



**WISCONSIN TRAFFIC OPERATIONS
& SAFETY LABORATORY**
UNIVERSITY OF WISCONSIN-MADISON

Department of Civil and Environmental Engineering

Date: 12/29/2009
To: Marie Treazise, WisDOT Bureau of Highway Operations
From: Amanda Ryadi, Wisconsin TOPS Lab
Subject: Ramp Metering Evaluation – Technical Memo #6
Crash Evaluation

This memorandum summarizes the crash evaluation for metering locations on highways around the Milwaukee and Madison areas. The crash data used are combined data from two sources: the state trunk network (STN) GIS crash maps and the WisTransPortal MV4000 Crash Database. Each source has some information that the other does not.

The influence zone for analysis around each meter is defined as 1000 feet upstream and downstream from the ramp meter merge location as well as any crashes found to have occurred on the ramp itself. This zone is consistent with previous studies, including the 2005 evaluation of ramp metering on the Madison Beltline. The WisTransPortal MV4000 Crash Database provides other needed information, such as crash severity, time, date and day of the crash. These two data sources are combined by relating them by the unique crash numbers that are provided by each source.

The crash evaluation was conducted to assess the impact of ramp meter installation on incidents. The analysis was done by looking at the change in the number of crashes and the crash severities before and after the installation.

The crash analyses were done over one of three timeframes:

- Comparison of 1 year before and after the start-up date
- Comparison of 2 years before and after the start-up date
- Comparison of 3 years before and after the start-up date

The analyses were done this way due to data limitation. There is no crash information available prior to 1998 while most ramp meters were installed during or before 1998. Since this time, ten meters have start-up dates recorded with known certainty by State Traffic Operations Center (STOC). Therefore this safety analysis looks at these ten metering locations that have at least a one year of before data. Therefore, for ramp meters that started in 1999, comparison analyses of 1 year before and after the start-up date were done. For ramp meters that started in 2000, comparison analyses of 2 years before and after the start-up date were done. Lastly, for ramp meters that started in 2001 or later, comparison analyses of 3 years before and after the start-up date were done.

Comparison analyses of 1 year before and after the start-up date were conducted for the following ramp meters:

- | | | |
|-------------|-----------------------------|-------------|
| • RM-40-082 | I-94 EB @ Mitchell Blvd | 22-Feb-1999 |
| • RM-67-113 | I-94 WB @ Hwy T (Grandview) | 23-Jun-1999 |

Comparison analyses of 2 years before and after the start-up date were conducted for the following ramp meters. Note that RM-13-006's start-up date is in the year 2006, but only 2 years before and after

analyses could be done because the crash data retrieved from the STN GIS Crash Map only had data up to the end of 2007.

- RM-13-006 US 12 @ Todd Dr. WB 1-Jan-2006
- RM-67-091 US 45 SB @ County Line Rd 16-Apr-2000
- RM-67-092 US 45 SB @ Pilgrim Rd 16-Apr-2000
- RM-67-093 US 45 SB @ Hwy 74 (Main St) 16-Apr-2000

Comparison analyses of 3 years before and after the start-up date were conducted for the following ramp meters:

- RM-40-117 US 41/45 SB @ Hwy 145 6-Dec-2001
- RM-67-118 US 45 NB @ Main St 14-Jan-2002
- RM-67-120 I-94 WB @ Hwy G 25-Oct-2001
- RM-67-121 I-94 EB @ Hwy G 15-Jul-2002

This analysis is a view of the data about crash occurrences by severity. It is not to be misconstrued as a more statistically robust analysis that would have to incorporate control conditions (e.g., an Empirical Bayes framework).

