I-35W North Managed Lanes Corridor Study Final Executive Summary

June 2013

Prepared By:

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1.0 Executive Summary

1.1 Introduction

The I-35W north corridor is a major radial freeway corridor connecting greater Minnesota and the growing north suburban area to downtown Minneapolis. As the region has grown and more development has occurred, traffic volumes have increased to the point that a number of segments along the corridor experience significant peak period congestion each day. Congestion is expected to significantly increase by year 2030 as additional growth and development occur in communities throughout the corridor.

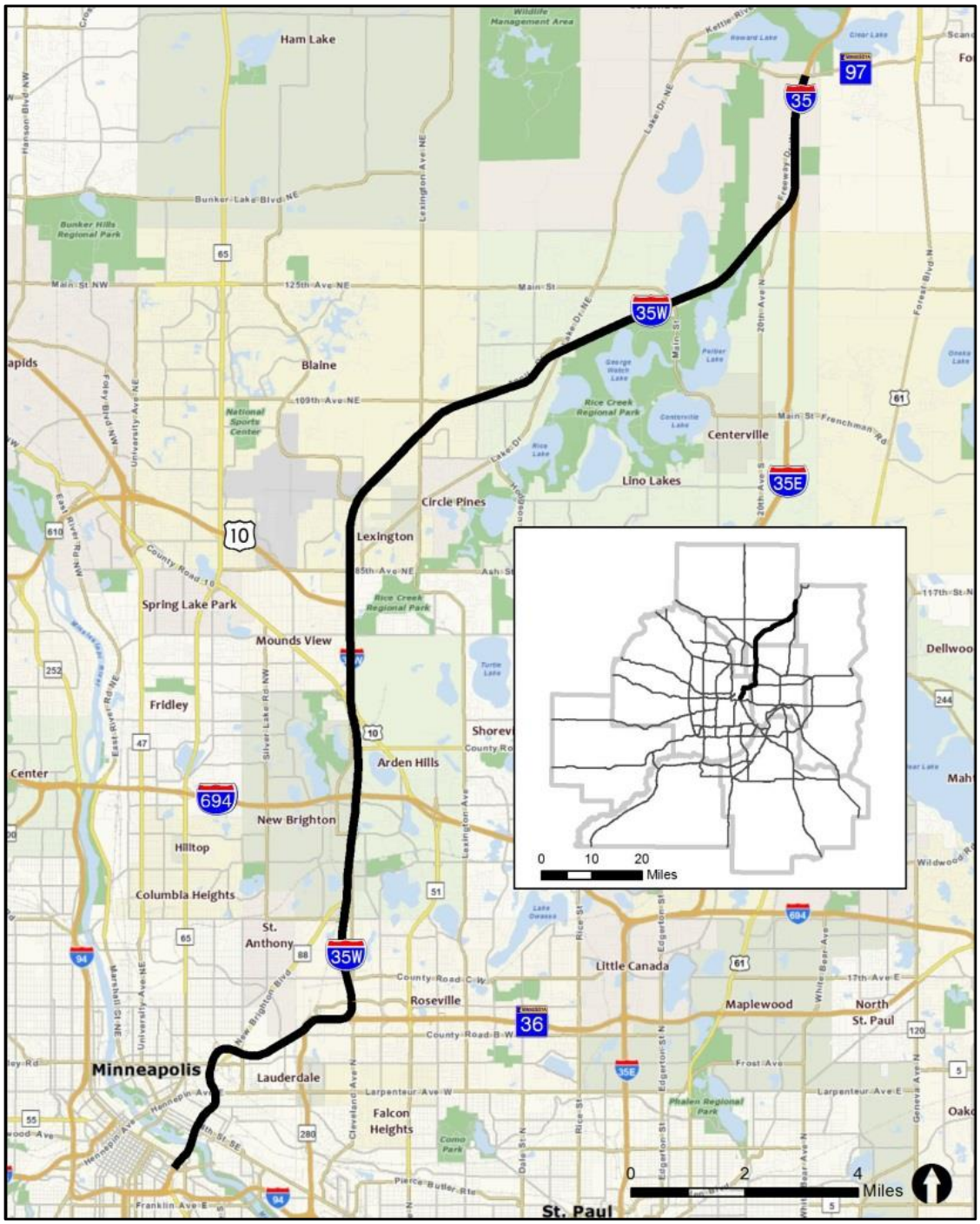
The purpose of the I-35W North Managed Lanes Corridor Study was to identify and evaluate lower-cost/high-benefits options for improving traffic operations along I-35W as well as to evaluate options for providing a managed lane in the corridor. For purposes of this study, managed lanes are considered to be priced and restricted to High Occupancy Vehicles (HOV), toll paying vehicles, transit vehicles, and motorcycles. These lanes are expected to operate similar to current MnPASS lanes in the Twin Cities which include I-394 and I-35W south. The corridor study limits are shown in Figure ES-1.

1.2 Study Process

The I-35W North Managed Lane Study was intended to investigate the feasibility and viability of a Managed Lane option along the corridor. This following process was used to accomplish this investigation:

- Background – review all pertinent corridor information, including existing safety and operational issues, traffic/roadway/transit characteristics and future year forecasts.
- Screening Criteria – confirm study goals and objectives and develop screening criteria based on the goals and objectives that corridor alternatives will be evaluated by.
- Study Framework – on a high level discuss corridor options such as Light Rail Transit and Bus Rapid Transit as well as managed lanes and how these are or are not consistent with regional polices and overall user demand.
- Alternative Development – develop localized improvements to address existing congestion as well as develop managed lane alternatives for the corridor.
- Primary Screening –evaluate corridor alternatives utilizing a high level analysis based on the screening criteria to reduce the amount of alternatives being considered.
- Secondary Screening – based on the results of the Primary Screening, evaluate the remaining corridor alternatives utilizing a more detailed level analysis based on the screening criteria to determine a viable alternative.
- Managed Lane Vision and Implementation Plan – develop a Managed Lane Vision based on the viable managed lane alternatives and other corridor improvements. Develop a Implementation Plan that systematically advances the Managed Lane Vision.
- Management and Outreach – work with corridor stakeholders throughout the study to obtain input and feedback on overall study process. Hold public outreach meetings to engage local officials and general public.
- Documentation – provide a report that documents study process and results.

Figure ES-1 Corridor Map



It should be noted that the I-35W North Managed Lane Study is the first step in a process; it is not intended to provide a detailed recommendation but rather a possible viable solution. If decision makers decide to continue the process, the next steps would include environmental documentation and preliminary design which include the National Environmental Policy Act (NEPA) process to fully evaluate alternatives and determine a preferred alternative. Then final design and construction would follow.

1.3 Management Team and Advisory Committee

The I-35W North Managed Lanes Corridor Study consulting team reported to a Project Management Team (PMT) and a Technical Advisory Committee (TAC). These groups provided valuable input and direction through the course of the study.

In addition to the PMT and TAC, public outreach meetings were held. The goals of the public outreach meetings were to:

- Educate those unfamiliar with managed lanes
- Receive input
- Convey benefits and impacts of alternatives

1.4 Goals and Objectives

The overarching goals of this study were developed and refined early on and remained consistent with the goals as presented by the proposal development committee. The purpose of the I-35W North Managed Lane Corridor Study is to identify improvement strategies that accomplish the following goals:

- Reduce congestion and improve safety along the corridor.
- Better utilize existing and future infrastructure investments.
- Increase transit ridership and the use of high occupancy vehicles by providing travel time advantages.
- Provide a choice for commuters during the peak periods.

The purpose of this study is to identify lower cost/high benefit improvement strategies for the corridor and how improvements could be strategically implemented over time. Specifically this study investigated the type of managed lane system, the location and implementation of said systems, and options for further study to determine a viable set of corridor improvement strategies and associated policies.

1.5 Existing Conditions

Traffic Operations

Understanding the existing operational issues was important to the I-35W North Managed Lanes Corridor Study. This understanding provided a baseline for developing concept alternatives to address issues and move toward the goal of better utilizing existing infrastructure investments. The review of the existing operation conditions identified the congestion causes affecting the I-35W north corridor. An illustration of congestion locations and causes is shown in Figure ES-2. Three major congestion causes for the I-35W corridor were identified along with several additional secondary congestion causes.

FIGURE ES-2

Interstate 35W North Managed Lanes Study
Existing Conditions

Congestion Causes

Congestion Cause 1:
The entering traffic from County Road 23 and County Road J puts the mainline at capacity.

Congestion Cause 2:
The entering traffic from TH 10 puts the mainline at capacity.

Congestion Cause 3:
The entering volume from CSAH 96 and the exiting volume to westbound I-694 create a weaving section in the right lane.

Congestion Cause 4:
The entering traffic from the eastbound I-694 puts the mainline at capacity.

Congestion Cause 5:
The entering traffic from County Road E2 creates right-lane turbulence that impacts mainline speeds.

Congestion Cause 6:
The entering traffic from County Road D creates right-lane turbulence that impacts mainline speeds.

Congestion Cause 7:
The entering traffic from County Road 88 and Johnson Street puts the mainline at capacity.

Congestion Cause 8:
The left lane drop on eastbound TH 36 at County Road 46 puts the mainline at capacity. Traffic queues spill back onto northbound I-35W.

Congestion Cause 9:
The entering traffic from County Road D and CSAH 88 add to mainline congestion generated by downstream locations.

Congestion Cause 10:
The northbound entrance and exit volumes at the I-694 loops create an over-capacity weave segment.

Congestion Cause 11:
The entering traffic from TH 10 and the exiting traffic to County Road I produces right-lane turbulence impacting mainline speeds.

NOT TO SCALE

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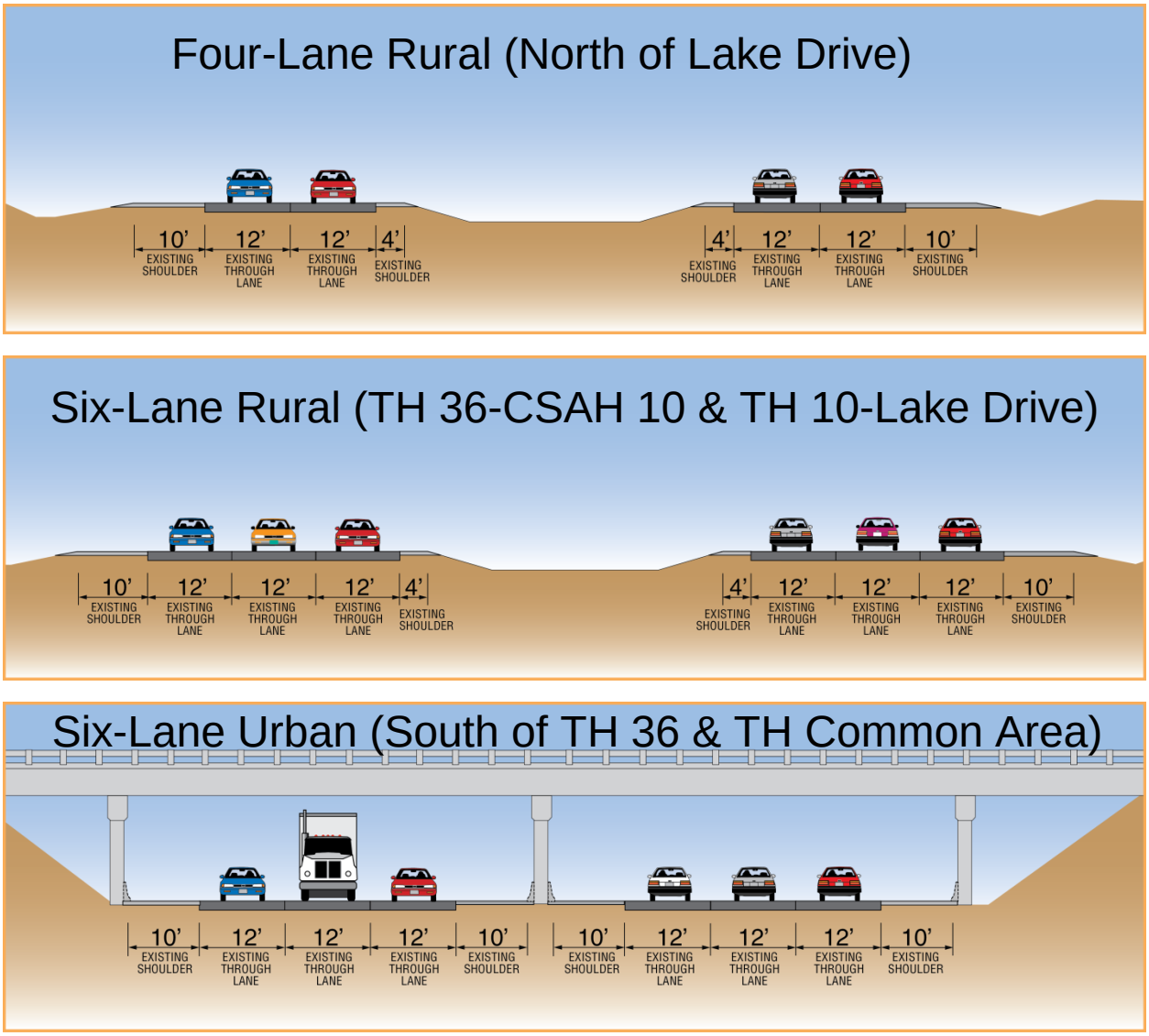
Physical Characteristics

The corridor consists of three main cross sections; rural four-lane, rural six-lane and urban six-lane however, there are multiple locations along the corridor where auxiliary lanes exist and shoulder widths may vary. These cross sections are shown in Figure ES-3 below.

