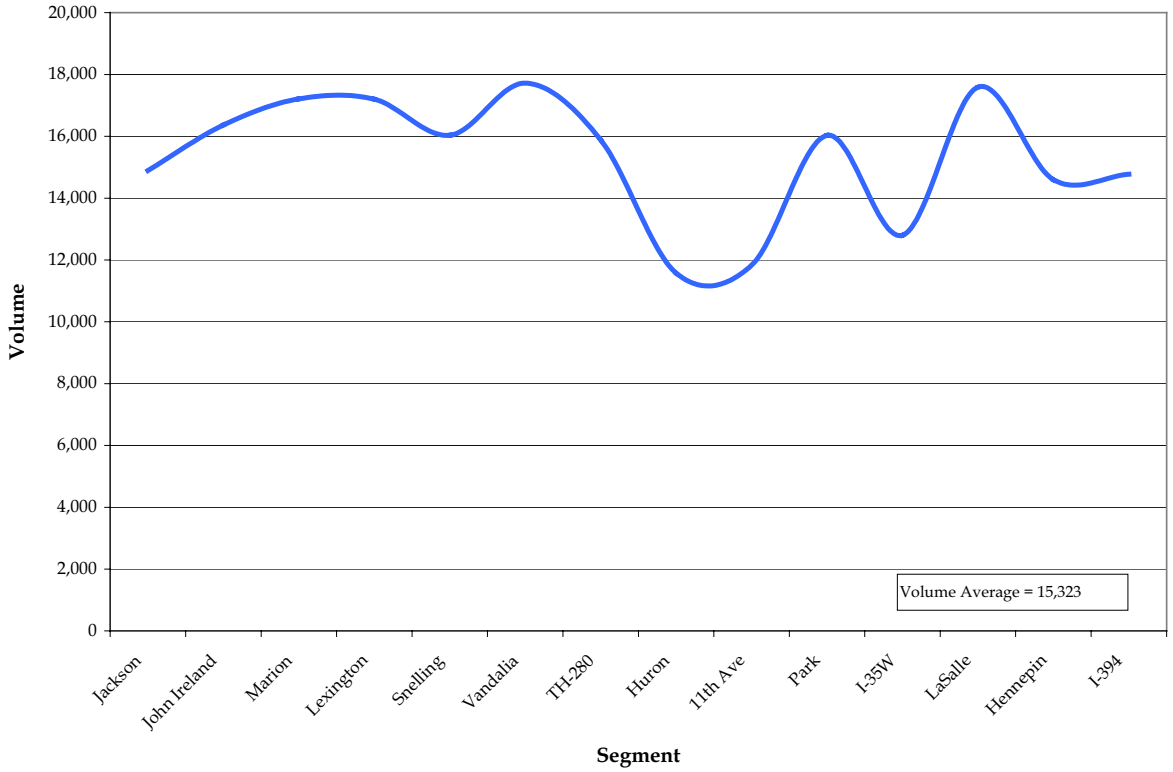


Figure 5.14 I-94 WB P.M. Traffic Volume

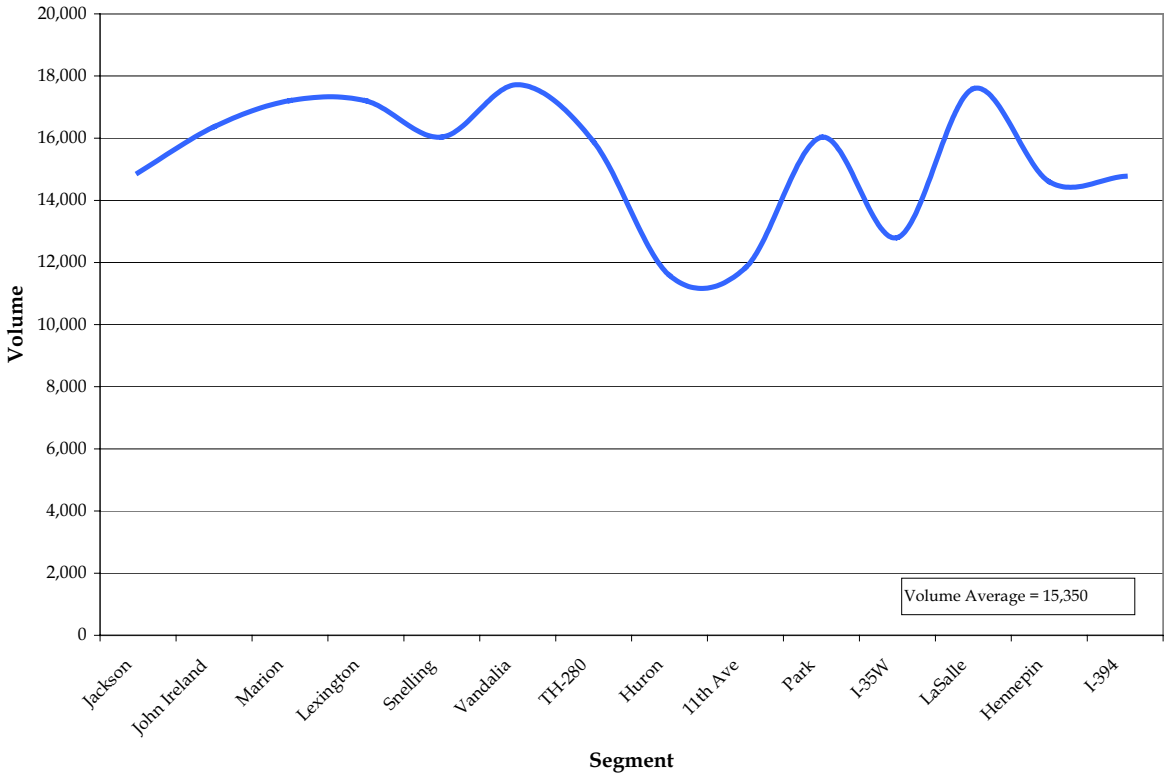


Figure 5.15 I-35E SB A.M. Traffic Volume

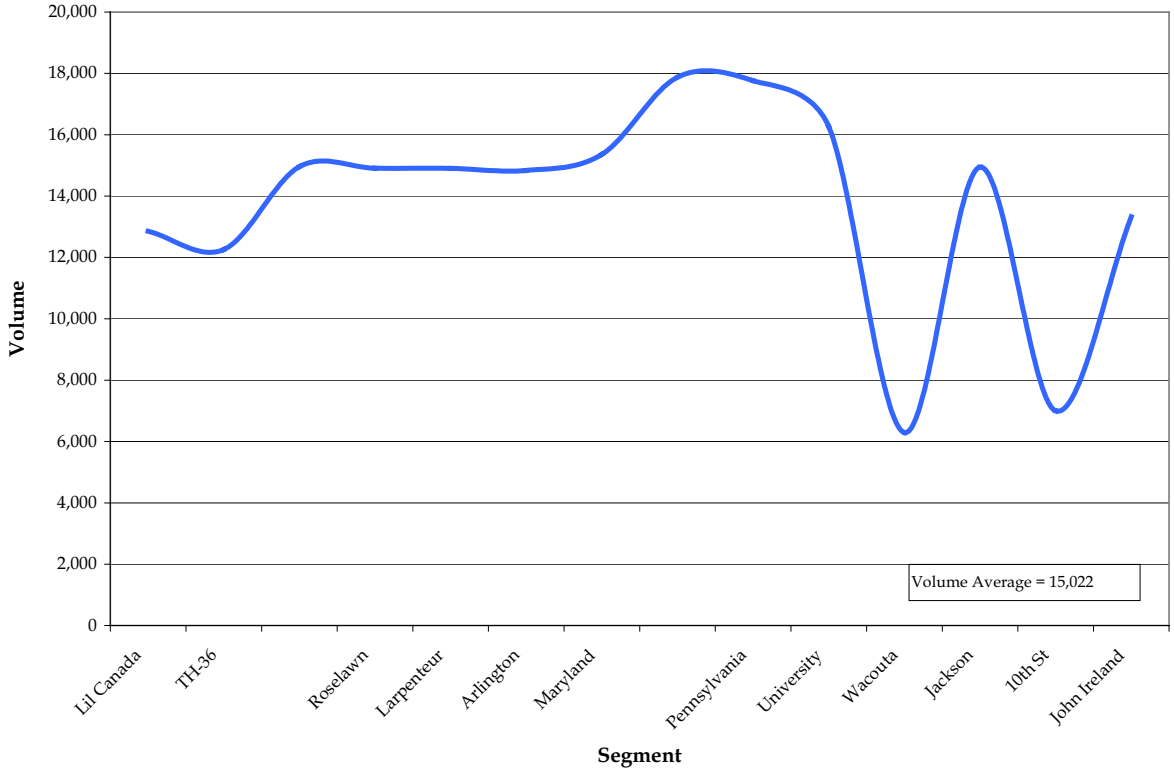
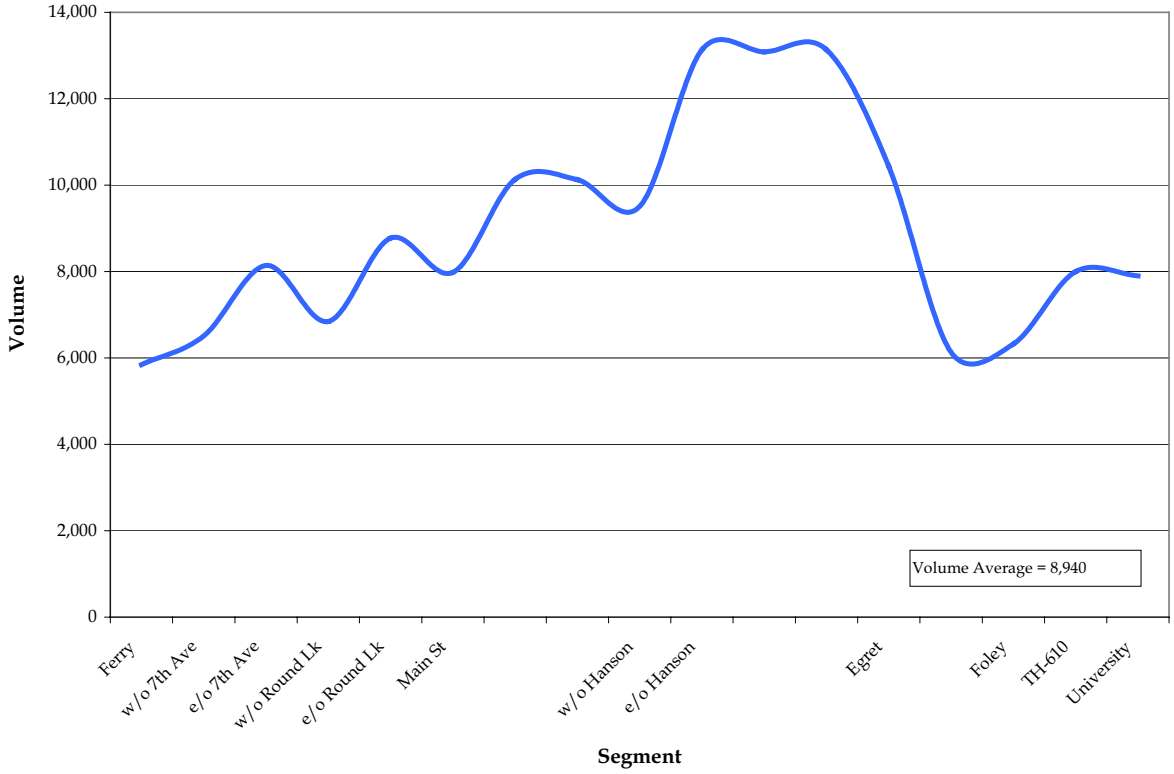


Figure 5.16 TH-10 EB A.M. Traffic Volume



5.3 Arterial Speed, Travel Time, and Volume

Arterial travel time data were collected at a five-mile stretch on University Avenue between Snelling Avenue and downtown St. Paul. Traffic counts along University Avenue were conducted at three locations. The data collection efforts were conducted during times when ramp meters on the main corridor were activated.

Table 5.2 summarizes the average speeds and travel times on University Avenue. Based on the results, University Avenue carried between 1,965 and 3,654 vehicles during the peaks, which ran at 18.4 to 22.3 mph.

Table 5.2 Summary of University Avenue Evaluation Results – Fall 2001

	University EB p.m.	University WB a.m.	University WB p.m.
Speed Average (mph)	18.4	22.3	21.3
Speed Standard Deviation[1] (mph)	2.47	3.38	1.64
Travel Time Average (min)	15.5	12.8	13.4
Travel Time Standard Deviation[1] (min)	2.40	2.28	1.12
Average Volume	3,654	1,965	2,436
Volume Standard Deviation[1]	212	118	263

[1] Standard Deviation is defined as the measure of distribution of travel time around an average value.