Analysis Results

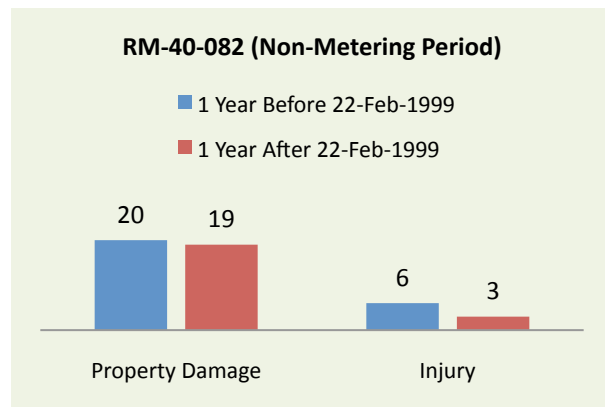
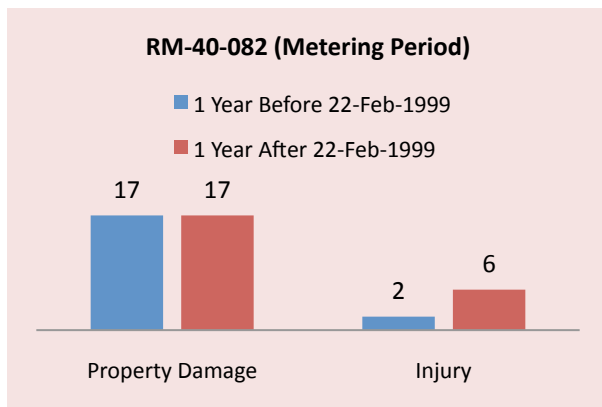
Note: Negative impacts of the ramp meter installation are highlighted in light red, positive impacts are highlighted in light green, and no impact is highlighted in light yellow. Each location on the following pages shows separately the metered times of the day and the non-metered times. The results are also divided by property damage and injury crashes. There were no fatal crashes observed in any of the data collected for this assessment.

RM-40-082 Before and After Crash Analysis (Metered Period)

	Property Damage	Injury	Total
1 Year Before 22-Feb-1999	17	2	19
1 Year After 22-Feb-1999	17	6	23
Change	0	4	4
% Change	0%	200%	21%

RM-40-082 Before and After Crash Analysis (Non-Metered)

	Property Damage	Injury	Total
1 Year Before 22-Feb-1999	20	6	26
1 Year After 22-Feb-1999	19	3	22
Change	-1	-3	-4
% Change	-5%	-50%	-15%



During the metering period, there is no change in property damage related incidents after the installation of RM-40-082, but injury related incidents increased by 200%. During the non-metering period, property damage related incidents decrease by 5% after the installation and injury related incidents decreased by 50%. This shows that RM-40-082 was likely ineffective in reducing the number of crashes.

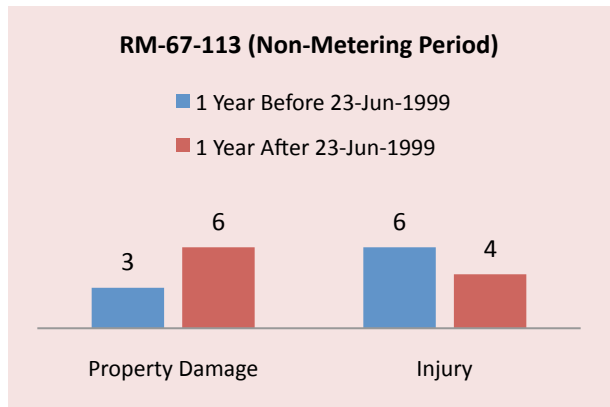
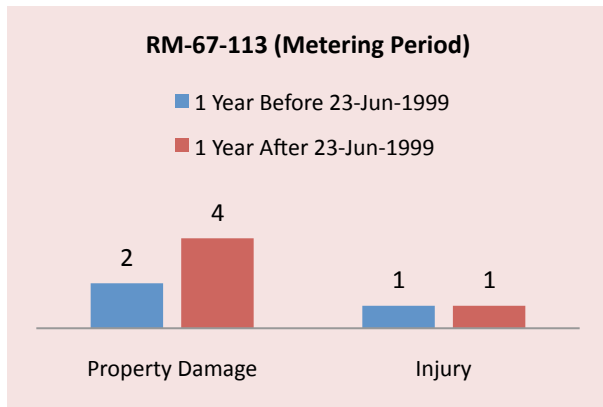
RM-67-113, I-94 WB @ Hwy T (Grandview)

