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CONGESTION MANAGEMENT SAFETY PLAN (CMSP) | PHASE 4

Previous CMSP Phases and Opportunity Lists Technical Report

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DEPARTMENT OF TRANSPORTATION

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report takes a comprehensive look at the Previous CMSP Phases and Opportunity Lists. This report consists of the project interview process, CMSP policy and process considerations, project narratives, before and after studies, summary of project categories and opportunities, and a series of project one-pagers.

Outcomes of Previous Phases of CMSP

Several previous phases of CMSP have been undertaken over the past decade. Phase 1 was completed in 2007 and identified 186 potential highway improvements on Metro District roadways. From these, 19 of the most promising solutions were recommended as demonstration projects, and 13 of these have been implemented since that time.

Phase 2 was completed in 2010 and addressed several policy considerations for adoption of the lower-cost/high-benefit investment approach for the region. In addition, the System Problem Statement was developed as part of this study to identify and characterize congestion and safety issues on the Metro highway system. Locations with recurring congestion on the freeway system were identified utilizing the annual Congestion Report produced by MnDOT's Regional Transportation Management Center (RTMC). Each location was then characterized by a description of the problem's cause such as entering traffic, lane drop, or weaving.

Phase 3 was completed in 2012. The study began with an extensive outreach effort to confirm highway problem locations and gather feedback on the CMSP process. This phase then built on these results to screen the locations in the System Problem Statement and identify the most pressing issues. Lower-cost/high-benefit improvement concepts were developed for these locations in design charrettes, and their costs and effectiveness were estimated. These factors were used to develop a return period, or anticipated length of time for the benefits to equal the cost, to prioritize the strongest solutions. From a list of 53 opportunities, several Phase 3 projects have been constructed. In addition, 25 of these project opportunities are in the process of further design and study, and 11 are programmed for construction over the next four years.

Project Interviews & Narratives

In an effort to complete the review process of the previous CMSP opportunity lists and outcomes, a series of interviews were conducted with the Area Managers, Engineers, and other Program Delivery Staff to debrief on the status of past opportunities, both those completed and not. The report includes detailed narratives for all the project that were discussed at the interviews.

The following table summarizes the status of CMSP projects by area:

Status / Area	East	North	South	West	Total	*Percentage*
Constructed	2	6	5	8	**21**	*25%*
Under Construction	1	1	1	2	**5**	*6%*
Programmed	1	8	2	1	**12**	*14%*
Study	1	4	2	19	**26**	*31%*
Superseded		3	1	1	**5**	*6%*
Low Priority	1		2	4	**7**	*8%*
Dropped	1	2	2	2	**7**	*8%*
Total	**7**	**24**	**15**	**37**	**83**	
Percentage	*8%*	*29%*	*18%*	*45%*		

Before & After Studies

For completed projects, quantitative before-and-after analyses have been undertaken to understand their impacts on traffic congestion and safety. The actual project costs and construction characteristics have also been reviewed and compared to the original estimates. Selected locations are highlighted and described in the project one-pagers in Appendix A.

The following summarizes the key takeaways and the rationale from the opportunity status review:

Project Type

- Freeway Capacity
- Auxiliary Lane
- Ramp Modification
- Acceleration/Escape Lane
- Ramp Meter
- Arterial Capacity
- Intersection Reconfiguration
- Turn Lane
- Signal Modification
- Signal Timing
- Restriping

Status

- **Successful**
  - Constructed
  - Under Construction
- **Programmed**
- **Superseded by Larger Project**
- **Not Implemented**
  - Study
  - Low Priority
  - Dropped

Rationale

- **Successful**
  - Stand-Alone Project
  - Coordinated with Preservation
  - Incorporated into Larger Project
  - I-35W Bridge Traffic Restoration
  - Internally Supported Project
  - Low Cost - Completed In-House
  - Locally Led Project
- **Superseded by Larger Project**
  - Traditional Project Implemented
- **Study**
  - Potential Project Conflict
- **Not Implemented**
  - Scope Exceeds CMSP Characteristics
  - Solution not Supported
  - Low Internal Support
  - Minimal Problems Observed
  - Ineligible Non-MnDOT Highway

INTRODUCTION

Congestion Management Safety Plan (CMSP) is a funding program that seeks to implement lower-cost/high-benefit improvements to address congestion and safety problems on MnDOT's Metro District highway system. Identification of problem locations and selection of solutions is completed using a data driven process to maximize the return on investments in terms of benefits for highway users. Solutions are intended to address specific problems under today's conditions. It is important to note that proposed solutions may not always solve or address all of the issues. These solutions are expected to resolve or alleviate a significant portion of the issues for a fraction of the cost of traditional "full build-out" alternatives. These solutions are typically lower cost and smaller in scope than traditional highway investments, which is intended to allow them to be delivered more quickly and simply. Solutions are also typically lower-cost and smaller in scope that traditional highway investments, which is intended to allow them to be delivered more quickly and simply.

Several previous phases of CMSP have been undertaken over the past decade. The first phase, titled Congestion Management Planning Study, was completed in 2007 and identified 186 potential highway improvements on Metro District roadways. From these, 19 of the most promising solutions were recommended as demonstration projects, and 13 of these have been implemented since that time.

Phase 2 of the Congestion Management Safety Plan, undertaken in 2009-2010, addressed several policy considerations for adoption of the lower-cost/high-benefit investment approach for the region. For example, workshops were conducted to facilitate instruction and dialog on flexible design and managed corridors. Managed corridor concept proposes using active traffic management technology rather than simply adding capacity to address operational needs. Flexible design is a principal that allows for tradeoffs between adherence to traditional design standards and cost-effective spot improvements to improve traffic flow. In addition, the System Problem Statement was developed as part of this study to identify and characterize congestion and safety issues on the Metro highway system. The System Problem Statement utilized the annual *Congestion Report* produced by MnDOT's Regional Transportation Management Center (RTMC) to identify locations with recurring congestion on the freeway system. Each location was then characterized by a description of the problem's cause such as entering traffic, lane drop, or weaving.

CMSP Phase 3 built on the results of Phase 2 to screen the locations in the System Problem Statement to identify the most pressing issues. Lower-cost/high-benefit improvement concepts were developed for these locations in design charrettes, and their costs and effectiveness were estimated. These were used to develop a return period, or length of time expected for the benefits to equal the cost, to prioritize the strongest solutions. From a list of 53 opportunities, several Phase 3 projects have also been constructed. In addition, 25 of these project opportunities are in the process of further design and study, and 11 are programmed for construction over the next years.

Phase 4, the current phase of CMSP, will repeat many of the key activities undertaken in Phases 2 and 3, by updating the System Problem Statement and developing a new list of opportunities that reflects changes to the Metro District highway system over recent years. Travel time reliability has also been added as an additional performance measure as part of the System Problem Statement. Reliability describes the variability in travel time experienced by highway users, due to factors such as weather, crashes, and changes in demand. This is important in capturing the conditions affecting travelers, as they may need to budget additional time to account for unreliable travel times.

As part of this effort, a thorough review has been undertaken of past CMSP opportunity lists. This includes a qualitative review of all of the opportunities to identify their current implementation status consisting of:

- Completed projects
- Projects that are in planning or construction phase
- Projects that are actively being pursued due to other circumstances

For completed projects, quantitative before-and-after analyses have been undertaken to understand their impacts on traffic congestion and safety. The actual project costs and construction characteristics have also been reviewed and compared to the original estimates. The comparisons of these real world implications of completed projects will be critical to the success of the Phase 4 work, by determining how cost and benefit estimation procedures can be improved and proposing solutions that can be most effective in relieving congestion, reliability, and safety problems.

PROJECT INTERVIEW PROCESS

In an effort to complete the review process of the previous CMSP opportunity lists and outcomes, interviews were conducted with the Area Managers, Engineers, and other Program Delivery Staff to debrief on the status of past opportunities, both those completed and not.

The following list of questions were discussed during these interviews to guide the conversation:

- How was the project viewed/interpreted?
- Concerns with scope/cost/effectiveness?
- Other factors or nearby work that influenced the decision?
- Local interest in project?
- Which remaining solutions/opportunities should be carried forward as candidates in CMSP4?
- What could be improved about the CMSP process?

The interviews took place on Wednesday June 8, 2016. The interviews were coordinated by Area, and the following people were present at the meetings:

North	East	South	West
▪ Sheila Kauppi ▪ Paul Jung ▪ Brian Kary ▪ Dale Gadi ▪ Tony Fischer	▪ Adam Josephson ▪ Dmitry Tomasevich ▪ Tony Fischer	▪ Jon Solberg ▪ Diane Langenbach ▪ Tony Fischer	▪ John Griffith ▪ Ron Rauchle ▪ Tony Fischer

The following is the outcome of interviews:

- CMSP Policy and Process Considerations
- Project Narratives
- Confirmation of Project Completion Status
- Implementation Characteristics

CMSP POLICY AND PROCESS CONSIDERATIONS

The following policy and process considerations were discussed during the interviews with the area managers. These statements reflect the experiences of program delivery (Area) staff based on previous phases of CMSP and subsequent implementation of project opportunities. The CMSP project team will use this input in an effort to improve the process for Phase 4.

- Consider more attention to potential projects on minor routes. Use prioritized project lists in conjunction with programmed maintenance list to determine optimal project selection.
- Instead of concentrating a lot of money on larger projects there would be a benefit to concentrating resources on smaller projects that could improve the mobility on smaller roadways, which would take the pressure off of principal routes. This would be an example of lower-cost, high-benefit projects.
- Consider doing small projects now to address the issues versus waiting until large projects can be constructed later.
- Selected projects don't necessarily have to involve reconstruction, smaller technological projects can also be highly beneficial.
- Developing multiple solutions for project locations at different scales.
- Identifying specific locations for CMSP forces conversation and awareness of issues even if an efficient solution is not feasible.
- Attempt to use data that represents benefits of the project and the project success that is more easily perceived by general public (e.g. travel time difference through area).
- CMSP Funds could be used for turn-backs, up to amount in original CMSP.
- Public perceives the bigger (reconstruction) projects more effective, rather than small technological improvements.
- The amount of money that CMSP is putting forth for a location should be reflective of the magnitude of the problem in that location.

PROJECT NARRATIVES *(SUMMARY OF INTERVIEWS WITH AREA MANAGERS)*

Introduction

The following provides a detailed summary of interviews with MnDOT area managers for each project. Projects are organized into categories based on their current status. These categories include:

- **Constructed:** Solutions have been implemented in these locations.
- **Under Construction:** Solutions are under construction in these locations.
- **Superseded by Larger Project:** Traditional project implementation was completed instead of a CMSP-style solution
- **Programmed:** Funding to construct solutions in these locations has been committed in the four-year State Transportation Improvement Program (STIP).
- **Study:** Corridor-specific studies (e.g. MnPASS, BRT) are underway along the facilities where these opportunities are located; these studies may recommend implementation of CMSP or similar solutions.
- **Low Priority:** Operational needs and/or local stakeholders indicate diminished support for these solutions. They are unlikely to proceed to implementation over the next several years.
- **Dropped:** These locations no longer have operational needs that would be addressed by the CMSP solution due to construction of a larger project or changes in travel patterns; these opportunities are not expected to receive further consideration.

The CMSP opportunity locations and status categories are shown in the CMSP Project Location Map on the next page. The Project IDs shown on the map correspond to the individual project narratives on the following pages of this report.

CMSP Projects

Constructed

Project: TH 8 near Chisago School **Area**: East | **Project ID:** III-4

- The original problem description was that the striping directs drivers into the turn lane and that the through lane is not clearly marked. This project was to revise striping to the east to improve safety by defining the right turn/left turn striping. The preliminary cost estimate for the project was $3,000.
- The restriping has been completed as part of the routine maintenance process, by adding skip strips along the outside of the through lane to delineate it from the turn lanes. The project was let in 2012.
- No congestion or safety issues have been observed or reported since the completion of the project.
- The ultimate solution in this location was consistent with the original scope for this project.

Project: I-35 - I-35W/I-35E Merge Area **Area**: East | **Project ID:** I-3

- This solution concept was to extend a fourth northbound lane from the I-35E/I-35W merge to the exit to TH 97. The CMSP concept solution had an estimated cost of $5,000,000.
- A smaller scale project was implemented in coordination with a pavement rehabilitation project in. This extended the two lanes on northbound I-35W to continue through the merge with I-35E, with a left-lane lane-drop downstream of the merge area.

Project: I-94 – D, TH 61 to White Bear Avenue **Area**: North | **Project ID:** I-9

- This project was to add an eastbound auxiliary lane with an estimated cost of $3,000,000. The actual cost of constructing the project was $1,141,000.
- The project was completed and was well received by the City Council, and the benefit of the project was recognized.
- The ultimate solution in this location was consistent with the original scope for this project.

Project: TH 10 – A, A1: Egret Boulevard to Hanson Boulevard **Area**: North | **Project ID:** I-10

- This project was to add a third lane eastbound, with an estimated cost of $6,000,000. The actual cost of constructing the project was $4,582,000
- This was a successful project. The legislature wants an extension to Round Lake Boulevard.
- The ultimate solution in this location was consistent with the original scope for this project.

Project: TH 10 – A, A2: Egret Boulevard to Hanson Boulevard **Area**: North | **Project ID:** I-10

- This project was to add westbound third lane, with an estimated cost of $6,000,000. The actual cost of constructing the project was $4,582,000
- This was a successful project. The legislature wants an extension to Round Lake Boulevard.
- The ultimate solution in this location was consistent with the original scope for this project.

Project: TH 65-Ops, I-694 to CSAH 24 (East Bethel) **Area**: North | **Project ID:** I-19

- This was a corridor tuning project for 25 signals in 3 zones plus wireless interconnect. The estimated cost of the project was $107,500. The final project tuned 24 signals and cost $66,000.

Project: TH 36 TH 120 (Century Avenue) **Area**: North | **Project ID:** III-16

- The original problem description was that there was signalized intersection failure and major queuing and delays on side-street approaches. This was an innovative intersection design project to construct quadrant roadways in northeast and southwest quadrants, construct a pedestrian bridge over southwest quadrant roadway, and convert to a two-phase signal at TH 36 and TH 120. The preliminary cost estimate for the project was $1,654,000.
- An extended eastbound left turn was implemented as a reduced scope solution, but it addressed a specific problem and was implemented with minimal impacts.
- The ultimate solution in this location was not consistent with the original scope for this project.

Project: TH 65 CSAH 10 **Area**: North | **Project ID:** III-29

- The original problem description was that southbound right lane from the 85th Avenue intersection must exit to CSAH 10 westbound and results in driver confusion and late lane changes. This was a freeway geometric improvement project to provide escape lane for right lane after the exit to CSAH 10 westbound. The preliminary cost estimate for the project was $103,500.
- The project was intended to improve safety by providing an escape lane for southbound TH65 traffic in the right lane.
- This solution was completed in coordination with a pavement overlay project along TH 65 near CSAH 10. The project was let in 2014.
- The ultimate solution in this location was consistent with the original scope for this project.

Project: I-35W – A, 106th Street to TH 13 **Area**: South | **Project ID:** I-4

- This project was to add a southbound auxiliary lane at an estimated cost of $6,000,000. The project was completed as part of UPA improvements constructed when the high-occupancy vehicle (HOV).
- The ultimate solution in this location was consistent with the original scope for this project.

Project: TH 13-Ops, Yankee Doodle Road to Prior Lake **Area**: South | **Project ID:** I-17

- This project included corridor tuning for 25 signals in five zones at an estimated cost of $97,500. The implemented project retimed 43 signals along this corridor at a cost of $152,000.
- This was an effective project on a signalized corridor at a low cost.
- This was a great example showing that selected projects don't necessarily have to involve reconstruction, smaller technological projects can be highly beneficial.

Project: I-35 CSAH 50 NB Entrance **Area**: South | **Project ID:** III-8

- The original problem description was that the entering traffic at the northbound entrance from CSAH 50 to I-35 causes congestion on northbound I-35. This was a freeway geometric improvement project to add parallel acceleration distance to the northbound entrance to improve merge operation. The preliminary cost estimate for the project was $399,400.

- This project was combined with a pavement project and was completed in 2014.
- The project scope was not expanded to tie in to the third lane to the north as it was not considered feasible and effective from a funding standpoint.
- The ultimate solution in this location was consistent with the original scope for this project.

Project: TH 61 TH 55 and 10th Street (Hastings) **Area**: South | **Project ID:** III-23

- The original problem description was that TH 61 through town was expected to operate poorly once the new TH 61 Bridge was constructed. This was an intersection geometric improvement project to construct an eastbound dual left turn lane, close property access on east approach at TH 55, close access on west approach at TH 61 and 10th Street, and eliminate left turns at TH 55 and Eddy Street. The preliminary cost estimate for the project was $365,400.
- This project was let in 2015. The completed project included construction of an eastbound dual left turn lane from eastbound TH 55 to northbound TH 61. It was modified from the original CMSP solution by not including the access closures on the east approach at TH 55 or the west approach at 10th Street. The actual construction cost of the project was $356,000.
- This project was constructed on its own as a lower-cost/high-benefit mobility improvement. It was a very quick project and there was a very short construction timeline of just three weeks.
- This project experienced some challenges as a result of the short implementation timeline. First, it was "out of cycle", meaning it did not follow the traditional multi-year approach including scoping, program, design, and construction. This limited the time available for all of MnDOT's functional groups to participate in the project development process.
- Lessons learned from this project was that quickly implemented projects can cause issues with different functional groups establishing their own needs for project area. However, limited scope projects can be implemented quickly and on their own, minimizing construction impacts and delivering benefits sooner. Cooperation from the City and adjacent developments allowed for the project to go smoothly.
- The ultimate solution in this location was generally consistent with the original scope for this project, but did not include all of the proposed access closures.

Project: TH 169 Marschall Road **Area**: South | **Project ID:** III-41

- The original problem description was that the westbound exit ramp backs up onto the TH 169 southbound mainline during the PM peak. This was an intersection geometric improvement project to add dual westbound right turn lanes at the north intersection. The preliminary cost estimate for the project was $250,000.
- This location was previously known to be a problematic intersection, and the City of Shakopee and Scott County led the implementation of improvements here. Improvements were coordinated with a project at the Marschall Road and Vierling Drive intersection.
- While this project was ultimately led locally, the CMSP process helped raise awareness of this opportunity by identifying it through the CMSP evaluation.
- The ultimate solution in this location was modified from the original scope for this project by adding dual left turn lanes rather than dual right turn lanes.

Project: I-494 – B, B2: I-35W to France Avenue **Area**: West | **Project ID:** I-7

- This project was to add a westbound auxiliary lane between the northbound I-35W entrance loop and the France Avenue exit ramp, with an option to extend the lane through France Avenue. The original estimated cost of the project was $4,000,000.
- The project ended up costing $9,000,000.
- The identified CMSP solution was ultimately constructed, however it was not done in isolation. The auxiliary lane was conducted as part of programmed bridge and pavement rehabilitation in the project area. A major barrier to constructing this project was the Xerxes Avenue bridge; the previous bridge was not long enough to accommodate additional lanes on I-494, however once it was reconstructed the westbound lane could be added.

Project: I-94 – A, TH 101 **Area**: West | **Project ID:** I-8

- The initial proposed scope for this project was to add half-mile westbound auxiliary lane along westbound I-94 approaching TH 101, a two-lane exit from westbound I-494 to TH 101, a three-lane mainline along northbound TH 101 from the I-94 westbound ramp to the South Diamond Lake Road intersection, and complete signal revisions and realignment of northbound through from Rogers at north ramp. The estimated cost of the project was $4,000,000.

- The project was completed with modified design, which was highly modified from the proposed scope. A more substantial project was implemented in this location, including a grade-separated ramp for westbound I-94 traffic destined to northbound TH 101 to avoid the South Diamond Lake Road intersection. The final project cost was $5,954,000.
- The ultimate solution in this location was not consistent with the original scope for this project. However, the project that was implemented has generally been credited with providing effective benefits in this location by improving mobility and safety.

Project: TH 100, I-694 **Area**: West | **Project ID:** I-11

- This project was to add a two-lane northbound on-ramp from TH 100 to eastbound I-694 by re-striping the existing ramp. The estimated cost for this improvement was $500,000.
- This project was completed as part of the I-35W Bridge Traffic Restoration efforts. The traffic improvement and low impacts demonstrate that stripping and lane-alignment modifications can be effective solutions.
- The ultimate solution in this location was consistent with the original scope for this project and cost $190,000 to implement.

Project: I-94 – B, I-394 **Area**: West | **Project ID:** I-13

- This project was to convert westbound I-94 exit to I-394 from tunnel to 2-2 fork, at an estimated cost of $300,000.
- The project was completed with modified design, where the center lane becomes two lanes north of the tunnel; the existing 3-2 split was maintained. Since project completion, there has been a noticeable shift in lane utilization. The lanes have become more balanced, resulting in an increase in safety in the project area.
- The ultimate solution in this location generally accomplished the intent of the original scope for this project.

Project: TH 7-Ops, East Ramp MN 100 - MN 41 **Area**: West | **Project ID:** I-18

- This was a corridor tuning project for 24 signals in four zones, with an estimated cost of $94,000.
- This project is an ongoing project on a five-year cycle.
- The final implemented project included 29 signals through the corridor with an actual cost of $67,000.

- Local stakeholders generally agree that these improvements have helped provide improved signal progression and travel times in the peak period

Project: TH 100-Ops, I-694 to I-394 **Area**: West | **Project ID:** I-16

- This was a project to install ramp meters at TH 55, Duluth Street, 36th Avenue, CR 81, and France Avenue. The estimated cost of the project was $120,000.
- This project was highly effective in reducing congestion, and had an actual cost of $123,000.
- The ultimate solution in this location was consistent with the original scope for this project.

