

Madison Beltline Flex Lane

Leveraging technology to increase capacity

State:	Wisconsin
Agency:	Wisconsin Dept. of Transportation
Award Category:	Emerging and Innovative Solutions
Project Title:	Madison Beltline Flex Lane
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EXECUTIVE SUMMARY

Chronic traffic congestion on one of Wisconsin's critical urban corridors was severely impacting travel reliability for commuters and commerce in a growing metropolitan area.

US 12/14/18/151 in the Madison area is the most heavily used route in southcentral Wisconsin, with more than 120,000 vehicles per day along a 10-mile segment. Commonly known as the Madison Beltline, the highway directly links four cities in a rapidly growing area that encompasses 43 industrial and business parks within 5 miles of the Beltline, 5,500 businesses within 1 mile of the highway, as well as the seat of state government and the University of Wisconsin. Additionally, there is a lack of alternate routes for traffic due to the area's geographic features including lakes, protected natural resources and marshland.

While WisDOT initiated a long-term planning study of the Beltline, it was imperative that an interim solution be implemented to mitigate the existing reliability issues until a major project could be delivered.

Without reconstructing and widening the footprint of the Beltline, the three 12-foot travel lanes were reduced to 11-foot lanes, a 13-foot median shoulder with the 10-foot driving lane, the Flex Lane, was constructed. The median lane is used dynamically -- the Flex Lane opening and closing as determined by prevailing traffic volumes. The Flex Lane allows for the added capacity only during the times of peak commuter travel and special events that bring high volumes of traffic into Madison.

Preliminary data indicates a 15-20 percent reduction in crashes. Data collection will be ongoing to identify safety trends.

Through construction of the Flex Lane on the existing footprint, traffic operations have been improved considerably while maximizing the existing assets, and as the early data shows, safety has not been negatively impacted.

IDEA

The Madison Beltline Flex Lane (Flex Lane) project involved significant intelligent transportation system (ITS) improvements between US 18/151/Verona Road and I-39/90. The Flex Lane allows for part-time use of median shoulders for travel during the busiest hours of the day along the Beltline. This was a cost effective interim solution to address recurring congestion and improve travel time reliability along the Beltline. The Beltline is an important commuter route in Dane County, as it carries more than 130,000 vehicles per day. It has experienced recurring peak period congestion and has crash rates up to 2.5 times higher than the statewide average.

The purpose of this project was to address the needs of deteriorating infrastructure in the pavement structure and median areas, and to address operational issues during weekday peak periods, unexpected congestion, and planned or special events. This project followed the Federal Highway Administration's (FHWA) initiative on performance-based practical design (PBPD). The PBPD approach encourages designers and decision makers to exercise engineering judgement in identifying and analyzing



alternatives to deliver cost-effective operational improvements. The Flex Lane concept implemented for the Beltline is consistent with the PBPD approach and is considered a Transportation Systems Management and Operations (TSM&O) strategy.

This active management system is the first deployment of its kind in Wisconsin. The substantial ITS deployment efforts included several years of extensive planning, design, construction, integration, system testing, and operations. The ITS devices implemented include more than 50 Lane-use Control Signs (LCS), 36 closed circuit television (CCTV) cameras, 18 detectors, and 5 dynamic message signs (DMS). More than 9 miles of existing and new fiber optic cable were deployed and integrated to system components to improve communications infrastructure. The system is operated through WisDOT's Traffic Management Center (TMC). Major items performed and managed by the TMC have included software development for the Advanced Traffic Management System (ATMS), DMS messaging, camera software, camera sweeps, LCS verification, detector calibration, coordination with other states, first responder coordination and training, and other ITS-focused topics.

The Flex Lane went into operation on July 13, 2022.

IMPLEMENTATION

FHWA's Systems Engineering process was followed for this project, including preparation of the concept of operations (ConOps) and the validation plan, preparation of system software, device requirements, and verification documents. An operations manual was prepared to detail step-by-step procedures for operators of the system. The systems engineering efforts and many other project activities have included extensive coordination with area first responders and Dane County maintenance.

ITS design efforts included preparing the ITS design plans, specifications, and cost estimates; coordinating with utilities; and performing field reviews. ITS devices within this project include LCS, overhead DMS, CCTV cameras, and microwave detectors. The ITS devices tie into the existing fiber network along the Beltline.

LCSs are located approximately every half mile in the median on cantilever or overhead structures. Placing all the new sign structures for the LCS and DMS was challenging, given the number of existing structures and signs along the Beltline. Imported Google Earth data was used during design to reference CAD files to get a high-level visual confirmation on the dynamic message sign placement. This has helped identify potential conflicts and check sight lines.

Although LCS signs and most ITS equipment are within the medians, all of the 34 new cabinets that were installed as part of the project are in the outside shoulders to provide ease of maintenance and to increase visibility of the LCS from the cabinet. Power supply in the cabinets was designed to accommodate the LCS, DMS, cameras, detection, equipment in cabinets, as well as provide room for future needs. Effective coordination with the electrical utility was important to determine proposed cabinet locations on the Beltline to reduce WisDOT electrical distribution costs.