RM-67-113 Before and After Crash Analysis (Metered Period)

	Property Damage	Injury	Total
1 Year Before 23-Jun-1999	2	1	3
1 Year After 23-Jun-1999	4	1	5
Change	2	0	2
% Change	100%	0%	67%

RM-67-113 Before and After Crash Analysis (Non-Metered)

	Property Damage	Injury	Total
1 Year Before 23-Jun-1999	3	6	9
1 Year After 23-Jun-1999	6	4	10
Change	3	-2	1
% Change	100%	-33%	11%



During the metering period, there was no change in injury related incidents after the installation of RM-67-113, but the property damage related incidents increase by 100%. During the non-metering period, the property damage related incidents increase by 100% after the installation, but the injury related incidents decreased by 33%. This shows that RM-67-113 was likely ineffective in reducing the number of crashes.

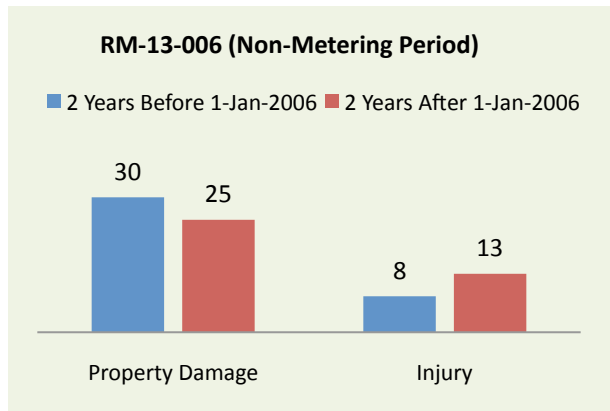
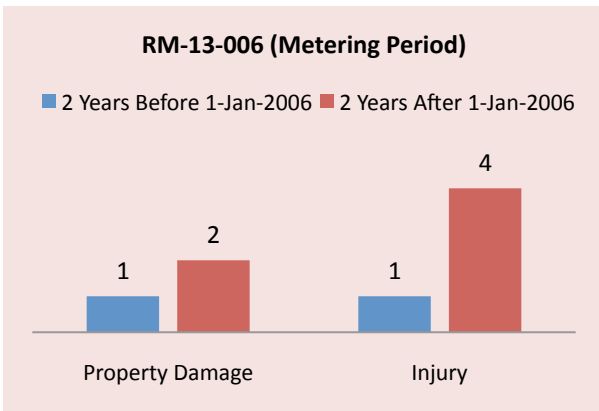
RM-13-006, US 12 Westbound @ Todd Drive (Madison)

RM-13-006 Before and After Crash Analysis (Metered Period)

	Property Damage	Injury	Total
2 Years Before 1-Jan-2006	1	1	2
2 Years After 1-Jan-2006	2	4	6
Change	1	3	4
% Change	100%	300%	200%

RM-13-006 Before and After Crash Analysis (Non-Metered)

	Property Damage	Injury	Total
2 Years Before 1-Jan-2006	30	8	38
2 Years After 1-Jan-2006	25	13	38
Change	-5	5	0
% Change	-17%	63%	0%



During the metering periods, the property damage related incidents increase by 100% after the installation of RM-13-006 and the injury related incidents increase by 300%. During the non-metering periods, the property damage related incidents decrease by 17% after the installation, but the injury related incidents increase by 63%. This shows that RM-13-006 was likely ineffective in improving safety.