Project: TH 55 at TH 100 NB Exit Ramp **Area**: West | **Project ID:** III-20

- The original problem description was that the queue from northbound left-turning traffic extends beyond the right turn lane blocking access for right-turning vehicles. This was an intersection geometric improvement project to extend the northbound exit ramp right turn lane as far as possible. The preliminary cost estimate for the project was $132,000.
- Only the northbound improvements were identified through the CMSP 3 evaluation. The actual turn lane improvements exceeded the scope of the initial concept. The constructed project implemented separate storage bays for right and left-turning traffic. It also constructed the additional turn lane length on the southbound exit ramp. The project was completed as a standalone project and was let in 2015.
- The ultimate solution in this location was not consistent with the original scope for this project. It has been generally been viewed as a positive and beneficial improvement.

Project: TH 47 at Broadway Avenue (Minneapolis) **Area**: West | **Project ID:** III-17

- The original problem description was that the urban corridor has pedestrian safety and crash problems. This project was a traffic signal modification project at the Broadway Avenue intersection. The original concept solution was traffic signal modification and coordination with upcoming improvements at this location. The preliminary cost estimate for the project was $20,000.
- This project was completed in coordination with a City of Minneapolis project to upgrade the signal system and repair pavement at this intersection.

Under Construction

Project: I-94 WB, Radio Drive, Woodbury Drive & Manning Avenue **Area**: East | **Project ID:** A-2

- This project is to add Ramp Meters. According to RTMC staff, the underground infrastructure to support ramp metering in these locations exists. It is anticipated that I-94 ramp meters will be installed in 2016.
- The ultimate solution in this location is expected to be consistent with the original scope for this project.

Project: I-35E CSAH E NB Entrance & I-35E/CSAH SB Exit **Area**: North | **Project ID:** III-10

- The original problem description was that the entering traffic from CSAH E puts the right lane of the mainline at capacity and that congestion affects both mainline lines. This freeway geometric improvement project is to add 580 feet of parallel acceleration distance to the northbound entrance and 340 feet of deceleration to the southbound exit. The preliminary cost estimate for the project was $300,000. The project was let in 2015.
- CMSP 3 had recommended parallel acceleration from CR 96 to SB 35E. This is being accomplished with a current bridge redeck project as well as at the northbound entrance ramp. This was estimated to cost the project approximately $0 (therefor $0 funding) because the shoulders had already been constructed to full depth under a previous unbonded overlay project and the bridge redeck of 96 already included unbonded overlay of the ramps so the geometric tweak was modest additional work. No parallel deceleration was recommended by CMSP and none is being built with the 96 project.

Project: I-35E at Diffley Road **Area**: South | **Project ID:** A-1

- This proposed project was to construct a south to east double left lane. The project came out of the signal timing study.
- The project constructed a left turn lane, and left, through shared lane, and a right turn lane and the estimated project cost was $921,000. The project was let in 2016.

Project: I-494 – A, TH 55 **Area**: West | **Project ID:** I-6

- This project was to lengthen northbound exit ramp turn lanes and triple left turn lanes, and also to add third lane westbound to Fernbrook Lane or Plymouth Boulevard. The estimated cost of the project was $2,500,000.
- This project is under construction as part of the I-494 project.

- Extending the third lane to Vicksburg or Peony is desired.
- The ultimate solution in this location was consistent with the original scope for this project.

Superseded by Larger Project

Project: I-35E Maryland Avenue to CR C **Area**: North | **Project ID:** III-9

- The original problem description was that the entering traffic at the southbound entrances at Larpenteur Avenue and Maryland Avenue put I-35E southbound over capacity. This was a freeway geometric improvement project to add a lane on the right from the Larpenteur Avenue southbound entrance and tie into Cayuga project area. The preliminary cost estimate for the project was $3,354,000.
- The CMSP concept was not pursued as the I-35E Cayuga Street / MnPASS projects provided a larger scale solution in this area.

Project: I-35W – B, Washington Avenue **Area**: West | **Project ID:** I-12

- This project was to re-stripe southbound on Mississippi River Bridge to have the right lane end at the Washington Avenue exit and second lane exit to the collector-distributor road, through traffic on southbound I-35W to TH 55 stays in left two lanes. The estimated cost of this project was $500,000.
- This project was completed as part of I-35W bridge reconstruction. It is difficult to determine the effectiveness of these improvements due to additional capacity of the bridge and changes in traffic patterns.
- The ultimate solution in this location had many similarities with the original scope for this project, however it was implemented as part of the overall reconstruction of the I-35W Bridge.

Project: I-694 Westbound at Rice Street **Area**: North | **Project ID:** III-53

- The original problem description was that the escape lane following the exit to Rice Street results in increased congestion on I-694 westbound. The original concept solution was to provide third westbound lane from Rice Street to Lexington Avenue. The preliminary cost estimate for the project was $4,080,000.

- This was a freeway geometric improvement/additional lane project to widen I-694 to six lanes between Rice Street and Lexington Avenue.
- Corridors of Commerce is funding the I-694 additional lanes preservation project. The project was let in 2015 and the actual cost for the project was 34.7 million dollars.
- The ultimate solution in this location was not consistent with the original scope for this project. It was expanded to a more traditionally scoped capacity expansion project.

Project: TH 101 at CSAH 61 (Carver) **Area**: South | **Project ID:** III-37

- The original problem description was that the "Y" intersection has operational and safety issues. The original concept solution was to remove three existing traffic signals and construct single new intersection near a park and ride lot. The preliminary cost estimate for the project was $1,740,000.
- The project under construction was modified from the CMSP solution by constructing a roundabout at the consolidated intersection location rather than a signalized intersection. This was driven by the TH 101 flood raising project and was not constructed as a lower-cost/high-benefit solution.
- The total project cost was about $55,000,000. Site specific issues caused cost increase compared to initial CMSP estimates.
- The ultimate solution in this location was not consistent with the original scope for this project.

Project: I-94 Dale Street **Area**: North | **Project ID:** III-33

- The original problem description was that the original interchange design only provided one through lane in the northbound and southbound directions across I-94, leading to congestion issues in peak periods. The solution proposed intersection geometric improvements and a pedestrian bridge. The original concept solution was to improve traffic signal phasing, remove pedestrian sidewalk, add southbound left turn lane, and construct new pedestrian bridge west of Dale Street. The preliminary cost estimate for the project was $2,573,750.
- Ramsey County received $5.6 million in Surface Transportation Program (STP) funding. This County-led project aims to improve connectivity and pedestrian accommodations across I-94, with less focus on congestion. As a result the project was not correlated with the original CMSP opportunity.

Project: I-494 TH 55 to East Fish Lake Rd **Area**: West | **Project ID:** III-50

- This is a freeway geometric improvement project to reconstruct the right shoulders along northbound and southbound I-494 as dynamic shoulder lanes between TH 55 and Fish Lake Road. Static signing would be used to operate the southbound lane in the AM peak only and the northbound lane in the PM peak only. The original project cost estimate was $26,400,000.
- The ultimate solution involved more significant capacity expansion and pavement rehabilitation. As part of a concrete pavement preservation project, additional lanes will be added to provide a six-lane section between TH 55 and East Fish Lake Road. Additional geometric enhancements, such as auxiliary lanes, will also be added in select locations between TH 55 and I-394. The project was let in 2015.
- The ultimate solution in this location was not consistent with the original scope for this project.

Programmed

Project: TH 97 Bridge over I-35 **Area**: East | **Project ID:** A-5

- This project is to add a third lane on the bridge for back to back left.
- The project will be constructed in 2017/2018 with an I-35 unbonded concrete overlay project.
- The turn lane will improve the operations, but will not meet all the needs desired at this location. The locals are pursuing funding for additional bridge widening, which MnDOT will accept if funds are procured.

Project: I-35W SB at I-694 EB Entrance **Area**: North | **Project ID:** III-11

- The original problem description was that the entering traffic from eastbound I-694 puts southbound I-35W at capacity in the AM peak. This is a freeway geometric improvement s to add an auxiliary lane on I-35W southbound from I-694 toCR E2. The preliminary cost estimate for the project was $902,000.
- This project was evaluated through the I-35W North MnPASS study and is recommended to move ahead with the MnPASS project.
- This project is planned as part of the I-35W North MnPASS project. While funding for the I-35W North MnPASS project is included in the STIP for 2019-2020, additional funding is needed to construct all elements of the

project scope. As a result, it is not known whether the project will include this auxiliary lane or be limited to the MnPASS lanes.

Project: I-35W – I-694 Interchange Inside Loops **Area**: North | **Project ID:** III-12

- The original problem description was ramp-to-ramp weaving between the northbound exit loop volume at I-694 and the northbound entrance loop volume from I-694. These movements combine to form a weaving volume that is over capacity for a cloverleaf loop-to-loop weave. The reason that these volumes are actually accommodated is due to the operation of the outside through lane as a buffer lane. This means that the through volume on I-35W is actually confined to the two left lanes. The maximum load point in this segment in the northbound direction is located between I-694 and CSAH 96. Ramp-to-ramp weaving occurs between those two interchanges.
- This is an interchange improvements project. The original concept solution was the bridge braid northbound to westbound and eastbound to northbound loops. The preliminary cost estimate for the project was $1,385,000.
- The project was evaluated through the I-35W North MnPASS study and is recommended to move ahead with the MnPASS project. The proposed solution is modified from the CMSP solution. It includes an auxiliary lane along northbound I-35W from the CR E2 entrance ramp to I-694. This auxiliary lane would tie into an additional buffer lane at the loop-to-loop weave at I-694. The cost estimate for this improvement is $2 million.
- This project is planned as part of the I-35W North MnPASS project. While funding for the I-35W North MnPASS project is included in the STIP for 2019-2020, additional funding is needed to construct all elements of the project scope. As a result, it is not known whether the project will include this auxiliary lane or be limited to the MnPASS lanes.

Project: I-35W – CSAH 96 to I-694 **Area**: North | **Project ID:** III-13

- The original problem description was that the entering volume from CSAH 96 and the exiting volume to WB I-694 create a weaving section in the right lane. The original concept solution was to add an auxiliary lane on I-35W southbound from CSAH 96 to I-694 westbound. The preliminary cost estimate for the project was $872,000.
- This project was evaluated through the I-35W North MnPASS study. The project is moving ahead with the MnPASS project. The cost estimate for this improvement is $800,000.

- This project is planned as part of the I-35W North MnPASS project. While funding for the I-35W North MnPASS project is included in the STIP for 2019-2020, additional funding is needed to construct all elements of the project scope. As a result, it is not known whether the project will include this auxiliary lane or be limited to the MnPASS lanes.

Project: I-35W – NB I-694 to CSAH 96 **Area**: North | **Project ID:** III-14

- The original problem description was about the entering volume and ramp-to-ramp weaving in northbound direction. The original concept solution was to add auxiliary lane on I-35W northbound from I-694 westbound to CSAH 96. The preliminary cost estimate for the project was $654,000.
- The project was evaluated through the I-35W North MnPASS study. The project is moving ahead with the MnPASS project. The cost estimate for this improvement is $700,000.
- This project is planned as part of the I-35W North MnPASS project. While funding for the I-35W North MnPASS project is included in the STIP for 2019-2020, additional funding is needed to construct all elements of the project scope. As a result, it is not known whether the project will include this auxiliary lane or be limited to the MnPASS lanes.

Project: I-35W at I-694 **Area**: North | **Project ID:** I-5

- This project was to add northbound buffer lane for the northbound loop-to-loop weave on I-35W at I-694. The estimated cost of the project is $1,500,000.
- The project is planned as part of the I-35W North MnPASS project. While funding for the I-35W North MnPASS project is included in the STIP for 2019-2020, additional funding is needed to construct all elements of the project scope. As a result, it is not known whether the project will include the buffer lane or be limited to the MnPASS lanes.

Project: SB I-35W to EB US 10 **Area**: North | **Project ID:** III-5

- This project is to add a second lane to the SB I35W to EB US 10 exit ramp, and add an auxiliary lane to EB US 10 from I35W to CSAH 96. Funding sources for the project is CMSP and the project cost for fiscal year of 2019 is $2,547,000. The project is anticipated to be let in 2018.
- According to the Metropolitan Freeway System 2013 Congestion Report the need in this location was identified as greater than 3 hours of daily congestion. Scherer Brothers along US 10 is not able to enter the highway during the morning due to high volumes and lack of gaps.

- The purpose of the project is that demand for exit exceeds capacity, a 2-lane exit will reduce congestion along SB 35W. The auxiliary lane will provide a lower volume lane for Scherer Brothers to access providing more gaps in traffic to enter the highway.

Project: EB US 10 at North Junction I35W **Area**: North | **Project ID:** III-5

- This project was to reconfigure the EB US 10 lane drop so that the third lane on EB US 10 is extended about a half mile and the third lane drops on the left side into the exit ramp to NB I35W, and the other 2-lanes go to SB I35W.
- EB US 10 is a 3-lane roadway just past County Road J where it drops the right lane and becomes a 2-lane roadway. There is less than a half mile between the lane drop and the left exit to NB I35W. A queue of traffic on EB US 10 occurs in the morning rush hour that starts at I35W and extends past the left exit to NB I35W.
- The purpose of this project was to allow traffic on EB US 10 to get to the NB I35W exit without encountering a queue of cars heading to SB I35W.
- The project was canceled. This project was evaluated as part of the I35W North MNPASS project. It was decided to reject doing this project, because its effect was to send more traffic into the I35W/US 10 commons, which would make I35W operate worse. This enhancement should not be considered until after either the interchange at TH 36 is reconstructed to handle more capacity or until a MNPASS lane is constructed all the way to downtown Minneapolis.

Project: TH 51 Larpenteur Avenue **Area**: North | **Project ID:** III-19

- This was an intersection geometric improvement project. The original concept solution was to add northbound and southbound dual left turn lanes, provide eastbound right turn lane, and modify access to right-in-right-out on southbound approach. The preliminary cost estimate for the project was $630,000.
- The project has moved forward and was combined with a concrete pavement repair project programmed for 2017.

Project: I-694 EB, entrance from EB US 10 **Area**: North | **Project ID:** A-3

- This project is to add a two-lane entrance and auxiliary lane to Lexington Avenue exit. The project is programmed for 2/24/2017, and will be let in fiscal year of 2017.
- It is likely that the project will get accomplished with 6285-143 study. A noise wall study was required but none deemed cost effective and feasible. The project may need to be delayed, this is an effective project and

will remain on the list until the right time comes. Once the project happens it will be a standalone project. This fits in with other improvements in this area including the I-694 expansion between Lexington Avenue and Rice Street and the southbound I-35 W to eastbound TH 10 two-lane exit.

Project: I-494 WB from Concord Street through 7th Avenue **Area**: South | **Project ID:** A-6

- The project is to add an auxiliary lane along westbound I-494 from Concord Street to 7th Avenue.
- The cost of this project is $11.6M. This cost is higher than the original vision for this project since it was not expected to include bridge widening and participating in moving a trunks storm sewer and noise walls. However, it is still seen as a beneficial improvement. The project is anticipated to be let in 2018.
- There was a challenges with this project in terms of getting people on board, as the Metro leadership and Metropolitan Council were still in transition of CMSP being a "low cost" solution versus "lower-cost".

Project: TH 77 at Old Shakopee Road **Area**: West | **Project ID:** A-7

- This project is to add 300' to the right turn lane. The cost estimate for the project is $166,000 and is attached to M&O 2758-77. The annual mobility benefits of this project has been estimated at $46,000. The project is anticipated to be let in 2019.

Project: 3rd Street/Lyndale Avenue to WB I-94 **Area**: West | **Project ID:** A-4

- This project is to add a two-lane entrance from the 3rd Street/Lyndale Avenue ramp to westbound I-94. The project was scheduled to have been let in 2016. The original cost estimate was $320,000 but some late changes might have increased the cost about $20,000. According to STIP the actual cost of the project is $400,000.

Study

Project: TH 120 near Century College **Area**: East | **Project ID:** III-39

- The original problem description was that the Century College traffic conflicts with commuter traffic causing major congestion, and backups that extend onto I-694. The project was to add an additional lane along northbound TH 120 along with intersection geometric improvements. Focus location will be the CR D/Long Lake Drive intersection. The original concept solution was to construct a second northbound through lane from CR D through South Campus Road. The preliminary cost estimate for the project was $430,000.

- The project was delayed, aiming to package improvements for turn back to the County. There is a resurfacing project around 2020, and potential for CMSP funds to address congestion and safety problems at the college intersections while turning back the roadway to the Ramsey and Washington Counties. The concept for the project is still being evaluated. There is also an interest in roundabouts at the north and south entrances and 3/4 or right-in-right-out at the middle access. There is an attempt to try to get funding from the bike and pedestrian unit at MnDOT. This project could serve as an example of leveraging CMSP funding to obtain funding from other entities.

Project: TH 10 - TH 47 Interchange **Area**: North | **Project ID:** III-6

- The original problem description was that the westbound exiting traffic backs up from TH 47 onto TH 10 mainline. This is an intersection geometric improvement project. The original concept solution was to look at Northstar Commuter Rail crossing, and lengthen the westbound exit ramp turn lanes. The preliminary cost estimate for the project was $70,000.
- This project will be considered with the Rum River bridge replacement in the mid-2020s. This project should be implemented with replacement of Rum River Bridge. It is a complicated project with TH 10 Bridge, railroad, and TH 47 realignment.

Project: I-94 WB at I-35E South **Area**: North | **Project ID:** III-34

- This is a freeway geometric improvement project to modify the ramp geometry along westbound I-94 just west of I-35E. The CMSP solution would convert the 12th Street left-side entrance from a merge to an add-lane, and convert the 6th Street right-side entrance from an add-lane to a merge.
- This project is part of the I-94 Preservation and Enhancement Study area.

Project: I-94 WB – TH 52 to I-35E North **Area**: North | **Project ID:** III-35

- The original problem description was about entering volume, ramp-to-ramp weaving, and substandard geometry. This segment of I-94 through the Saint Paul CBD has several items causing or adding to congestion. The first is the heavy entering volume from northbound TH 52. This ramp adds a full lane of traffic volume and the demand is even higher. Then the portion of that traffic that is headed west on I-94 must weave with the westbound I-94 traffic headed for I-35E north.
- The original concept solution was to add lane from TH 52, drop one lane to I-35E northbound and one to local exit. The preliminary cost estimate for the project was $1,803,000.

- This project is part of the I-94 Preservation and Enhancement Study area.

Project: Highway 65 at Viking Boulevard **Area**: North | **Project ID:** A-8

- This is a signalized RCI project. This project was initially intended to be funded by CMSP, but bigger projects were funded by HSIP. The area is currently under study to implement a series of coordinated RCI installations and is expected to be programmed.

Project: TH 169 at TH 41 **Area:** South | **Project ID:** III-40

- The original problem description was that this is a high crash location (rear end crashes, high costs). The original concept solution was to construct an interchange to grade separate TH 169 from TH 41/CSAH 78. The preliminary cost estimate for the project was $16,600,000.
- FHWA asked the County to evaluate this project but didn't come out as a cost effective, high benefit project. The County-led design involved a more substantial solution to address other concerns in the area. Scott County received $7,000,000 from the Metropolitan Council Regional Solicitation process and an additional $17,700,000 as part of the USDOT TIGER grant program to aid in the construction of a grade-separated interchange, overpass, access closures, and frontage road system.

Project: TH 169 NB Minnesota River Crossing **Area**: South | **Project ID:** III-42

- The original problem description was that there was major bottleneck on northbound TH 169 at CSAH 18 and TH 101 merge points. This is a restriping project to provide additional lane. The original concept solution was modification of Flood Plan in place Spring of 2011, with removal of loop from TH 101 eastbound to TH 169 northbound. The preliminary cost estimate for the project was $1,460,000.
- This project came out of the 2011 Flood Mitigation study and is currently under study in the TH 169 Mobility study. There are concerns about maintenance and drainage structures if this were made permanent. It also doesn't provide HOV or transit advantage.

Project: TH 5 at CSAH 4 (Hennepin) **Area**: West | **Project ID:** III-1

- The original problem description was that the intersection of TH 5 and Hennepin CSAH 4 in Eden Prairie is a high crash and high congestion location. The original concept solution was to extend the westbound right turn and eastbound left turn storage bay lengths. The preliminary cost estimate for the project was $210,000.

Project: TH 62 WB Entrance from SB TH 100 **Area**: West | **Project ID:** III-24

- The original problem description was that the entering traffic at the ramp from TH 100 southbound to TH 62 westbound puts the mainline volume at capacity. The original concept solution was to provide auxiliary lane on TH 62 westbound from TH 100 southbound to Tracy Avenue. The preliminary cost estimate for the project was $1,936,000
- The project is now under consideration in the I-494/TH 62 Congestion Relief Study.

Project: TH 62 EB Loops at TH 100 **Area**: West | **Project ID:** III-25

- The original problem description was ramp-to-ramp weaving, the loop-to-loop weaving section at the TH 100 interchange is the primary cause of congestion during the AM peak in the eastbound direction. The original concept solution was to bridge braid eastbound to northbound and southbound to eastbound loops. The preliminary cost estimate for the project was $1,655,000.
- This is an interchange improvements project. It is now under consideration in the I-494/TH 62 Congestion Relief Study.

Project: TH 62 WB – Valley View Road to TH 100 **Area**: West | **Project ID:** III-26

- The original problem description was about the ramp-to-ramp weaving and entering traffic; the westbound entering volume from Valley View Road and weaving to TH 100 northbound also adds to the congestion. The original concept solution was to provide auxiliary lane on TH 62 westbound from Valley View Road to TH 100 northbound. The preliminary cost estimate for the project was $2,056,000
- The project is now under consideration in the I-494/TH 62 Congestion Relief Study.