Figure ES-3 Existing Cross Sections



Transit and Freight

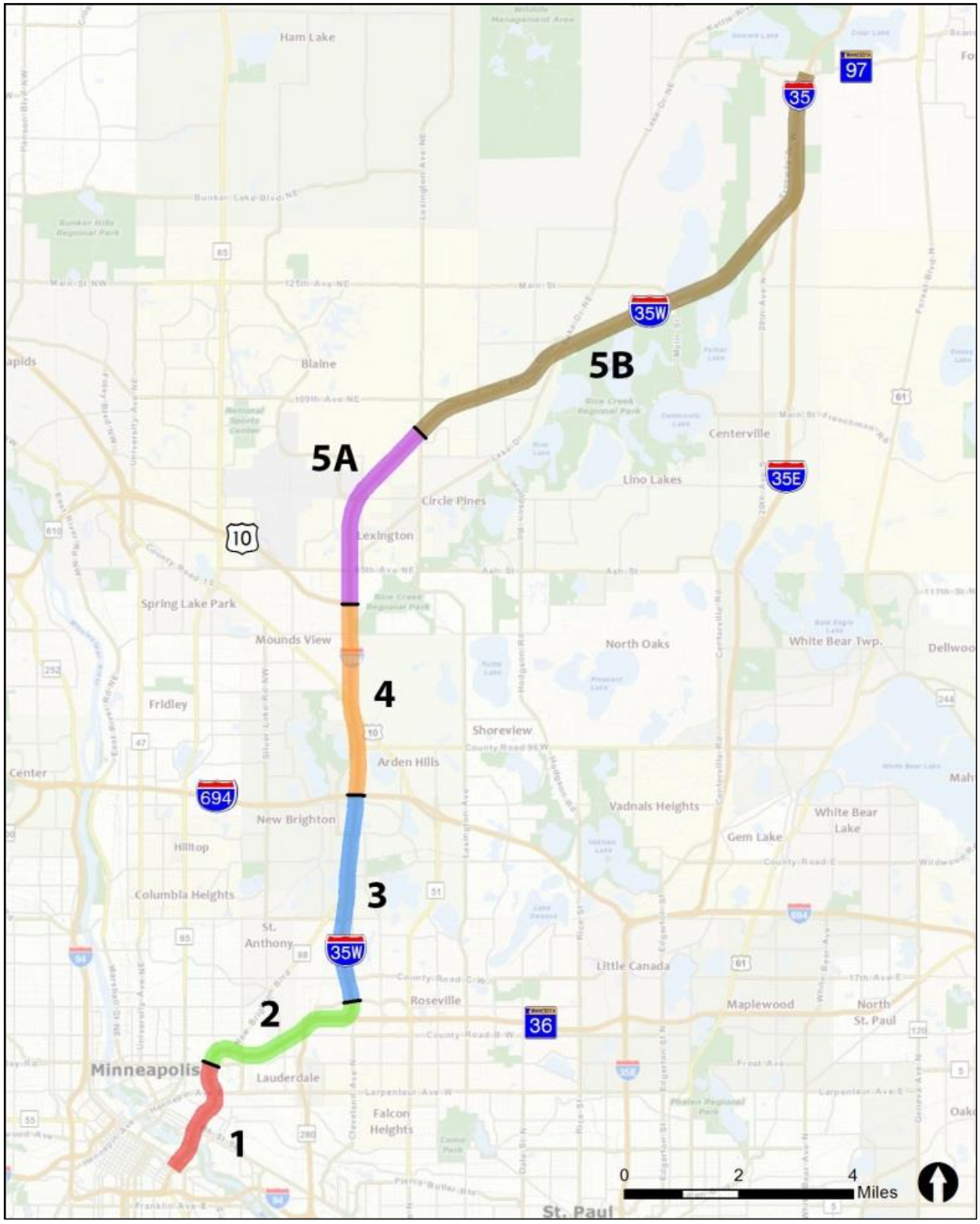
The I-35W north corridor supports a significant amount of transit use. On average over 5,800 weekday transit riders travel the I-35W north corridor on nine routes. A total of 194 in-service buses traverse the corridor on these routes on a typical weekday. The vast majority of the service (86 percent) and ridership (90 percent) occur during the peak periods, between 6:00 a.m. and 9:30 a.m. and between 3:00 p.m. and 6:30 p.m., as defined by Metro Transit. There are 14 Metro Transit park and ride lots located within the study area which service bus routes operating on the I-35W north corridor. More detailed transit information can be found in the main body of the report.

Current data suggests a significant percent of truck volumes in the I-35W north corridor. The pattern suggests that the northbound truck volumes follow a similar pattern to the daily northbound commuter volumes. Truck volumes in the southbound direction also share a peak with commuter volumes in the morning hours. The largest truck volume occurs in the I-35W segment between TH 36 and TH 10 N where trucks represent nine to twelve percent of daily traffic volumes.

1.6 Segmentation

The overall study corridor is 25 miles in length and has multiple variances in physical and traffic characteristics. Based on these physical and traffic characteristics the I-35W north corridor was broken down into logical segments. This ensured the proper evaluation of the managed lane alternatives since a certain alternative may be a good option in one segment and not be adequate in another. Detailed division of the corridor segments is shown in Figure ES-4.

Figure ES-4 Segmentation Map



1.7 Travel Demand Forecasting

Future year travel demand was evaluated for highway, transit, and freight modes. Travel demand results were developed for existing (year 2010/2011) conditions, year 2030 no-build and various build/managed lane alternatives using the Metropolitan Council Regional Travel Demand Model.

Year 2030 No-Build

No-build baseline forecasts included programmed roadway improvements identified in the STIP and roadway network assumptions identified in the Metropolitan Council's TPP. Lane use assumptions are consistent with the most current Metropolitan Council-accepted comprehensive plan information submitted by local communities. Daily growth of highway volumes in the corridor was expected to be higher on the northern segments of I-35W compared to the southern segments. Approximate annual growth rates in the corridor are 0.5 percent south of TH 36, 0.5 percent to 1 percent between TH 36 and TH 10, and slightly more than 1 percent north of TH 10. Overall, traffic patterns in the study area are expected to remain similar to existing conditions. The exceptions to this relate to assumed highway improvements in the study area. The south 4th Street entrance ramp to northbound I-35W and northbound auxiliary lane from southeast 4th Street to the combined Johnson Street is expected to result in increased traffic on northbound I-35W between downtown Minneapolis and TH 280. The TH 10/CSAH 96 Grade Separation project is expected to attract more trips to TH 10 from I-35W and I-694.

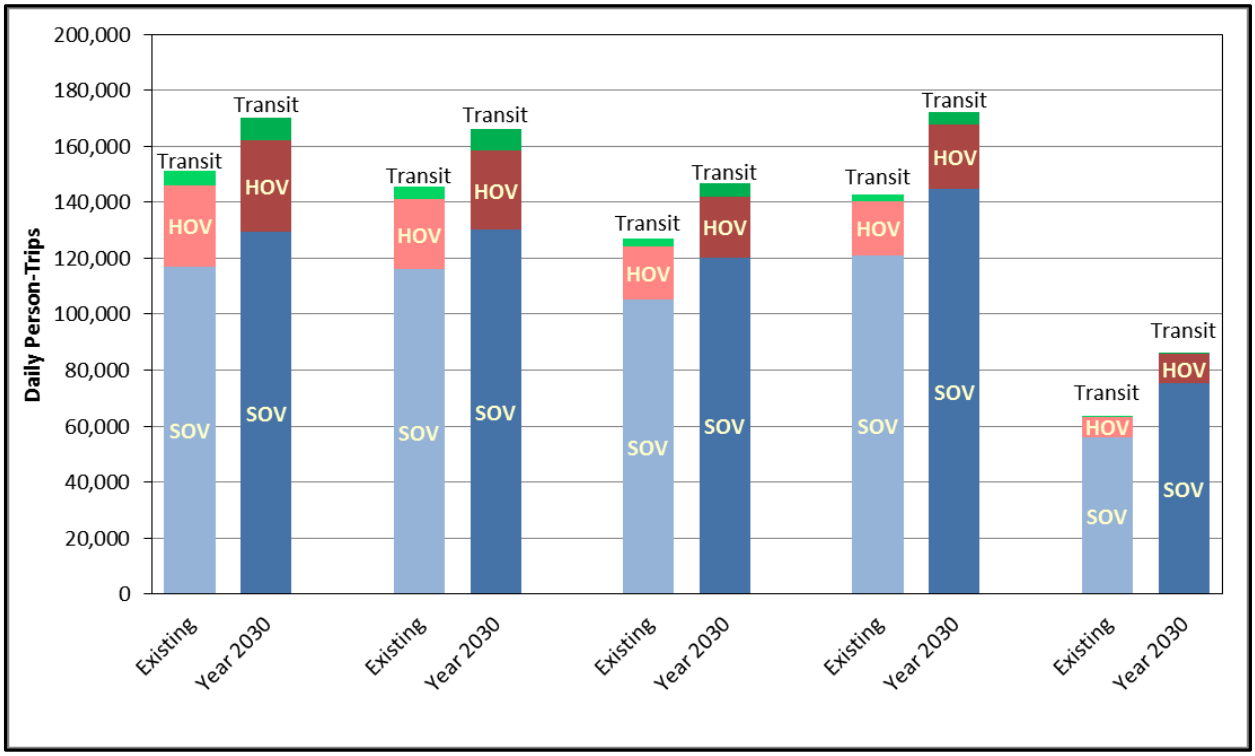
The forecast reasonableness checks included a review of peak demand during the five-hour a.m. and p.m. peak periods. This review indicated that some freeway segments within the study area are expected to approach capacity across the five-hour peak period. During the a.m. peak this included southbound I-35W between TH 10 and CR 88 and eastbound TH 10 between 93rd Lane and I-35W. During the p.m. peak this included northbound I-35W between CR 88 and Lexington Avenue and westbound TH 10 between I-35W and TH 65. All these areas experienced peak period congestion under existing conditions, and the results showed the duration and extent of congestion is expected to grow under year 2030 no-build conditions.

Transit ridership forecasts were also prepared for year 2030 no-build conditions. These forecasts included the programmed improvements as listed in the full report. Transit ridership in the I-35W north corridor is expected to experience substantial growth by year 2030. I-35W corridor routes are expected to increase from approximately 2,750 to 4,425 daily riders and TH 36 routes are expected to increase from 2,175 to 3,225 daily riders. These represent increases of 60 percent and 48 percent respectively, and 55 percent overall. These increases are attributable to a number of factors, including: increased highway congestion along I-35W results in mode shift to transit, increased park and ride capacity at stations in the I-35W north corridor, and increased frequency of transit routes serving the study area.

Travel Demand Model Shares

Results from the travel demand model were summarized for each of the five segments in the I-35W north corridor. The number of person-trips was estimated based on assigned model highway and transit volumes and vehicle occupancy ratios. Figure ES-5 shows the results of this summary. These results show in addition to overall growth in person-throughput in the I-35W North Managed Lanes Corridor Study, the relative proportions of HOV and transit person-trips are expected to increase between existing and year 2030 no-build conditions.

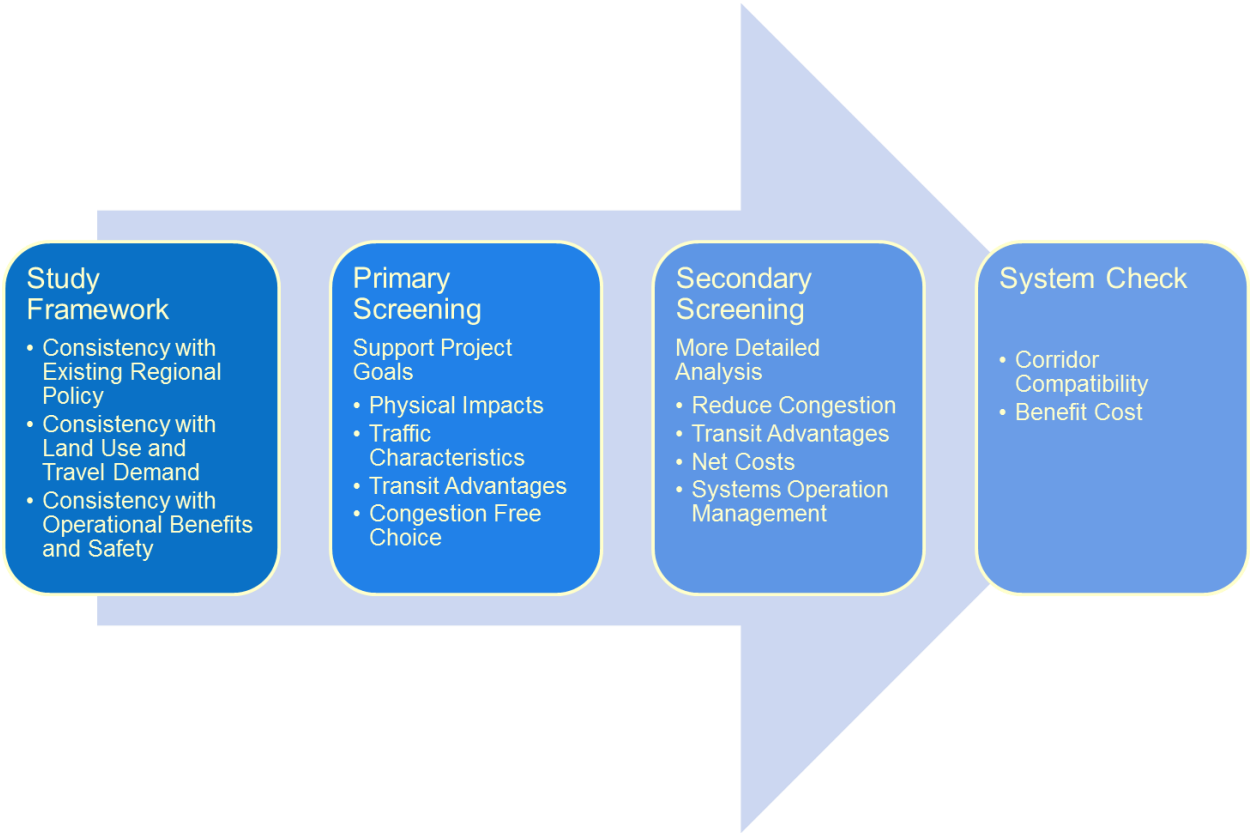
Figure ES-5 I-35W Person Throughput by Segment



1.8 Corridor Alternative Evaluation

The overall evaluation process is broken down into four distinct evaluation steps. First is the Study Framework which ensures that only alternatives that fit into regional policies and are feasible based on project demand. Second is the Primary Screening that evaluates the corridor alternatives at a high level and recommend alternatives to be carried forward into the more detailed secondary screening process. Third is the Secondary Screening that completes a detailed evaluation of the corridor alternatives that were carried forward from the primary screening analysis. Finally, a System Check is completed to ensure the viable alternatives for each segment are compatible with each other. A summary of the process can be seen in Figure ES-6

Figure ES-6 Process Chart



1.9 Managed Lane Forecasts

Results of the build alternative model runs indicated the addition of managed lane capacity along the I-35W north corridor would result in increased traffic on this roadway (including both the general purpose and managed lanes). The largest traffic increases are expected along I-35W between Lexington Avenue and downtown Minneapolis. Other roadways expected to result in traffic increases include Lexington Avenue (CSAH 17) north of I-35W, 95th Avenue north/west of I-35W, TH 10 between TH 610 and I-35W, and TH 36 between I-35W and I-35E.

Table ES-1 shows the change in volume along all segments of the I-35W within the study area. It also shows the total daily traffic expected to use the managed lanes. Due to multiple factors, volumes in the table show the overall increase in traffic for each segment is less than the volumes using the managed lanes. For example, traffic shifting to the managed lanes from the general purpose lanes and other parallel routes reduced congestion in the general purpose lanes which in turn attracted backfill traffic from other parallel routes.

