

I-270 Innovative Congestion Management (ICM) Ramp Metering



By Maryland Department of Transportation

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Benefits Statement

The I-270 Innovative Congestion Management project aims to save lives by enhancing safety and reducing traffic congestion. It shortens rush hour, saving up to 30 minutes during peak times. Cost-effective strategies like ramp metering and geometric improvements promise to save money. By improving traffic flow and using data-driven decisions, the project is already showing promising results, including travel time savings of up to 17%. Public outreach efforts ensure that drivers understand and benefit from these changes, making the project a valuable initiative to save lives, time, and money.

In this case study you will learn:

1. How Maryland DOT allocated \$100 million to tackle recurring congestion on the vital I-270 highway from Frederick to DC in 2016. The project aimed to reduce congestion and improve safety through innovative solutions and geometric improvements.
2. How the project aligned with Maryland's TSMO Strategic Plan, focusing on active traffic management capabilities and ramp metering to reduce travel times and enhance safety. Ramp metering was deployed in 2021, showing positive results.
3. Successful deployment of ramp metering involved extensive coordination and public outreach. The system went live in September 2021, delivering significant travel time savings, with up to 31 minutes of improvement in the southbound direction during peak hours.



BACKGROUND

I-270 is a critical 30-mile interstate from I-70 in Frederick, MD to I-495 in Washington, DC, carrying over 200,000 vehicles per day in some segments. I-270 has been plagued by recurring and non-recurring congestion and delays for many years. In 2016, Maryland Department of Transportation Secretary Pete Rahn allocated \$100M and challenged the private sector to improve mobility and safety on I-270 as part of the first major highway Progressive Design-Build contract in the nation dubbed the I-270 Innovative Congestion Management (ICM) project. MDOT SHA issued a Request for Proposals with no defined scope to provide “unfettered, boundless reign to ingenuity, innovation and development for the optimal solution”. The only limitation was the fixed total contract value of \$100M to move the most vehicles fastest and farthest along the corridor.

During the following year, MDOT SHA selected a Progressive Design-Build Team led by Concrete General Inc. (CGI) with RK&K as the lead designer and Bruce & Merrilees as the specialty subcontractor for ITS and electrical work to implement technology (ramp metering and active traffic management) and 14 discrete geometric improvement projects to reduce recurring and non-recurring congestion, improve safety, improve reliability, and be adaptable to future improvements along the full length of I-270 between I-495 and I-70 which projected up to 30 minutes of travel time savings along I-270 southbound in the AM weekday peak period. During the procurement of this Progressive Design-Build contract, the CGI Team conducted a thorough benefit/cost analysis that identified ramp metering and specific geometric improvement locations, providing a significant congestion and mobility improvement at a high ratio of benefits to cost.

TSMO PLANNING, STRATEGIES AND DEPLOYMENT

In 2016, Maryland’s TSMO Strategic Plan was developed and subsequently updated. This project directly addresses the Systems & Technology and Customer Experience & Engagement goals, specifically Strategy 2.1a - Launch the first set of TSMO Active Traffic Management (ATM) capabilities as part of the I-270 Innovative Congestion Management Project (Systems & Technology).

The CGI Team sought to improve mobility related to daily recurring congestion by improving travel times and speeds during the peak congested periods and reducing the length of time that the corridor experiences congestion, i.e., “shortening the rush hour”. Improving mobility resulting from non-recurring congestion would be accomplished by improving safety on I-270 and reducing the total number of traffic incidents.