Project: TH 62 EB – I-35W to TH 77 **Area**: West | **Project ID:** III-27

- The original problem description was that the AM peak congestion causes queuing on TH 77 northbound along with high crash costs. This is a freeway geometric improvements/auxiliary lane project. The original concept solution was to provide auxiliary lane on TH 62 westbound from TH 77 northbound to Portland Avenue. The preliminary cost estimate for the project was $4,058,000.
- The project is now under consideration in the I-494/TH 62 Congestion Relief Study.

Project: TH 62 WB TH 77 to I-35W **Area**: West | **Project ID:** III-28

- The original problem description was that the PM peak congestion causes queuing on I-35W southbound along with high crash costs. This is a freeway geometric improvements/auxiliary lane project. The original concept solution was to provide auxiliary lane on TH 62 eastbound from Portland Ave to TH 77 southbound, and to discuss elimination of Bloomington Ave Interchange. The preliminary cost estimate for the project was $3,222,000.
- Some modeling and scoping was done but there is concern about bus shoulder, and other small individual projects. There was interest in these improvements from the West Area and local agencies, but by the time there was some movement on them, it was anticipated that the I-494/TH 62 Congestion Relief Study would consider improvements in this location.

Project: I-94 WB Merge with NB I-494 **Area**: West | **Project ID:** III-30

- The original problem description identified substandard geometry and mainline weaving. I-94 westbound inside merge with I-494 northbound and traffic crossing from I-494 northbound to the Weaver Lake Road exit cause PM peak congestion near Hemlock Lane and Weaver Lake Road interchanges. This is a freeway geometric improvements project. The original concept solution was to add lane on left to remove inside merge with I-494 northbound and drop left lane after Weaver Lake Road exit. The preliminary cost estimate for the project was $2,190,000.
- The project will be studied after the I-494 expansion project to the south is completed.

Project: I-94 EB – Lyndale Avenue to I-35W **Area**: West | **Project ID:** III-31

- The original problem description identified ramp-to-ramp weaving as the primary issue. The entering traffic from Lyndale Avenue must weave with the traffic moving over to exit to I-35W southbound. Traffic entering from this ramp may also be headed for the left exit to I-35W northbound and therefore must cross lanes.
- This is a freeway geometric improvement/auxiliary lane project. The original concept solution was to construct buffer lane between Lyndale Avenue and I-35W southbound. The preliminary cost estimate for the project was $5,514,000.
- The project will be studied as part of the I-94 Preservation and Enhancement Study. The project might be potentially deferred until after the Lake Street project.

Project: I-94 WB – TH 55 to 11th Street **Area**: West | **Project ID:** III-32

- The original problem description was about the lane drop and exit capacity, the exit demand to 5th Street may approach the capacity of that ramp. Additionally, there is the left lane drop with the exit to I-35W southbound which also causes added lane changes and compromises the capacity of the left lane.
- This is a freeway geometric improvement/auxiliary lane project. The original concept solution was to provide two-lane entrance from I-35W southbound/TH 55 westbound, drop one lane at the 11th Street exit, and provide escape lane after 11th Street exit. The preliminary cost estimate for the project was $984,000.
- The project will be studied as part of the I-94 Preservation and Enhancement Study and may be deferred until after the Lake Street project.

Project: TH 101 at the I-94 Interchange **Area**: West | **Project ID:** III-38

- The original problem description was the congestion and safety issues at the I-94/TH 101 interchange ramp intersections. The original concept solution was to extend TH 101 northbound left turn lane at north ramp intersection. The preliminary cost estimate for the project was $72,000
- The project will be studied after the TH 610 project is completed.

Project: TH 169 – I-394 to Medicine Lake Road **Area**: West | **Project ID:** III-44

- The original problem description was the ramp-to-ramp weaving and substandard geometry, closely spaced interchanges and heavy weaving volumes result in major congestion on northbound TH 169. An uphill grade in the northbound direction contributes to congestion in this segment. The original concept solution was to provide auxiliary lanes on TH 169 northbound and southbound between Medicine Lake Road and Plymouth Road. The preliminary cost estimate for the project was $3,434,000.
- The project will be reevaluated after the TH 169 Mobility Study, and is currently outside of the current scope.

Project: TH 252 at 85th Avenue **Area**: West | **Project ID:** III-45

- The original problem description identified existing intersection operations issues, signal deficiencies, and safety problems. The original concept solution was to construct third northbound lane between Humboldt Avenue and TH 610 and construct noise walls between 85th Avenue and 66th Avenue. The preliminary cost estimate for the project was $6,555,000.

- The TH 252 corridor is under evaluation in the Principal Arterial Intersection Conversion Study (PAICS) to be considered for potential future grade separation. The results of that study may lead to a future TH 252 Conversion Study to investigate this location in greater detail.

Project: I-394 WB – TH 169 C-D Road **Area**: West | **Project ID:** III-46

- The original problem description was that the volumes on westbound I-394 are near capacity when the MnPASS lane and two general purpose lanes are combined with the lane entering from the TH 169 C-D Road. The original concept solution was to provide access for traffic to enter I-394 westbound from the C-D Road between TH 169 northbound and TH 169 southbound entrances, and extend the existing auxiliary lane through the Hopkins Crossroad interchange. The preliminary cost estimate for the project was $664,000.
- This is a freeway geometric improvements project to open up the westbound I-394 C-D road near TH 169. Additional modeling and study is needed to confirm the benefits of this concept.

Project: I-394 WB at I-94 **Area**: West | **Project ID:** III-48

- The original problem description was where the I-394 mainline is reduced to one lane immediately west of I-94. This is a freeway geometric improvements/additional lane project to eliminate the lane drop on I-394 coming out of downtown. The original concept solution was to eliminate lane drop by continuing two lanes from downtown to merge with I-94 eastbound and westbound entrances, and provide four lanes to TH 100. The preliminary cost estimate for the project was $1,000,000.
- Subsequent review of this project area has suggested that additional width would be required on the westbound I-394 bridge to the west of Dunwoody Boulevard to accommodate the additional lane. This is a major factor in a potential cost that is higher than the original CMSP concept estimate.
- This project will cost about $10,000,000 to be coordinated with bridge preservation work in 2024, but is likely to continue moving forward.
- It is expected to be considered in greater detail as part of MnPASS System Study Phase 3.

Project: I-694 WB approach to I-94/TH 252 **Area**: West | **Project ID:** III-52

- The original problem description was about the ramp entering volume and ramp exit capacity. The exiting volume from I-694 westbound to I-94 eastbound (southbound) is at capacity and the two-lane entrance from TH 252 onto I-94 also is a controlling feature for capacity resulting in backups extending onto TH 252. The original concept solution was to provide two-lane exit loop from I-694 westbound to TH 252 southbound, provide additional lane on TH 252 southbound between I-694 and I-94, and connect I-694 westbound

auxiliary lanes through the East River Road interchange. The preliminary cost estimate for the project was $2,214,500.

- Further scoping work completed by MnDOT identified that these improvements would trigger a need for three miles of an additional lane on I-94 from I-694 south to Dowling Avenue. The four lanes on I-94 are currently near capacity, in a constrained area under the I-694 overpass. The additional work to address these secondary impacts were seen to be unrealistic in the context of a CMSP solution.

Project: I-35W SB – Johnson Street through University Avenue **Area**: West | **Project ID:** A-9

- This is an auxiliary lane project to connect the long parallel acceleration lane from the Johnson Street entrance to the existing auxiliary lane between Hennepin Avenue and 4th Street/University Avenue exit.
- This will be reevaluated following the completion of the I-35W North MnPASS project.

Project: TH 169 at TH 55, Betty Crocker Drive, I-394. **Area**: West | **Project ID:** III-43

- The original problem description was that ramp entering volume and ramp-to-ramp weaving was causing significant congestion along northbound and southbound TH 169 approaching this area. The congestion originating in this segment of TH 169 southbound causes congestion to extend along TH 169 southbound extending all the way back to I-94/I-694. The primary cause is the volume entering from TH 55. However, once that traffic joins the mainline volume already on TH 169 that flow must negotiate four closely spaced areas with ramp-to-ramp weaving: (1) The loops at TH 55, (2) TH 55 to Betty Crocker Drive, (3) Betty Crocker Drive to I-394, and (4) the loops at I-394.
- The original concept solution was to revise TH 169/TH 55 cloverleaf interchange to folded diamond to the north, close all of the Betty Crocker Drive ramps, provide a west frontage road between TH 55 and Betty Crocker Drive, and connect the TH 169 auxiliary lanes between I-394 and TH 55 through Betty Crocker Drive. The preliminary cost estimate for the project was $6,900,000.
- This is location is currently under evaluation through the TH 169 Mobility Study which will consider potential improvements in this area.

Low Priority

Project: I-94-Ops 2, TH 61 to Radio Drive **Area**: North/East | **Project ID:** I-15

- This project was to install ramp meters at TH 61, White Bear Avenue, McKnight Avenue, and Radio Drive. An eastbound meter was added at TH 61 and the rest are still pending. The estimated cost of this project was $40,000.
- There is a project to add westbound meters at Radio Drive, Woodbury Drive, and Manning Avenue but the intent of this project was just looking at eastbound. Currently ramp meters are being installed in Woodbury for westbound entrance ramps.

Project: I-35E - TH 77 to CR 11 **Area**: South | **Project ID:** I-1

- This solution was to add a southbound auxiliary lane along I-35E between TH 77 and CR 11.The original concept had an estimated cost of $4,000,000.
- The auxiliary lane was not added. There wasn't the need to implement this project yet as this was not a priority location, and the project didn't have much benefit for the south area. This was not an area that was considered as a big congestion driver.

Project: TH 55 Between CSAH 42 East/West Junctions **Area**: South | **Project ID:** III-22

- This section of TH 55 was characterized by heavy traffic volumes and high numbers of crashes on a highway with a two-lane rural design. Several cross street access locations do not have left turn lanes resulting in vehicles decelerating to make left turns in heavy traffic.
- This was a segment geometric improvements project to develop a three-lane section with center two-way left turn lane. Adding westbound left turn lane at the west junction and a free-right movement for eastbound traffic at the west junction. The concept estimate was $4,200,000.
- This will be perhaps considered with the next pavement preservation project. Intersection improvements at west junction are a high priority for the County. There were some key safety issues to be addressed by this project.

Project: I-494 – B, B1: France Avenue to I-35W **Area**: West | **Project ID:** I-7 & III-49

I-494 – B, B1: France Avenue to I-35W:

- This project was to add eastbound auxiliary lane between southbound France Avenue loop and southbound I-35W, with an estimated cost of $4,000,000.
- Previously this could not be constructed due to a constraint at the Xerxes Avenue overpass. This project is being examined as part of the I-494/TH 62 Congestion Relief Study. The project may have issues with moving bottleneck to 35W interchange or further east.

I-494 EB – France Ave to I-35W:

- The original problem description identified the lane drop and entering traffic at France Avenue as the cause of congestion along eastbound I-494 in this area. The eastbound lane drop to France Avenue and France Avenue entrance ramps put I-494 over capacity, resulting in queues extending back to TH 169. The original concept solution was to extend an eastbound auxiliary lane from France Avenue to I-35W. The preliminary cost estimate for the project was $7,054,000.
- This project is being studied through the I-494/ TH 62 Congestion Relief Study.

Project: I-94-Ops 1, TH 101 to I-494 **Area**: West | **Project ID:** I-14

- A ramp meter was installed at Maple Grove Parkway. Installation of ramp meter at Northbound TH 101 is still pending. The estimated cost of the project is $20,000.

Project: I-494 – CSAH 9 (Rockford Road) **Area**: West | **Project ID:** III-51

- The original problem description was that there is a narrow bridge over I-494 that causes congestion on CSAH 9. This is an intersection geometric and operational improvements project. The original concept solution was to provide dual northbound left turn lanes, and re-time traffic signals. The preliminary cost estimate for the project was $439,000.
- The local agencies have bigger ideas for this area, and most likely this project will not be a standalone project. Hennepin County and City of Plymouth are considering options in this location before initiating a project here.

Project: TH 7 at Aquila Avenue/Blake Road **Area**: West | **Project ID:** III-2

- The original problem description was that there is heavy congestion and crash history along TH 7 near the Aquila Avenue/Blake Road intersection. The original concept solution was to provide three through lanes on TH 7 between Texas Avenue and the Minnehaha Creek Bridge. The preliminary cost estimate for the project was $1,400,000.
- This is an intersection geometric improvements project, which is the CMSP 3 solution. The current roadway configuration complicates potential solutions, and a local entity partner is needed as a project partner to steward potential improvements through construction.
- Being on the list of CMSP identified projects, sets the expectation for MnDOT participation.

Project: I-394 EB at TH 100 **Area**: West | **Project ID:** III-47

- The original problem description was about lane drop along eastbound I-394 at TH 100; the mainline of eastbound I-394 has two lanes through the TH 100 interchange, in the PM hours the HOV lane ends in this area which results in demand exceeding capacity in the two remaining lanes. The original concept solution was to start the right lane at the C-D Road entrance and merge TH 100 northbound entrance. The preliminary cost estimate for the project was $384,000.
- There is potential of queuing back to I-394 mainline, there has been limited modeling done on this project. NB 100 to EB 394 becomes a merge and is high volume and could back up onto TH 100, this project should be revisited again after TH 100 in St. Louis Park project is done.
- There are concerns about the effectiveness of this concept due to significant downstream congestion.

Dropped

Project: TH 8 CR 23/Green Lake Trail/Pioneer Road **Area**: East | **Project ID:** III-3

- The original problem description was that this area is a high crash intersection. The original concept solution was to improve traffic signal timing, install traffic signal ahead signs, and extend the northbound right turn lane. The preliminary cost estimate for the project was $120,000.
- There were no specific measures found to address the problem. This project was included in the CMSP project list because of a safety issue rather than an operational issue.

Project: TH 36 WB at I-35E **Area**: North | **Project ID:** III-15

- The original problem description was entering volume and ramp-to-ramp weaving. The entering traffic from I-35E reinforces the congestion extending back from the west during AM and PM peaks.
- The original concept solution was to provide auxiliary lane on TH 36 westbound between I-35E southbound and Rice Street. The preliminary cost estimate for the project was $1,220,000.
- The proposal is upstream of a congested corridor, and there is low support for improvements in this location.

Project: TH 47 – CSAH 116 to 142nd Avenue **Area**: North | **Project ID:** III-18

- The original problem description was that the intersection is over capacity in the northbound direction, along with significant queuing, poor signal phasing, and inadequate geometry. This is an additional lane/intersection geometric improvements project. The original concept solution was to provide two northbound through lanes and a northbound right turn lane at CSAH 116 and 142nd Avenue. The preliminary cost estimate for the project was $716,000.
- The project was rejected by locals as it was viewed as being too small. This project would have required relocation of an existing recreational trial and reconstruction of intersections and roadway exceeding the intent of the original CMSP concept. Local agencies may pursue a longer-term vision for TH 47 extending from the City of Anoka through the City of Ramsey.

Project: TH 77 Northbound - 138th Street to Diffley Road **Area**: South | **Project ID:** I-2

- The problem description in this area showed that the lane drop along northbound TH 77 near 138th Street, combined with a steep uphill grade at this location, resulting in congestion.
- This proposed CMSP solution was to add a northbound auxiliary lane to eliminate the lane drop and connect to the start of the existing three-lane section near Diffley Road. The concept had an estimated cost of $13,000,000.
- An auxiliary lane is no longer under consideration, as any additional capacity in this area will be constructed to be MnPASS-ready. The identification of this CMSP project may have helped to trigger investigation and momentum for future MnPASS improvements in this area.

Project: TH 13 and CSAH 21 (Scott) **Area**: South | **Project ID:** III-7

- The original problem description was about congestion and safety issues due to lack of intersection capacity.
- The original concept solution included flashing yellow left-turn arrow, traffic signal timing improvements, CSAH 21 eastbound and westbound right turn lanes, and turn lane extensions on TH 13. The preliminary cost estimate for the project was $521,400.
- The proposed work was found to be ineligible for trunk highway funding since physical improvements were located primarily on the cross streets. Local stakeholders agree there are issues on CR 21 and turn lanes are needed to address them. This project would need to prove improvements and impact to trunk highway system

Project: TH 55 at 26th Street **Area**: West | **Project ID:** III-21

- The original problem description was that there were safety issues at this signalized intersection. The concept solution was to remove the right-turn islands in the southeast and northwest quadrants. The preliminary cost estimate for the project was $180,000.
- Further investigation by MnDOT indicated that the skew angle of these roads requires additional truck turning space and was not feasible. It is no longer being pursued as part of CMSP.

Project: TH 100 SB at I-394 **Area**: West | **Project ID:** III-36

- The original problem description was exit capacity; the combined exit from southbound TH 100 to I-394 eastbound and westbound has volumes that are approaching the exit capacity resulting in congestion on TH 100 southbound. The original concept solution was to provide separate access points to the southbound C-D Road for exits to I-394 westbound and MnPASS Lane and to I-394 eastbound. The preliminary cost estimate for the project was $72,000.
- Further investigation by MnDOT showed there is no measureable deficiency at this location and the need for this project was dismissed.

BEFORE AND AFTER STUDIES

Introduction and Purpose

With nearly a decade since the CMSP program was introduced and two iterations of project opportunities there is now a collection of solutions that have been developed and implemented through the process. This allows practitioners to review the problem statement development process, analysis methodologies, concept development, and screening criteria used in this process. With the intent of improving upon previous CMSP studies, before and after studies were conducted. The purpose of the before and after studies is threefold:

- Demonstrate that the CMSP process is able to identify problem locations, develop effective and low cost solutions, and implement high benefit projects.
- Review previous methodology to identify accuracy of prediction methods for congestion and safety benefits, and project costs. Findings will be used to modify and improve the process for CMSP Phase 4 project identification and screening.
- Identify project types (auxiliary lanes, traffic management, restriping, etc.) that were more or less effective than expected, and compare relative effectiveness to other project types.

To conduct before and after studies the team reviewed project opportunity lists from previous phases and categorized them as completed, programmed, under study, low priority, or dropped. Projects that had been completed were evaluated with before and after studies to capture the projects' impacts on the congestion, reliability, and safety performance on the affected highway segments. This section of the report describes the methods, results, and summary of the findings of these before and after studies.

Methods

The following methodology, data sources, and assumptions were used for the before and after studies:

Freeway Analysis

- **Travel Time Delay:** For projects on MnDOT's instrumented system, annual travel time delay was computed based on loop detector data. The data acquired for delay analysis included vehicle travel times and vehicle-miles traveled (VMT). These performance values were collected using Traffic Information/Condition Analysis System (TICAS) for 15-minute time intervals over the entire year, both before and after the construction year of each project. Corridor analysis extents were determined by assessing the physical length of congestion along the study corridor, while taking into consideration the reasonable range of impacted area for each project, based on MnDOT's *Metropolitan Freeway System Congestion Reports*. The selected coverage area was the wider of the two ranges mentioned above and was kept consistent for both study years.

  Delay was computed from the number of hours traveled below the designated corridor free-flow speed.

- Corridor free-flow speed represented the speed at which it would take a vehicle to traverse the corridor at the observed 85th percentile travel time during non-peak period conditions. In cases where the free-flow speeds differed between alternatives the minimum of the two speeds was selected.

The delay was aggregated for each 15-minute interval over the year and was converted to annual hours of delay. Travel time delay was then monetized in accordance with recommended values published by the MnDOT Office of Transportation System Management, July 2016.

- **Safety Analysis:** A safety assessment was performed for each project by utilizing crash data from the Minnesota Crash Mapping Analysis Tool (MnCMAT). Three years of crash data before and after the construction year was used to reduce the impacts of annual variability in crashes while still using data that pertained to traffic trends during the study period. If three full years of crash data was unavailable, full-year data for the maximum number of available years was used. The number of crashes was then converted to annual frequencies by crash severity and monetized using recommended crash costs published by the MnDOT Office of Transportation System Management, July 2016.

  - One exception to the crash cost values used in this evaluation, however, was in regards to the fatal crash cost. The monetary value applied for fatal crashes was reduced to a cost twice the value of incapacitating injuries. Due to the nature of variability in crash occurrence, this adjustment was made to lessen the bias fatal crashes would have on the estimated overall project effectiveness.

  The corridor extents used for the safety analyses were consistent with those determined during the delay evaluation.

- **Travel Time Reliability:** Similar to the travel time delay analysis, vehicle-miles traveled and vehicle travel times from detector data was used to evaluate travel time reliability for freeway projects. The methodology used for assessing reliability is detailed below:

  - Standard deviation – The standard deviation of annual travel times ranging from the 2.5th percentile to the 97.5th percentile was computed for each dataset. These values were then multiplied by the observed annual volume to produce a representation of travel time variability experienced by users over the course of a year, in terms of vehicle-hours. The process was evaluated for a.m. and p.m. peak periods during weekdays, as well as all 15-minute time intervals throughout the year.

Arterial Analysis

- **Travel Time Delay:** Traffic operations for projects that were located off MnDOT's instrumented system were evaluated using microsimulation. A.m. and p.m. peak hour Synchro/SimTraffic models were created for before and after project conditions. Traffic counts published at MnDOT's Metro Intersection Warrant Information Website were utilized to obtain peak hour intersection turning movement counts at all study locations. Counts

that were performed closest to the years of analysis were applied in the microsimulation models. It should be noted that traffic volumes were consistent for before and after scenarios in each project. The observed peak hour delay from the models was first converted to a daily delay using peak hour-to-daily delay profiles, before finally being factored up by 250 to represent accrued annual delay during non-holiday weekdays. The resulting annual delay was then monetized using the recommended value of time published by the MnDOT Office of Transportation System Management, July 2016.