Table ES-1 Year 2030 Daily Traffic Forecasts with I-35W Managed Lane

Route	Segment	Location	No Build	Build	Change	Managed Lane Volume
I-35W	1	South of Washington Ave	125,200	127,300	2,100	
		Washington Ave to University Ave	155,900	158,500	2,600	
		4th St to Hennepin Ave	156,200	160,700	4,500	7,000
		Hennepin Ave to Johnson St	142,500	147,100	4,600	6,800
	2	New Brighton Blvd to Industrial Blvd	127,500	132,500	5,000	7,100
		Industrial Blvd to TH 280	129,900	135,000	5,100	7,100
		TH 280 to TH 36	173,200	178,100	4,900	7,800
	3	Cleveland Ave to CR C	130,700	136,700	6,000	7,600
		CR C to CR D	130,800	136,900	6,100	7,800
		CR D to CR 88	122,000	128,200	6,200	7,700
		CR 88 to CR E2	133,500	139,700	6,200	7,900
		CR E2 to I-694	136,200	142,400	6,200	7,900
	4	I-694 to CSAH 96	136,100	142,200	6,100	8,200
		CSAH 96 to CSAH 10	129,100	135,100	6,000	8,000
		CSAH 10 to CR H	163,000	168,600	5,600	7,900
		CR H to CR I	177,100	182,100	5,000	8,000
		CR I to TH 10	173,400	177,800	4,400	7,700
	5	TH 10 to CR J	116,400	119,900	3,500	6,000
		Lake Dr to 95th Ave	86,700	90,000	3,300	5,500
		95th Ave to Lexington Ave	77,300	79,800	2,500	4,400
		Lexington Ave to CSAH 23	56,400	57,200	800	
		CSAH 23 to I-35E	48,500	49,100	600	
I-35		I-35E/W to TH 97	96,300	96,400	100	
		North of TH 97	80,300	80,400	100	

1.10 Transit Forecasts

Transit ridership forecasts were also prepared for the build alternative to evaluate the effects of improved transit travel times on express bus ridership. The same background assumptions of planned and programmed transit improvements used in the no-build transit ridership forecasts carried forward into this scenario. The only change was a modification to the travel time of Route 250 service from the 95th Avenue Park and Ride to downtown Minneapolis. A travel time savings of approximately seven minutes was identified for this route based on the difference in peak hour travel times expected with the addition of managed lanes along the I-35W north corridor.

The results of the build scenario transit assignment showed improved travel time for Route 250 resulting from future managed lanes along I-35W which would increase ridership. The year 2030 daily ridership would be expected to increase from 3,050 to 3,450 compared to no-build conditions, showing an increase of 13 percent. The forecast ridership for the entire study area's transit routes is shown in Table ES-2.

Table ES-2 Year 2030 Daily Transit Ridership Forecasts with I-35W Managed Lane

Route	Description	Type	2030 No Build	2030 Build
	Corridor Routes			
	I-35W Routes			
118	Downtown Minneapolis to Columbia Heights	Local	150	150
250	**Downtown Minneapolis to Lino Lakes**	**Express**	**3,050**	**3,450**
252	Downtown Minneapolis to Blaine	Express	175	175
288	Downtown Minneapolis to Forest Lake	Express	425	425
860	Downtown St. Paul to Coon Rapids	Express	625	625
	TH 36 Routes			
260	Downtown Minneapolis to Roseville	Express	225	225
261	Downtown Minneapolis to Shoreview	Express	275	275
264	Downtown Minneapolis to Roseville	Express	800	800
270	Downtown Minneapolis to Maplewood	Express	1,925	1,925
	Summary			
	Corridor Routes		**7,650**	**8,050**
	I-35W Corridor Routes Subtotal		*4,425*	*4,825*
	TH 36 Corridor Routes Subtotal		*3,225*	*3,225*

A Bus Rapid Transit (BRT) scenario was also considered. The purpose of the investigation was to determine whether the I-35W North corridor has the potential to support possible future BRT service and if so, the extent to which design of these managed lanes would be impacted by this service. A number of conclusions were drawn from the results of the express bus and BRT evaluation which help to answer these questions and can guide subsequent transit and BRT studies along I-35W, as well as design of the roadway improvements.

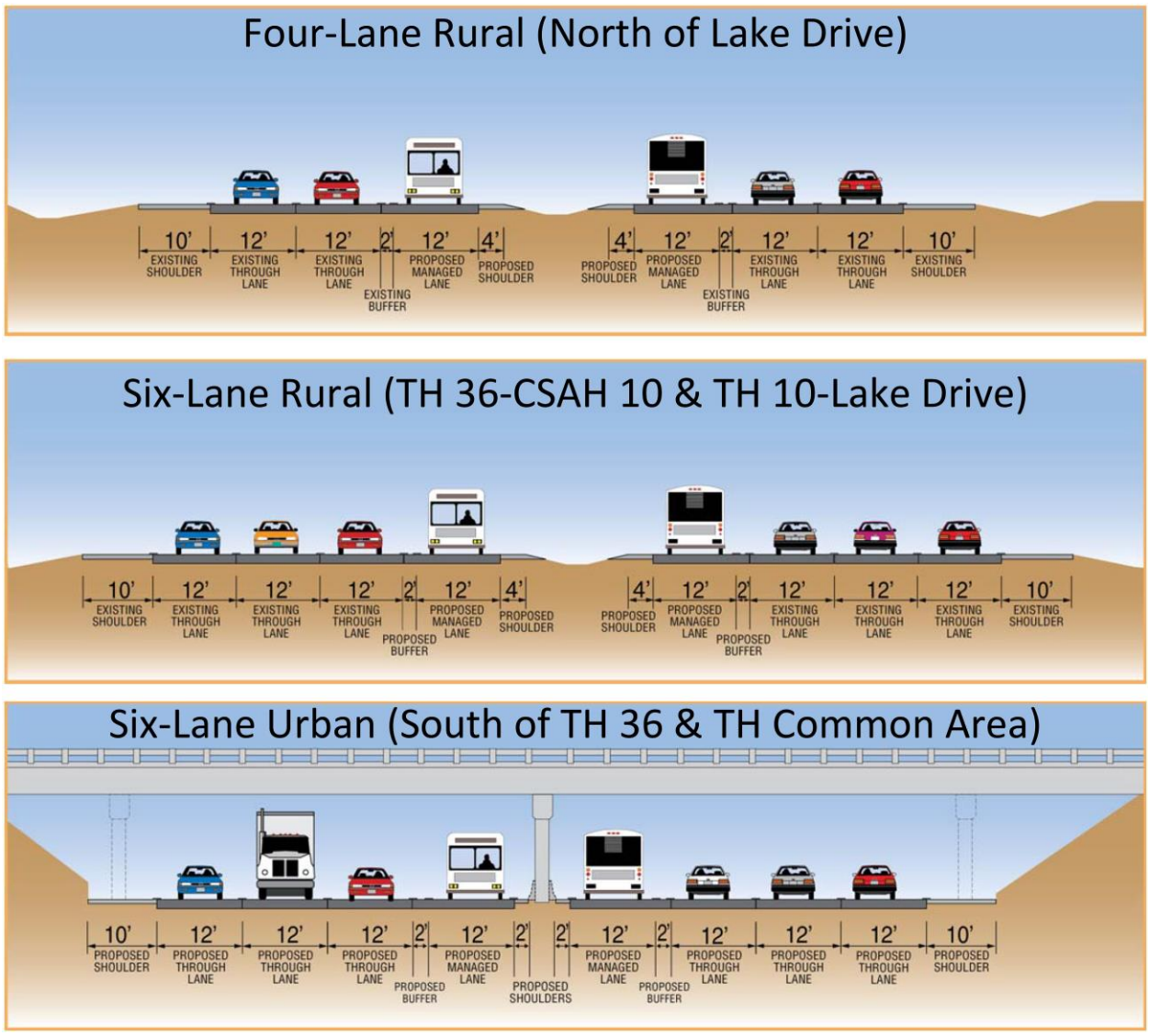
- Managed lanes provide travel time benefits to express bus service, resulting in higher ridership, and would help facilitate possible BRT service.
- The I-35W north corridor may be able to support all-day, station-to-station BRT service in year 2030 under the conditions assumed in this evaluation.
- Ridership forecasts were more sensitive to service frequency than to differences in corridor travel times associated with providing online stations.
- Minor differences in forecasted ridership totals would not be expected to justify the high capital costs associated with a BRT system using online stations.
- Construction of managed lanes can proceed without precluding future development of a BRT system that utilizes inline and offline stations.

1.11 Identification of Viable Managed Lane Alternative

Based on information that was produced during the evaluation process, the PMT carefully considered trade-offs regarding a viable managed lanes alternative. The group elected to move forward with Alternative 3B for completing the remaining steps in the I-35W North Managed Lanes Corridor Study.

Alternative 3B is characterized by the addition of a managed lane on the inside of the existing lanes in both directions between University Avenue SE in Minneapolis and Lexington Avenue in Blaine. It has full, ten-foot outside shoulders and two to four-foot inside shoulders. In locations where space is available, the width of the inside shoulder could be increased. Figure ES-7 illustrates the proposed cross-sections of this alternative.

Figure ES-7 Viable Alternative Cross Sections



The selection of Alternative 3B as a viable alternative balances construction costs with design standards and operational trade-offs. The specific rationales for selection of Alternative 3B include:

- Fulfills the study goals and objectives
- Provides competitive construction costs when coordinated with preservation needs
- Provides operational benefits
- Provides a full outside shoulder and a variable inside shoulder

In addition to these critical considerations, a number of other characteristics make this viable alternative a strong candidate for managed lane construction. First, it received good scores in primary and secondary screening and no fatal flaws were identified in the screening process. Next, it provides a consistent design through the corridor, resulting in favorable conditions for driver expectations and maintenance strategies. Finally, the inclusion of a full outside shoulder can be utilized as a bus only shoulder for shorter-distance transit service not using managed lanes. Even though Alternative 3B was used as a basis to complete the study; further evaluation and confirmation will be conducted during future environmental process.

1.12 Managed Lanes Vision

The I-35W North Managed Lanes Vision is the set of all improvements selected for the corridor as a result of the I-35W North Managed Lanes Corridor Study. These improvements included additional managed lane capacity through the corridor, localized improvements to relieve existing congestion, and localized improvements to facilitate the addition of managed lanes. The completion of the Managed Lanes Vision is intended to fulfill the study's goals and objectives listed.

I-35W North Managed Lanes Vision was developed by utilizing the project goals and objectives. The four goals and objectives as previously described in this report are:

- Reduce congestion and improve safety along the corridor
- Better utilize existing and future infrastructure investments
- Increase transit ridership and the use of high occupancy vehicles by providing travel time advantages
- Provide a choice for commuters during the peak periods

It is understood that the full Managed Lanes Vision cannot be completed as a single project. It will take many years of separate phases to be realized. The purpose of identifying the Managed Lanes Vision was to ensure that as improvements are made through the corridor, they support and build toward the vision while providing benefits to corridor users with each new improvement. Specific details of the chronological order of these improvements are described in the Implementation Plan chapter.

The improvements included in the I-35W North Managed Lanes Vision were identified through a number of steps in the study evaluation process. First, localized improvements to address existing congestion were developed and evaluated with traffic modeling. The strongest-performing and most cost effective concepts were included in the vision. The viable managed lanes alternative (Alternative 3B) was evaluated in the secondary screening process and included in the vision based on the evaluation results and input from the PMT. Finally, localized improvements to facilitate the managed lanes were developed based on a variety of needs, such as access reconfiguration, roadway realignment, or future congestion issues.

Overview

The I-35W North Managed Lanes Vision developed for the I-35W north corridor includes the following elements:

- Managed lanes between downtown Minneapolis and Lexington Avenue
- Interchange improvements at the I-35W and TH 10 north junction
- Interchange improvements along I-35W at I-694
- Managed lane direct connections to downtown Minneapolis
- Left lane extension to Snelling Avenue along TH 36 eastbound (other potential concept)
- North ramp access at Hennepin Avenue (other potential concept)

It is important to note that the study did identify several geometric concepts that are not included in the vision that will provide operational benefit to the corridor. These concepts require larger investments and could be implemented in the future if needed. More detail on these concepts can be found in the body of the document.

An implementation plan was developed that defines distinct stages that could realistically be constructed in a one to four-year period. The implementation plan was developed to capitalize on bridge and pavement preservation needs that have been identified by MnDOT.

The managed lane phases also provide an orderly approach to addressing corridor congestion with the addition of managed lanes. The projects identified in each stage were based on a combination of these factors and grouped by location and/or consideration of construction impacts.

An illustration of the Managed Lane Vision is shown in Figure ES-10 including the stages and phasing for overall implementation.

The State Transportation Improvement Program (STIP) is the current four-year program of funded projects for the period 2013 to 2016. The I-35W north corridor includes a number of STIP projects as described in the implementation plan. The total cost for these programmed improvements is approximately $35 million. These investments are fully expected to move forward to construction, and are not influenced by other factors of the managed lane vision.

Implementation Plan Cost Synergy

The Secondary Screening Analysis chapter described how cost synergy would be achieved by coordinating managed lane construction with programmed improvements and identified preservation needs. As a result, the proportion of the total construction costs attributable to the managed lanes and associated improvements are much lower than the total required to construct these improvements on their own.

The cost summary is presented in Table ES-3. The total corridor expenditures in 2011 dollars were $35 million for STIP, $250 million for preservation needs, $430 million for managed lanes, for a total corridor investment of $715 million. Following the schedule outlined in the implementation plan, it is expected that approximately $165 million of corridor investments will overlap between the managed lane and preservation needs categories. This results in a total corridor investment of $550 million.

Table ES-3 Implementation Plan Cost Summary

Category	Cost
Managed Lane Investments	$430M
Preservation Investments	$250M
2013-2016 Program	$35M
Corridor Investments – Subtotal	$715M
Cost Synergy	-$165M
Corridor Investments – Total	$550M

Interim Managed Lane Connection

Upon completion of the first phase of construction, the southbound managed lane will terminate near TH 36. The traffic operations analysis completed for this study indicated an increase in congestion during the a.m. peak period south of TH 36.

The segment between TH 36 and downtown Minneapolis is identified as the third phase of the project which may not be constructed for a significant amount of time after the first phase is operational. In order to address the study's goals, an interim managed lane connection should be considered during the next phase of this project. This connection is identified as Alternative 1B in the main body of the document.

The interim managed lane connection would consist of a managed lane with minimal pavement widening on southbound I-35W between TH 36 and downtown Minneapolis. This option introduces placing dynamic lane controls above each southbound lane at a set designated interval. The outside lane may be designated as a general purpose through lane or as a shoulder lane and the inside lane may be designated as a managed lane or a general purpose lane.