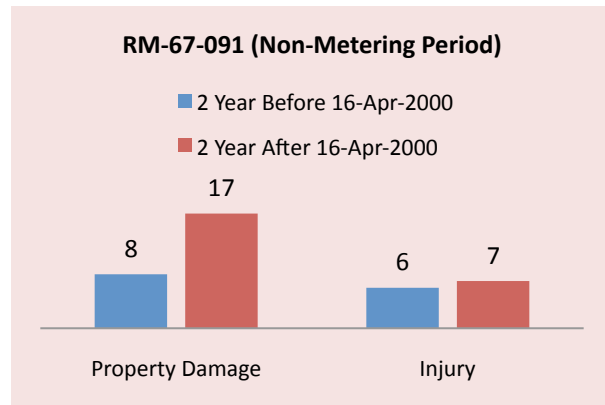
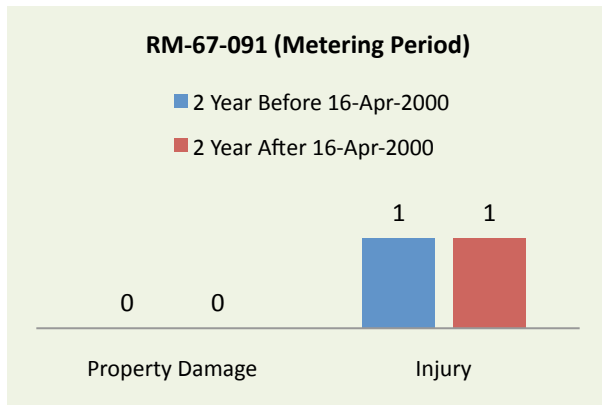
RM-67-091, US 45 SB @ County Line Rd

RM-67-091 Before and After Crash Analysis (Metered Period)

	Property Damage	Injury	Total
2 Year Before 16-Apr-2000	0	1	1
2 Year After 16-Apr-2000	0	1	1
Change	0	0	0
% Change	0%	0%	0%

RM-67-091 Before and After Crash Analysis (Non-Metered)

	Property Damage	Injury	Total
2 Year Before 16-Apr-2000	8	6	14
2 Year After 16-Apr-2000	17	7	24
Change	9	1	10
% Change	113%	17%	71%



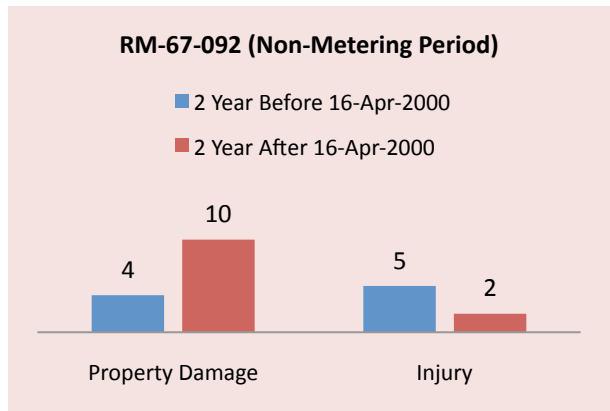
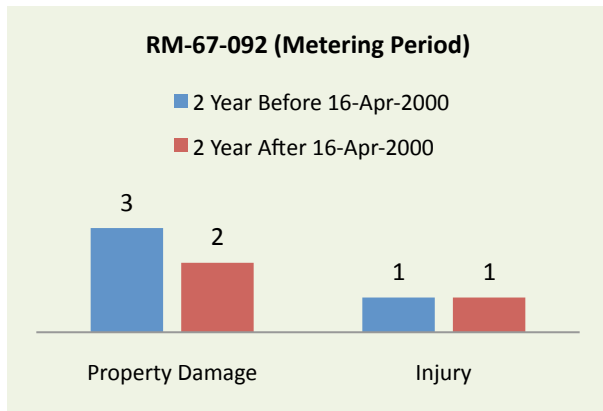
During the metering period, there was no change in property damage related incidents and injury related incidents. During the non-metering period, the property damage incidents increased by 113% after the installation of RM-67-091 and the injury related incidents increased by 17%. This shows that RM-67-091 was likely ineffective in improving safety.

