4.0 Field Data Collection Plan

4.0 Field Data Collection Plan

The objective of the field data collection portion of this study was to measure the impacts of ramp metering on a host of transportation variables over different types of freeway corridors. The results of these corridor-specific data and analysis were used to report the effects of the new ramp metering strategy on each corridor studied.

4.1 Study Areas

All Phase I study corridors were used again as study areas for the Phase II evaluation. In addition, a new corridor, TH-10, was included in this evaluation. University Avenue (paralleling I-94), was the only parallel arterial studied, because in the Phase I evaluation it was the only arterial to show a statistically significant change in traffic patterns as a result of the meter shutdown. The corridors, arterial, and freeway-to-freeway ramp selected for the study are listed in Table 4.1. Market research was also conducted to gather public opinion and preferences on the modified ramp meter strategy.

Table 4.1. Phase II Study Area Extents

Corridor	When	Boundaries
I-494	NB p.m. peak	TH-62 to Bass Lake
	SB a.m. peak	Weaver Lake (I-94) to TH-62
I-35W	NB a.m. peak	Crystal Lake to 98th (Old Shakopee)
I-94	EB p.m. peak	I-394 to TH-52 (Lafayette)
	WB a.m. peak	TH-52 (Lafayette) to I-394
	WB p.m. peak	TH-52 (Lafayette) to I-394
I-35E	SB a.m. peak	Little Canada to I-94
TH-10	EB a.m. peak	TH-169 to TH-610

4.2 Field Data Collection Plan

The premise of the field data collection test plan was to measure the transportation system impacts of the new ramp metering strategy at the selected corridors. This task involved an extensive Fall 2001 traffic data collection program to address the impacts on traffic operations and safety by means of on-the-ground collection of empirical data about the non-metered and metered systems.

4.2.1 Field Data Sources

Most of the field data were supplied by the routine automated data collection systems used by Mn/DOT to monitor traffic flow, such as freeway and ramp loop detectors. Arterial traffic volumes, speed, and travel time data were collected separately through road tubes and travel time runs, while incident data are gathered from the Department of Public Safety's (DPS) incident database. Lastly, manual observations by the Traffic Management Center (TMC) staff were used to assess ramp meter violation rates, spillover frequency, and traffic conflicts. Table 4.2 summarizes the performance measures and data sources used in the field data collection.

Table 4.2 Summary of Performance Measures and Data Sources

Objective		Performance Measures		Data Source
1	Assess traffic flow impacts	1.1	Freeway volume	TMC station detectors
		1.2	Freeway occupancy	TMC station detectors
		1.3	Alternate route volume	Road tubes
2	Assess travel time impacts	2.1	Freeway speed	TMC station detectors
		2.2	Alternate route speed and travel time	GPS- and Jamar™-equipped vehicles
3	Assess ramp impacts	3.1	Ramp volume	TMC ramp detectors
		3.2	Ramp queue length	TMC ramp detectors
		3.3	Ramp queue delay	TMC ramp detectors
4	Assess safety impacts	4.1	Incidents on freeway corridors and ramps within study area	DPS/TMC incident logs

4.2.2 Data Collection

This section provides additional detail on the format, assumptions, and collection methods used in gathering data to allow the evaluation of the new ramp metering strategies.

Freeway Mainline Traffic Volume, Speed, and Occupancy

Data from the Mn/DOT TMC freeway loop detector stations were collected along each of the corridors under evaluation. Travel times were derived based on the collected speed and occupancy data. The following information pertains to freeway data:

1. Sample size:
   - Thirty-second traffic volume data per lane, 24-hours per day;
   - Data aggregated to 15-minute periods during the four-hour a.m. and four-hour p.m. peak periods;
   - Four-hour peak periods selected to allow analysis of any peak-period spreading;
   - Data aggregated to daily totals;
   - Five days of data per week (Monday through Friday); and
   - Data collected from the detector stations within the corridor study limits.
2. Data collection methods and tools:
   - Spreadsheet and/or database tools were used to process data.

Alternate Route Traffic Volume

Road tubes were used to collect traffic volume data along each of the arterial corridors under evaluation. The following information pertains to alternate route data:

1. Sample size:
   - Fifteen-minute volumes per lane during the four-hour a.m. and four-hour p.m. peak periods;
   - Daily volume totals; and
   - Five days of data per week (Monday through Friday).
2. Data collection methods and tools:
   - Collect data on arterial routes during the same period as the corresponding freeway route;
   - Road tubes were used to collect the data; and
   - Spreadsheet and/or database tools were used to process the data.