Figure ES-8 represents Alternative 1B with the inside lane operated as a dynamic managed lane and the outside lane operating as a dynamic general purpose lane. Figure ES-9 represents Alternative 1B with the inside lane operated as a dynamic general purpose lane and the outside lane operated as a dynamic shoulder.

Figure ES-8 Alternative 1B - Southbound Dynamic Managed Shoulder/Lane

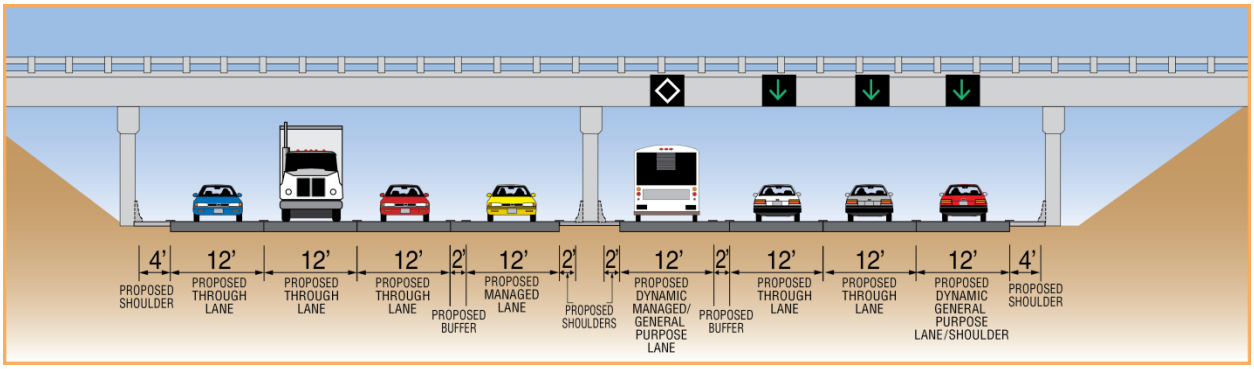


Figure ES-9 Alternative 1B - Southbound Dynamic Managed Shoulder/Lane

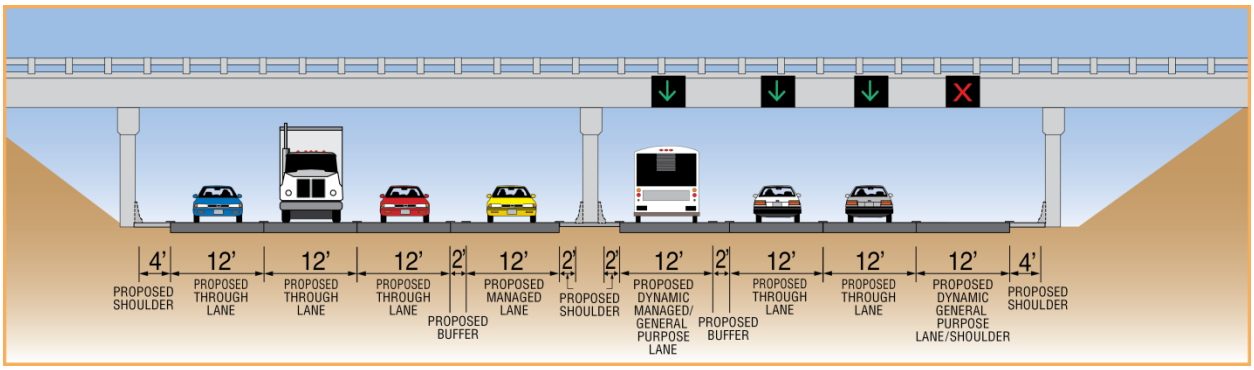
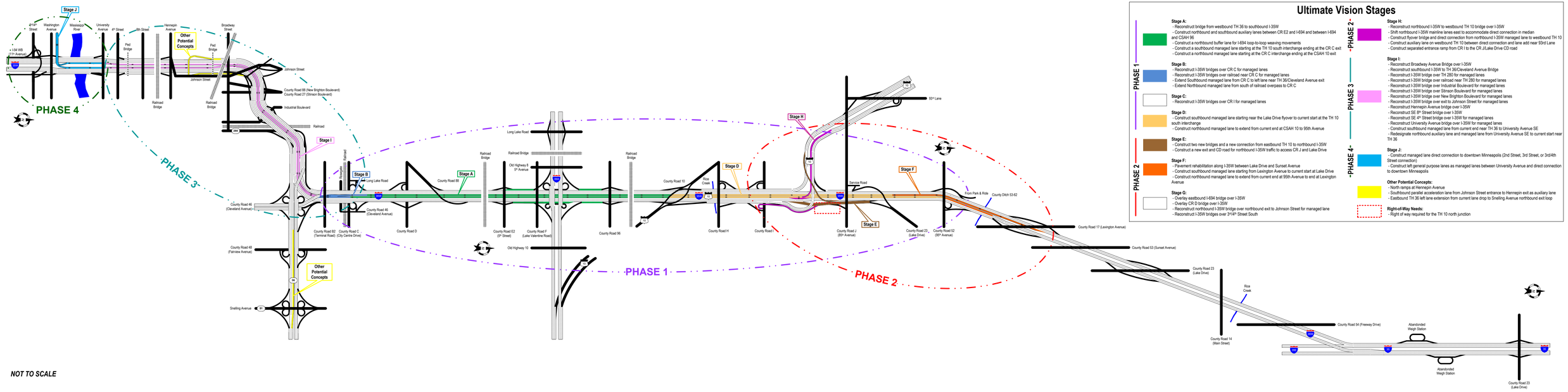


FIGURE ES-10

Interstate 35W North Managed Lanes Study
Ultimate Vision



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LIST OF ABBREVIATIONS

AADT	Annual Average Daily Traffic
AA	Alternatives Analysis
BRT	Bus Rapid Transit
CAD	Computer-Aided Design
CD	Collector-Distributer
CMSP	Congestion Management and Safety Plan
CORSIM	Corridor Simulation
CR	County Road
CSAH	County State Aid Highway
DTV	Daily Traffic Volumes
FHWA	Federal Highway Administration
HOV	High Occupancy Vehicles
HT	Heavy Truck
I	Interstate
IRC	Interregional Corridor
LRT	Light Rail Transit
MHSIS	Metropolitan Highway System Investment Study
MnDOT	Minnesota Department of Transportation
MPH	Miles per Hour
MT	Medium Truck
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
O&M	Operations and Maintenance
PC	Personal Car
PMT	Project Management Team
RMSE	Root Mean Square Error
RTDM	Regional Travel Demand Model
RTMC	Regional Transportation Management Center
SOV	Single Occupancy Vehicles
STIP	Statewide Transportation Improvement Plan
TAC	Technical Advisory Committee
TAZ	Transportation Analysis Zone

TCAAP	Twin Cities Army Ammunition Plant
TH	Trunk Highway
TIP	Transportation Improvement Program
TPP	Transportation Policy Plan
VHT	Vehicle Hours Traveled
VMT	Vehicle Miles Traveled
vpd	Vehicles per Day
vphpl	Vehicles per Hour per Lane

1.0 Introduction and History/Background

1.1 Introduction

The I-35W north corridor is a major radial freeway corridor connecting greater Minnesota and the growing north suburban area to downtown Minneapolis. As the region has grown and more development has occurred, traffic volumes have increased to the point that a number of segments along the corridor experience significant peak period congestion each day. Congestion is expected to significantly increase by year 2030 as additional growth and development occur in communities throughout the corridor.

The purpose of the I-35W North Managed Lanes Corridor Study was to identify and evaluate lower-cost/high-benefits options for improving traffic operations along I-35W as well as to evaluate options for providing a managed lane in the corridor.

For purposes of this study, managed lanes are considered to be priced and restricted to High Occupancy Vehicles (HOV), toll paying vehicles, transit vehicles and motorcycles. These lanes are expected to operate similar to current MnPASS lanes in the Twin Cities which include I-394 and I-35W south.

1.2 History/Background

A number of segments along the I-35W north corridor experience traffic volumes in excess of 100,000 vehicles per day (vpd). Traffic volumes in the area south of the I-35W/TH 36 interchange currently exceed 120,000 vpd. Congestion is expected to become worse as forecasts show the corridor's travel shed adding thousands of vpd by year 2030. In addition, many infrastructure elements along the I-35W north corridor are nearing the end of their useful lives and need replacement.

In recent years, the Minnesota Department of Transportation (MnDOT) and other governmental agencies, have taken a strong interest in the operations and condition of the I-35W north corridor. Also, the North Metro I-35W Corridor Coalition, which membership includes various communities along the corridor, advocated for a reduction in congestion and crashes and for improved mobility along the corridor.

Previous studies have identified capacity needs along the corridor. In 2005, the I-35 Interregional Corridor (IRC) Management Plan was developed to preserve and enhance mobility and safety, and to better plan for the future needs of I-35. The recommendations from that study identified general purpose capacity improvements. However, current Metropolitan Council and MnDOT plans (Transportation Policy Plan (TPP) and Statewide Transportation Improvement Program (STIP) respectively) do not identify general purpose capacity improvements along the corridor. The Metropolitan Highway System Investment Study (MHSIS) vision identified "managed lane expansion" as an option along the corridor.

In year 2010, MnDOT completed the MnPASS System Study (Phase II). This study identified the I-35W north corridor, from 3rd/4th Street in downtown Minneapolis to County State Aid Highway (CSAH) 17 in Blaine, as a viable candidate for MnPASS lanes and/or a managed corridor. The MnPASS System Study Final Corridors designations are shown in Figure 1-1. Specifically, the corridor was identified for potential:

- Increased traveler information
- Enhanced transit facilities and service
- A congestion free choice
- HOV advantages
- Transit advantages

Given the daily congestion levels and operational needs of the corridor, MnDOT recognized that leveraging preservation and bridge replacement funds with safety and mobility funds could substantially increase benefits to corridor users. Based on projections developed in 2009, MnDOT Metro District anticipates having available funding of $500 million over a 15 year period to invest in strategic capacity/managed lane improvements. Due to this limitation in funding, MnDOT is seeking cost-effective projects to invest its limited resources. The I-35W North Managed Lanes Corridor Study is being undertaken per these funding limitations.

Funding for this study was obtained through the efforts of the North Metro I-35W Corridor Coalition along with the MnPASS initiative and the initiative of the local communities.

The corridor study limits are shown in Figure 1-2. Limits extend from 3rd/4th Street in downtown Minneapolis to Trunk Highway (TH) 97 in the Columbus/Forest Lake area.

Figure 1-1 MnPass Phase Two Final Corridors

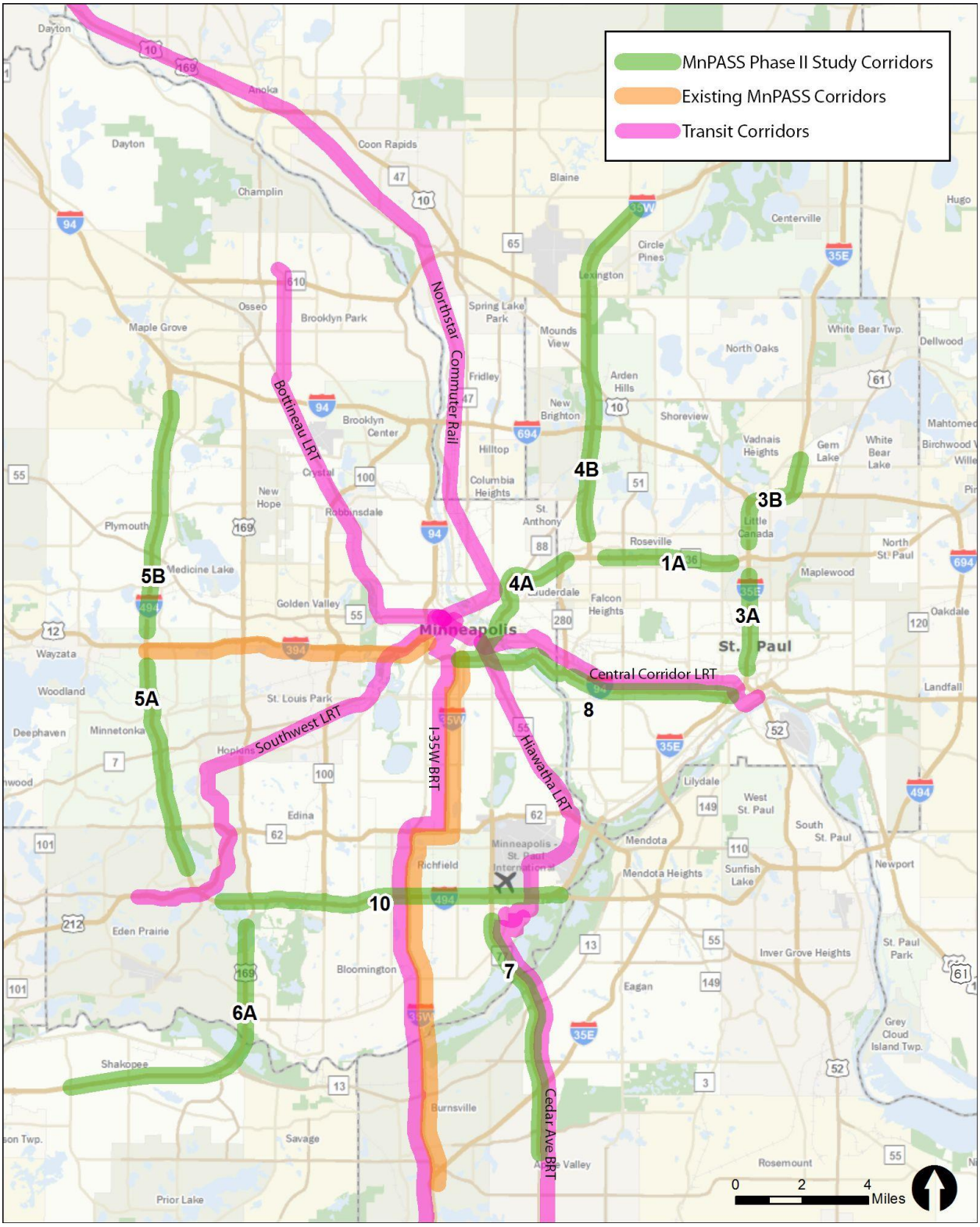
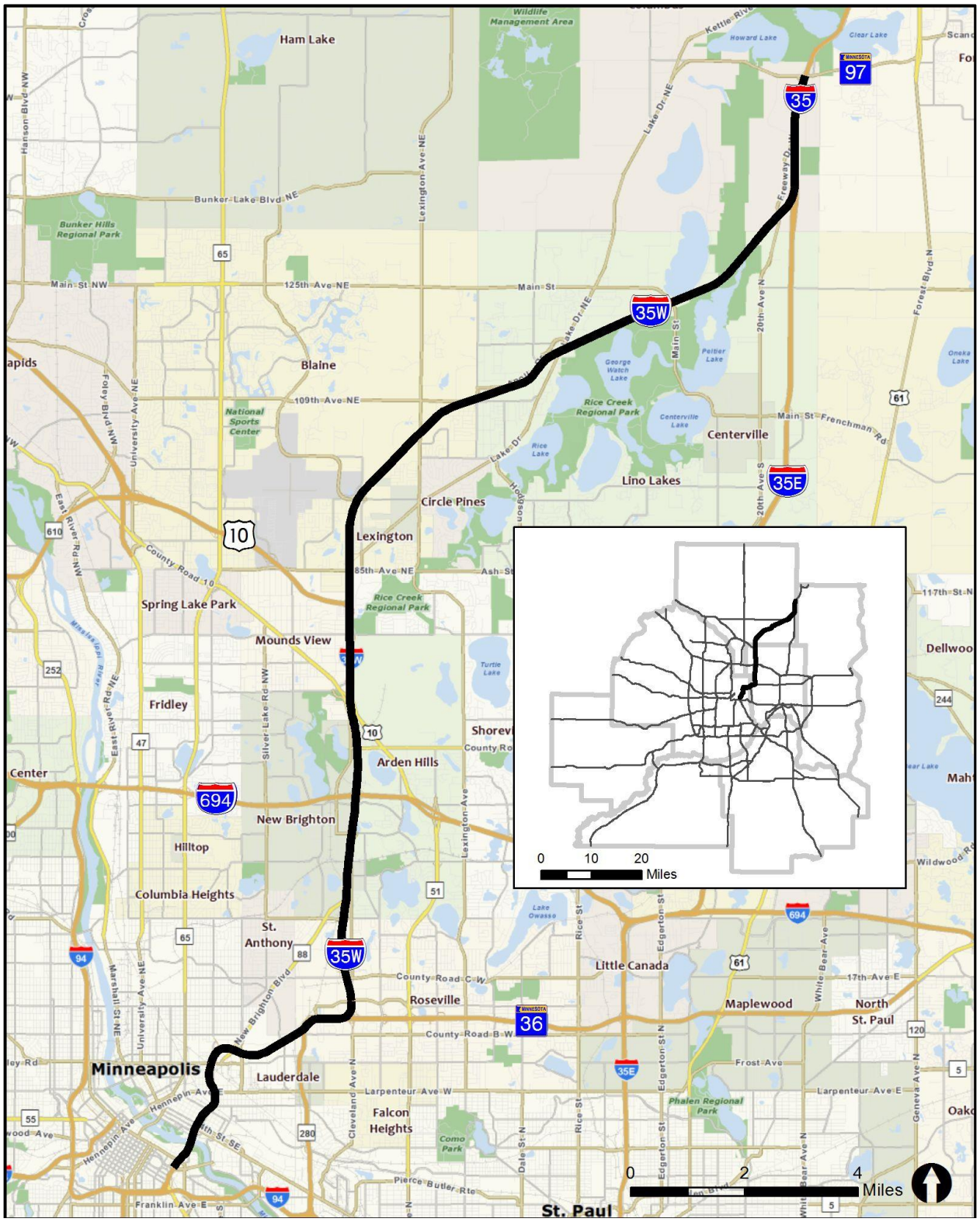