- Safety Analysis:
    - A similar process used for freeway safety analysis, as detailed above, was utilized for arterial safety evaluation
- **Travel Time Reliability:** INRIX data was used to evaluate travel times over a period of time. If possible, data was analyzed for a year prior to and after the year of construction. Similar performance measures that were quantified for freeway projects were assessed for arterials.

Results

The information below provides an overview of the before and after study results. Crash and delay savings are summarized along with project implementation costs and the ensuing return period. Results are compared back to previous CMSP phase projections.

TH 8 – Revised Striping Outside of Chisago Schools

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
N/A (N/A)	N/A ($35,000)	N/A ($3,000)	N/A (0.1)

Notes:

- Full year of crash data after project completion is unavailable
- Restriping completed with scheduled mill and overlay (minimal implementation cost)

TH 100 – I-694 to I-394 Ramp Metering

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$768,252 ($855,858)	$830,533 (N/A)	$122,765 ($120,000)	0.1 (0.1)

Notes:

- Due to the year before project completion being the same year as the I-35W bridge collapse, delay results were assessed for months January through July and factored up to represent an estimated annual delay savings
- P.m. peak northbound throughput increased through the central part of the corridor, resulting in bottlenecks relocating downstream (further north) near Brooklyn Boulevard and 57th Avenue
- Results were likely influenced by the completion of the two-lane ramp from northbound TH 100 to eastbound I-694 during the fall of the 'before' analysis year

I-35W – 106th Street to TH 13 Southbound Auxiliary Lane

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$567,537 ($838,431)	$613,733 ($0)	$4,049,086 ($6,000,000)	3.4 (7.2)

Notes:

- P.m. peak period trips served increased by over 700 per day

I-94 – TH 61 to White Bear Avenue Eastbound Auxiliary Lane

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$363,777 ($681,430)	$254,733 (N/A)	$1,140,565 ($3,000,000)	1.8 (4.4)

I-494 – I-35W through France Avenue Westbound Auxiliary Lane

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$14,166,439 ($655,906)	-$871,200 (N/A)	$4,000,000 ($4,000,000)	0.3 (6.1)

Notes:

- Analysis extents for projections only covered I-494 from I-35W to France Avenue as compared to the extents used for actual savings, which spanned the corridor from TH 5 to TH 169
- Only one year of crash data was available after project completion; therefore, results may hold less statistically certainty

TH 10 – Egret Boulevard to Hanson Boulevard Eastbound Third Lane

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$1,065,506 ($684,697)	$2,183,067 (N/A)	$4,582,149 ($6,000,000)	1.4 (8.8)

TH 10 – Egret Boulevard to Hanson Boulevard Westbound Third Lane

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$261,204 ($815,113)	-$1,132,000 (N/A)	$4,582,149 ($6,000,000)	-5.3 (7.4)

Notes:

- Two fatal crashes occurred after project completion – neither of these are likely attributable to this project influence

I-35W – Restripe Southbound on Mississippi River Bridge to Washington Avenue

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$686,799 ($336,432)	$841,667 (N/A)	N/A ($500,000)	N/A (1.5)

Notes:

- Added capacity from bridge construction likely influenced results

I-94 – Restripe Westbound I-94 to have Center Lane Split into Two Lanes Prior to I-394 Exit

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
-$15,263 ($1,249,141)	$564,533 (N/A)	$238,297 ($300,000)	0.4 (0.2)

Notes:

- Lane utilization became more balanced after project completion, resulting in fewer crashes due to oversaturation of exiting vehicles in outside lane
- A.m. peak period throughput increased by roughly 1,500 vehicles over five hours

I-35 – CSAH 50 Northbound Entrance Parallel Acceleration Lane

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$31,387 ($22,624)	-$54,267 ($197,000)	$217,800 ($399,400)	-9.5 (1.8)

Notes:

- Only one year of crash data was available after project completion; therefore, results may hold less statistically certainty

TH 65 – Southbound Escape Lane after Westbound CSAH 10 Exit

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
N/A (N/A)	$59,200 ($105,000)	$50,000 ($103,500)	0.8 (1.0)

Notes:

- Only one year of crash data was available after project completion; therefore, results may hold less statistically certainty

I-94 – Westbound Two-Lane Exit to TH 101 with Northbound Flyover Ramp

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$869,905 ($2,555,359)	$2,079,600 (N/A)	$5,954,004 ($4,000,000)	2.0 (1.6)

Notes:

- Reduction in congestion near the westbound I-94 diverge to TH 101 relocated bottleneck downstream to the TH 101 westbound entrance ramp

TH 100 – Two-Lane Northbound On-Ramp to Eastbound I-694

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$123,137 ($207,857)	$963,200 (N/A)	$190,000 ($500,000)	0.2 (2.4)

Notes:

- Allowed for increase of 6,000 additional daily trips served along northbound TH 100
- Only one year of crash data available before project completion with one severe injury crash, zero severe crashes in three years following project completion

TH 36 and TH 120 (Century Avenue) – Extend Eastbound Left-turn Lane

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$277,388 ($268,444)	N/A ($587,000)	*$350,000 ($1,654,000)	1.3 (1.9)

Notes:

- Implemented project was altered from proposed solution (i.e. dual-quadrant intersection)
- *Actual project cost is based on estimates

TH 55 and TH 100 Exit Ramps – Extend Northbound and Southbound Exiting Turn Lanes

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$35,539 ($0)	N/A ($40,000)	$865,495 ($132,000)	24.4 (3.3)

Notes:

- Constructed project exceeded scope of initial concept
- Projections assumed no delay reduction

TH 61 and TH 55 – Eastbound Dual Left-Turn Lane

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$67,710 ($288,425)	N/A ($333,000)	$356,378 ($365,400)	5.3 (0.6)

Notes:

- Access closures at TH 55 and 10th Street were assumed in projection calculations; these particular improvements were not implemented with the addition of the turn lane

TH 169 and Marschall Road (CSAH 17) – Add Turn Lane to Westbound Exit

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$132,702 ($8,253)	N/A ($23,000)	*$250,000 ($250,000)	1.9 (8.0)

Notes:

- Previous estimations assumed dual right-turns, constructed layout consisted of dual left-turns
  - Off-ramp left-turn volume exceeds 600 vehicles per hour during p.m. peak hour
- *Actual project cost is based on estimates

TH 13: Yankee Doodle to Prior Lake – Corridor Tuning for 43 Signals

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$2,115,406 ($2,262,364)	$581,333 (N/A)	$152,012 ($97,500)	<0.1 (<0.1)

Notes:

- Delay projections were developed based on estimated delay reduced per intersection, rather than using microsimulation
- Delay savings were taken from MnDOT's *Traffic Signal Coordination Project – TH 13*, completed November, 2009.

TH 7: TH 100 to TH 41 – Corridor Tuning for 29 Signals

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$799,250 ($8,687,500)	-$654,667 (N/A)	$67,000 ($94,000)	0.5 (<0.1)

Notes:

- Delay projections were developed based on estimated delay reduced per intersection, rather than using microsimulation
- Delay savings were taken from MnDOT's *TH 55 and TH 7 Signal Optimization Project*, completed October, 2011.

TH 65: I-694 to CSAH 24 (East Bethel) – Corridor Tuning for 24 Signals

Delay Savings Actual (Projected)	Crash Savings Actual (Projected)	Project Cost Actual (Projected)	Return Period Actual (Projected)
$2,975,469 ($4,072,266)	-$540,133 (N/A)	$66,000 ($107,500)	<0.1 (<0.1)

Notes:

- Delay projections were developed based on estimated delay reduced per intersection, rather than using microsimulation
- Overall number of crashes decreased after the project was completed, although severe crashes increased in frequency
- Delay savings were taken from MnDOT's *Highway 65 Signal Optimization Project*, completed June, 2012.

Detailed results for each project can be found in Appendix B.

Summary and Findings

This section summarizes the findings and key takeaways of the before and after studies. Items for discussion include, comparisons back to cost estimates and projected delay and crash reduction developed during previous CMSP phases, improvements that can be made to enhance projection accuracy, the observed effectiveness of implemented CMSP projects, and trends in project types that were more or less beneficial.

1.1 CMSP Analysis Methodology

A key goal of the before and after analyses was to compare the benefit and cost projections developed during the previous CMSP phases to the observed impacts of each project. The following sections provide detail on the methods used in previous CMSP phases to estimate project costs and effectiveness, as well as an evaluation of how the projected values compared to the empirical before and after project results.

1.1.1 Congestion Effectiveness

The projected congestion impacts of each project were developed in either Phase I or Phase III of CMSP, both of which used unique methods for predicting project effectiveness. For freeway projects, both studies utilized annual MnDOT Congestion Reports as a basis in determining annual hours of congestion reduced. The table below summarizes the assumptions made in regards to the congestion duration, project impact area, and severity of congestion in terms of vehicle speeds.

Table 1 – Previous CMSP Congestion Methodology Assumptions

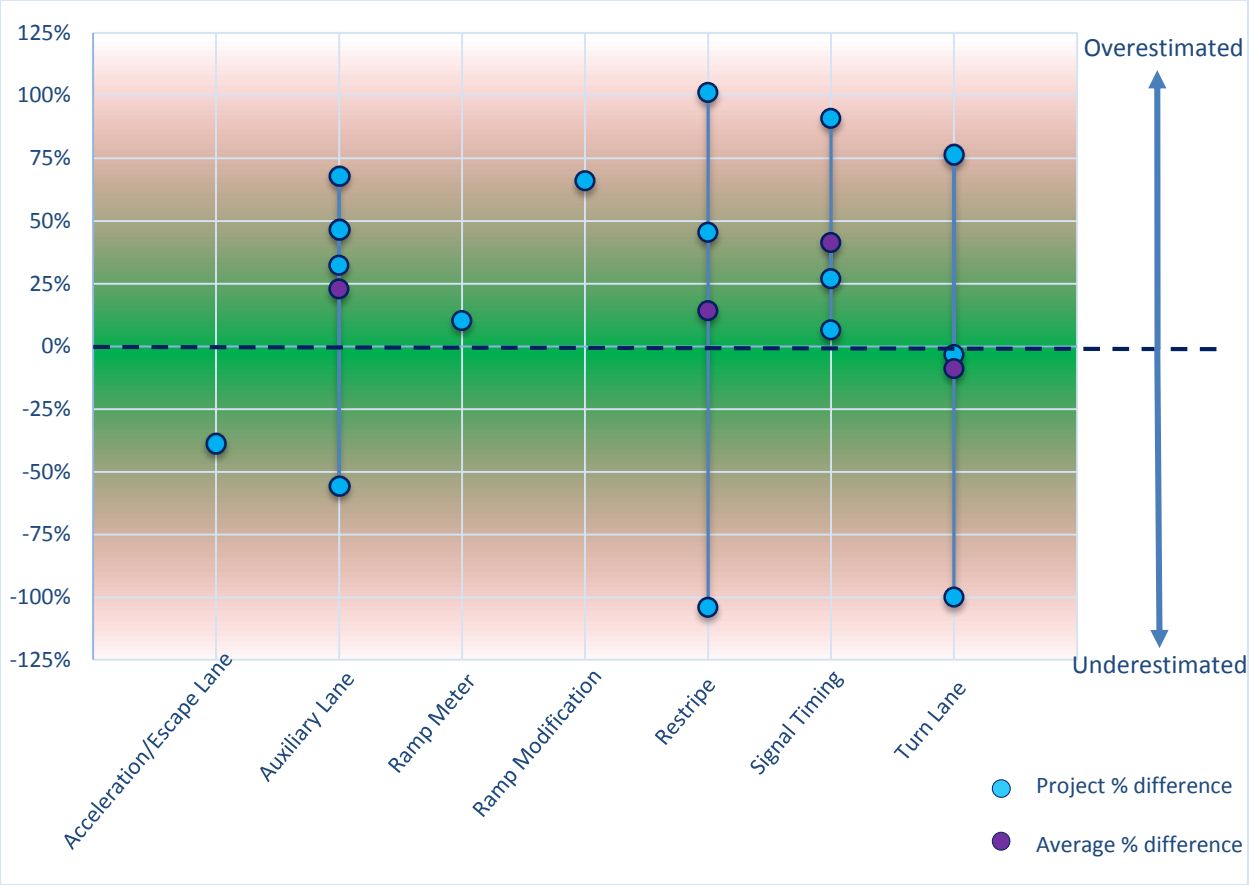
Criteria	CMSP I	CMSP III
Congestion Duration	Congestion Report (15-min precision)	Congestion Report (5-min precision)
Impact Area (analysis extents)	Constructed project extents	Congestion extents near project area within Congestion Report
Congestion Severity (average vehicle speeds during congestion) (assumed 60 mph free-flow speed)	45 mph during congestion	Based on duration of congestion in Congestion Report: Less than 1 hr – 45 mph 1-2 hr – 40 mph 2-3 hr – 35 mph 3+ hrs – 30 mph

The congestion parameters in the table above were applied in accordance with peak hour vehicle flow rates to determine total person-hours of congestion during the peak periods, which were then extrapolated to annual delay by multiplying by 250 to represent non-holiday weekdays over a year period. Estimations for reduction in congestion duration and congestion extent due to project implementation were determined based on the scope of improvement, and thus, a resulting delay savings was computed.

For arterial projects, CMSP I projections were developed by estimating a reduction in delay per vehicle at signalized intersections, and extrapolated using peak hour flow rates to an annual delay savings during non-holiday weekdays. The CMSP III methodology utilized Synchro and HCM to determine intersection delay during a.m. and p.m. peak hours for both the non-improved and improved geometric conditions. Total peak period delay was first extrapolated out to daily delay to account for travel time savings during non-peak hours before being converted to an annual delay savings by multiplying daily delay by 250 non-holiday weekdays in a year.

To determine the quality of the delay savings estimates, the proposed delay reductions were compared to the actual delay reductions for projects that have been implemented into the field. The figure below displays the percent difference between annual hours of estimated delay reduction and observed delay reduction for each project. Negative percentages represent projects where delay reduction was underestimated, and positive percentages represent projects where delay reduction was overestimated. The blue and purple dots signify percent differences for individual projects and the average value by project type, respectively.

Figure 2 – Delay Reduction Comparison by Project Type: Projected vs. Actual



There appears to be significant variation in percent reduction within certain project types, as denoted by the large range between individual project values. Common reasons projects experienced less delay reduction than what was projected included the development of downstream bottlenecks and an increase in vehicle demand in response to the improvement. Projects where the projected reduction of delay was less than the observed delay often had an underestimated extent of impact area resulting from the improvement, or undervalued the severity of existing congestion in terms of vehicle speed.

There were two outliers in the dataset that are not included in the figure above:

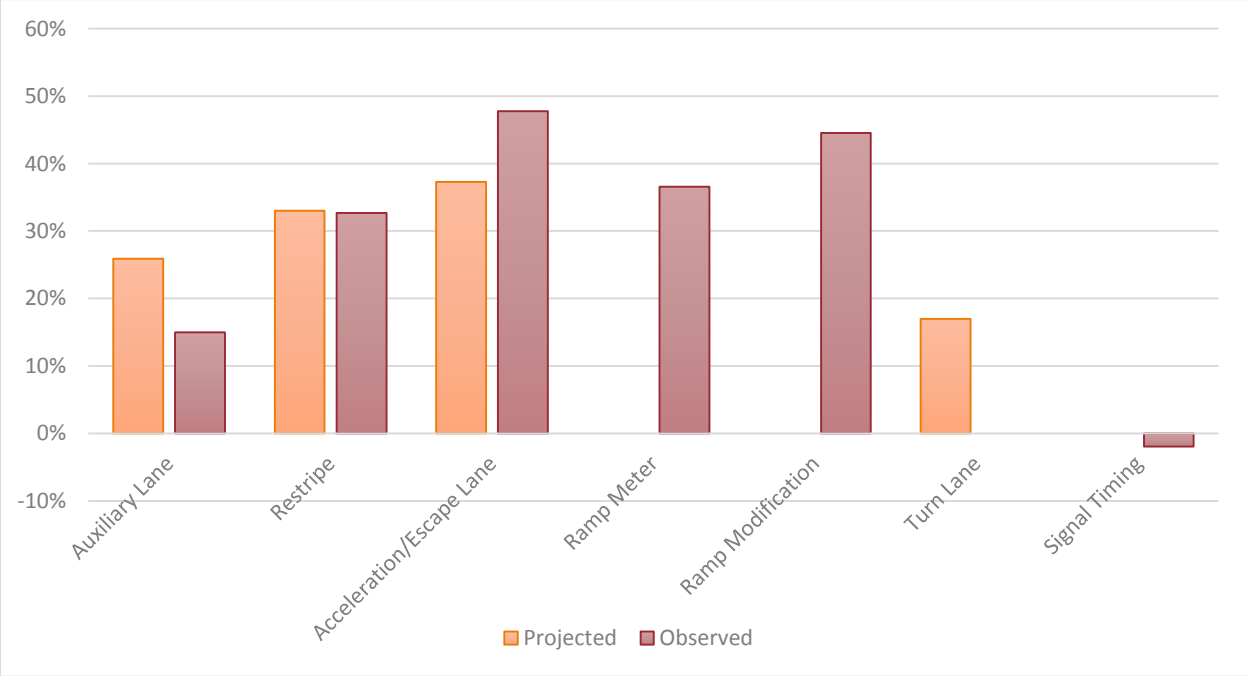
- WB I-494 auxiliary lane between I-35W and France Avenue
- TH 169 and Marschall Road (CSAH 17) added turn lane on westbound off-ramp

Annual hours of delay were underestimated for these two projects by a factor of 20 and a factor of 15, respectively. Incorporating these values into the project type comparison heavily skewed the averages, which diminished the usefulness of the visual comparison, but factoring the outliers in would result in four of the project types having an overestimated delay reduction and three having underestimated reduction, on average.

1.1.2 Safety Effectiveness

Projects that were proposed during CMSP III applied a crash savings estimate based on the reduction of congestion. Rear end crashes were reduced by an amount similar to the projected change in congestion. Sideswipe crashes were also reduced if additional merging/weaving capacity was provided. Crash reductions were not estimated during the CMSP I evaluation. The figure below displays estimated crash cost reduction by project type, where available, as compared to the actual crash cost reduction.

Figure 3 – Crash Effectiveness by Project Type: Projected vs. Actual



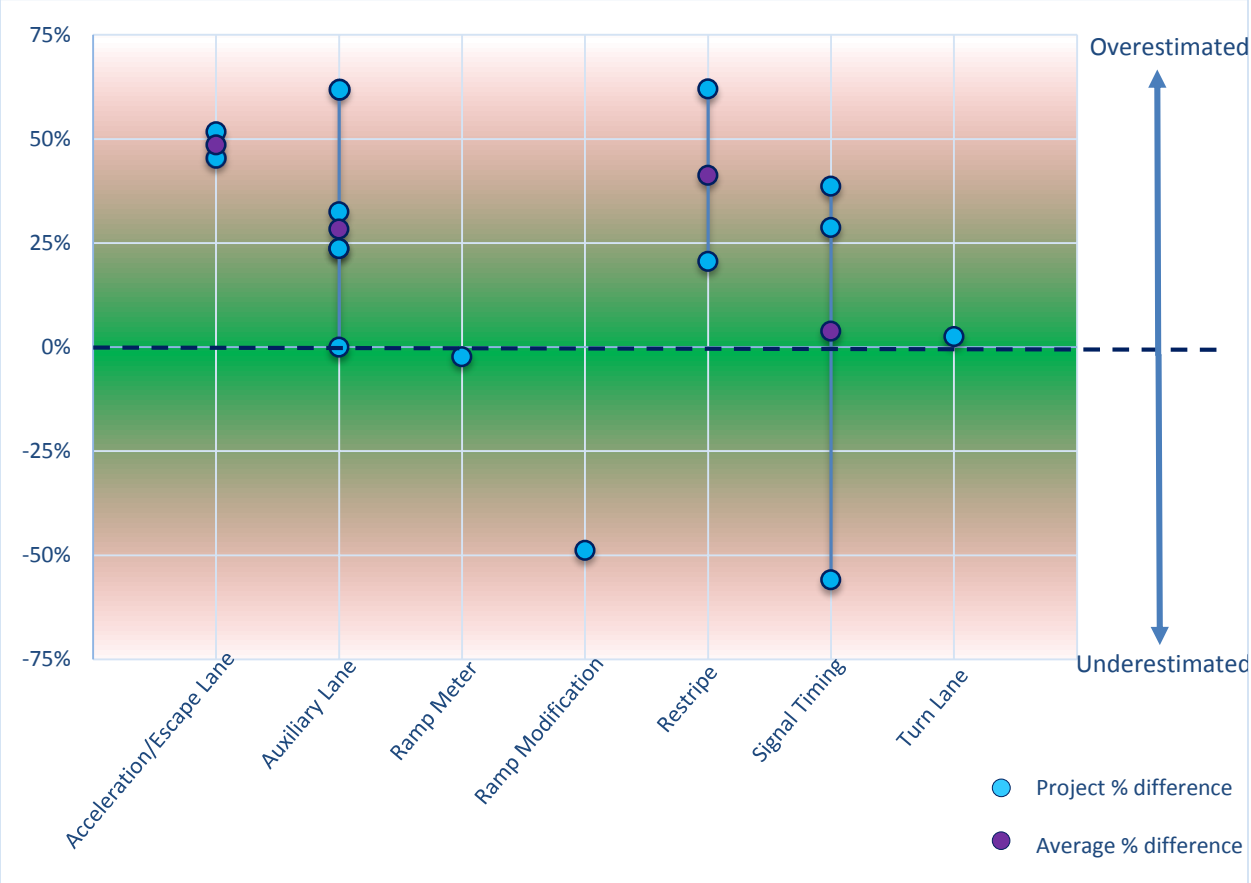
With the majority of before and after projects originating from CMSP I, many of the analysis projects did not have crash effectiveness projections. The three project types that had both estimated and empirical data show a variation in comparison results. One project type showed an overestimation in crash cost reduction, one type had an estimated effectiveness similar to what was observed after project completion, and another project type was shown to generate more crash savings than was projected. A common trend observed across projects was that improvements led to increased vehicle demand, and therefore higher exposure to crashes. Projections for CMSP Phase 3 opportunities did not factor in induced traffic volumes in determining the number of post-construction crashes. This may have been a cause of overestimated crash effectiveness for improvements that increase vehicle capacity, such as auxiliary lanes.