The CGI Team completed a high-level analysis of the freeway segments between interchanges to find the segments where the existing traffic volume exceeded capacity for the base segment. This analysis allowed for a quick understanding of what could happen downstream once upstream bottlenecks are relieved. Through this process, we used principles of performance-based practical design to develop the 14 roadway improvements to address specific bottlenecks and minimize

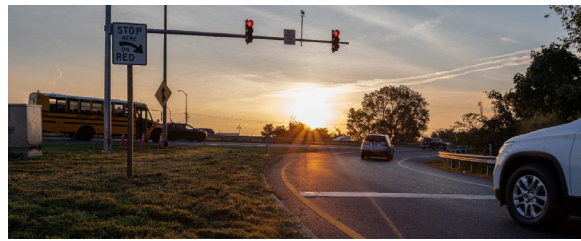
adverse impacts. Adaptive ramp metering was evaluated through detailed microsimulation and was found to provide additional travel time savings and improved safety through the reduction of congestion-related crashes. Other technology strategies considered to be part of the program included active traffic management and virtual weigh station installation. However, budget limitations did not allow these two elements to move ahead.

In 2021, the southbound direction of I-270 was addressed first with 23 ramps on the southbound side and another 22 ramps under construction on the northbound side. Ramp metering signal timing plans were developed based on sensor data collected. Queue detection thresholds were estimated based on ramp volumes. A partial acceptance test was conducted to ensure all systems were functioning properly prior to going live. Regarding operations for non-recurring (off-peak) congestion, a mainline detector is used to start-up or shut down ramp metering, if traffic warrants. The system is off between 11 PM and 4 AM with thresholds for turning the system on set to five miles per hour (mph) less than the speed limit.

COMMUNICATIONS PLANNING AND EXECUTION

The I-270 ICM project included the first deployment of ramp metering in Maryland, so extensive coordination was required within the agency, with the public, and with other agencies. After award of the contract, significant intra-agency and inter-agency coordination was begun for the ramp metering portion of the project. The CGI Team led ramp metering task force meetings which included representatives from across MDOT SHA as well as other affected stakeholders including police, Montgomery County signal operations, freeway incident responders, etc. Task force and coordination

meetings progressed as ramp metering design was completed and construction was started.



For the ramp metering deployment, MDOT SHA and the CGI Team laid out a process for commissioning, testing, and piloting of the ramp metering system before Go Live. Before the ramp metering pilot location and Go Live of the I-270 southbound ramp metering system, extensive public outreach was undertaken including development of educational videos, social media posts, and traffic alerts to keep the public up to date on the project progress. The Go Live for the ramp metering system occurred on September 15, 2021 without any major issues and benefits were realized immediately.

OUTCOME, BENEFITS AND LEARNINGS

This is the first application of ramp metering in Maryland and has so far proven successful. At the time that ramp metering went live on September 15, 2021, CGI Team staff were stationed at all 23 southbound ramps to monitor operations and queues. All functioned well with staff observing no significant issues. 53 Flashing hazard identification beacons were used to notify traffic approaching the ramp to slow down (this feature was emphasized in the public outreach campaign prior to the Go Live date). “Green Time” (length of green indication for traffic to proceed) proved to be an area that required additional public outreach emphasis since ramp metering operates differently from a traditional signal (shorter “Green Time”), though drivers now appear to have a better understanding of how ramp metering works.

A Regional Integrated Transportation Information System (RITIS) congestion scan comparison was conducted, consisting of an analysis of data in the following four time periods in September: (1) 2021 ICM geometric improvements with ramp metering, (2) 2021 ICM geometric improvements before ramp metering, (3) 2019 - some ICM geometric improvements before ramp metering, and (4) 2017 before any ICM geometric improvements. The results showed for I-270 mainline southbound from MD 80 to I-495 that up to 31 minutes of travel time savings were realized with ICM geometric roadway improvements and ramp metering, which is close to modeling estimates in 2017, with up to 13% in travel time savings due directly to ramp metering. The savings were most pronounced in the later hours of the morning peak period (where the greatest benefits of ramp metering have been realized). A comparison of traffic immediately before ramp metering took effect (September 14th) and during similar days for the rest of September 2021 revealed up to 10 minutes in travel time savings due directly to ramp metering becoming operational; comparisons of October 2017, 2019, and 2021 (the first full month that ramp metering had been in place) showed up to 17% in travel time savings; and, for local lanes (I-270 local southbound from MD 124 to Y Split), up to 13 minutes of travel time savings with ICM improvements and ramp metering in place. Overall, the initial results have been encouraging.