Figure 1-2 Corridor Map



2.0 Study Structure

2.1 Study Process

The I-35W North Managed Lane Study was intended to investigate the feasibility and viability of a Managed Lane option along the corridor. This following process was used to accomplish this investigation:

- Background – review all pertinent corridor information, including existing safety and operational issues, traffic/roadway/transit characteristics and future year forecasts.
- Screening Criteria – confirm study goals and objectives and develop screening criteria based on the goals and objectives that corridor alternatives will be evaluated by.
- Study Framework – on a high level discuss corridor options such as Light Rail Transit and Bus Rapid Transit as well as managed lanes and how these are or are not consistent with regional polices and overall user demand.
- Alternative Development – develop localized improvements to address existing congestion as well as develop managed lane alternatives for the corridor.
- Primary Screening – evaluate corridor alternatives utilizing a high level analysis based on the screening criteria to reduce the amount of alternatives being considered.
- Secondary Screening – based on the results of the Primary Screening, evaluate the remaining corridor alternatives utilizing a more detailed level analysis based on the screening criteria to determine a viable alternative.
- Implementation Plan – based on the viable alternative develop a corridor staging plan that supports the goals and objectives of the study.
- Management and Outreach – work with corridor stakeholders throughout the study to obtain input and feedback on overall study process. Hold public outreach meetings to engage local officials and general public.
- Documentation – provide a report that documents study process and results.

It should be noted that the I-35W North Managed Lane Study is the first step in a process; it is not intended to provide a detailed recommendation but rather a possible viable solution. If decision makers decide to continue the process, the next steps would include environmental documentation and preliminary design which include the National Environmental Protection Agency (N.E.P.A.) process to fully evaluate alternatives and determine a preferred alternative. Then final design and construction would follow.

2.2 Management Team and Advisory Committee

The I-35W North Managed Lanes Corridor Study consulting team reported to a management team and an advisory committee. These groups provided valuable input and direction through the course of the study. The following paragraphs detail the roles and responsibilities of the various groups.

A Project Management Team (PMT) consisted of MnDOT, Metropolitan Council and Metro Transit technical staff. This team provided guidance and directed the overall study process supervision. Approximately once a month, the corridor study team presented on topics such as study progress, schedule, technical analysis and results regularly to the PMT.

A Technical Advisory Committee (TAC) consisted of representatives from the following organizations:

- Anoka County
- City of Arden Hills
- City of Blaine
- City of Circle Pines
- City of Columbus
- City of Forest Lake
- City of Forest Lake/Stantec
- City of Hugo
- City of Lexington
- City of Lino Lakes
- City of Minneapolis
- City of Mounds View
- City of New Brighton
- City of Roseville
- City of Shoreview
- Federal Highway Administration
- Hennepin County
- North Metro I-35W Corridor Coalition
- Metropolitan Council
- Metro Transit
- MnDOT
- Ramsey County
- Ramsey County Regional Rail
- Washington County

This committee was responsible for providing feedback on the study process and recommendations as well as provided communications between the respective agencies. The corridor study team presented topics such as study progress, schedule, technical analysis and results to the TAC approximately once every two months.

In addition to the PMT and TAC, public outreach goals and tools were established. Public outreach goals were to:

- Educate those unfamiliar with managed lanes
- Receive input
- Convey benefits and impacts of alternatives

Public outreach tools to be implemented for the study included:

- Website with E-updates and fact sheets
- Elected Official/Policy Makers Briefings
- Public Open Houses
- North Metro I-35W Coalition Meetings
- Additional Community Outreach and Meetings as requested

The implementation of the public outreach tools used in this study is included in this report.

2.3 Goals and Objectives

The overarching goals of this study were developed and refined early on and remained consistent with the goals as presented by the proposal development committee. The purpose of the I-35W North Managed Lane Corridor Study is to identify improvement strategies that accomplish the following goals:

- Reduce congestion and improve safety along the corridor.
- Better utilize existing and future infrastructure investments.
- Increase transit ridership and the use of high occupancy vehicles by providing travel time advantages.
- Provide a choice for commuters during the peak periods.

The purpose of this study is to identify lower cost/high benefit improvement strategies for the corridor and how improvements could be strategically implemented over time. Specifically this study investigated the type of managed lane system, the location and implementation of said systems, and options for further study to determine a viable set of corridor improvement strategies and associated policies.

The study team recognized these goals and, with input from both the PMT and the TAC, developed the following overarching goals and objectives:

Goal: Reduce congestion and improve safety along the corridor.

Objectives:

- Minimize geometric elements that negatively impact capacity along the corridor
- Improve incident identification, emergency response and clearance time
- Minimize the impact inclement weather has on capacity
- Improve travel time reliability (vehicles, transit and freight)
- Reduce crashes (number and severity)

Goal: Better utilize existing and future infrastructure investments.

Objectives:

- Develop lower cost/high benefit strategies
- Optimize the use of all available pavements
- Optimize synergies with programmed improvements and study recommendations
- Provide a source of revenue

Goal: Increase transit ridership and the use of high occupancy vehicles by promoting travel time advantages.

Objectives:

- Provide a congestion free trip for transit and high occupancy vehicles
- Provide transit and high occupancy vehicles convenient access to/from a congestion free lane
- Reduce travel times for transit and high occupancy vehicles

Goal: Provide a choice for commuters during peak periods.

Objectives:

- Provide a choice to utilize a lane that maintains free flow
- Provide a choice to utilize convenient access to/from a congestion free lane
- Provide advantages to transit and high occupancy vehicles

The corridor study team, PMT and the TAC referred back to these goals and objectives throughout the duration of the study.

3.0 Existing Conditions

Introduction

Understanding the existing operational issues was important to the I-35W North Managed Lanes Corridor Study. This understanding provided a baseline for developing concept alternatives to address issues and move toward the goal of better utilizing existing infrastructure investments. The review of the existing operation conditions identified the congestion causes affecting the I-35W north corridor. Data sources used to develop this understanding of existing operations were the *System Problem Statement* technical memorandum completed as part of *Congestion Management and Safety Plan Phase II* along with the *Metropolitan Freeway System 2008* and *2010 Congestion Report.*

MnDOT defined congestion as traffic flowing at speeds less than or equal to 45 miles per hour (MPH). Congestion is measured by two processes: surveillance detectors in roadways and field observations[1]. MnDOT currently uses electronic surveillance systems in place throughout the I-35W north corridor.

Lack of roadway capacity (i.e., number of lanes) is not the only cause of congestion. Often congestion may be caused by a downstream constraint such as a large volume of entering or exiting traffic, a short weaving section, closely spaced interchanges, or a lane drop, etc. For example, p.m. peak period drivers on northbound I-35W experience congestion at county road (CR) C (City Centre Drive) but the congestion is actually a symptom from the volumes of entering, exiting, and weaving traffic at the I-694 interchange. The purpose of the operational assesment was to clearly identify the actual causes of congestion and develop possible solutions to those causes. This analysis also considered the potential that changes in one location may cause increased congestion in other locations.

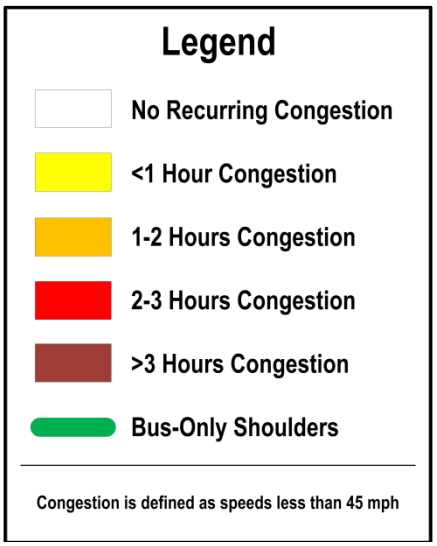
Metropolitan freeway system year 2008 and year 2010 congestion reports are provided in Appendix A.

3.1 Congestion Causes

Congestion Reports are freeway maps which display color coding corresponding to a certain number of hours of recurring congestion. The typical legend for congestion reports use a range of color coding; no color represents no recurring congestion while gradually moving to a dark color represents multiple hours of recurring congestion. An example of such a legend can be seen in Figure 3-1. As each congestion cause is discussed, a corresponding Congestion Report segment is presented using this legend.

[1] Metropolitan Freeway System 2010 Congestion Report

Figure 3-1 Congestion Legend



Three major congestion causes for the I-35W corridor were identified along with several additional secondary congestion causes. Each congestion cause location is accompanied by a flow rate/capacity graph (vehicles per hour per lane (vphpl)) by time of day. The graph displays the time and duration where flow rate approaches/exceeds anticipated capacity. For purposes of this analysis, the expected capacity of a freeway lane is 2,000 vphpl.

Congestion Causes – Southbound I-35W

Congestion Cause 1

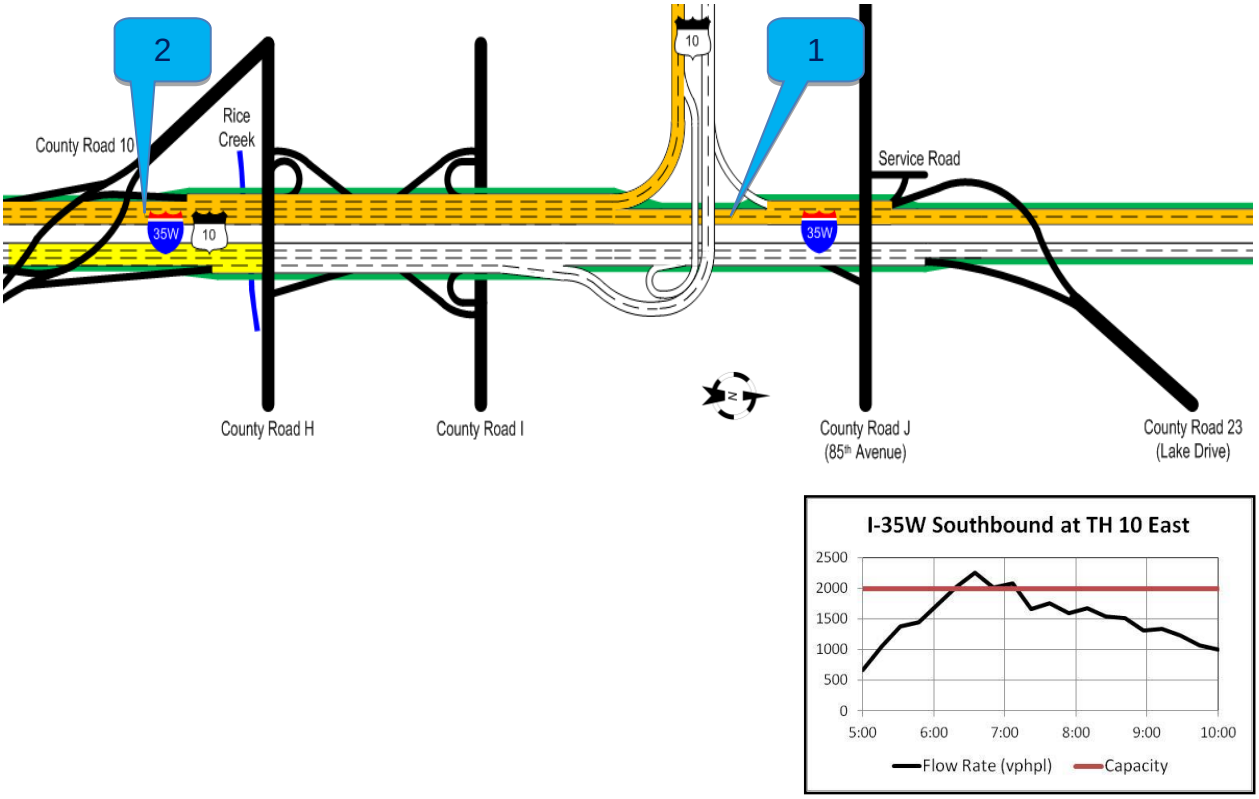
Entering traffic from CR 23 (Lake Drive) and CR J (85th Avenue) caused southbound mainline to reach capacity. This along with downstream congestion resulted in backups extending to the park and ride just north of 95th Avenue. This area is congested from one to two hours per day.