One other notable consideration is that a number of projects did not have a full three years of crash data available for one of the two analysis scenarios. This occurrence can lead to less statistical certainty in observed results.

1.1.3 Project Cost Estimation

During the CMSP I project conceptual development process, projects were broken down into categories of project type before being assigned a cost estimate based on their specific size and location. Projects that were proposed through CMSP III were applied unit costs and estimated quantities of each item to produce preliminary costs. A comparison between estimated project costs and actual project costs is shown in the figure below. Positive percent difference values signify that project costs were overestimated during previous CMSP phases compared to the actual project costs, and negative values represent projects that costed more than what was estimated.

Figure 4 – Project Cost Comparison by Project Type: Projected vs. Actual



The TH 100 and TH 55 interchange off-ramp turn lane improvement project was removed from the cost comparison because the constructed project exceeded the scope of the initial concept, resulting in a project cost over 5.5 times the estimate. A prominent cause for other variations in project costs originated from the fact that several projects underwent modified designs compared to what was initially conceived in earlier CMSP phases. It was also common for many of the before and after projects to be implemented as part of larger-scoped construction or rehabilitation projects. This would have produced a lower effective project cost compared to it being a standalone project. Finally, site-specific characteristics (e.g. soil, terrain, etc.) made project implementation more or less challenging than originally expected, in some cases.

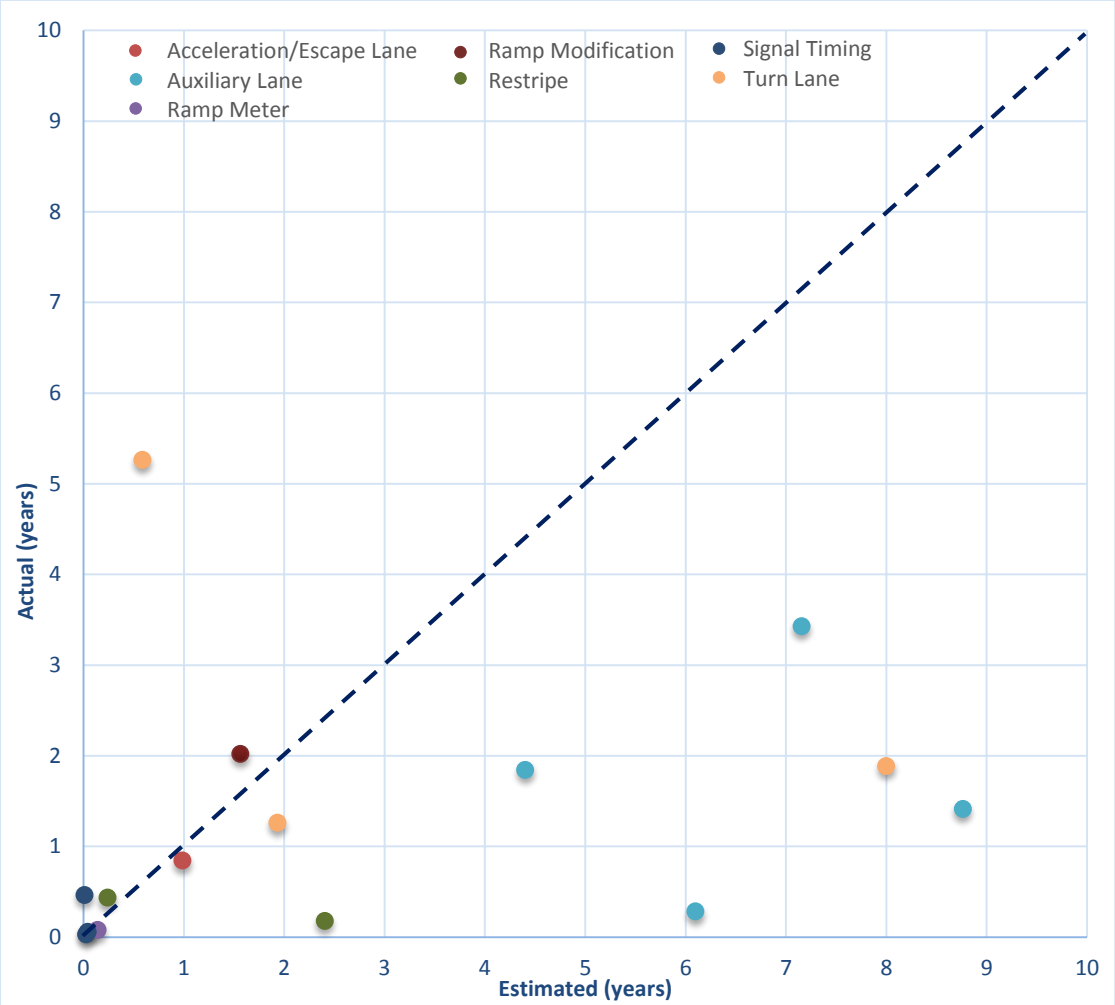
With the exception of ramp meters and ramp modifications, all project types had average costs less than the average estimated construction cost.

1.1.4 Effectiveness Comparison

In previous CMSP phases, user costs and project costs were utilized to determine the return period, or the expected number of years to achieve a return on investment, for all projects. This parameter played a prominent role in determining the cost-effectiveness of projects and prioritizing of project implementation. Return periods based on delay savings, safety savings, and project costs that were estimated in previous CMSP phases were compared to

the calculated return periods from the empirical analyses. The results of the comparison can be found in the figure below.

Figure 5 – Project Return Period Comparison



One common trend between the estimated and observed return periods is in regards to the order of magnitude by project type. Typically, relatively large estimated return period values have high observed values, and vice versa. However, it appears the distribution is skewed to the bottom-right of the chart area, signifying that projects tended to achieve shorter return periods than they were projected to have. This is particularly evident with the auxiliary lane projects, where the four projects on the figure have empirical returns on investment multiple years earlier than previous CMSP phase estimates. There were also several projects that had return periods of less than one year; of which, many consisted of lower-cost, less environmentally impacting improvements. In summary, this result is an indicator that the primary objective of CMSP to identify cost-effective solutions was largely accomplished.

1.1.5 Comparison Summary

Although many outcomes between the projected and observed project effectiveness and return on investment comparisons pointed towards the same conclusion (e.g. project success), variation between the estimated and empirical results were prominent throughout the before and after analysis process. Listed below are potential areas of improvement for estimating travel time delay, crash reduction, and project costs:

Delay

Preventing underestimation:

- Deliberate improvement impact area and consider expanding upstream influence extents
- Use detector speeds to determine severity of congestion (i.e. actual travel speeds rather than estimates)

Preventing overestimation:

- Factor for induced demand
- Consideration of downstream bottlenecks

General:

- Utilize operational analysis tools (e.g. HCM) to assess project impacts with more detail

Crashes

- Consideration of increased vehicle exposure due to improvement
- Limit crash reductions to low-severity crashes
  - Consider further limiting to rear-ends and sideswipes occurring during congested peak periods only if improvement is directed exclusively at reducing delay

Project Cost

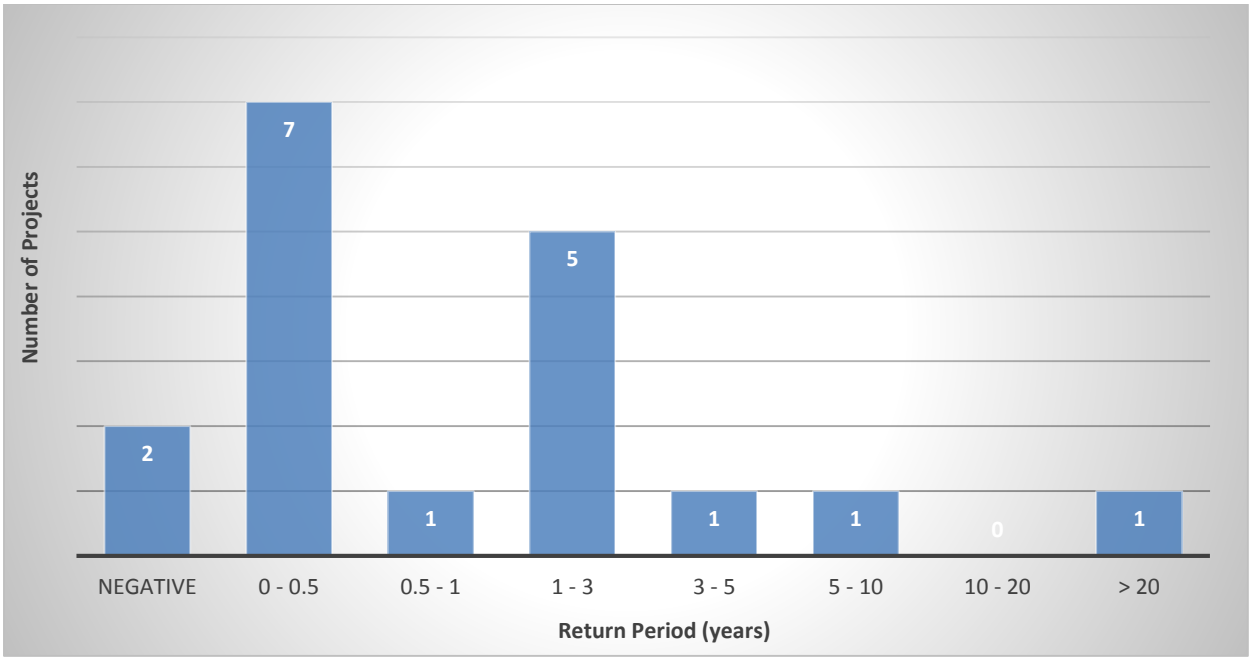
- Consideration of environmental variables such as soil and water conditions
- Account for construction of noise walls
- Correspond with area/local entities about potential location-specific hurdles

1.2 Effectiveness of Previous CMSP Opportunities

A key initiative to CMSP is to strategically target problematic areas and implement cost-effective improvements in a relatively timely manner. A review of completed CMSP-selected projects was performed to assess the program's previous efforts. Overall, the 21 selected projects accumulated over $25M in travel time savings, $5.7M in crash cost savings, and $11.5M in travel time reliability benefits for users annually. All projects produced a reduction in vehicle delay after project implementation (with the exception of one project which had a slightly negative impact on travel times but a higher magnitude in crash cost reduction). Average delay effectiveness, which represents the degree at which delay was reduced due to the project, was 25% across all CMSP I and CMSP III projects. Similarly, the average crash cost reduction was computed to be 16%.

The project return period is a measure of the duration needed for a project to accumulate user cost savings (benefits) greater than the initial project cost. It is an important aspect in project prioritization not only because it represents the time at which a full return on investment will be realized, but because it is also an indicator of how cost-effective each project may be. The distribution of return periods for the analysis projects is shown in the figure below.

Figure 1 – Return Period of Previous CMSP Projects

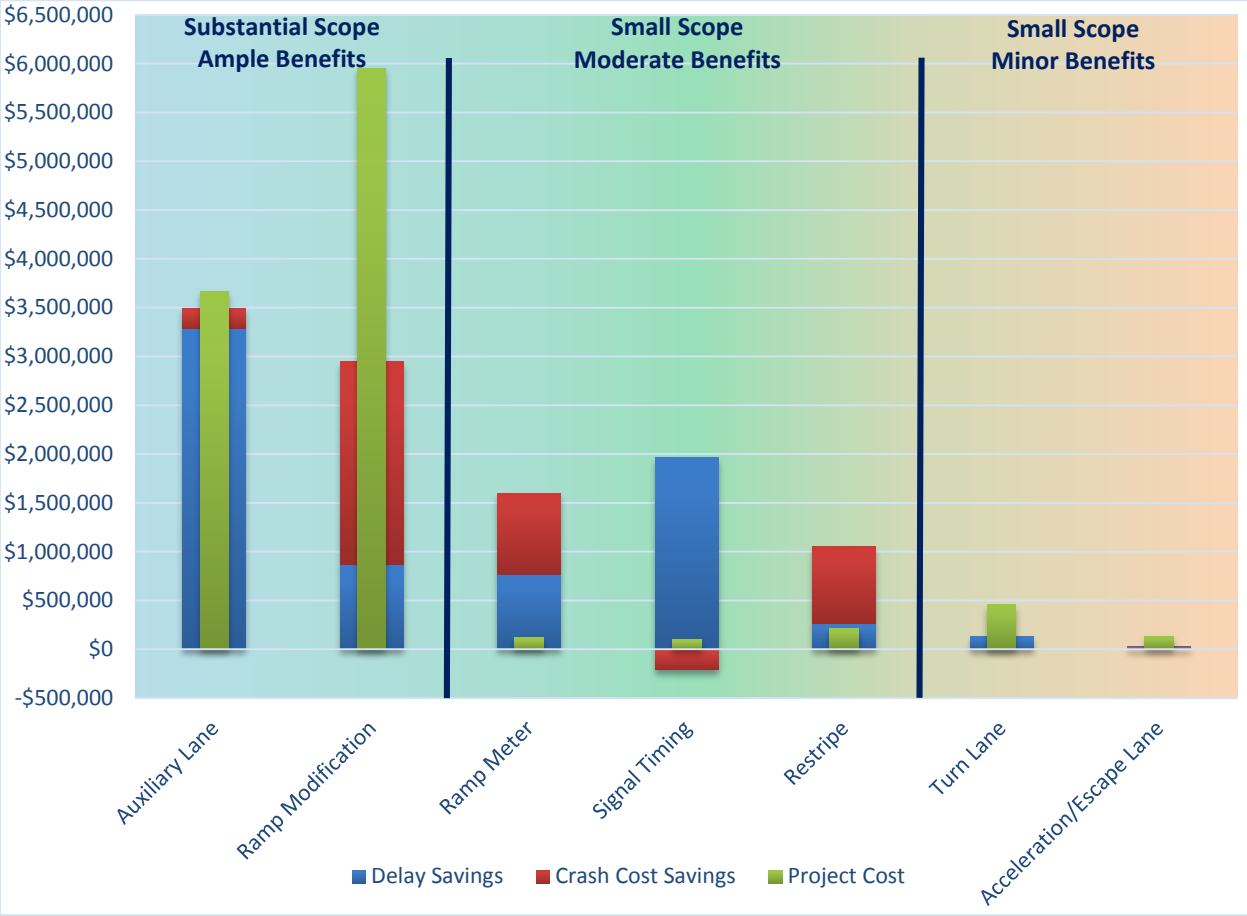


The projects with a negative return period represent projects that had increased user costs (sum of delay and crash costs) after they were constructed. It should be noted that both of these results were attributed to increased crash costs after project implementation and would have had positive return periods if evaluating delay savings, exclusively. In addition, the project with a return period of over 20 years did not incorporate potential crash savings due to limited crash data availability following project completion. With the scope of this project concerning interchange turn-lane improvements, it is anticipated that the resulting queuing and vehicle delay will induce a decrease in crashes, thus creating supplementary user savings. All other projects met the target return period of under ten years, with the majority of projects having a return on investment of under three years.

Project Effectiveness by Project Type

An additional objective of the before and after studies was to evaluate the effectiveness of completed CMSP projects to help identify solutions that have been either more or less cost-effective. One categorization of interest is to assess projects by type. The following figure summarizes the annual travel time and crash cost reductions as compared to the project implementation cost. The comparisons are broken down by project type and are also grouped according to project scope and benefit magnitude.

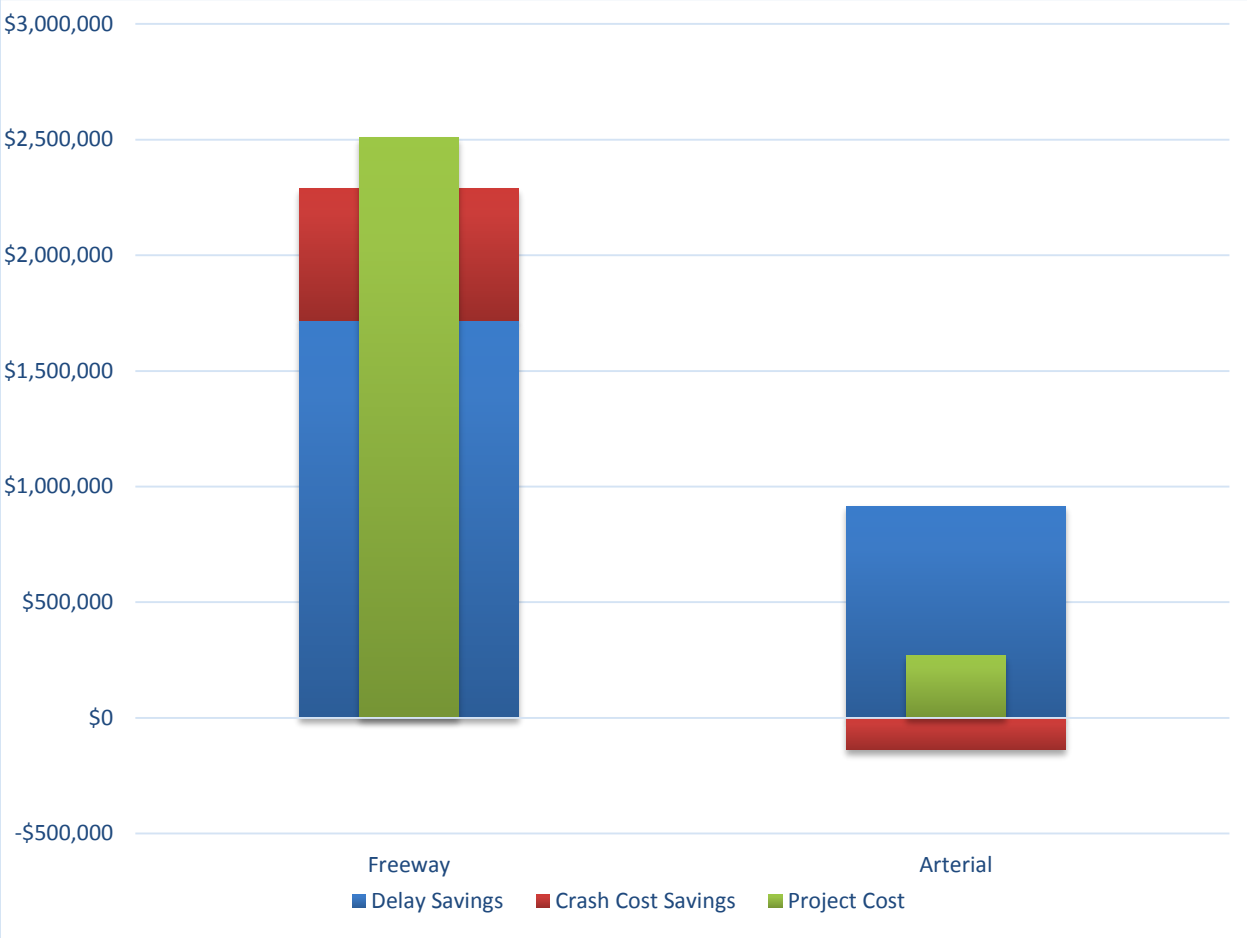
Figure 5 – Average Costs and Benefits by Project Type



An important takeaway regarding the figure above is that project costs represent the one-time fee attributed to completing the project, while delay and crash cost reductions represent the annual savings experienced by users after construction. Consequently, projects that realize a substantial magnitude in user savings will likely accrue a positive return on investment over time, even when the initial capital costs are higher than the aggregated annual savings. This particular example is depicted by the auxiliary lane project type, where accumulated user benefits are likely to significantly surpass project costs if benefits continue to accrue on the observed trend.

Comparing the impacts of different project types, auxiliary lane projects were found to be the most influential delay reduction solution, while the ramp modification project had the greatest influence on reducing crash costs. Restriping and ramp metering projects tended to be more balanced between delay and crash effectiveness. A similar comparison can also be made between freeway and arterial projects (see figure below).

