Evaluation of Ramp Meter Effectiveness for Wisconsin Freeways, A Milwaukee Case Study:
Part 2, Ramp Metering Effect on Traffic Operations and Crashes

Project identification number 0092-45-17

Final Report

Alex Drakopoulos
Mery Patrabansh
Georgia Vergou
Marquette University, Milwaukee

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NOTICE:

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The purpose of the research is to determine the benefits of ramp meters in the Milwaukee area freeway system, to determine underlying relationships that permit evaluation of new ramp meters or ramp meter systems elsewhere, and to develop a coherent framework for performing evaluation of ramp meter effectiveness on a whole system. Part 2 concentrates on the traffic operations effect six new ramp meters had on the 14-mile long corridor where six ramp meters were already operational. A crash rate comparison was performed between the periods the corridor operated without and with the six new ramp meters. Metered on-ramp queue length and delay information is presented in Appendix A; details of the operation of a metered on-ramp as well as mainline speed occupancy and volume information in the vicinity of the ramp are presented in Appendix B.

Average corridor speeds improved when the new ramp meters were operational. Vehicle-hours of travel were lower during the more congested afternoon peak period. It is suggested that fine-tuning of ramp metering parameters is very likely to result in additional benefits for the corridor.

Crash rates during ramp metering hours were lower by 13% with the new ramp meters operational.
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Inventory of
Ramp Delay and Queue Length Information
Introduction

The present appendix contains all collected ramp delay and queue length information. Information is presented in spatial order, from the North to the South end of the analyzed corridor. Data for each ramp are presented in a temporal sequence; High-Occupancy-Vehicle (HOV) ramp data are presented, wherever available, following Single-Occupancy-Vehicle (SOV) ramp data. Where no HOV ramp was present, the term SOV was used, although high-occupancy vehicles would also use the same ramp.

The index in pages A - ii through A - v provides Appendix page numbers where information about a specific location can be found for a specific peak period and a specific ramp. Shaded cells indicate that ramp metering was not operational during this time. Blank cells indicate that, although the ramp was operational, information for a specific period was not available. HOV cells left blank for all four weeks indicate locations that did not have an HOV ramp.

Weeks 1 and 2 (February 1-3 and 8-10) correspond to freeway operation without the new ramp meters; weeks 3 and 4 (March 14-16 and 21-23) correspond to freeway operation with the new ramp meters on-line.

Graphs contained in this Appendix provide a visual representation of queue length (used as the y-axis) and delay (the shaded area in each graph) during any instant (the x-axis represents time) of a reported peak period. Heavily shaded graphs represent peak periods with more significant ramp delay.

Certain ramps present an appearance of frequent narrow “spikes,” indicating an increased arrival rate (the left side of the spike, leading to the peak), followed by vehicles being released from the stop line, leading to shorter queues or completely dissipated queues (the right side of the spike). When ramp occupancies reached a predetermined level, “queue override” took over and set the fastest ramp metering rate, until ramp occupancy was at a predetermined low level. Such occurrences would be indicated by a faster queue length dissipation.

The operation of the Wisconsin Avenue ramp meter during the afternoon peak period of February 9, 2000, is examined in Appendix B, where the factors determining ramp metering rates are analyzed in detail.
## RAMP DELAY DATA AVAILABILITY

February-March 2000

Table entries indicate appendix page number

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### NOTES:

SOV = Single-Occupancy-Vehicle lane
HOV = High-Occupancy-Vehicle lane

Shaded areas: ramp meters operational only during the after period
## RAMP DELAY DATA AVAILABILITY

February-March 2000

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### NOTES:
- SOV = Single-Occupancy-Vehicle lane
- HOV = High-Occupancy-Vehicle lane
- Shaded areas: ramp meters operational only
### RAMP DELAY DATA AVAILABILITY

February-March 2000

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**NOTES:**

SOV = Single-Occupancy-Vehicle lane

HOV = High-Occupancy-Vehicle lane

Shaded areas: ramp meters operational only during

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A - iv
RAMP DELAY DATA AVAILABILITY
February-March 2000
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NOTES:
SOV = Single-Occupancy-Vehicle lane
HOV = High-Occupancy-Vehicle lane
Shaded areas: ramp meters operational only during peak travel hours.
County Line Road 3/23/2000 AM peak