Congestion Cause 2

Entering traffic from TH 10 and CR I caused southbound mainline to reach capacity. This compounded downstream congestion to create long queues and reduced speeds. The area is congested from one to two hours per day.

Figure 3-2 provides the location of congestion causes 1 and 2, the hours of congestion along the I-35W mainline and the traffic flow rate at the indicated location. The traffic flow rate at this location exceeds capacity from approximately 6:15 a.m. to 7:15 a.m.

Figure 3-2 Congestion Causes 1 and 2



Congestion Cause 3

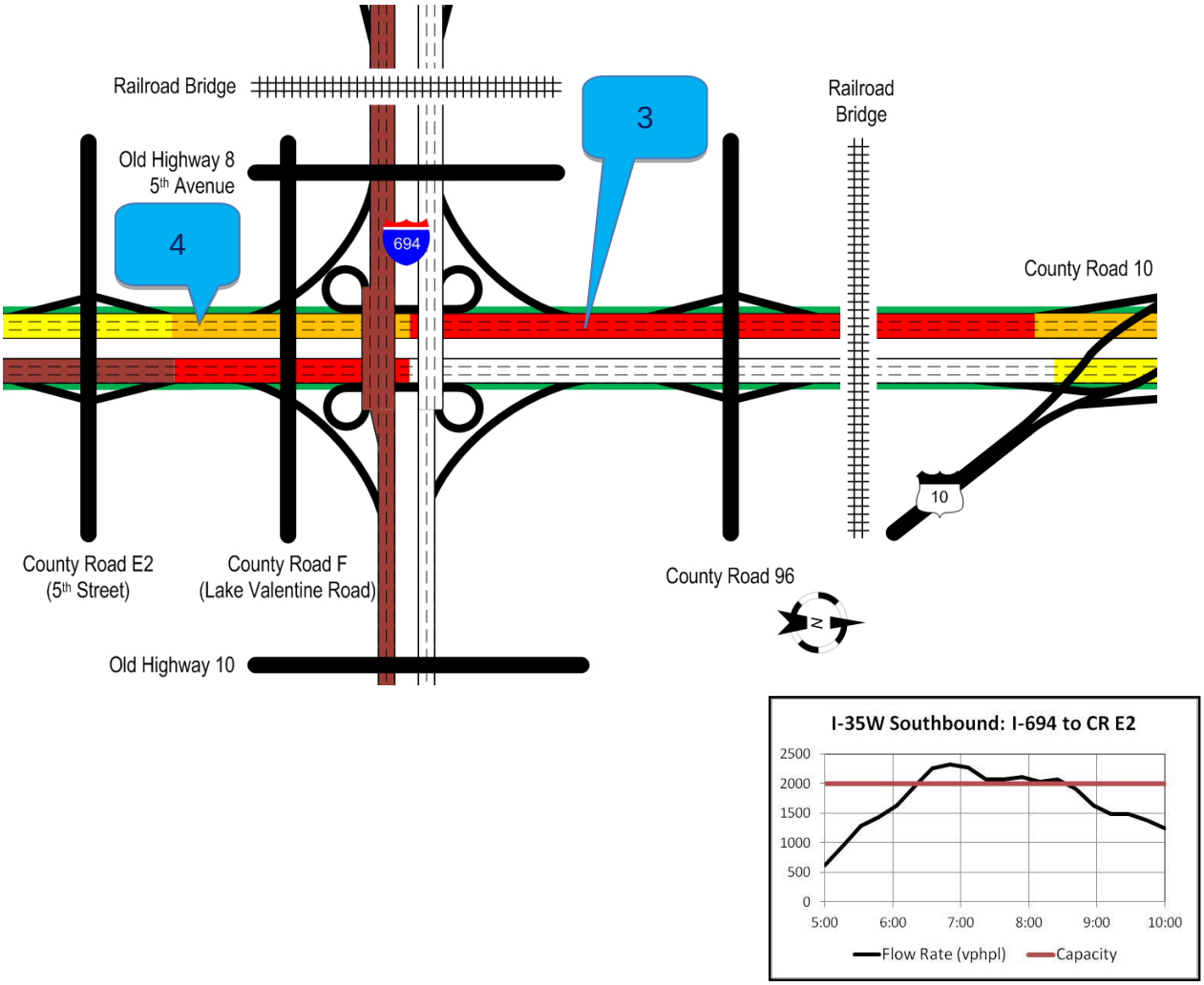
Entering vehicles from CSAH 96 and vehicles exiting to westbound I-694 created a weaving section in the right lane of southbound I-35W. This area is congested from two to three hours per day. This is considered a major cause of congestion.

Congestion Cause 4

Entering traffic from eastbound I-694 caused southbound mainline to reach capacity. This area is congested from one to two hours per day. This is considered a major cause of congestion. Southbound I-35W at the I-694 interchange is one of the three major congestion locations.

Figure 3-3 provides the location of congestion causes 3 and 4, the hours of congestion along the I-35W mainline and the traffic flow rate at the indicated location. The traffic flow rate at this location exceeds capacity from approximately 6:20 a.m. to 8:30 a.m.

Figure 3-3 Congestion Causes 3 and 4



Congestion Cause 5

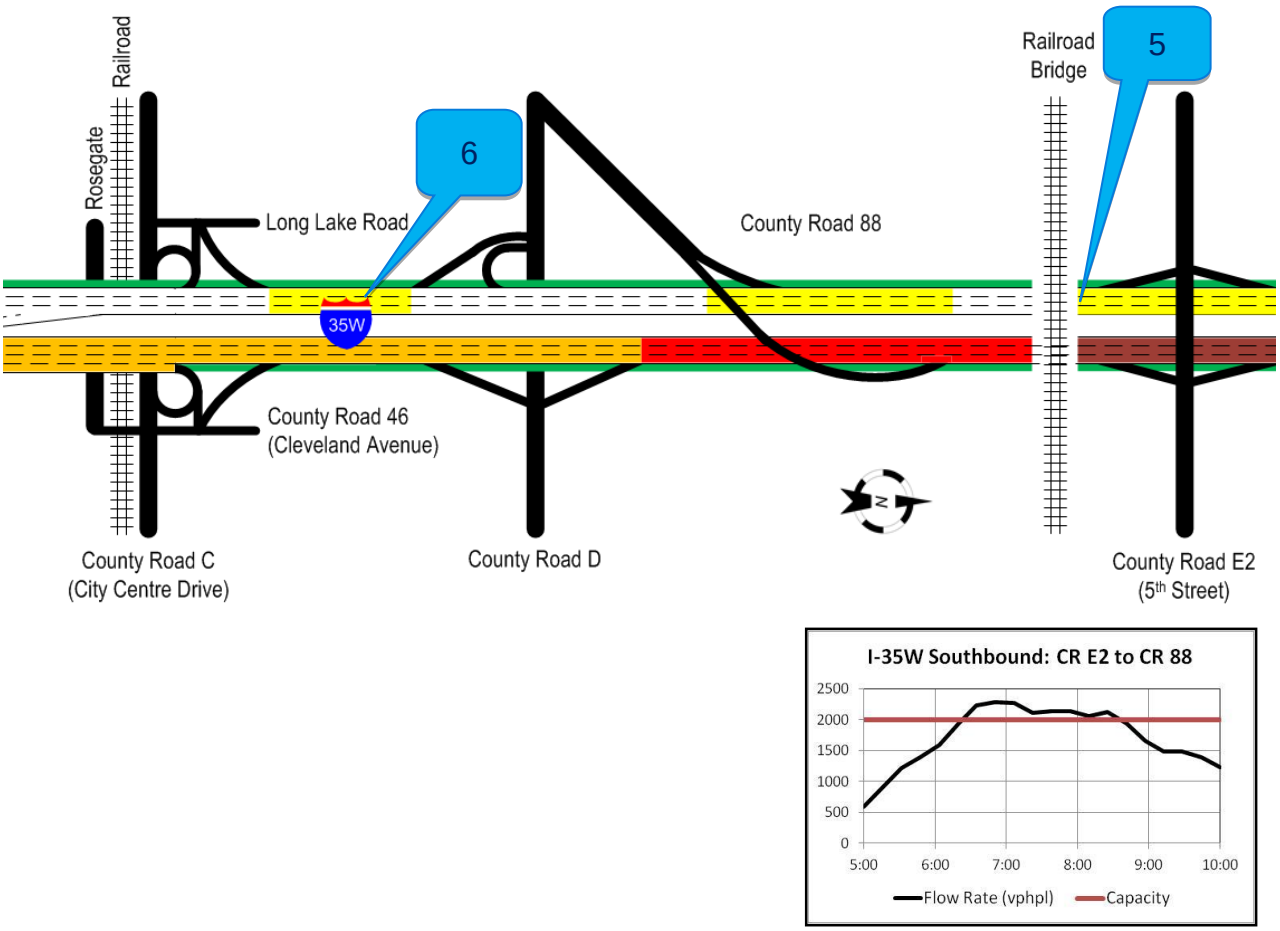
Entering traffic from CR E2 created right-lane turbulence that impacted southbound mainline speeds. This area is congested less than one hour per day.

Congestion Cause 6

Entering traffic from CR D created right-lane turbulence that impacted southbound mainline speeds. This area is congested less than one hour per day.

Figure 3-4 provides the location of congestion causes 5 and 6, the hours of congestion along I-35W mainline and the traffic flow rate at the indicated location. The traffic flow rate at this location exceeds capacity from approximately 6:20 a.m. to 8:30 a.m.

Figure 3-4 Congestion Causes 5 and 6

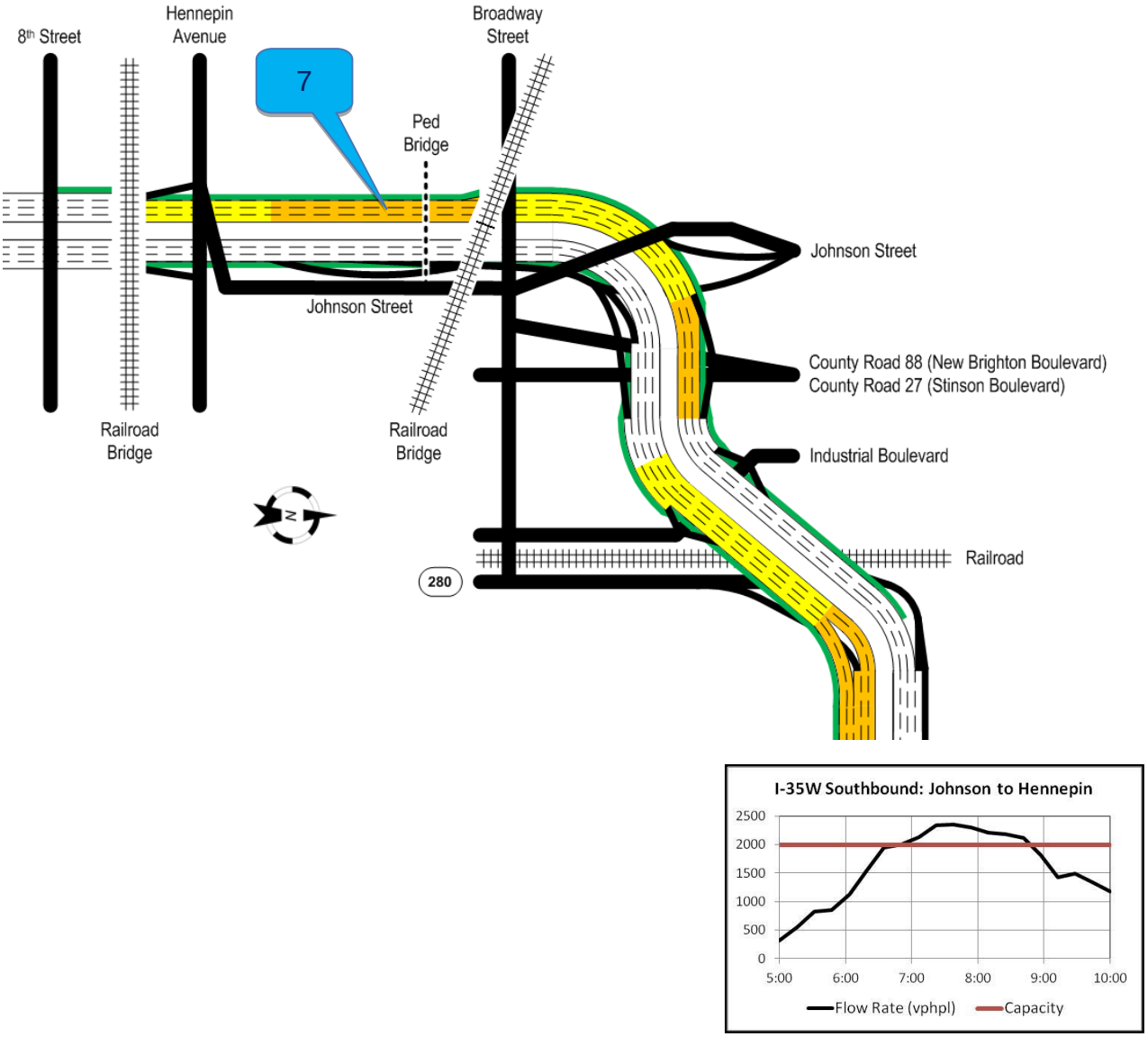


Congestion Cause 7

Entering traffic from CR 88 and Johnson Street caused the southbound mainline to exceed capacity. This area is congested from one to two hours per day.

Figure 3-5 provides the location of congestion cause 7, the hours of congestion along the I-35W mainline and the traffic flow rate at the indicated location. The traffic flow rate at this location exceeds capacity from approximately 6:55 a.m. to 8:45 a.m.