RM-67-092 Before and After Crash Analysis (Metered Period)

	Property Damage	Injury	Total
2 Year Before 16-Apr-2000	3	1	4
2 Year After 16-Apr-2000	2	1	3
Change	-1	0	-1
% Change	-33%	0%	-25%

RM-67-092 Before and After Crash Analysis (Non-Metered)

	Property Damage	Injury	Total
2 Year Before 16-Apr-2000	4	5	9
2 Year After 16-Apr-2000	10	2	12
Change	6	-3	3
% Change	150%	-60%	33%



During the metering periods, there was no change in injury related incidents after the installation of RM-67-092, but the property damage incidents decreased by 33%. During the non-metering period, the property damage related incidents increase by 150% after the installation, but the injury related incidents decrease by 60%. This shows that RM-67-092 may have been effective in improving safety.

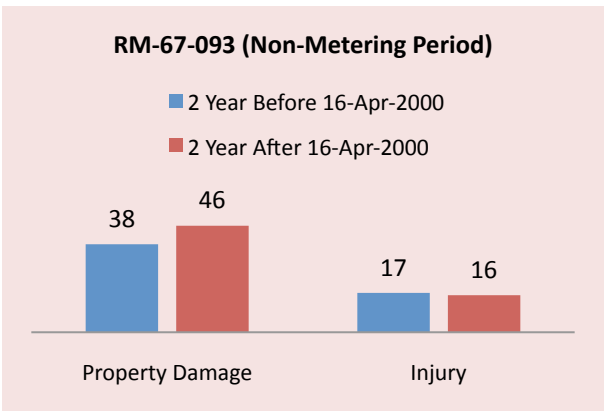
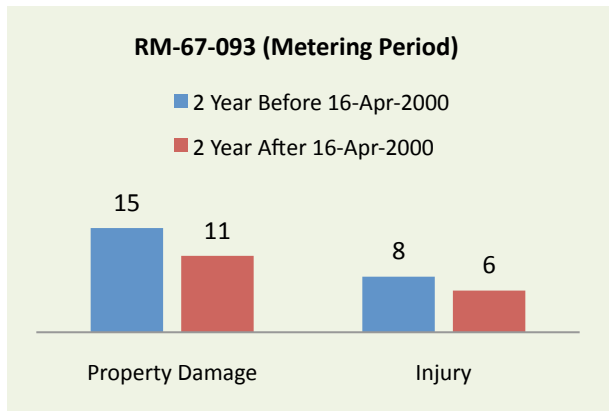
RM-67-093, US 45 SB @ Hwy 74 (Main St)

RM-67-093 Before and After Crash Analysis (Metered Period)

	Property Damage	Injury	Total
2 Year Before 16-Apr-2000	15	8	23
2 Year After 16-Apr-2000	11	6	17
Change	-4	-2	-6
% Change	-27%	-25%	-26%

RM-67-093 Before and After Crash Analysis (Non-Metered)

	Property Damage	Injury	Total
2 Year Before 16-Apr-2000	38	17	55
2 Year After 16-Apr-2000	46	16	62
Change	8	-1	7
% Change	21%	-6%	13%