Alternate Route Speed and Travel Time

Geographic Positioning System (GPS)- or Jamar™-equipped vehicles were used to capture the travel time profiles at discrete intervals. Data were collected in both directions of travel along the arterial. Further details on the data collection approach are provided below.

1. Assumptions:
   - Four-hour morning period is 5:00 to 9:00 a.m.;
   - Four-hour afternoon period is 3:00 to 7:00 p.m.; and
   - Monday through Friday data collection days.
2. Data collection methods and tools:
   - Floating Car Method was used to collect travel time data – with this method the probe vehicle driver estimated the median speed by passing and being passed by an equal number of vehicles;
   - GPS or Jamar™ data collection tools were used to collect travel time data in three of the probe vehicles;
   - Travel time data were collected in both the peak and non-peak direction; and
   - Probe vehicle drivers recorded weather, pavement conditions, light conditions, construction activity, and incidents to enable the isolation of anomalous data.

Ramp Volume, Queue Length, and Delay

Ramp volume data (ramp merge detector data) and ramp meter turn-on times were readily available from the TMC system.

1. Sample size:
   - Collect data for every on-ramp within the defined test corridors;
   - Five days of peak-period counts per site; and
   - Data collected in 15-minute intervals.
2. Tools:
   - Spreadsheets and/or databases tools were used to process the data.

Safety Impacts

The DPS incident database was used to assess safety impacts at selected corridors and on-ramps.

1. Sample size:
   - At corridors and on-ramps within study area; and
   - TMC documents number and duration of incidents on freeways that are monitored by the traffic management system.
2. Tools:
   - DPS incident database; and
   - TMC incident log for study corridors.

3. Analysis:
   - Separate data by freeway corridor;
   - Separate data for non-metered versus metered conditions;
   - Identify crashes by type (rear-end, side-swipe, etc.);
   - Separate data by crash severity (property damage only (PDO), injury, fatality); and
   - Separate data by time of day: crash data while meters are in operation versus data in the off-peak while meters are off-line.

4.3 Evaluation Methodology

A database contains the Fall 2001 peak-period performance characteristics for each of the study corridors during meter-operational time periods. The studied alternative arterial was analyzed in a similar fashion to examine whether or not the ramp meter strategy change affected its operation.

4.3.1 Freeway, Ramp, and Arterial Data Evaluation Methodology

Performance measures extracted from the TMC and field data include:

- Average freeway mainline speeds;
- Standard deviation of mainline speeds;
- Average mainline volumes;
- Standard deviation of mainline volumes;
- Average on-ramp delay per vehicle;
- Standard deviation of ramp delay per vehicle;
- Average ramp volumes; and
- Standard deviation of ramp volumes.

Quantitative performance measures were used to estimate the positive and negative impacts of the new ramp metering strategy, including travel time, travel time reliability, and safety. Changes between each quantitative performance measure at each corridor were calculated to measure the impacts of the new ramp metering strategy at each corridor. Only corridor segments and travel directions having operating ramp meters were included in the analysis for each of the peak periods. No impacts were applied to non-metered segments. Qualitative performance measures and anecdotal information were documented and used to support the hard data in determining the effectiveness of the new metering strategy.

Use of the Spreadsheet Tool

A summary spreadsheet tool, developed in Microsoft Excel™, was used to calculate quantitative performance measure changes between the two study periods. Figure 4.1 presents a sample view of the summary worksheet. The user may enter the speed and volume averages and standard deviations of the collected field data for each corridor, time period, and direction. The tool automatically calculates the differences, as well as the travel time average and its standard deviation.