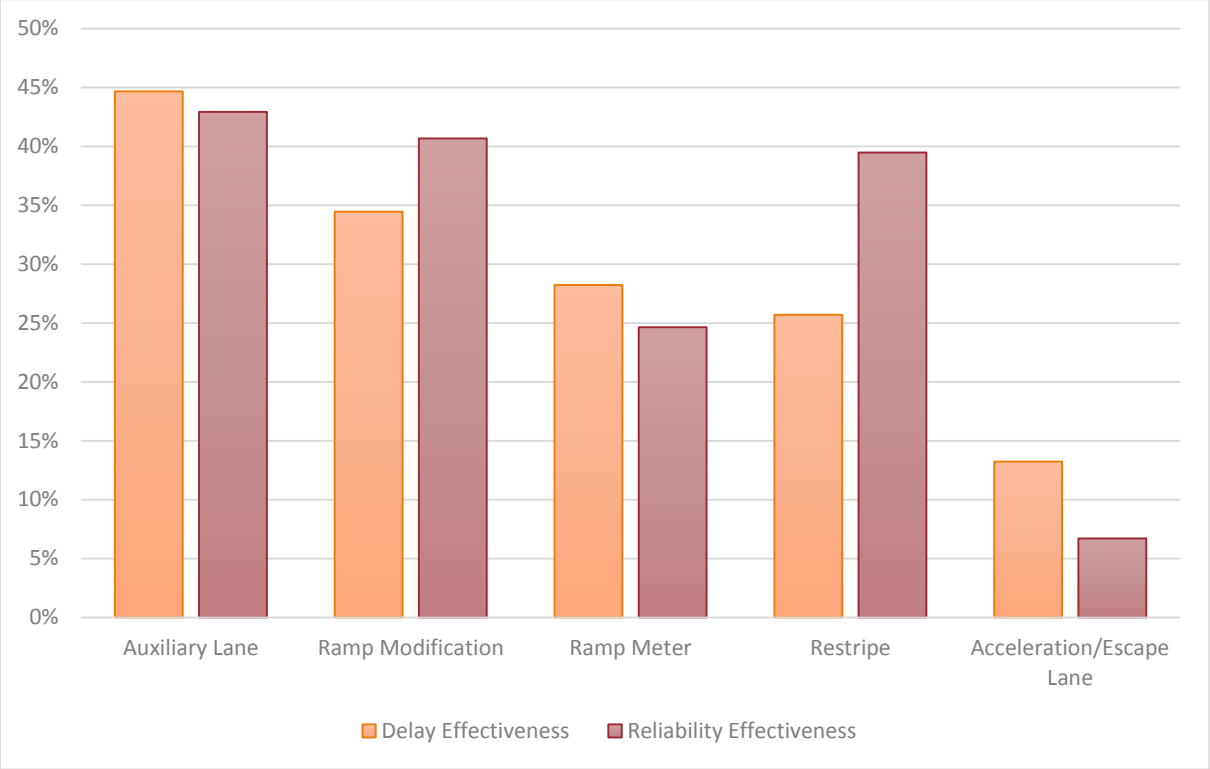
Figure 6 – Average Costs and Benefits by Facility Type



Overall, freeway projects inflicted greater reduction on both crash and delay user costs. The crash effectiveness for arterials is based solely on signal timing projects due to unavailable post-construction data for other project types. Once additional crash data for the turn lane and restriping arterial projects becomes available, the data may reflect a positive reduction in crash costs. As mentioned above, categorized projects that typically had higher capital costs produced greater reductions in user costs. Meanwhile, lower-cost projects provided an earlier return on investment.

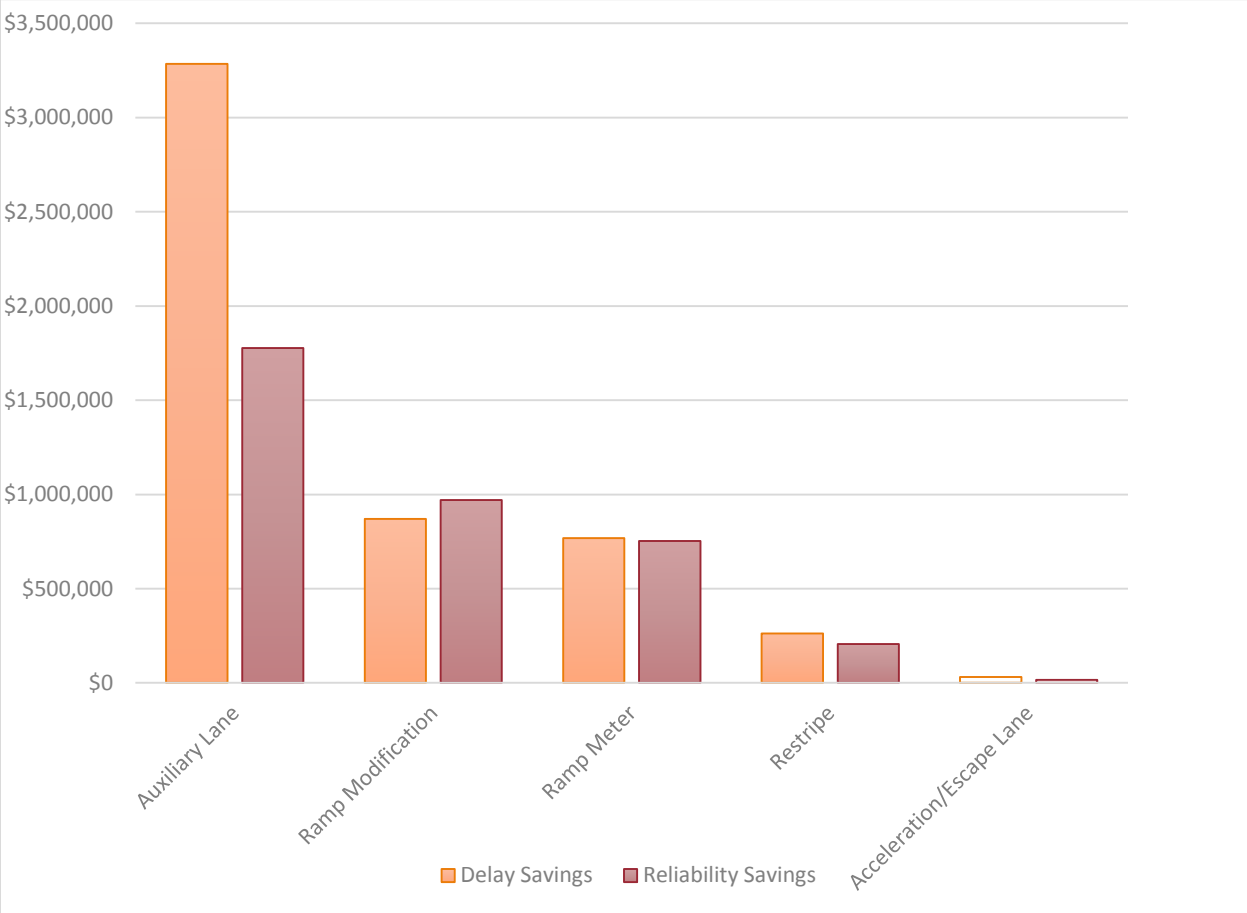
The fluctuation in travel time reliability before and after project completion was also evaluated. The performance measure of choice for the reliability analysis was the standard deviation method, as discussed in detail previously, to provide consistency with the proposed methodology in the CMSP 4 problem statement development. As a reminder, the standard deviation of morning and evening peak period travel times falling between the 2.5th and 97.5th percentiles were multiplied by the traffic volume experiencing those respective travel times to generate VHT of unreliable travel. Reliability benefits were monetized by taking the sum of unreliable morning and evening VHT and multiplying by the value of reliability, which was assumed to be 80% of the value of time. The figure below depicts the observed effectiveness in reducing both annual delay and travel time variability, by project type.

Figure 7 – Delay and Reliability Effectiveness by Project Type



The overall trend between the two performance measures is similar; reliability effectiveness tends to rise and fall with delay effectiveness. Both restriping and ramp modifications, however, stand out as project types that had a larger impact on travel time reliability than delay. On the contrary, acceleration/escape lanes affected vehicle delay twofold in relation to reliability. Assuming a reliability ratio of 0.8 (value of reliability/value of time), the overall increase in reliable travel times translates to over $11M in annual user savings, as compared to $25M in delay savings. Monetized travel time reliability savings compared to the observed delay savings is illustrated in Figure 8.

Figure 8 – Delay and Reliability Savings by Project Type

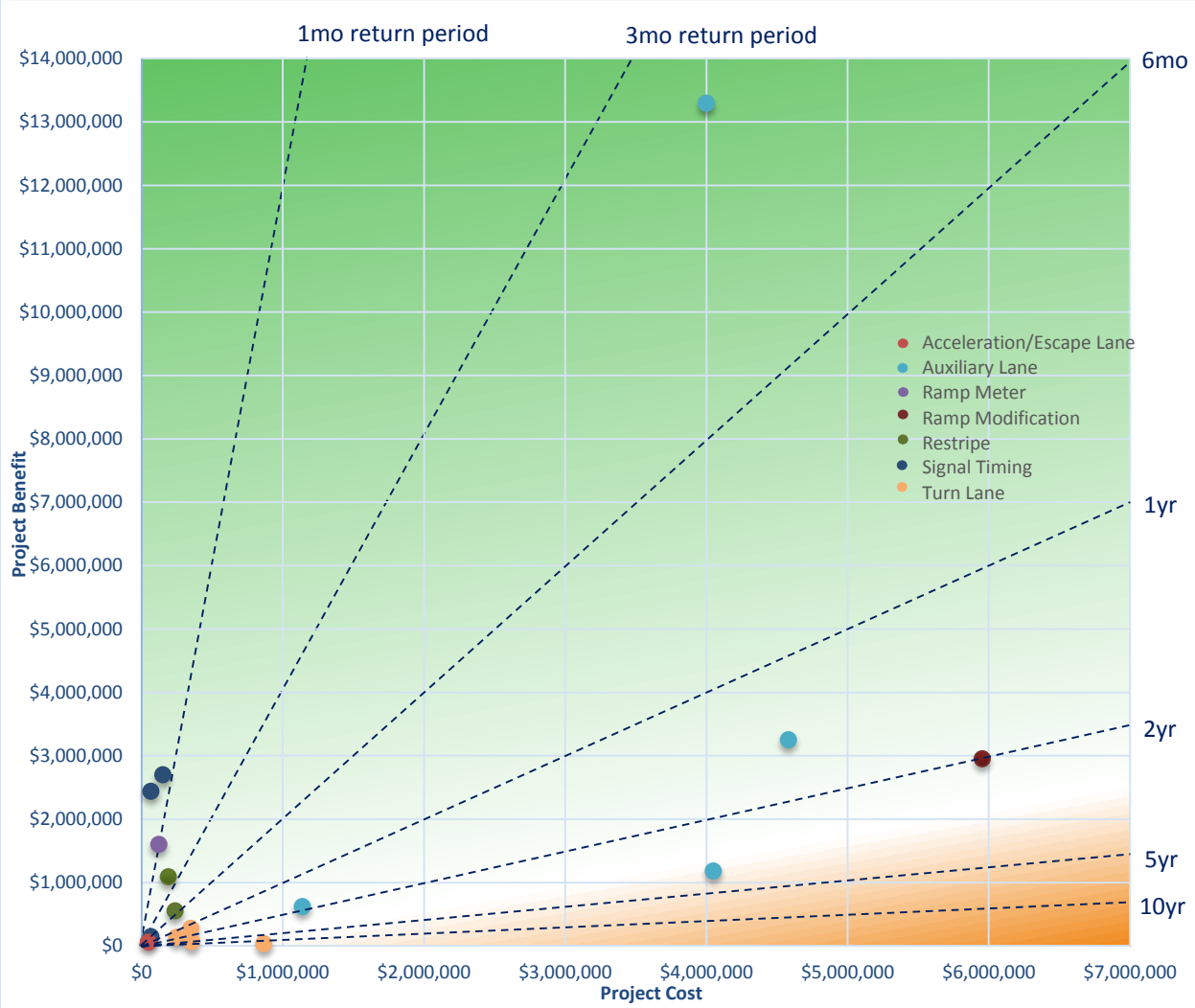


Applying a reliability ratio of 0.8 yields reliability savings similar in magnitude to delay savings for most project types. The auxiliary lane projects were one exception, where delay savings were observed to have an average delay savings roughly twice the amount of reliability benefits. Since the value of reliability is not currently universally established, there is flexibility in adjusting this value to produce reliability-to-delay savings ratios that coincide with expectations of the agency.

Return on Investment Comparison

Comparison of both costs and effectiveness demonstrates that the relatively more expensive project types had a greater impact on reducing existing delay and crash costs. Figure 9 displays project implementation costs and user benefits for before and after analysis projects. Projects without provided costs, as well as projects with negative observed user benefits, were not included in the figure.

Figure 9 – Comparison of Project Costs and Benefits



A notable finding from the before and after studies is that the three most expensive projects also yielded the highest magnitude of user savings. The key difference between these higher-cost projects and many of the lower cost projects is that the high-cost, large-benefit projects will net greater returns over the project life, while lower-cost, moderate benefit projects tend to have a shorter return period. Additionally, the technological project types, such as signal timing and ramp metering, proved to yield significant benefits at a relatively low cost. Thus, these projects generally experienced rapid returns on investment while still inflicting substantial reductions in user costs.

SUMMARY OF PROJECT CATEGORIES AND OPPORTUNITIES

CMSP Projects

Status / Area	East	North	South	West	Total	*Percentage*
Constructed	2	6	5	8	**21**	*25%*
Under Construction	1	1	1	2	**5**	*6%*
Programmed	1	8	2	1	**12**	*14%*
Study	1	4	2	19	**26**	*31%*
Superseded		3	1	1	**5**	*6%*
Low Priority	1		2	4	**7**	*8%*
Dropped	1	2	2	2	**7**	*8%*
Total	**7**	**24**	**15**	**37**	**83**	
Percentage	*8%*	*29%*	*18%*	*45%*		

CMSP 1 Projects

Status / Area	East	North	South	West	Total	*Percentage*
Constructed	1	4	2	6	**13**	*62%*
Under Construction				1	**1**	*5%*
Programmed		1			**1**	*5%*
Study				1	**1**	*5%*
Superseded				1	**1**	*5%*
Low Priority	1		1	1	**3**	*14%*
Dropped			1		**1**	*5%*
Total	**2**	**5**	**4**	**10**	**21**	
Percentage	*10%*	*24%*	*19%*	*48%*		

CMSP 3 Projects

Status / Area	East	North	South	West	Total	*Percentage*
Constructed	1	2	3	2	**8**	*13%*
Under Construction	1	1	1	1	**4**	*6%*
Programmed	1	7	2	1	**11**	*18%*
Study	1	4	2	18	**25**	*40%*
Superseded		3	1		**4**	*6%*
Low Priority			1	3	**4**	*6%*
Dropped	1	2	1	2	**6**	*10%*
Total	**5**	**19**	**11**	**27**	**62**	
Percentage	*8%*	*31%*	*18%*	*44%*		

CMSP Opportunity Summary

A review of CMSP opportunities can reveal how successful the previous CMSP processes were in terms of selecting projects that were feasible to implement. Projects that have been constructed, are undergoing construction, or are programmed were depicted as being successful. Low priority and dropped projects were deemed unsuccessful. A summary of previous CMSP opportunities is shown below:

	Solution Type	Total	Success	Study	Superseded	Unsuccessful
Freeway	Freeway Capacity	*3*	1	1	1	
	Auxiliary Lane	*25*	9	12	1	3
	Ramp Modification	*13*	6	5		2
	Acceleration/Escape Lane	*4*	4			
	Ramp Meter	*4*	2			2
Arterial	Arterial Capacity	*5*	1	2		2
	Intersection Reconfiguration	*5*	0	2	1	2
	Turn Lane	*14*	8	3	1	2
	Signal Modification	*2*	1			1
	Signal Timing	*3*	3			
Both	Restriping	*5*	3	1	1	
	Total	*83*	*38*	*26*	*5*	*14*

Status Review

The following information summarizes the different levels of success of various project types as well as rationale for why proposed solutions were more or less feasible. The characteristics of each of the project categories are outlined as follows. 'Success' projects were those that were typically completed as either a stand-alone project, or coordinated with preservation activities. 'Superseded' projects were those where a traditional project implementation was completed instead of a CMSP-style solution. 'Study' categorization occurred when there was a larger project context to consider, or the project conflicted with stakeholder/agency vision for the problem location. Finally, 'Unsuccessful' projects were characterized by the scopes exceeding CMSP solutions, solutions not being supported, minimal issues observed, or the identified issue at the problem location was related to a non-MnDOT highway.

Outlined below are more detailed findings and trends that were identified for specific solution types, or status categorizations:

Auxiliary Lanes

Auxiliary lanes were the most commonly proposed type of project, accounting for nearly a third of all recommended solutions. Of the 25 potential auxiliary lane projects, 21 were either deemed successful for implementation or were planned to undergo a more comprehensive study.

Success

- Coordinated with preservation – 2
- Incorporated into larger project – 4
- Stand-Alone project – 3

Study

- Potential project conflict – 12

Ramp Modification

The second most abundant solution to freeway problem locations were ramp modifications. This solution type made up roughly 25% of freeway solutions, and 85% of the proposed projects were a success or are under study.

Success

- Incorporated into larger project – 3
- Stand-alone project – 3

Study

- Potential project conflict – 3
- Scope exceeds CMSP characteristics – 1

Acceleration/Escape Lane

Acceleration and escape lanes were typically a lower-cost solution for freeway problem locations. A product of the lower costs was increased feasibility, resulting in all four of the recommended projects being successful.

Success

- Coordinated with preservation – 3
- Incorporated into larger project – 1

Turn Lane

Nearly half of all arterial projects involved turn lane improvements. Eight of the fourteen proposed turn lane solutions have been a success while only two have been unsuccessful.

Success

- Stand-alone project – 5
- Coordinated with preservation – 1
- Incorporated into larger project – 1
- Locally led project – 1

Signal Timing

All three of the proposed corridor signal timing enhancement projects were successful, supporting the feasibility of lower-cost solutions.

Success

- Internal MnDOT support
- Low cost – completed in-house

Intersection Reconfiguration

Of the five suggested intersection reconfiguration projects, zero were successful in being constructed or programmed. Two projects have been under study for potential implementation in the future, while two others were dropped from consideration. The following intersections that were proposed for geometric reconfiguration are as follows:

Locations

- TH 65 at Viking Blvd
- TH 101 at CSAH 61 (Carver)
- TH 13 at CSAH 21 (Scott)
- TH 169 at TH 41
- TH 55 at 26th St

Unsuccessful Opportunities

Common rationales for projects becoming a low priority or being dropped from consideration are listed below:

- Minimal problems observed – 4
- Low internal support – 3
- Solution not supported – 3
- Ineligible non-MnDOT highway – 1
- Locally led project – 1
- Potential project conflict – 1
- Traditional project implemented – 1

Conclusions

The following information summarizes the characteristics of the various project scopes and projects that provided different levels of return on investment.

Substantial Scope/Ample Benefits

- Auxiliary lanes / ramp modifications
- Stand-alone or project synergy

Small scope/moderate benefits

- Ramp meter / signal timing / restriping
- Internal MnDOT support/implementation

Small Scope/Minor Benefits

- Acceleration/escape lane – project synergy
- Turn lane – stand-alone projects

Of the 83 recommended CMSP opportunities, roughly 45% can be classified as a success. Additionally, 26 of the proposed solutions are currently under study and could potentially be introduced at a later date. Five projects were superseded by other, typically larger-scale, solutions. However, many of the projects that were constructed incorporated the design concepts originally identified in the CMSP process. This indicates that the proposed CMSP improvements targeted high-priority areas with beneficial solutions, but were ultimately substituted for strategies that captured a larger breadth of the problem. Approximately 17% of the solutions previously recommended through the CMSP process were either dropped or considered a low-priority, deeming the project opportunities unsuccessful. These solutions commonly dealt with problem locations that didn't warrant the complexity or cost of the improvement that was required to address the issue, likely resulting in an undesirable return on investment.

APPENDIX A: PROJECT ONE-PAGERS

Introduction

CMSP is a funding program that seeks to implement lower-cost/high-benefit improvements to address congestion and safety problems on MnDOT's Metro District highway system. Identification of problem locations and selection of solutions is completed using a data driven process to maximize the return on investments in terms of benefits for highway users. Solutions are intended to address specific problems under today's conditions, and while they are not necessarily intended to be 100 percent effective, they should make conditions noticeably better than they are today. Solutions are also typically lower-cost and smaller in scope that traditional highway investments, which is intended to allow them to be delivered more quickly and simply.

Several previous phases of CMSP have been undertaken over the past decade. As part of the efforts for Phase 4, the current phase, of CMSP a thorough review has been undertaken of past CMSP opportunity lists. This includes qualitative review of all the opportunities to identify their current implementation status, whether they have been completed, are in a planning or construction phase, or are not actively being pursued due to other circumstances.

For completed projects, quantitative before-and-after analyses have been undertaken to understand their impacts on traffic congestion and safety. The actual project costs and construction characteristics have also been reviewed and compared to the original estimates. The comparisons of these real-world implications of completed projects will be critical to the success of the phase 4 work, by determining how cost and benefit estimation procedures can be improved and proposing solutions that can be most effective in relieving congestion, reliability, and safety problems. Selected locations are highlighted and described in this series of project summaries.