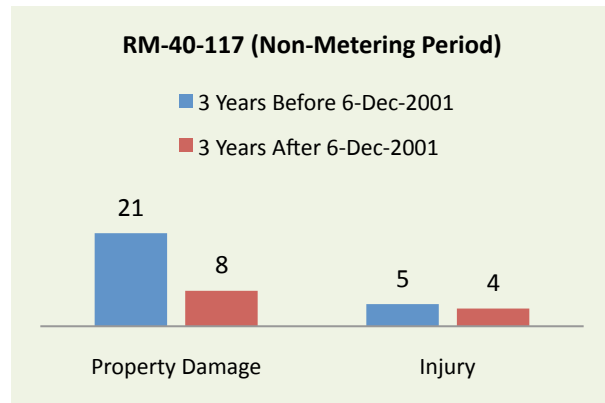
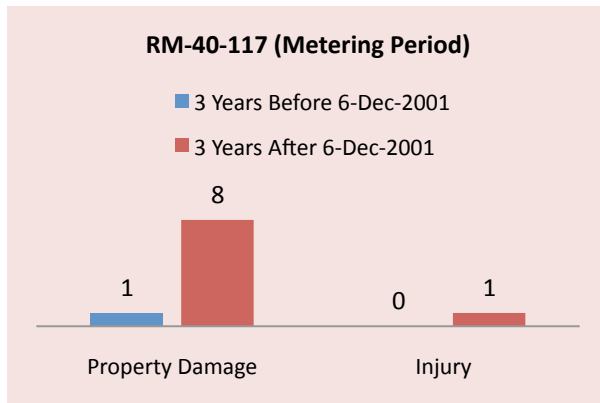
During the metering period, the property damage related incidents increased by 27% after the installation of RM-67-093 and the injury related incidents increased by 25%. During the non-metering period, the property damage related incidents increase by 21%, but the injury related incidents decrease by 6%. This shows that RM-67-093 was likely effective in improving safety.

RM-40-117 Before and After Crash Analysis (Metered Period)

	Property Damage	Injury	Total
3 Years Before 6-Dec-2001	1	0	1
3 Years After 6-Dec-2001	8	1	9
Change	7	1	8
% Change	700%	n/a	800%

RM-40-117 Before and After Crash Analysis (Non-Metered)

	Property Damage	Injury	Total
3 Years Before 6-Dec-2001	21	5	26
3 Years After 6-Dec-2001	8	4	12
Change	-13	-1	-14
% Change	-62%	-20%	-54%



During the metering period, the property damage related incidents increase by 700% after the installation of RM-40-117 and the injury related incidents increased from none to one in the three years that followed. During the non-metering period, the property damage related incidents decreased by 62% and the injury related incidents decrease by 20%. This shows that RM-40-117 was likely ineffective in improving safety.

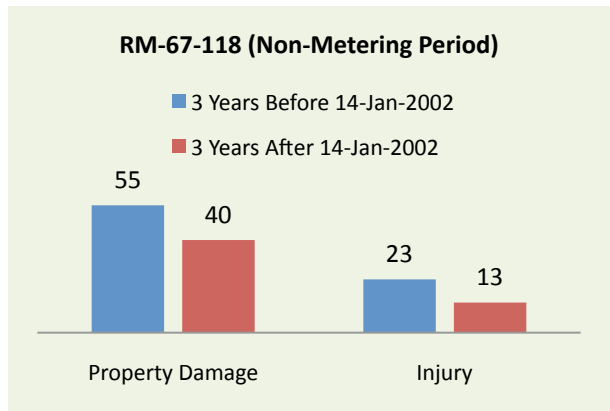
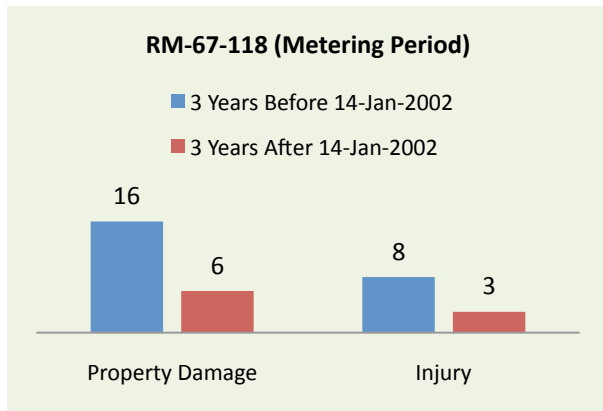
RM-67-118, US 45 NB @ Main St

RM-67-118 Before and After Crash Analysis (Metered Period)