Figure 4.1 Sample View of the Field Data Summary Worksheet

	A	B	C	D	E	F	G	H	I	J
1		494 NB pm	494 SB am	35W NB am	94 EB pm	94 WB am	94 WB pm	35E SB am	TH-10 EB am	All Freeways
2	**General Information**									
3	# of Metered Ramps	14	18	5	15	14	14	6	6	92
4	Corridor Length (mi)	13	15	7	12	12	12	6	8	10.6
5										
6	**Speed Average**									
7	Phase 2 - Before	38.65	41.34	37.91	41.84	38.44	34.43	39.74	47.49	40.17
8	Phase 2 - After	34.70	37.20	34.12	37.66	34.60	30.98	35.77	42.74	36.07
9	Difference (%)	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
10	Difference (mph)	-3.86	-4.13	-3.79	-4.18	-3.84	-3.44	-3.97	-4.75	-4.20
11										
12	**Speed Std Dev**									
13	Phase 2 - Before	12.45	16.13	18.70	13.56	10.27	10.44	11.16	14.64	13.42
14	Phase 2 - After	6.22	8.07	9.35	6.78	5.13	5.22	5.58	7.32	6.71
15	Difference (%)	-50%	-50%	-50%	-50%	-50%	-50%	-50%	-50%	-50%
16	Difference (mph)	-6.22	-8.07	-9.35	-6.78	-5.13	-5.22	-5.58	-7.32	-6.71
17										
18	**Travel Time Average**									
19	Phase 2 - Before (min)	20.2	21.8	11.1	17.2	18.7	20.9	8.3	10.1	15.04
20	Phase 2 - After (min)	22.6	24.2	12.3	19.1	20.8	23.2	9.2	11.2	17.83
21	Difference (%)	11%	11%	11%	11%	11%	11%	11%	11%	11%
22	Difference (min)	2.25	2.42	1.23	1.91	2.08	2.32	0.92	1.12	1.78
23										
24	**Travel Time Std Dev**									
25	Phase 2 - Before (min)	9.6	13.9	10.8	8.2	6.8	9.1	3.2	4.5	8.29
26	Phase 2 - After (min)	4.9	6.7	4.6	4.2	3.6	4.7	1.7	2.3	4.10
27	Difference (%)	-49%	-52%	-57%	-49%	-47%	-48%	-47%	-48%	-50%
28	Difference (min)	-4.73	-7.24	-6.14	-4.05	-3.20	-4.40	-1.54	-2.18	-4.18
29										
30	**Vol Average**									
31	Phase 2 - Before	10458	10433	10579	15016	15323	15350	15022	8940	12640
32	Phase 2 - After	11504	11476	11637	16518	16855	16884	16525	9834	13904
33	Difference (%)	10%	10%	10%	10%	10%	10%	10%	10%	10%
34	Difference (veh)	1046	1043	1058	1502	[illegible]	[illegible]	1502	894	1264

Summary / No Meter - Before / Example

4.3.2 Crash Data Evaluation Methodology

Detailed crash data, maintained by the DPS and Mn/DOT, were obtained for the study area during the appropriate study periods. The crash database contained information for each crash, including information on:

- Crash severity (fatality, injury, property damage);
- Type of crash (rear-end, side-swipe, etc.);