Figure 3-5 Congestion Cause 7



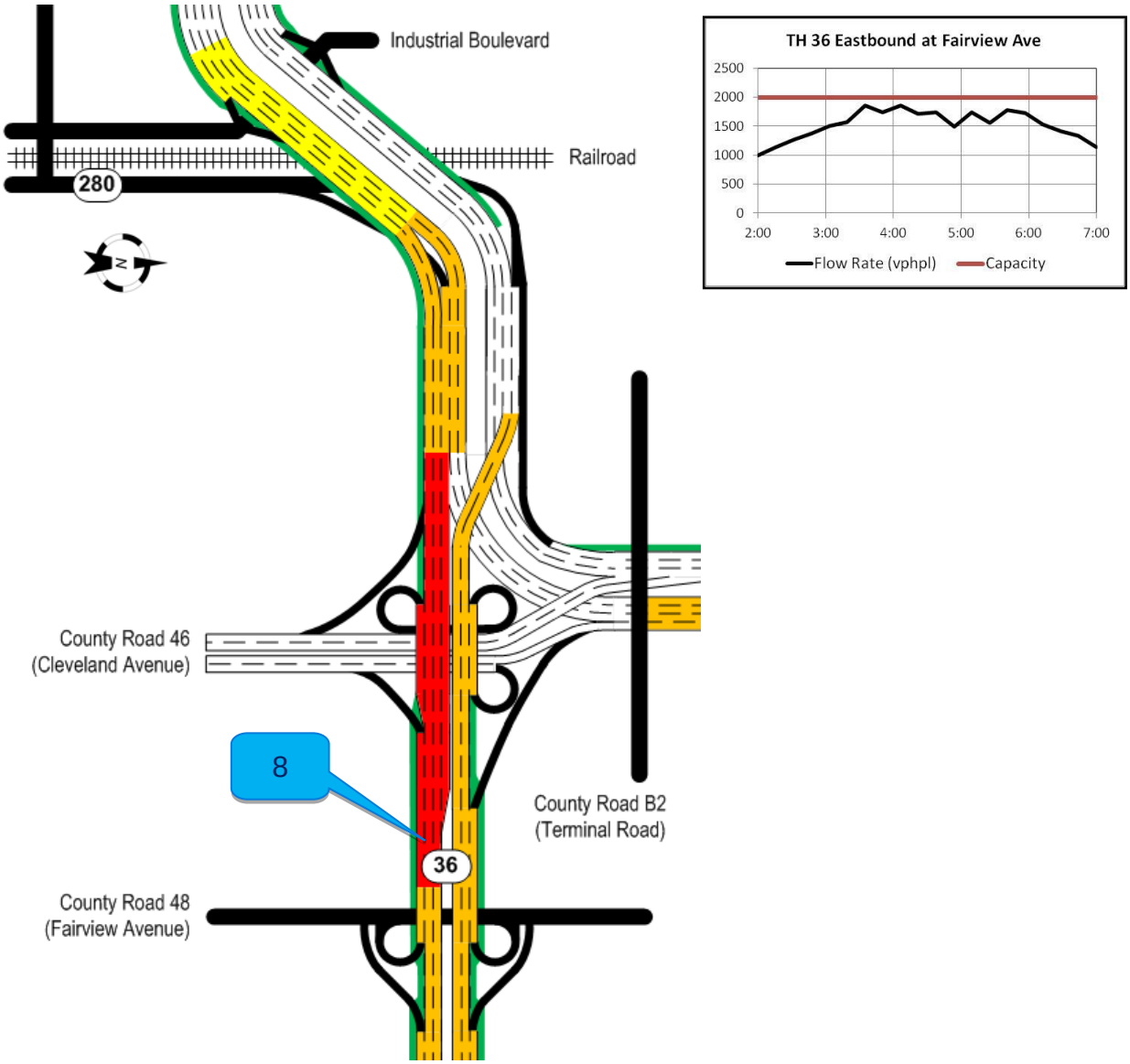
Congestion Causes – Northbound I-35W

Congestion Cause 8

The left lane drop on eastbound TH 36 at CR 46 caused the mainline of TH 36 to reach capacity. Traffic queues from TH 36 spill back onto northbound I-35W. The segment of TH 36 from CR 46 to CR 48 is congested from two to three hours per day. The impacted segment of I-35W is congested from one to two hours per day. This is considered a major cause of congestion.

Figure 3-6 provides the location of congestion cause 8, the hours of congestion along the I-35W mainline and the traffic flow rate at the indicated location. The traffic flow rate at this location does not exceed capacity.

Figure 3-6 Congestion Cause 8



Congestion Cause 9

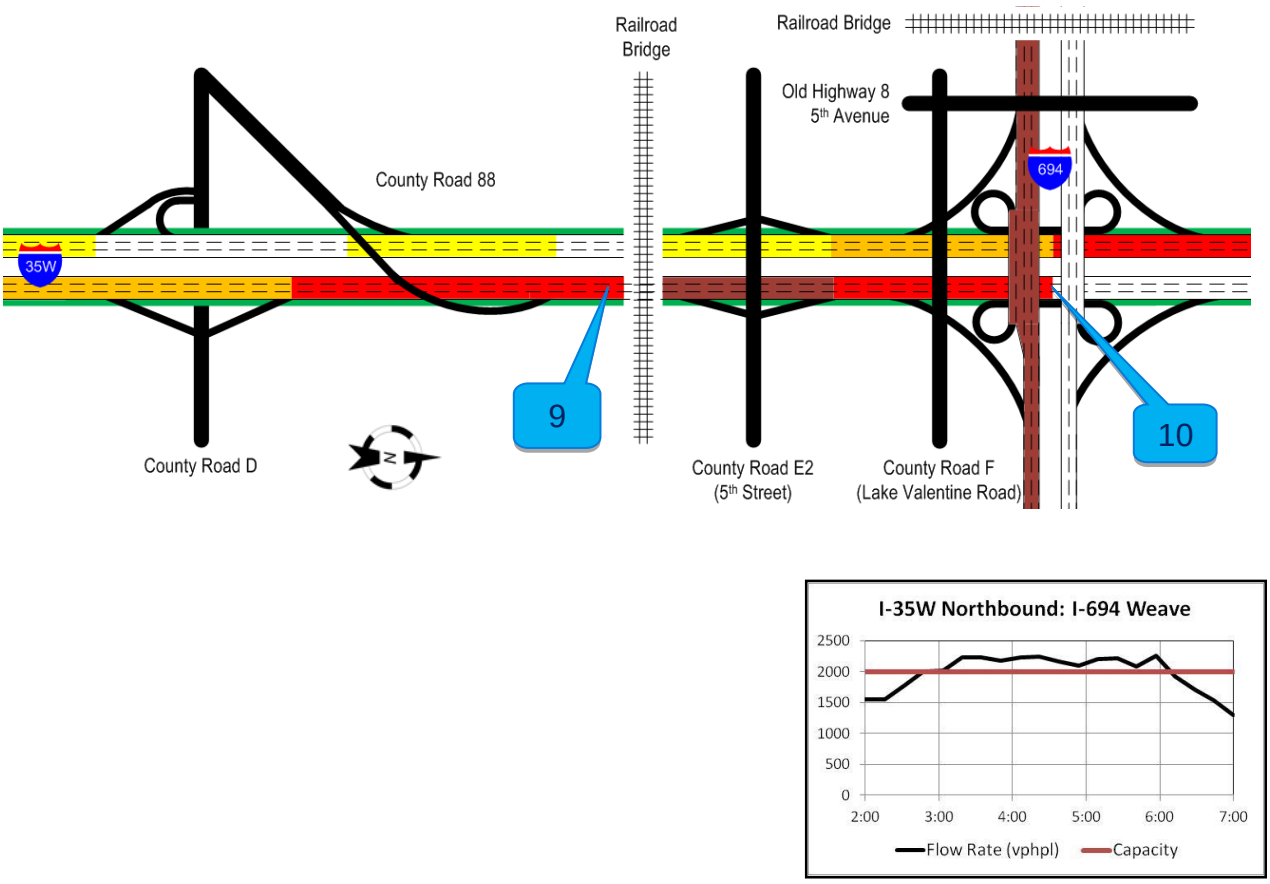
Entering traffic from CR D and CSAH 88 add to northbound mainline congestion generated by downstream locations. This area is congested from two to three hours per day.

Congestion Cause 10

The northbound entrance and exit volumes at the I-694 loops created an over-capacity weave segment. This area is congested more than three hours per day.

Figure 3-7 provides the location of congestion causes 9 and 10, the hours of congestion along the I-35W mainline and the traffic flow rate at the indicated location. The traffic flow rate at this location exceeds capacity from approximately 3:00 p.m. to 6:10 p.m. This area is identified as a major congestion location.

Figure 3-7 Congestion Causes 9 and 10

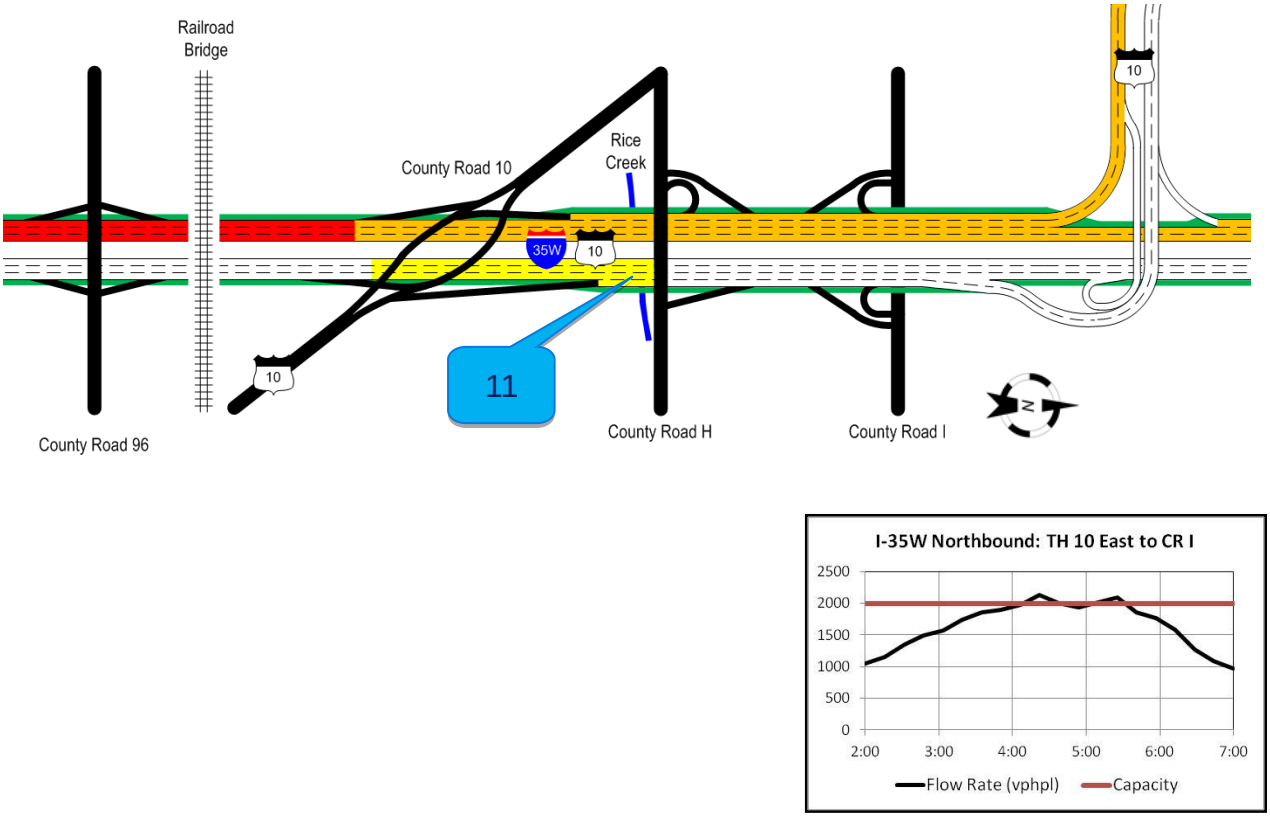


Congestion Cause 11

Entering traffic from TH 10 and exiting traffic to CR I produced right-lane turbulence impacting northbound mainline speeds. Congestion occurred at this location less than one hour per day.

Figure 3-8 provides the location of congestion cause 11, the hours of congestion along the I-35W mainline and the traffic flow rate at the indicated location. The traffic flow rate at this location exceeds capacity from approximately 4:30 p.m. and again at 5:30 p.m.

Figure 3-8 Congestion Cause 11



3.2 Safety

Introduction

The study limits of the safety analysis included the area from the junction of TH 55 near the Minneapolis Central Business District to TH 97 south of Forest Lake. The corridor consists of 26 interchanges, 15 of which are cited in MnDOT's safety assessment[2]. Three of the 15 interchanges cited in MnDOT's safety assessment are found in the top 25 percent of crash cost interchanges statewide. During the three-year period ending in year 2010, this corridor had 2,113 state reported crashes on the interstate mainline. This resulted in an average of 704 mainline crashes each year and an overall crash density of 27 crashes per mile per year.

Congestion and safety are inextricably linked. The probability of crashes increase when congestion is present, driver confusion exists and/or driver expectancy is not met. Three individual safety assessments of the corridor were completed covering crash data from the calendar years 2008 to 2010. Three assessments were conducted using standard MnDOT reporting processes or reports.

1. Mainline Assessment: included crash density, crash rate, and severity rate data
2. Interchange Assessment: had crash cost assessment, crash rate and severity rates
3. Corridor Peak Period Assessment: incorporated a.m. and p.m. peak period crash density data

It should be noted that during the period of time from August 2007 to September 2008 the I-35W Mississippi River Bridge was under construction. MnDOT reported an 11 percent decrease in the total number of crashes in 2007 compared with 2006 due to traffic diversions away from the Mississippi Bridge. The affected I-35W crash patterns were south of the junction with TH 36. This was taken into account by cross checking the data with previous information. Therefore, the overall magnitude of the data is somewhat understated on the south end of the project area.

In general, the I-35W north corridor experienced lower crash densities than other metro freeway corridors. Individual segments on both I-94 and I-494 have significantly higher crash densities than the I-35W north corridor. The corridor crash issues generally increased closer to the Minneapolis Central Business District.

Mainline Assessment

To more closely evaluate the crash data and road characteristics, the mainline was divided into four crash data segments, (south, south central, north central and north) as shown in Figure 3-9.

Table 3-1 provides a summary of the crash data characteristics within each of the crash data segments.