	Property Damage	Injury	Total
3 Years Before 14-Jan-2002	16	8	24
3 Years After 14-Jan-2002	6	3	9
Change	-10	-5	-15
% Change	-63%	-63%	-63%

RM-67-118 Before and After Crash Analysis (Non-Metered)

	Property Damage	Injury	Total
3 Years Before 14-Jan-2002	55	23	78
3 Years After 14-Jan-2002	40	13	53
Change	-15	-10	-25
% Change	-27%	-44%	-32%



During the metering period, the property damage related incidents and injury related incidents decrease by 63% after the installation of RM-67-118. During the non-metering periods, the property damage related incidents decreased by 27% and the injury related incidents decreased by 44%. This shows that the installation of RM-67-118 was likely effective in improving safety.

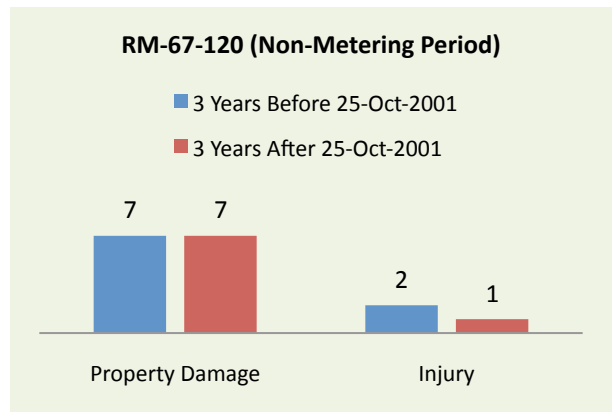
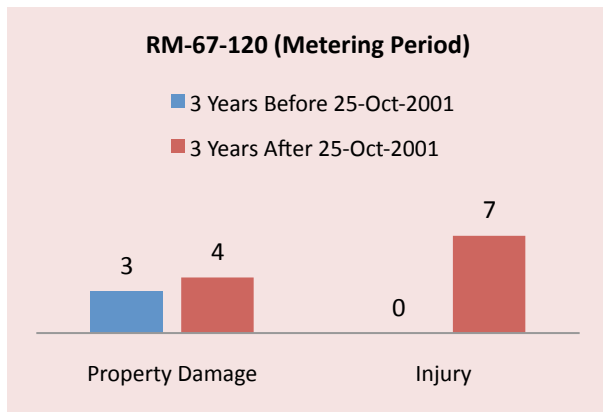
RM-67-120, I-94 WB @ Hwy G

RM-67-120 Before and After Crash Analysis (Metered Period)

	Property Damage	Injury	Total
3 Years Before 25-Oct-2001	3	0	3
3 Years After 25-Oct-2001	4	7	11
Change	1	7	8
% Change	33%	n/a	267%

RM-67-120 Before and After Crash Analysis (Non-Metered)

	Property Damage	Injury	Total
3 Years Before 25-Oct-2001	7	2	9
3 Years After 25-Oct-2001	7	1	8
Change	0	-1	-1
% Change	0 %	-50%	-11%



During the metering period, the property damage related incidents increased by 33% after the installation of RM-67-120 and the injury related incidents increased from none to seven crashes in three years.. During the non-metering period, there is no change in the property damage related incidents, but the injury related incidents decrease by 50%. This shows that RM-67-120 was likely ineffective in improving safety.