Congestion Management Safety Plan

TH 8

Revised striping to improve safety outside of Chisago Schools from Dew Drop Lane to Pleasant Knoll/Cresent Road

Solution Concept

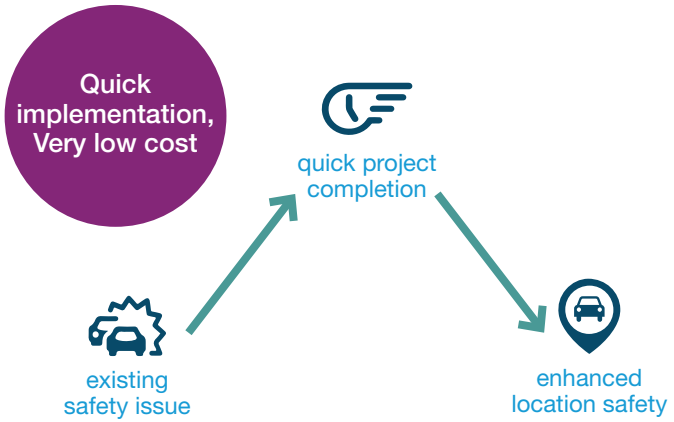
Year Built: 2015

Construction Duration: Less than 1 year

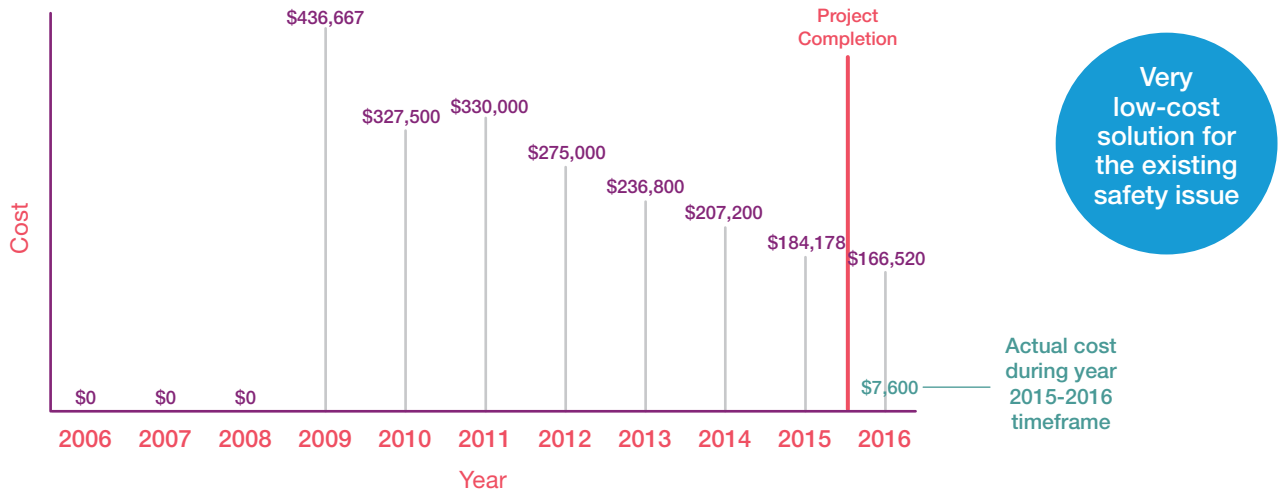
TH 8 is a principal arterial in the northern Twin Cities metro region that connects I-35W to west-central Wisconsin. The roadway is characterized by higher speeds in rural sections and lower speeds through several towns, with access to both residential and commercial development. The nature of the facility has proven problematic from a traffic safety perspective, one location of interest is outside of the Chisago Lakes School, with seven crashes occurring between the years 2008 and 2014.

Review of the location indicated that some drivers were inadvertently entering the turn lanes instead of staying in the through lane as they traveled through a long horizontal curve.

- Striping was included with planned mill and overlay project.
- This project revised the pavement markings to better define the right and left turn lanes with a short skip stripe.
- The project revised striping to the east to improve safety by defining the right turn/left turn striping.
- The restriping was completed as part of a pavement preservation.



MOVING AVERAGE CRASH COST PER YEAR



Congestion Management Safety Plan

TH 100

Install ramp meters at TH 55, Duluth St., 36th Ave., CR 81, and France Ave in northbound and southbound directions

Solution Concept

Year Built: 2008
Construction Duration: 1 year
Cost: $125,000

TH 100 between I-394 and I-694 is a north-south principal arterial serving local, regional, and commuter trips in the cities of Golden Valley, Robbinsdale, and Brooklyn Center. The north end of the corridor is characterized by less-than-one-mile interchange spacing, and large peak hour entering volumes leading to stop-and-go traffic conditions.

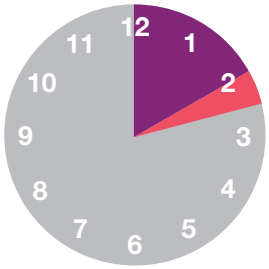
Cheap and quick project

Project resulted in five fewer injury crashes per year

RECOMMENDED PLANNING TIME TO TRAVERSE CORRIDOR DURING RUSH HOUR

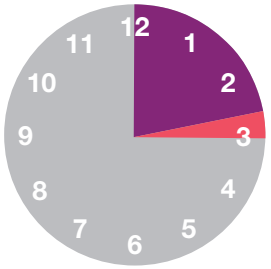
Before After

Southbound AM Peak



Planning time reduced from 12 mins to 9.5 mins

Northbound PM Peak



Planning time reduced from 15 mins to 13.5 mins

Annual User Benefits

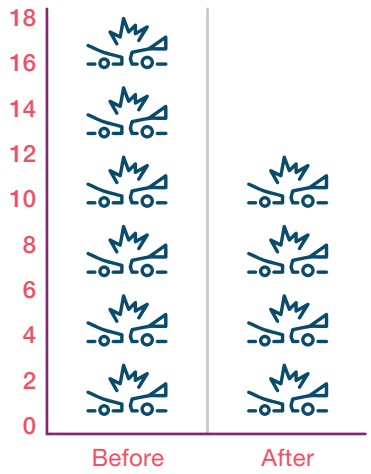
$770,000 in delay savings

Crash cost savings of **$830,000**

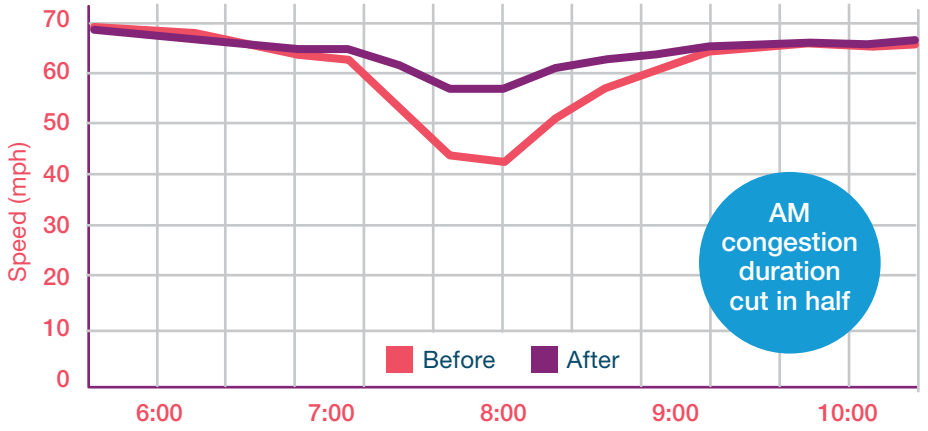
$750,000 in travel time reliability benefit

Increased peak period throughput by **175,000** vehicles

INJURY CRASHES PER YEAR



AVERAGE CORRIDOR SPEEDS - SOUTHBOUND AM PEAK PERIOD



Commuters each experience a reduction in 8 hours of time spent in traffic over a year period

Congestion Management Safety Plan

I-94

Eastbound Auxiliary Lane
between TH 61 on-ramp and
White Bear Avenue off-ramp

Solution Concept

Year Built: 2011
Construction Duration: 1 year
Cost: $1.1M

The section of eastbound I-94 from downtown St. Paul to White Bear Avenue has been congested during the p.m. peak period since the early 2000's. Large volumes of traffic commuting from downtown Minneapolis and St. Paul to the east suburbs exacerbate the congestion problem and cause congestion related crash issues.

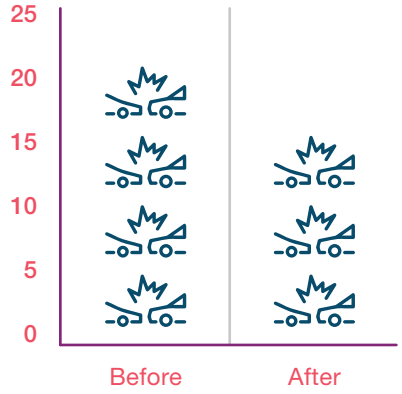
This project added an eastbound auxiliary lane from the TH 61 on-ramp to the White Bear Avenue off-ramp.

The project was completed and was well received by local officials, recognizing the benefit of the project.

$

Low cost for auxiliary lane

CRASHES PER YEAR



Project resulted in a 25% crash reduction

Before After

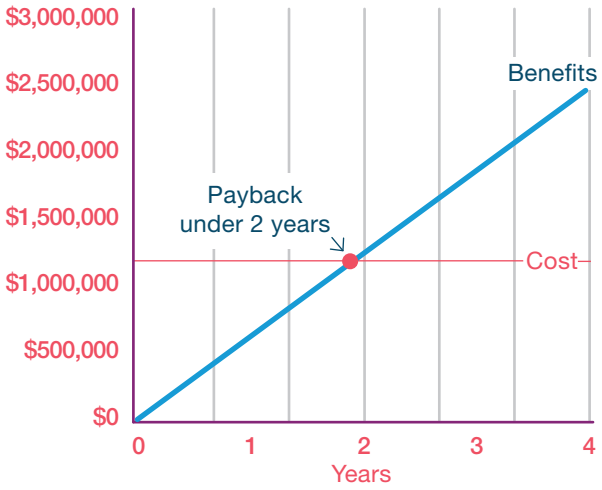
crash cost savings of **$255,000**

Annual User Benefits

$364,000 in daily savings

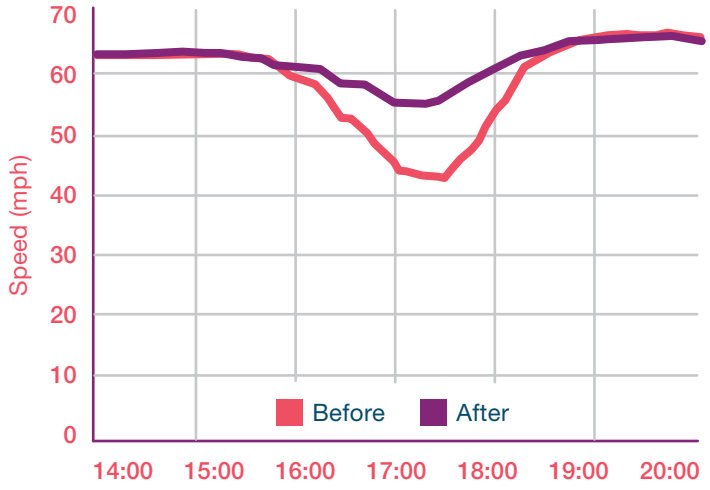
$527,000 in travel time reliability benefit

PROJECT PAYBACK



Project benefits only included delay and crash savings

AVERAGE CORRIDOR SPEEDS



Commuter travel time was reduced by 25% during p.m. peak period

Congestion Management Safety Plan

I-494

Westbound auxiliary lane between northbound I-35W loop and France Avenue

Solution Concept

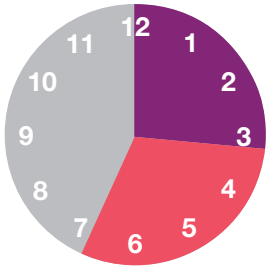
Year Built: 2013
Construction Duration: 1 year
Cost: $4M

I-494 is a principal arterial freeway that makes up half of the beltline surrounding the Twin Cities metro area. I-494 serves a large variety of regional and local trips, and provides access to numerous north-south principal arterials including TH 212, US 169, TH 100, I-35W, TH 77. The section of I-494 between France Avenue and I-35W is routinely one of the most congested segments of freeway in the entire Twin Cities metro. A combination of entering, weaving, and heavy through traffic contributes to both a.m. and p.m. peak hour congestion issues.

CORRIDOR PLANNING TRAVEL TIME

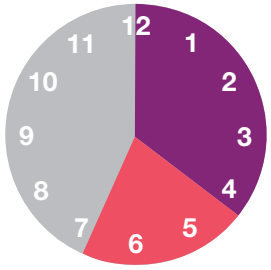
Before After

AM Peak



Planning time reduced from 34 mins to 16.5 mins

PM Peak



Planning time reduced from 34 mins to 22.5 mins

MNDOT PM CONGESTION REPORTS

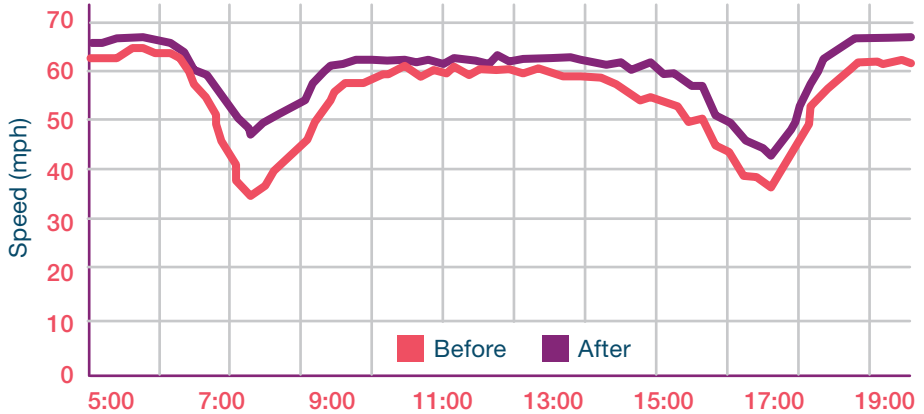
Annual User Benefits

$14.2M in delay savings

$6.8M in travel time reliability benefit

Increased peak period throughput by **200,000** vehicles

AVERAGE CORRIDOR SPEEDS



Each AM commuter saves 23 hours in traveling time over a year
Each PM commuter saves 15 hours in travel time throughout a year

Congestion Management Safety Plan

TH 10

Add eastbound and westbound third lane from Egret Boulevard to Hanson Boulevard

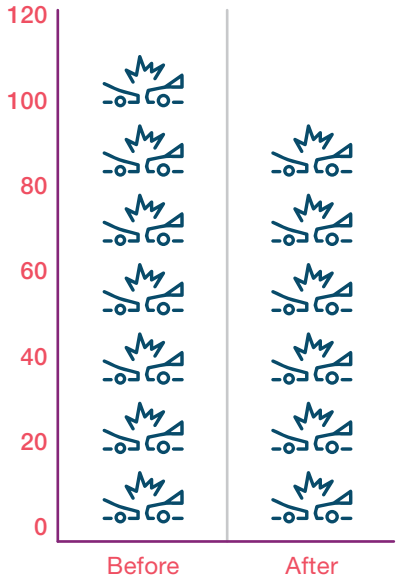
Solution Concept

Year Built: 2009
Construction Duration: 1 year
Cost: $9M

The section of TH 10 between Egret Boulevard and Hanson Boulevard is a principal arterial in the north metro and carries 86,000 daily trips through the city of Coon Rapids. The facility is characterized by commuter peaks and experiences related congestion and crash issues, eastbound during the a.m. peak and westbound during the p.m. peak.

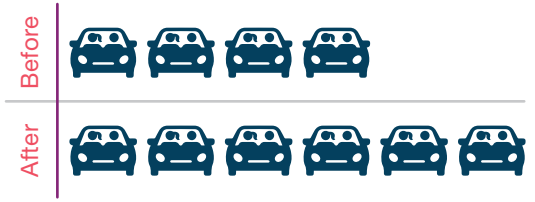
Before After

CRASHES PER YEAR



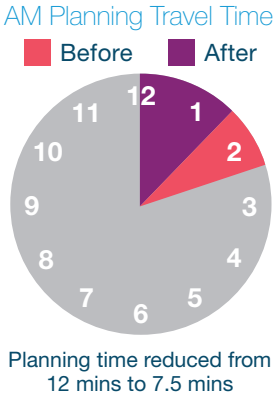
Project resulted in a reduction of 15 crashes per year

DAILY PEAK PERIOD THROUGHPUT



Project allowed nearly 1,000 more daily vehicles through corridor during peak periods

AM Planning Travel Time



Planning time reduced from 12 mins to 7.5 mins

Annual User Benefits

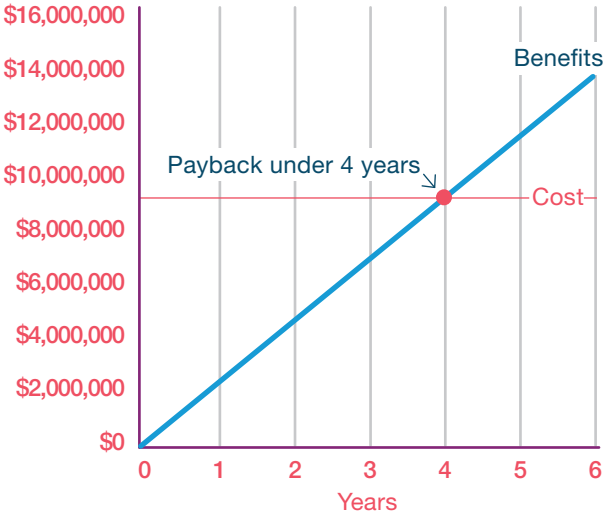
$1.33M in delay savings

Crash cost savings of **$1.05M**

$667,000 in travel time reliability benefit

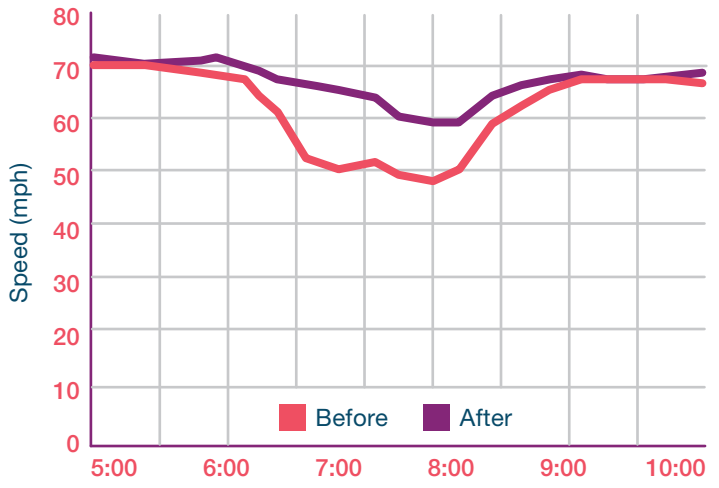
Increased peak period throughput by **200,000** vehicles

PROJECT PAYBACK



Project benefits only included delay and crash savings

AVERAGE CORRIDOR SPEEDS



AM travel times were reduced by 25% for each commuter

Congestion Management Safety Plan

TH 100 at I-694

Two-lane northbound on-ramp from TH 100 to eastbound I-694 and re-stripe

Solution Concept

Year Built: 2007
Construction Duration: 1 year
Cost: $190,000

TH 100 northbound from France Avenue to I-694 eastbound was unchanged in the freeway conversion of TH 100 (TH 55 to France Avenue). This segment's single-lane entrance onto I-694 eastbound had been adequate for the TH 100 expressway. The conversion to a freeway fed more traffic into the entrance and developed a two-mile congested queue on the roadway segment. This was exacerbated by the shifting traffic patterns as a result of the I-35W bridge collapse.

This project provided a two-lane northbound ramp from TH 100 to eastbound I-694 This project was completed as part of the I-35W Bridge Traffic Restoration efforts.

The traffic improvement and low impacts demonstrate that striping and lane-alignment modifications can be effective solutions.

Low cost

Duration of congestion decreased by 1Hour

TYPICAL TRAVEL TIME RANGE

Before After

Before

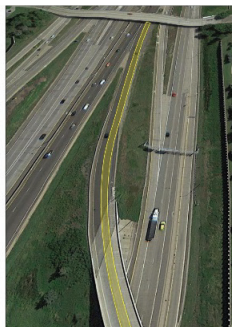
ranged from **3-7 mins**

After

ranged from **2-5 mins**

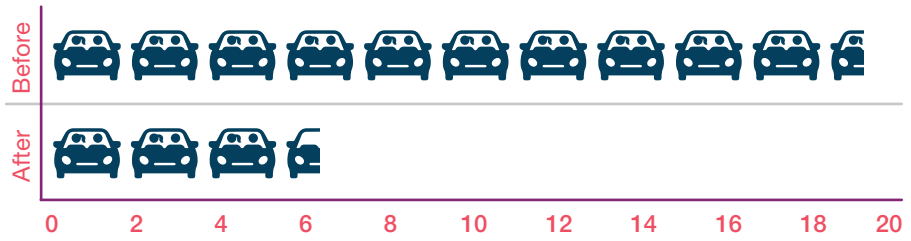
Both duration and range of travel times decreased, allowing users to be on time more frequently

Before

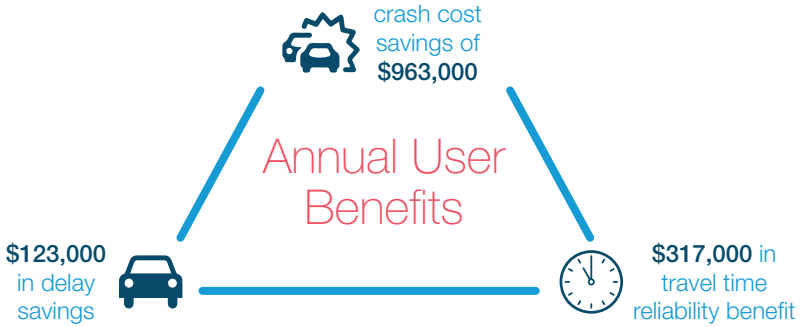


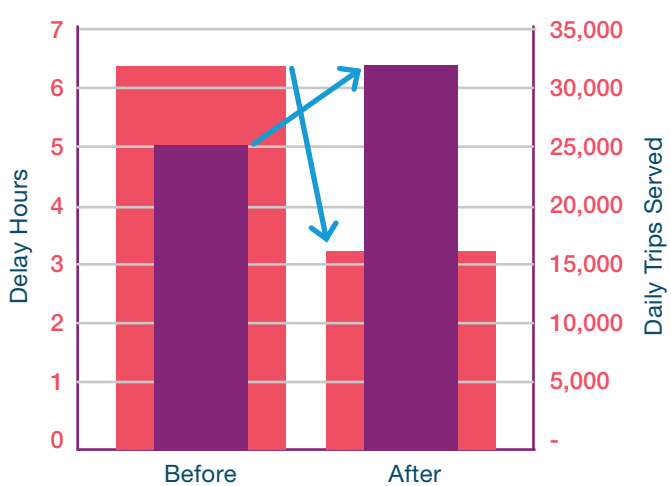
After

REAR-END CRASHES PER YEAR



Reduced congestion resulted in a 67% rear-end crash reduction





Each commuter's travel time delay was reduced by 50% during p.m. peak period, resulting in a three hour savings over a year period.