CCTV cameras are used for verifying traffic incidents, viewing traffic impacts resulting from incidents and/or events, monitoring traffic flow on the device's roadway segments, and verifying the flex lane is clear of obstruction and debris prior to opening. Cameras are at every interchange and on nearly every structure holding an LCS. Cameras were also added in areas where coverage was limited by geometric constraints. Supplemental cameras were used to fill gaps in coverage and to provide redundancy at critical locations like the Yahara River Bridge. Twenty-five existing detectors and 18 new detectors



are within the project. The new detectors were placed primarily at weaving sections between interchanges, where there are currently no existing microwave detectors. The new detectors were typically mounted on a LCS median structure or a DMS overhead structure.

COMMUNITY IMPACT

The Madison Beltline, once notorious in Wisconsin for its congestion and delays, is now a model of reliability thanks to a dynamic part-time shoulder use system designated as the Flex Lane and completed in July 2022.

The improvements have been dramatic, significantly easing congestion and enabling free flowing traffic during the busiest morning and afternoon drive times, and for maintenance operations, incident management or the large special events held regularly in the area. Data shows that average travel times during peak Beltline hours were reduced by up to 50 percent.

The Madison Beltline Flex Lane has made travel times more reliable for users across the entire area. Commuters across all social and economic groups are experiencing travel time reductions of up to 50% using the Flex Lane or the Beltline's three other general-purpose lanes. Travel time reliability has been improved substantially as well, with reductions of up to 60%. For many of the 120,000 motorists who use the Beltline daily, the Flex Lane has made the difference in delivering reliability toward all the activities in their daily lives.

Implementing the Beltline Flex Lane is conservatively estimated to save more than \$11 million per year in user delay costs. The project's success has dramatically improved travel times along an urban commuter corridor that directly connects four cities and many other communities in southcentral Wisconsin.

The Flex Lane is an innovative solution to ease backups during the busiest times and provide reliability for motorists who use it every day for work or business. It provides a safe, cost-effective solution to address periodic and recurring congestion without the need to expand the highway beyond its current footprint.

TESTIMONIALS

The WisDOT Madison Beltline Flex Lane Project has been a success for Dane County on many fronts. It has been a very costeffective way to keep the Beltline investment up and running, continuing to serve area residents. By prolonging the life of the Beltline investment, WisDOT has been a steward of infrastructure dollars as it delayed more expensive and impactful construction improvements.



Beyond congestion relief, the project has had many ancillary benefits that have served our residents well. Travel delay is down considerably and travel reliability up, even with higher traffic volumes. The Beltline is also experiencing 10 to 20 percent fewer crashes during peak hours, decreasing serious injuries, which is a key objective of the City and the State.

I encourage the American Transportation Awards panel to look favorably on this project, which creatively and efficiently used infrastructure dollars to decrease delay, increase safety, and preserve historic highway investments.

Thomas W. Lynch PE PTOE PTP AICP Director of Transportation, City of Madison We will continue here in Dane County to apply innovative and evidence-based solutions to roadway safety and traffic congestion. It has been an honor to be part of this new and innovative approach to traffic congestion.

Dane County Sheriff Kalvin Barrett

Reducing congestion on the Beltline is of great importance to the local community, including the thousands of Epic staff, customers, recruits, and service providers who use the Beltline every day to get to and from work. The flex lane project has provided a solution to help alleviate rush-hour congestion on an important transportation artery in our community.

Jim Schumacher, Director of Facilities Epic Systems

IN THE NEWS

Behind the scenes: A look at the nerve center that monitors the Flex Lanes and other highways Channel 3000 / News 3 Now

https://www.youtube.com/watch?v=mQ11W2fTzxs

Flex lane reduced commute times by up to 60% on Beltline, early data shows Wisconsin State Journal

https://www.google.com/url? sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwi92J3Nsaj-AhWyj4kEHU0ABdk4ChAWegQIAhAB&url=https%3A%2F%2Fmadison.com%2Ftraffic%2Fflexlane-reduced-commute-times-by-up-to-60-on-beltline-early-datashows%2Farticle_0c322541-d226-56d4-aa7ae64cddd82305.html&usg=AOvVaw0IhTLAtIOJUOi_TEuvf6_R

Beltline Flex Lane nears six months of operation, WisDOT says travel times improving Channel 27 / WKOW-TV

https://www.google.com/url? sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwi92J3Nsaj-AhWyj4kEHU0ABdk4ChAWegQIGhAB&url=https%3A%2F%2Fwww.wkow.com%2Fnews%2Fbel tline-flex-lane-nears-six-months-of-operation-wisdot-says-travel-timesimproving%2Farticle_60177f26-922f-11ed-8876-83e71ac79cb7.html&usg=AOvVaw0dAcYzhUsvu0JC2pkDqFCn