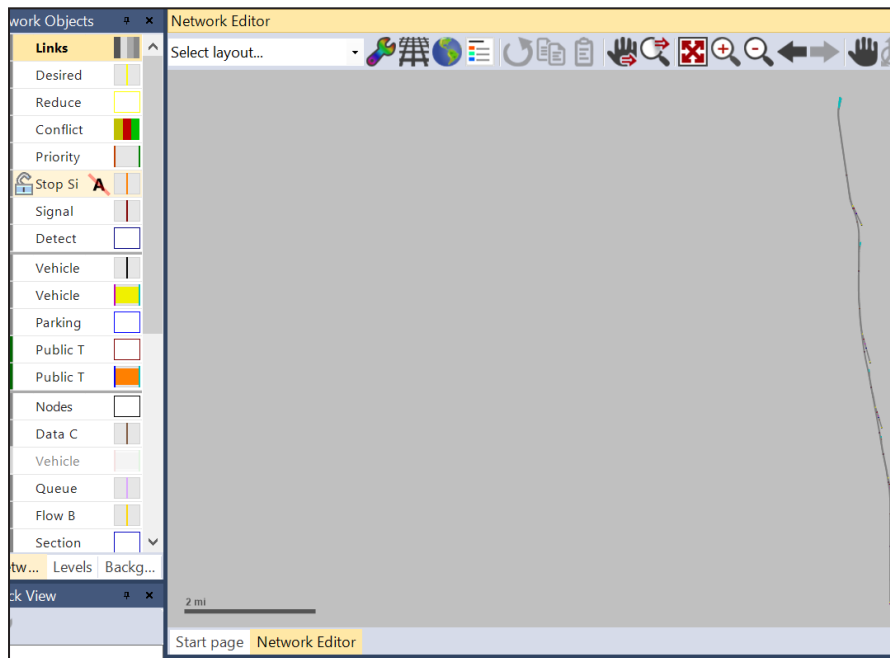


# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 22-486 (project 641) | September 2022

## Design and Evaluate Coordinated Ramp Metering Strategies for Utah Freeways



### the ISSUE

Freeway ramp metering control has been widely implemented in many U.S. states, including Utah. Numerous studies and applications have demonstrated that ramp metering control is an effective strategy to reduce overall freeway congestion by managing the amount of traffic entering the freeway. Ramp metering controllers can be implemented as coordinated or uncoordinated systems. Currently, Utah freeway on-ramps are operated in an uncoordinated way. Despite improvements to the operational efficiency of mainline flows, uncoordinated ramp metering will inevitably create additional delays to the ramp flows. There is a need to deploy coordinated ramp metering systems and evaluate their performance.

### the RESEARCH

This project collects related data from the Utah Department of Transportation to first conduct a network-wide analysis to identify current freeway bottlenecks in Utah and select the site that may benefit from coordinated ramp metering techniques. A VISSIM model for performance analysis is created based on the corridor chosen. Before running simulations, we calibrate the VISSIM model using traffic flow data gathered from the highway performance measurement system. The calibrated VISSIM model is then used to conduct experimental investigations to answer the fundamental question, “To achieve a certain freeway congestion level, how many additional delays will be created at those ramps?”



A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

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Utah State University  
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### Project Title

Design and Evaluate  
Coordinated Ramp Metering  
Strategies for Utah Freeways

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Transportation

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Innovative Technology  
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## the FINDINGS

The calibrated VISSIM model was applied to test the coordinated ramp metering control strategy of the bottleneck algorithm. According to simulation results, the bottleneck method can reduce freeway mainline time. Sensitivity analysis is used to examine different levels of improvement for freeway mainstream operation. Note that the coordinated ramp metering control technique may result in uneven on-ramp delay distribution. Researchers then conducted additional simulation tests to see how the system performs when the on-ramp delays are within a certain range.

## the IMPACT

The research will help UDOT identify freeway bottleneck locations that are suitable for coordinated ramp metering control and evaluate both the safety and operational performances of the system. The work will also study the additional delay created to the ramps by ramp metering controls when a certain congestion level on the freeway mainline is expected to be achieved. Improved regulation of vehicles entering the freeway will reduce overall congestion and delay while increasing freeway traffic throughput. Additionally, collisions on the freeway can be prevented by breaking up on-ramp platoons that merge onto the freeway. Finally, reducing long periods of stop-and-go traffic on the freeway due to smooth merging traffic can reduce vehicle emissions and fuel consumption.

For more information on this project, download the main report at <https://www.ugpti.org/resources/reports/details.php?id=1104>

For more information or additional copies, visit the Web site at [www.mountain-plains.org](http://www.mountain-plains.org), call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.



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