Data Collection Time

SOV queue length

County Line Road 3/23/2000 AM peak

Data Collection Time

HOV queue length
Pilgrim Road 3/14/2000 AM peak

Pilgrim Road 3/16/2000 AM peak

Data Collection Time

Data Collection Time
Good Hope Loop Ramp  3/15/2000 PM peak

TIME

Good Hope Loop Ramp  3/16/2000 AM peak

TIME
Good Hope Road Loop Ramp 3/22/2000 AM peak

DATA_COL

Good Hope Road Loop Ramp 3/23/2000 PM peak

DATA_COL
Good Hope Road Slip Ramp 2/1/2000 PM peak

**SOV queue length**

Time

Good Hope Road Slip Ramp 2/1/2000 PM peak

**HOV queue length**

Time
Good Hope Road Slip Ramp 2/2/2000 AM peak

SOV queue length

TIME

Good Hope Road Slip Ramp 2/2/2000 AM peak

HOV queue length

TIME
Good Hope Slip Ramp 3/16/2000 PM peak

HOV queue length

TIME

Good Hope Road Slip Ramp 3/21/2000 PM peak

SOV queue length

DATA_COL
Appleton Avenue 3/14/2000 PM peak

Data Collection Time

SOV queue length

Appleton Avenue 3/15/2000 AM peak

Data Collection Time

SOV queue length
Appleton Avenue 3/15/2000 PM peak

Data Collection Time

SOV queue length

Appleton Avenue 3/16/2000 AM peak

Data Collection Time

SOV queue length
Appleton Avenue 3/21/2000 PM peak

Appleton Avenue 3/22/2000 AM peak
Hampton Avenue 3/16/2000 AM peak

Hampton Avenue 3/16/2000 PM peak

Data Collection Time

HOV queue length

SOV queue length
Hampton Avenue 3/16/2000 PM peak

Hampton Avenue 3/21/2000 AM peak

DATA_COL
Hampton Avenue 3/23/2000 PM peak

Capitol Drive 3/14/2000 AM peak
Capitol Drive 3/21/2000 PM peak

Data Collection Time

Capitol Drive 3/22/2000 AM peak

Data Collection Time
Capitol Drive 3/23/2000 AM peak

Data Collection Time

Capitol Drive 3/23/2000 PM peak

Data Collection Time
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Burleigh Street 3/14/2000 PM peak
Burleigh Street 3/15/2000 AM peak

Data Collection Time

Burleigh Street 3/15/2000 PM peak

Data Collection Time
Burleigh Street 3/15/2000 PM peak

HOV queue length

Data Collection Time

Burleigh Street 3/16/2000 AM peak

SOV queue length

Data Collection Time
Burleigh Street 3/16/2000 AM peak

Data Collection Time

HOV queue length

Burleigh Street 3/16/2000 PM peak

Data Collection Time

SOV queue length
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Data Collection Time

Burleigh Street 3/21/2000 PM peak
Burleigh Street 3/21/2000 PM peak

DATA_COL

Burleigh Street 3/22/2000 AM peak

DATA_COL

A - 68
Burleigh Street 3/23/2000 AM peak

Burleigh Street 3/23/2000 PM peak

DATA_COL
Burleigh Street 3/23/2000 PM peak

North Avenue 2/1/2000 AM peak

Data Collection Time

DATA_COL
North Avenue 2/1/2000 PM peak

North Avenue 2/2/2000 AM peak
North Avenue 3/16/2000 AM peak

Data Collection Time

North Avenue 3/16/2000 PM peak

Data Collection Time
Watertown Plank Road 2/8/2000 PM peak

SOV queue length

Time

Watertown Plank Road 2/9/2000 AM peak

SOV queue length

Time
Watertown Plank Road 2/9/2000 AM peak

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Watertown Plank Road 2/9/2000 PM peak

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TIME
Watertown Plank Road 3/15/2000 PM peak

Watertown Plank Road 3/16/2000 AM peak
Watertown Plank Road 3/23/2000 PM peak

Wisconsin Avenue 2/1/2000 PM peak

Data Collection Time
Wisconsin Avenue 2/10/2000 PM peak

Data Collection Time

Wisconsin Avenue 3/14/2000 AM peak

Data Collection Time
Wisconsin Avenue 3/21/2000 PM peak

![Graph showing SOV queue length from 16:00 to 17:28]

Wisconsin Avenue 3/22/2000 AM peak

![Graph showing SOV queue length from 07:00 to 08:28]
Greenfield Avenue 2/2/2000 PM peak

Data Collection Time

Greenfield Avenue 2/8/2000 PM peak

Data Collection Time
Greenfield Avenue 2/14/2000 PM peak

Data Collection Time

Greenfield Avenue 2/15/2000 AM peak

Data Collection Time
Greenfield Avenue 2/23/2000 PM peak

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