Congestion Management Safety Plan

TH 36 / TH 120 (Century Ave)

Extend eastbound left-turn lane

Solution Concept

Year Built: Fall 2015

Construction Duration: Less than 1 year

The intersection of TH 36 and TH 120 is located on the border of the cities of Oakdale and North St. Paul.

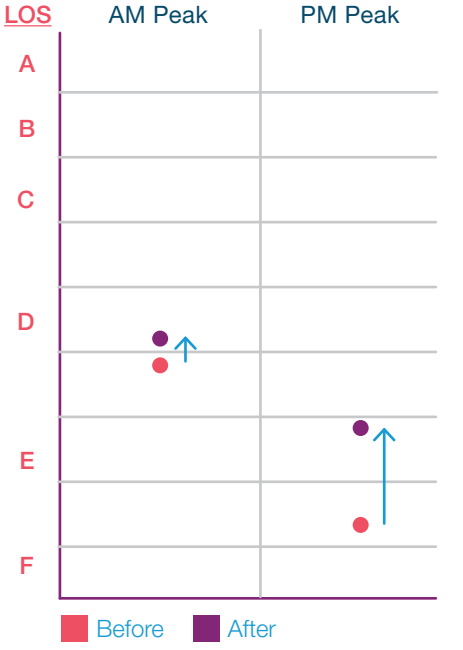
The intersection is also located at a point where TH 36 transitions from a freeway (where access is provided by interchanges) to an expressway (characterized by traffic signal control). The TH 120 signal is the first signal motorist encounter as they travel eastbound on TH 36 leading to a rear-end crash problem, particularly in the p.m. peak period. The amount of volume also leads to congestion and major queuing and delay on side street approaches. Due to a heavy eastbound to northbound left-turn volume and general intersection delays, queuing left-turn traffic frequently backed up into the through lanes.

The extended eastbound left-turn lane addressed a major problem and was implemented with minimal impacts.

Before the project, this location had a crash rate 1.75 times higher than what is considered critical for similar intersection types

Annual delay savings of $277,000

INTERSECTION LEVEL OF SERVICE

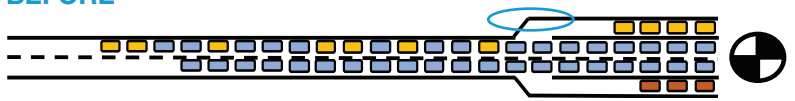


Each p.m. peak hour motorist will save an hour in travel time over a year at this intersection

Before

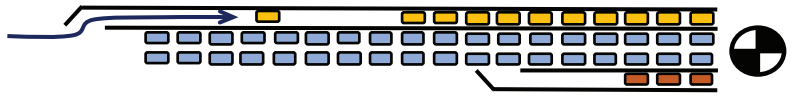
After

BEFORE



Through-lane queue blocks traffic from entering turn bay

AFTER



Extension of turn bay decreases delay by allowing left-turning vehicles to catch their signal and by decreasing the through-lane queue length

Congestion Management Safety Plan

TH 61 / TH 55 and 10th St.

Eastbound double left-turn lane

Solution Concept

Year Built: Fall 2015
Construction Duration: 1 year
Cost: $356,378

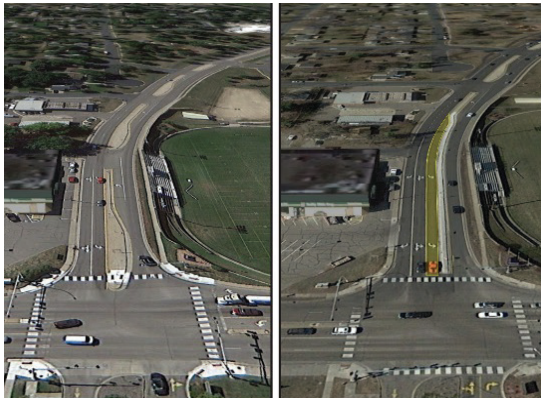
The intersection of TH 61 and TH 55 is located in the City of Hastings. TH 61 through town was expected to operate poorly when the new TH 61 Bridge was constructed. Buildings and direct access to TH 61 makes it difficult to increase capacity.

This project was an individual project that was built by itself. It was constructed quickly with a very short construction timeline (3 weeks).

Cooperation from the City and adjacent developments allowed for the project to go smoothly.

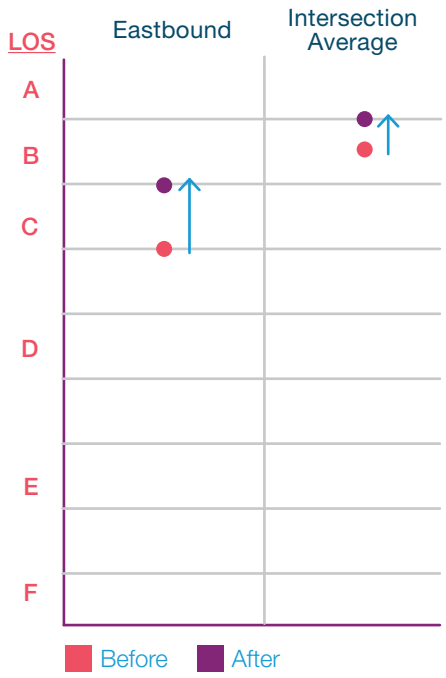
Low cost

Annual delay savings of $68,000



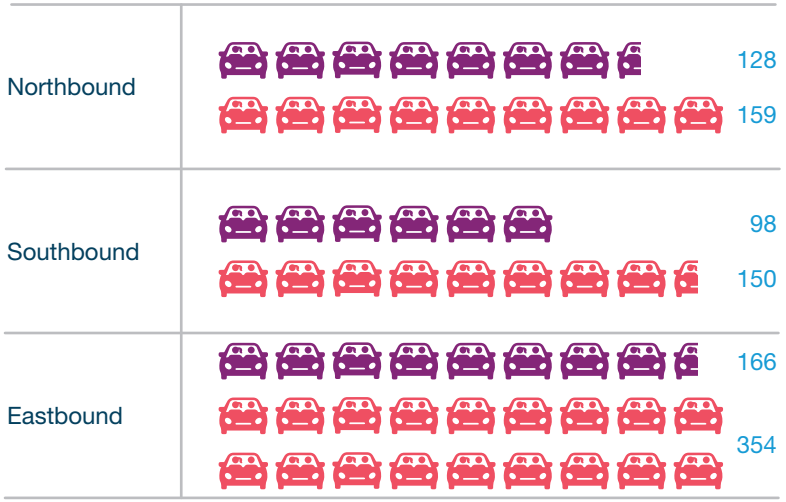
Before After

PM INTERSECTION LEVEL OF SERVICE



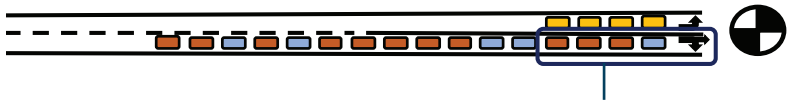
ESTIMATED PM PEAK QUEUE LENGTHS *(FEET)*

Before After



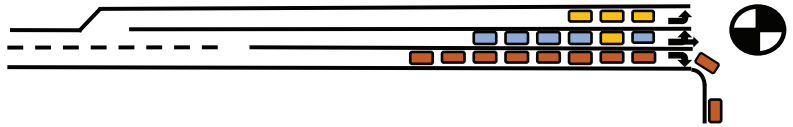
Additional capacity on the eastbound approach also benefits queue lengths and vehicle delay on the other approaches

BEFORE



High number of right-turn movements blocked from taking right-turn on red gaps due to through movement vehicles waiting at red signal

AFTER



Separation of movements increases right-turn capacity

Congestion Management Safety Plan

TH 169 / Marshall Rd

Add turn lane to westbound exit

Solution Concept

Year Built: Fall 2014

Construction Duration: 1 year

The intersection of TH 169 and Marshall Road is located in the City of Shakopee in Carver County. The interchange provides access to this quickly growing suburb south of the Mississippi River. The 1,000+ vehicles using the westbound off-ramp during the p.m. peak hour routinely experience queuing that backs up and impacts freeway operations.

The project was led locally. The CMSP process helped raise awareness of this opportunity by identifying it through the CMSP evaluation.

Annual delay savings of $133,000

ESTIMATED PM PEAK QUEUE LENGTHS

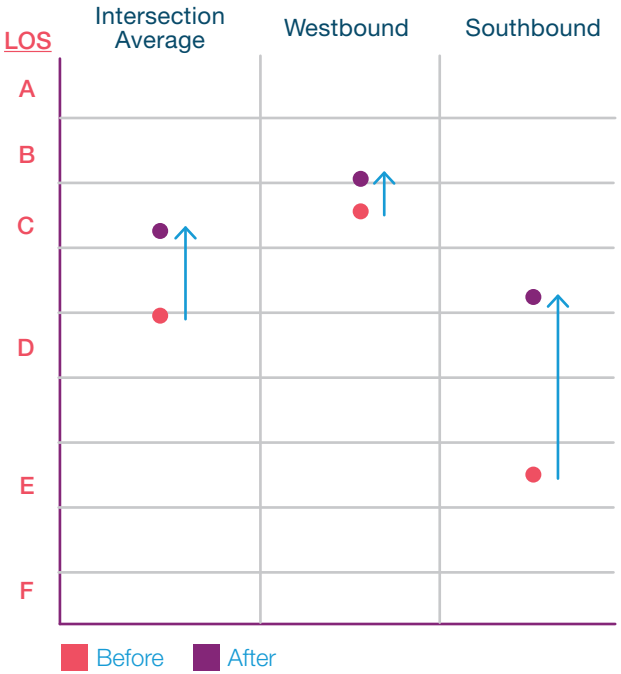
(FEET)

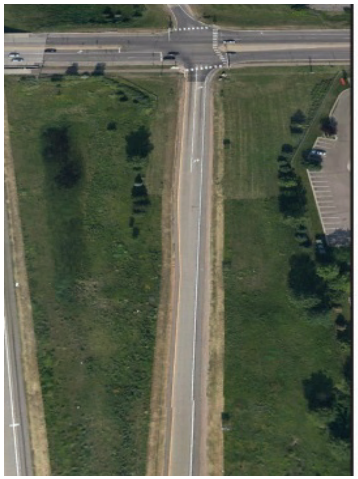
Before After

Southbound		181
		401
Westbound		451
		605

- Increased off-ramp capacity
- More green time for other approaches
- Queue and delay reduction
- Signal delay is reduced by an average of 25 seconds per user for southbound vehicles
- PM commuters will save nearly an hour a year at this intersection

PM INTERSECTION LEVEL OF SERVICE





Before

After

Congestion Management Safety Plan

TH 7

Corridor tuning for 29 traffic signals

Solution Concept

Year Built: AUG and SEPT 2011

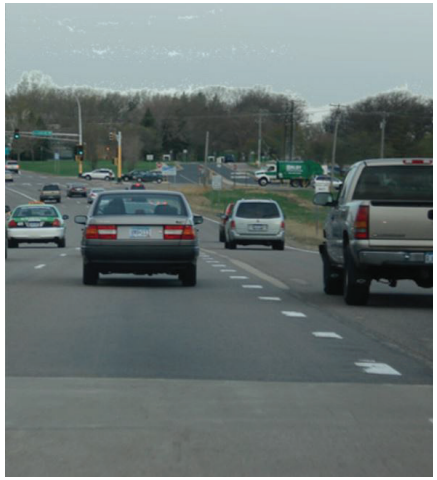
Construction Duration: 2 months

Cost: $67,000

TH 7 is a primary east/west arterial linking Minneapolis to the western suburbs. The section of TH 7 included in the signal timing optimization project was from Ottawa Avenue in St. Louis Park at the east terminus, and TH 41 in Shorewood at the west terminus. TH 7 serves as a heavy peak commuter route with volumes ranging between 25,000 and 46,000 vehicles per day, and provides connections to several principal arterials including I-494, TH 169, and TH 100. The purpose of the signal timing project was to reduce mainline delays along the corridor, particularly for the peak hour commuter direction, while minimizing adverse impacts to cross streets.

Low cost, quick return on investment

$123,000 in delay savings



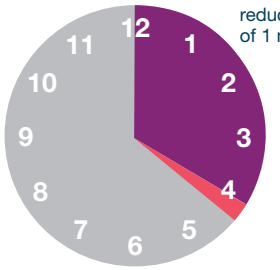
Signal timing improved performance for both corridor directions during each peak period

Intersection delay across all approaches also decreased in the study area

EASTBOUND CORRIDOR TRAVEL TIMES

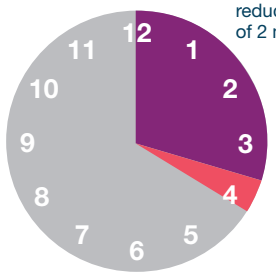
AM Peak — Average travel time reduction of 1 min

PM Peak — Average travel time reduction of 1 min



WESTBOUND CORRIDOR TRAVEL TIMES

AM Peak — Average travel time reduction of 2 min



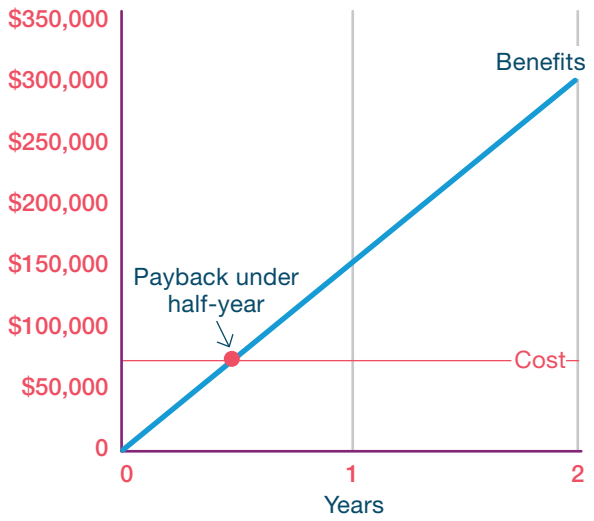
PM Peak — Average travel time reduction of 1.5 min

Before

After

Daily travel time reduction saved commuters 10 hours per year

PROJECT PAYBACK



APPENDIX B: DETAILED BEFORE AND AFTER PROJECT RESULTS

Before and After Results Matrix can be found on the next page.

Appendix B: Detailed Before and After Results

		Observed										Projections										
Index	Project Description	Actual Project Cost	VMT Shift (After-Before)	Annual Delay Savings	Annual Crash Savings	Total Savings	Annual Reliability Savings	Delay Effectiveness	Crash Effectiveness	Total Effectiveness	Return Period (Years)	Old Estimated Annual Reduction in Delay (hours)	Annual Delay Savings	Annual Crash Savings	Total Savings	Delay Effectiveness	Crash Effectiveness	Total Effectiveness	Return Period (Years)	Project Type	Area	CMSP Phase
1	TH 8 – Revised Striping Outside of Chisago Schools	-		-	-	-	-	-	-	-	-	-	$0	$35,000	$35,000	-	33%	33%	0.1	Restripe	East	3
2	TH 100 – I-694 to I-394 Ramp Metering	$122,765		$768,252	$830,533	$1,598,785	$752,294	28%	37%	32%	0.1	49,258	$855,858	$0	$855,858	-	-	-	0.1	Ramp Meter	West	1
3	I-35W – 106th Street to TH 13 Southbound Auxiliary Lane	$4,049,086		$567,537	$613,733	$1,181,270	$906,582	40%	62%	49%	3.4	48,255	$838,431	$0	$838,431	-	-	-	7.2	Auxiliary Lane	South/West	1
4	I-94 – TH 61 to White Bear Avenue Eastbound Auxiliary Lane	$1,140,565		$363,777	$254,733	$618,510	$527,165	46%	33%	39%	1.8	39,219	$681,430	$0	$681,430	-	-	-	4.4	Auxiliary Lane	North	1
5	I-494 – I-35W through France Avenue Westbound Auxiliary Lane	$4,000,000	1,056,997	$14,166,439	-$871,200	$13,295,239	$6,788,276	64%	-8%	40%	0.3	37,750	$655,906	$0	$655,906	-	-	-	6.1	Auxiliary Lane	West	1
6	TH 10 – Egret Boulevard to Hanson Boulevard Eastbound Third Lane	$4,582,149	296,349	$1,065,506	$2,183,067	$3,248,572	$761,473	63%	55%	58%	1.4	39,407	$684,697	$0	$684,697	-	-	-	8.8	Auxiliary Lane	North	1
7	TH 10 – Egret Boulevard to Hanson Boulevard Westbound Third Lane	$4,582,149	(4,928,971) 15,300,847	$261,204	-$1,132,000	-$870,796	-$94,604	11%	-67%	-22%	-5.3	46,913	$815,113	$0	$815,113	-	-	-	7.4	Auxiliary Lane	North	1
8	I-35W – Restripe Southbound on Mississippi River Bridge to Washington Avenue	-		$686,799	$841,667	$1,528,466	$475,733	67%	28%	38%	-	19,363	$336,432	$0	$336,432	-	-	-	1.5	Restripe	West	1
9	I-94 – Restripe Westbound I-94 to have Center Lane Split into Two Lanes Prior to I-394 Exit	$238,297	860,611 (3,159,156)	-$15,263	$564,533	$549,270	$34,224	-5%	10%	10%	0.4	71,893	$1,249,141	$0	$1,249,141	-	-	-	0.2	Restripe	West	1
10	I-35 – CSAH 50 Northbound Entrance Parallel Acceleration Lane	$217,800	(2,593,261)	$31,387	-$54,267	-$22,879	$16,525	13%	-4%	-2%	-9.5	1,302	$22,624	$197,000	$219,624	43%	41%	41%	1.8	Acceleration/Escape Lane	South	3
11	I -35E - Larpenteur Avenue to Cayuga Auxiliary Lane	-		-	-	-	-	-	-	-	-	12,305	$213,794	$883,000	$1,096,794	62%	26%	29%	3.1	Auxiliary Lane	North	3
12	TH 65 – Southbound Escape Lane after Westbound CSAH 10 Exit	$50,000	180,425	-	$59,200	$59,200	-	-	100%	100%	0.8	-	$0	$105,000	$105,000	-	33%	33%	1.0	Acceleration/Escape Lane	North	3
13	I-94 – Westbound Two-Lane Exit to TH 101 with Northbound Flyover Ramp	$5,954,004	985,486	$869,905	$2,079,600	$2,949,505	$969,617	34%	45%	41%	2.0	147,071	$2,555,359	$0	$2,555,359	-	-	-	1.6	Ramp Modification	West	1
14	TH 100 – Two-Lane Northbound On-Ramp to Eastbound I-694	$190,000		$123,137	$963,200	$1,086,337	$316,884	17%	60%	46%	0.2	11,963	$207,857	$0	$207,857	-	-	-	2.4	Restripe	West	1
15	TH 36 and TH 120 (Century Avenue) – Extend Eastbound Left-turn Lane	$350,000	1,361,914	$277,388	-	$277,388	**	16%	-	16%	1.3	15,450	$268,444	$587,000	$855,444	18%	32%	25%	1.9	Turn Lane	North/East	3
16	TH 55 and TH 100 Exit Ramps – Extend Northbound and Southbound Exiting Turn Lanes	$865,495	-	$35,539	-	$35,539	**	4%	-	4%	24.4	-	$0	$40,000	$40,000	0%	4%	3%	3.3	Turn Lane	West	3
17	TH 61 and TH 55 – Eastbound Double-left Turn Lane	$356,378	5,248,294	$67,710	-	$67,710	**	21%	-	21%	5.3	16,600	$288,425	$333,000	$621,425	27%	29%	28%	0.6	Turn Lane	South	3
18	TH 169 and Marschall Road (CSAH 17) – Add Turn Lane to Westbound Exit	$250,000		$132,702	-	$132,702	-	29%	-	29%	1.9	475	$8,253	$23,000	$31,253	1%	2%	2%	8.0	Turn Lane	South	3
19	TH 13: Yankee Doodle to Prior Lake – Corridor Tuning for 43 Signals	$152,012		$2,115,406	$581,333	$2,696,740	*	9%	6%	8%	0.1	130,208	$2,262,364	$0	$2,262,364	-	-	-	< 0.1	Signal Timing	South	1
20	TH 7: TH 100 to TH 41 – Corridor Tuning for 29 Signals	$67,000	-	$799,250	-$654,667	$144,583	*	3%	-8%	0%	0.5	500,000	$8,687,500	$0	$8,687,500	-	-	-	< 0.1	Signal Timing	West	1
21	TH 65: I-694 to CSAH 24 (East Bethel) – Corridor Tuning for 24 Signals	$66,000	-	$2,975,469	-$540,133	$2,435,335	*	5%	-4%	4%	< 0.1	234,375	$4,072,266	$0	$4,072,266	-	-	-	< 0.1	Signal Timing	North	1
		$27,233,699		$25,292,144	$5,719,333	$31,011,478	$11,454,169						$24,703,893	$2,203,000	$26,906,893							

*INRIX data unavailable during project analysis timeframe

**Full year of post-construction INRIX data unavailable for reliability analysis

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