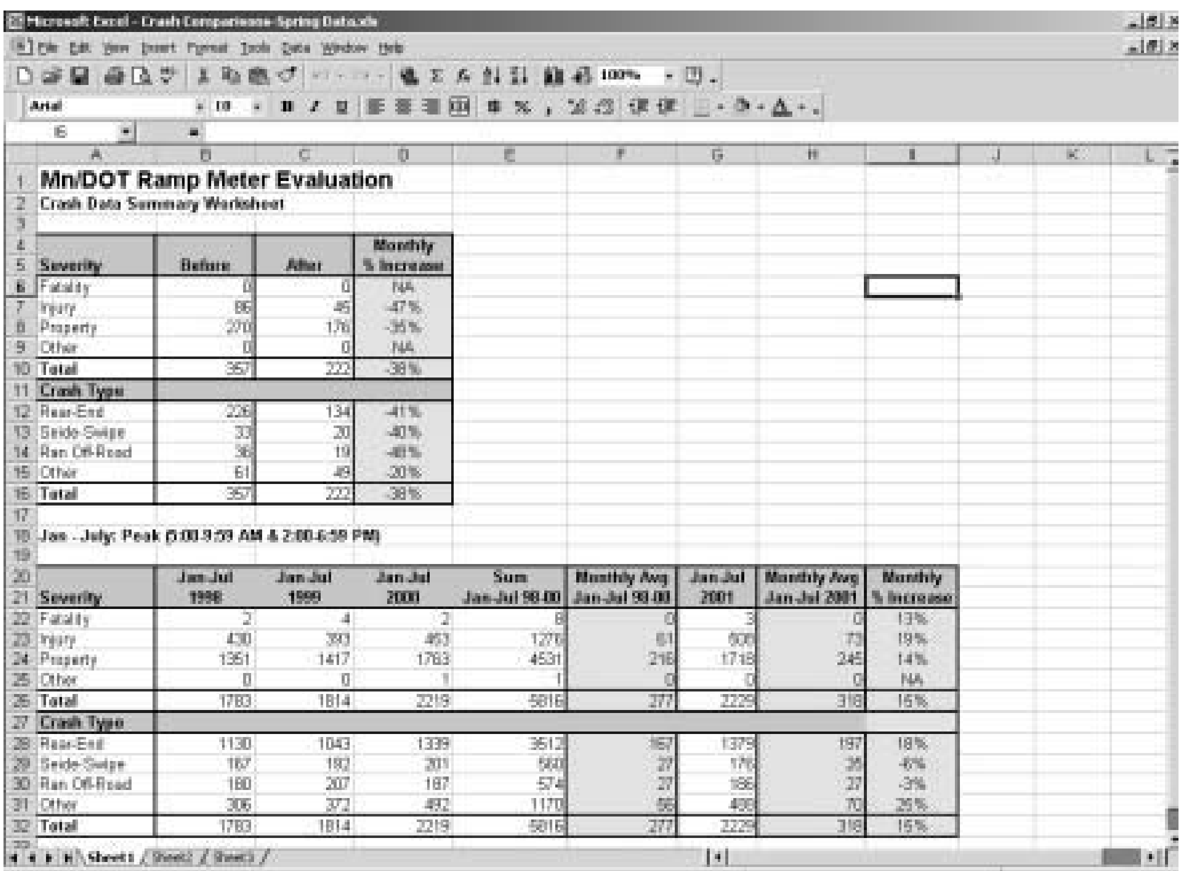
- Location of the crash;
- Facility type;
- Time of crash; and
- Other factors, including pavement condition, lighting, weather, etc.

In addition to collecting these data for the study periods, the evaluation team analyzed crash data for the first seven months (January through July) of years 1998 through 2001. These historical data were used to identify any changes in crash rates resulting from the changed ramp metering strategy in the fall of 2000, and to identify the seasonal impacts of safety in the Twin Cities region.

Use of the Spreadsheet Tool

Similar to the field data summary spreadsheet, the crash data summary sheet was developed in Microsoft Excel™. Figure 4.2 presents a sample view of the crash summary worksheet. The analyst may enter the number of crashes for each type and severity from the DPS database within the boundaries of the study area and time periods. Once these figures are entered into the worksheet, the changes in crashes are automatically calculated.

Figure 4.2 Sample View of the Crash Data Summary Worksheet



Mn/DOT Ramp Meter Evaluation

Crash Data Summary Worksheet

Severity	Before	After	Monthly % Increase
Fatality	0	0	NA
Injury	86	45	-47%
Property	270	176	-35%
Other	0	0	NA
Total	357	222	-38%
Crash Type			
Rear-End	226	134	-41%
Side-Swipe	33	20	-40%
Ran Off-Road	36	19	-48%
Other	61	49	-20%
Total	357	222	-38%

Jan - July: Peak (5:00-9:59 AM & 2:00-6:59 PM)

Severity	Jan-Jul 1998	Jan-Jul 1999	Jan-Jul 2000	Sum Jan-Jul 98-00	Monthly Avg Jan-Jul 98-00	Jan-Jul 2001	Monthly Avg Jan-Jul 2001	Monthly % Increase
Fatality	2	4	2	8	0	3	0	13%
Injury	430	393	453	1276	61	506	73	19%
Property	1351	1417	1763	4531	216	1718	245	14%
Other	0	0	1	1	0	0	0	NA
Total	1783	1814	2219	5816	277	2229	318	15%
Crash Type								
Rear-End	1130	1043	1339	3512	167	1379	197	18%
Side-Swipe	167	192	201	560	27	176	25	-6%
Ran Off-Road	180	207	187	574	27	186	27	-3%
Other	306	372	492	1170	56	488	70	25%
Total	1783	1814	2219	5816	277	2229	318	15%