5.4 Ramp Travel Time and Delay

During the Fall 2001 study period, the ramp meters were operated at a reduced capacity, with the main objective of breaking up platoons of vehicles as they entered the freeway. Under this condition, metering delays were minimal. Based on visual observations conducted by Traffic Management Center (TMC) staff, no queues were formed at the ramp meters within the study area.

Since no queues were found under this reduced metering capacity, vehicles traveled on the ramps at free-flow speed, which was assumed to equal the speed on the right-most lane of the freeway mainline. Table 5.3 summarizes the ramp meter travel times during the Fall 2001 study period.

Table 5.3 Ramp Travel Time and Delay – Fall 2001

	I-494		I-35W	I-94			I-35E	TH-10
	NB p.m.	SB a.m.	NB a.m.	EB p.m.	WB a.m.	WB p.m.	SB a.m.	EB a.m.
Average Free-Flow Travel Time (sec)	15	19	15	21	29	29	16	24
Average Ramp Delay (sec)	0	0	0	0	0	0	0	0
Total Ramp Travel Time (sec)	**15**	**19**	**15**	**21**	**29**	**29**	**16**	**24**

5.5 Safety Impacts

The evaluation team analyzed the average crash data for the first seven months of years 1998 through 2001. These historical data were used to identify any changes in crash rates resulting from the implementation of less restrictive ramp metering strategies starting in December 2000. The analysis found that the metering strategy adopted prior to Fall 2000 resulted in 15 percent fewer crashes of all types. Figures 5.17 and 5.18 show the comparisons between historical crash rates (original metering strategy) and the post-shutdown 2001 crash rates (reduced metering capacity).

Figure 5.17 Comparison of Crash Occurrence by Crash Type (for Peak Period Metered Freeways)

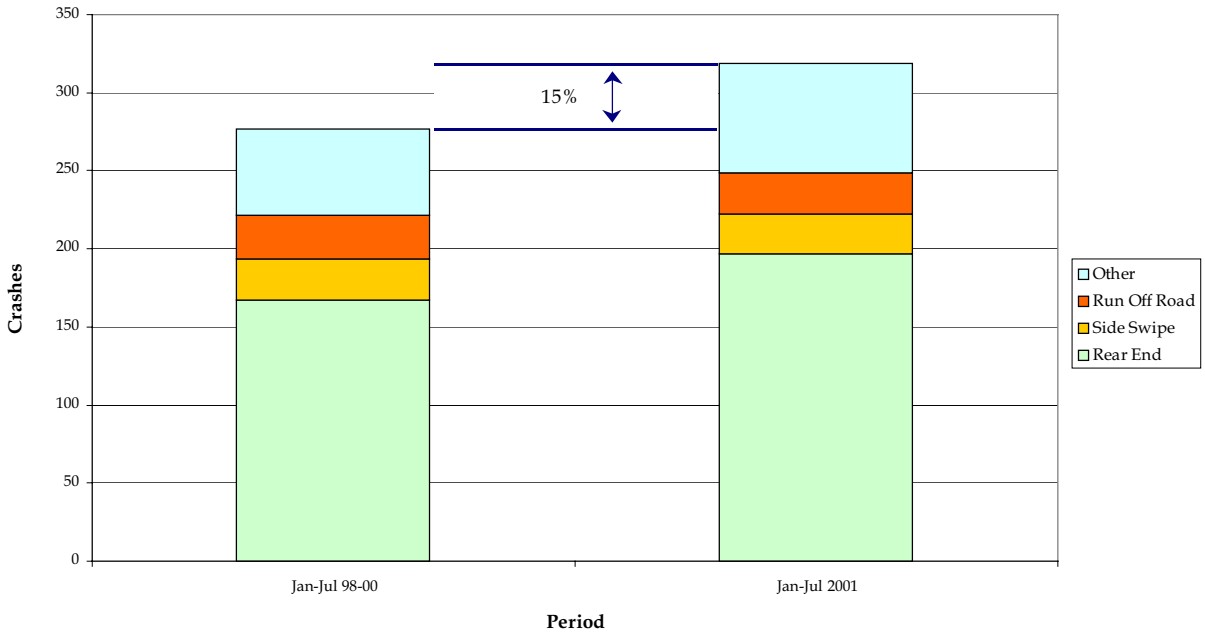


Figure 5.18 Comparison of Crash Occurrence by Crash Type (for Peak Period Metered Freeways)