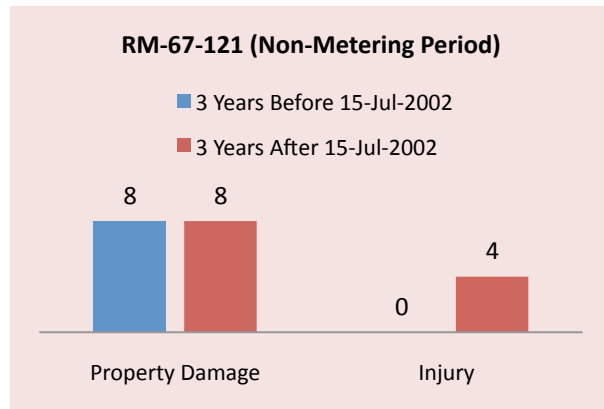
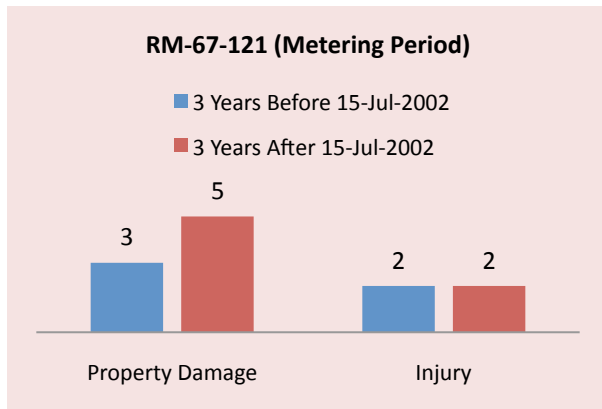
RM-67-121, I-94 EB @ Hwy G

RM-67-121 Before and After Crash Analysis (Metered Period)

	Property Damage	Injury	Total
3 Years Before 15-Jul-2002	3	2	5
3 Years After 15-Jul-2002	5	2	7
Change	2	0	2
% Change	67%	0%	40%

RM-67-121 Before and After Crash Analysis (Non-Metered)

	Property Damage	Injury	Total
3 Years Before 15-Jul-2002	8	0	8
3 Years After 15-Jul-2002	8	4	12
Change	0	4	4
% Change	0%	n/a	50%



During the metering period, there is no change in the injury related incidents after the installation of RM-67-121, but the property damage related incidents increased by 67%. During the non-metering period, there is no change in property damage related incidents, but the injury related incidents increased from none to four crashes in three years. This shows that RM-67-121 was likely ineffective in improving safety.

Concluding Remarks

The results of the analyses show that some ramp meters show improvement after the installation. Note that not all of the improvements and declinations are too substantial. Since there are no substantial changes after the installation, more analyses could be done on the list of ramp meters that do not show improvement before taking further action.

The followings are ramp meters that show increased crashes after the installation:

- | | | | |
|-------------|-----------------------------|----------|----------------------------------|
| • RM-40-117 | US 41/45 SB @ Hwy 145 | PD and I | Metering period |
| • RM-67-091 | US 45 SB @ County Line Rd | PD and I | Non-metering period |
| • RM-13-006 | US 12 @ Todd Dr. WB | PD and I | Metering period |
| • RM-67-120 | I-94 WB @ Hwy G | PD and I | Metering period |
| • RM-67-092 | US 45 SB @ Pilgrim Rd | PD | Non-metering period |
| • RM-67-093 | US 45 SB @ Hwy 74 (Main St) | PD | Non-metering period |
| • RM-67-113 | I-94 WB @ Hwy T (Grandview) | PD | Metering and non-metering period |
| • RM-67-121 | I-94 EB @ Hwy G | PD | Metering period |
| • RM-40-082 | I-94 EB @ Mitchell Blvd | I | Metering period |
| • RM-13-006 | US 12 @ Todd Dr. WB | I | Non-metering period |
| • RM-67-121 | I-94 EB @ Hwy G | I | Non-metering period |

Looking broadly at all the crash data for these ten locations, including both property damage and injury crashes, the overall crash frequency change was nearly zero between before and after time periods. Recall there were no fatal crashes observed in the data for this assessment. What is important to note is that during the metering periods, only three of the ten locations showed an improvement in safety (i.e., a drop in crash frequency) after the installation of a meter. On average across the ten locations the crash frequency increased by 11% during metering times and decreased by 4% otherwise. It goes nearly without mentioning that if meters introduce increased crash risk this is a substantial deterrent to their efficacy.