[2] Top 200 Statewide Interchanges Ranked by Crash Cost

Figure 3-9 Crash Data Segments

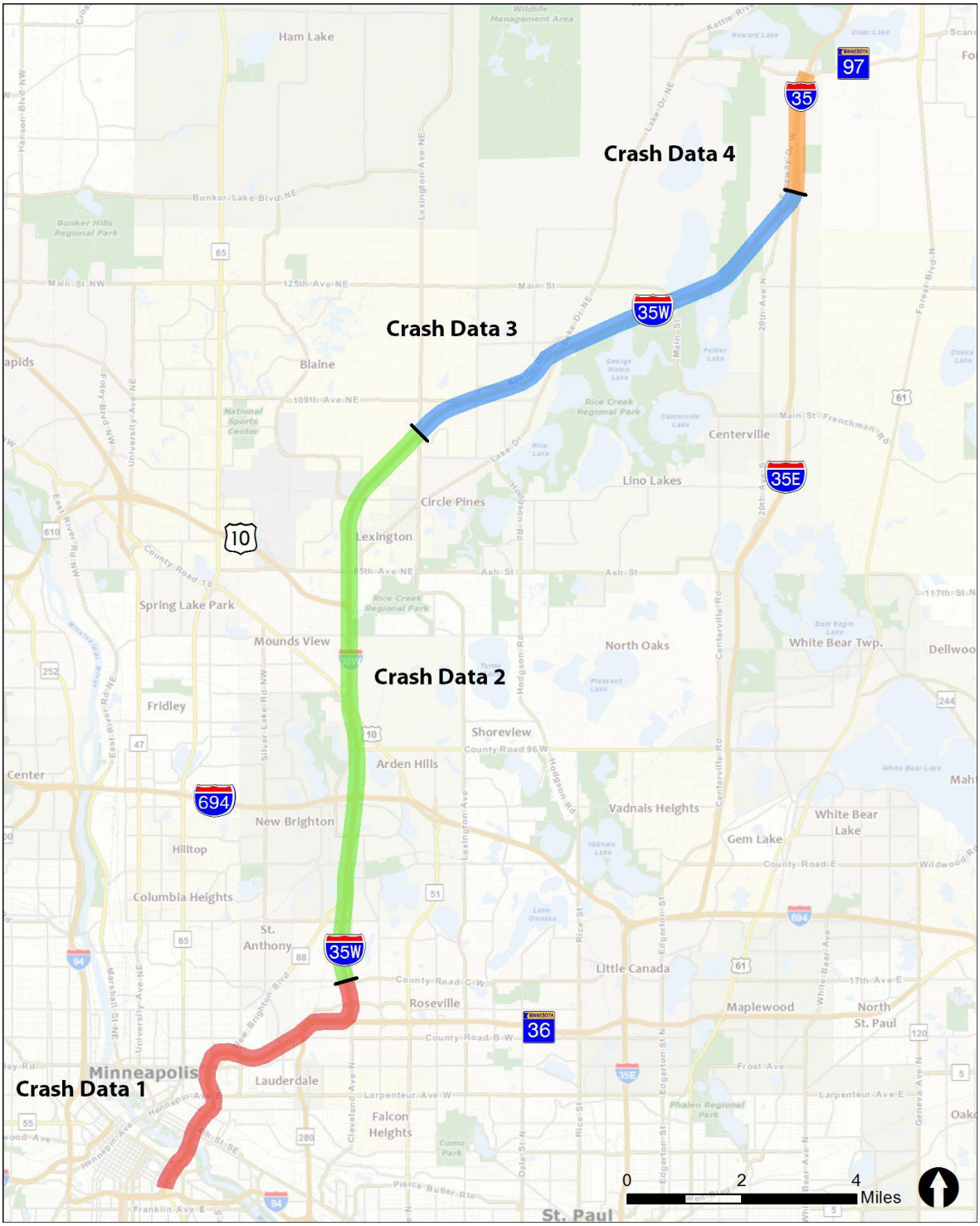


Table 3-1 Crash Data for Years 2008 - 2010

Crash Data Segment	Length	Freeway Type	Total Crashes	Crash Density	Crash Rate	Crash Severity Rate	Average Crash Rate by Roadway Type(1)	Average Crash Severity by Roadway Type(1)
1: TH 55 to CR C	5.7 miles	6 lane urban	734	43.0	1.4	1.9	1.5	1.9
2: CR C to CR 17	9.9 miles	6 lane urban 4 lane rural	1065	36.0	1.2	1.6	0.7 0.5	1.0 0.8
3: CR 17 to I-35E	8.4 miles	4 lane rural	242	9.6	0.7	1.0	0.5	0.8
4: I-35E to TH 97	2.0 miles	6 lane rural	72	12.0	0.2	0.3	0.5	0.6

Crash Density: Crashes per mile per year
Crash Rate: Crashes per million vehicle miles
(1) Source: MnDOT Metro Traffic

Crash Data 1: South Segment

The south segment is 5.7 miles and extends from TH 55 to CR C. This segment is a six-lane, urban freeway with a concrete jersey median barrier. Distinct elements include the entry into the Minneapolis Central Business District in a road configuration that can best be described as a complex interchange series with significant weaving issues at numerous locations. A second unique configuration is the commons section at the junctions with TH 280, and TH 36. This segment experiences varying degrees of congestion in both the a.m. and p.m. peak periods. As shown in Table 3-1, the crash rate for segment 1 is less than the average crash rate; however the crash severity rate is equal to the average crash severity rate.

Crash Data 2: South Central Segment

The south central segment is 9.9 miles from CR C to Lexington Avenue. This segment is a six-lane, suburban freeway with a high-tension cable median barrier. The four mile segment from CR E2 to CR J has eight interchanges including the I-35W/I-694 system interchange. As shown in Table 3-1, the crash rate for segment 2 is greater than the average crash rate; in addition the crash severity rate is also greater to the average crash severity rate.

Crash Data 3: North Central Segment

The north central segment is an 8.4 mile segment from Lexington Avenue to I-35E. The segment is a four-lane rural freeway with a high-tension cable median barrier. The roadway segment has a major fork design at its northern termini. As shown in Table 3-1, the crash rate for segment 3 is greater than the average crash rate; in addition the crash severity rate is also greater to the average crash severity rate.

Crash Data 4: North Segment

The north segment is a two mile stretch of I-35 from I-35E to TH 97. This segment of roadway is a six-lane freeway with a wide median and no barrier. A major fork interchange exists at the south terminus of this segment. As shown in Table 3-1, the crash rate for segment 4 is less than the average crash rate; in addition the crash severity rate is less than the average crash severity rate.

This data show that 85% of the 2,113 reported crashes occur in the south (crash data 1) and south central (crash data 2) segments of the study corridor.

Interchange Assessment

The second safety assessment was a review of the 26 interchanges along the corridor. This assessment reviewed not only corridor mainline crashes within the interchange influence area but also crashes on the cross road. The analyses used the standardized assessment zones within the Transportation Information Systems data base I/I file.

Table 3-2 identifies 15 interchanges in the study area listed in the *Top 200 Interchange Crash Cost List Report* for year 2010. MnDOT's list presented the worst interchanges over a three-year period (2008-2010) by crash cost. Three interchanges within the study corridor are in the top 25 percent and were evaluated in greater detail.

The I-35W/CR I interchange was ranked 50th in the state in year 2010, based on crash costs. This interchange has weave issues on I-35W in both the northbound and southbound directions. These weaves are due to the lane configurations and the close proximity of the TH 10 interchange. During peak periods these weaves could expose traffic to an increased risk of crashes. Also the ramp from eastbound TH 10 to northbound I-35W has a substandard design speed due to a tight radius. This portion of the ramp forces significant speed reductions that, unheeded, can produce a run off the ramp crash. MnDOT is currently evaluating a signing mitigation effort at this location.

The I-35W/I-694 interchange was ranked 6th in the state in year 2010 based on crash costs. A critical move in this interchange, eastbound I-694 to northbound I-35W, had a particularly severe ramp crash problem prior to 2008. This was mitigated with a bridge expansion project in the year 2011 construction year that widened the eastbound I-694 bridge. The project developed a more standard eastbound cloverleaf weave and provided an escape lane configuration at the downstream end of the weave. The mitigation effort has not been evaluated, nor is reflected in the reported data. The expectation is the construction will, at a minimum, reduce the crashes attributed to the weave on the eastbound I-694 bridge and reduce its standing in the MnDOT *Top 200 Interchange Crash Cost List Report* for year 2010. Congestion on other portions of the interchange is still responsible for a significant number of related crashes.

The I-35W Interchange at TH-55 and I-94 were ranked 5th in the state in year 2010 based on crash costs. The collector-distributer (CD) ramp to I-94 is affected by severe congestion and by several poor weaving conditions. The I-35W southbound mainline just south of the interchange area contains two low speed 35 MPH curves coupled with the I-94 westbound entrance followed by a lane drop. I-35W and the included CD both operate in a congested mode for several hours a

day exposing drivers to higher risks of crashes. Even though these locations are outside the study area, the crash problems have direct influence on I-35W segments within the study area.

The collective crash costs for the 15 interchanges on the I-35W corridor on MnDOT's *Top 200 Interchange Crash Cost List Report* amount to $28.7 million dollars over three -year period.

Corridor Peak Period Assessment

The third assessment of the corridor is a review of MnDOT's *Freeway and Major Arterial Crash Summary*. This year 2010 report documented a.m. and p.m. peak period crash densities from 2007 through 2009. Figure 3-10 is the annual crash density graphs depicting one mile crash density values during peak periods on I-35 and I-35W. These are direct excerpts from the *Twin Cities Metropolitan Area Freeway and Major Arterials Crash Summary* for 2007 - 2009.

A review of these charts indicated a concentration of crashes in the a.m. peak period between CR I and I-694. Also, during the a.m. peak period, there was a concentration of crashes at the junction of I-94 / TH 55 and at I-35W / Washington Avenue.

The p.m. peak chart shows a concentration of crashes between I-94 and Industrial Boulevard and a significant mainline crash problem near the I-694 interchange.

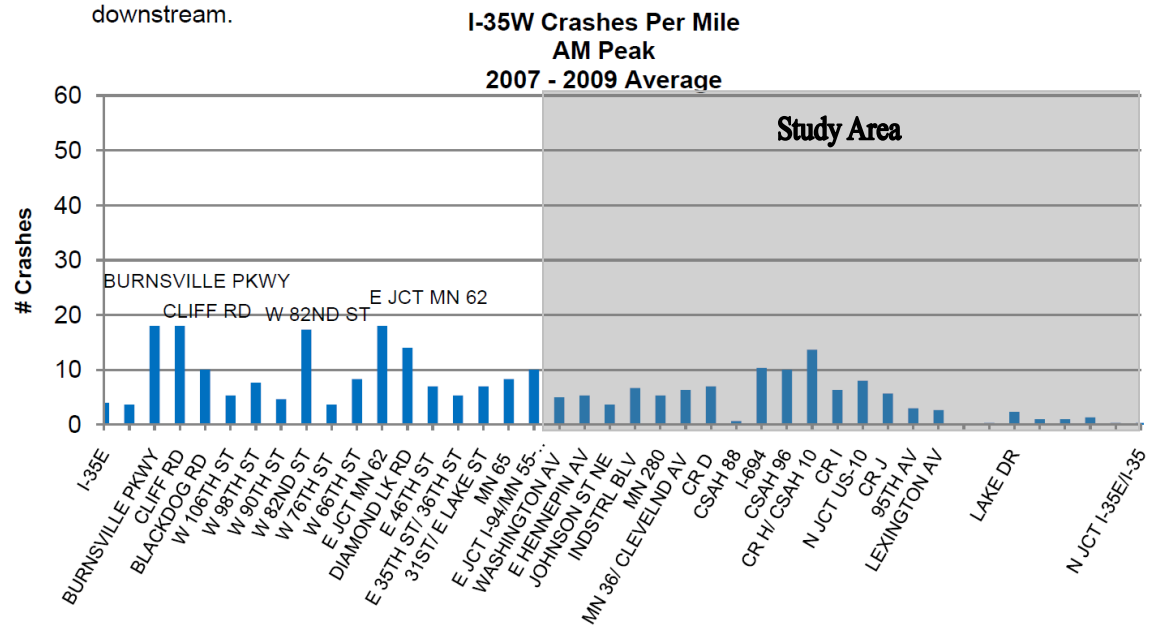
Table 3-2 I-35W Corridor Interchanges Included in MnDOT Top 200 Interchanges Report for 2010

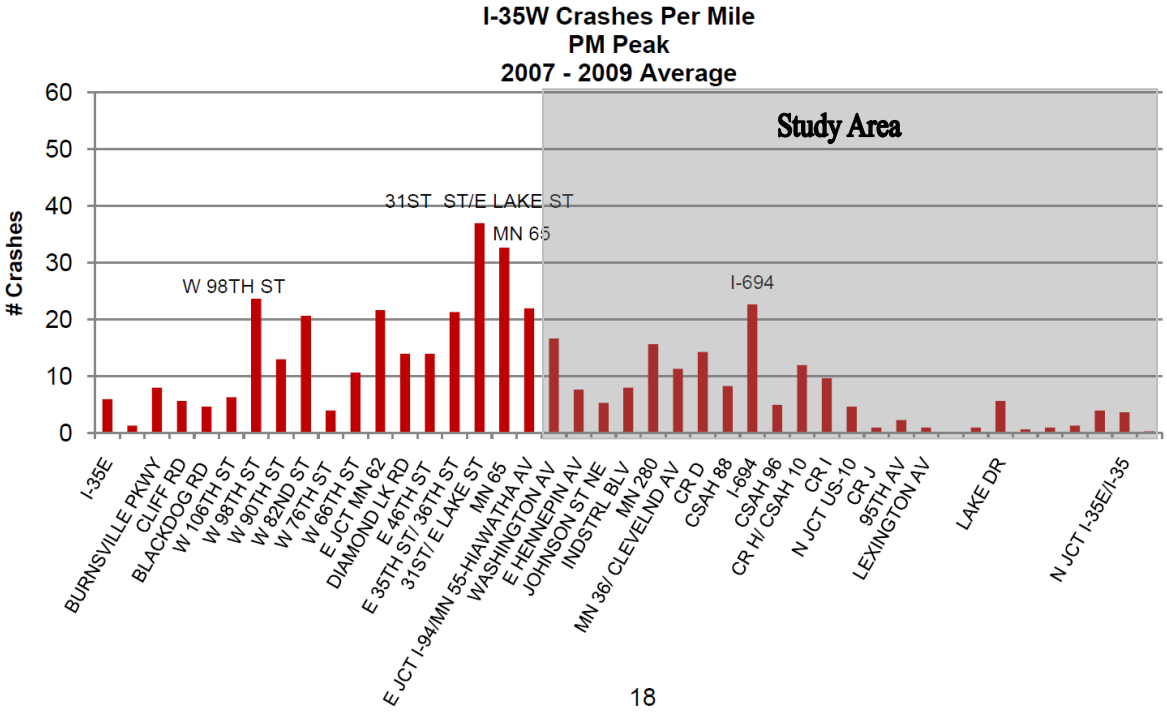
Interchange Description	Approach Volume	Overall Rank	Crash Cost	K	A	B	C	PD	TOT	CR	SR	DETAILED INTERCHANGE DESCRIPTION
E JCT I 94 TH55 HIAWATHA AVE	293,450	5	$4,468,667	2	1	21	61	233	318	0.99	1.34	Complex
WASHINGTONAVCSAH152 MPLS	123,560	144	$1,264,000	0	0	8	21	63	92	0.68	0.95	Half Diamond
4TH ST SE& UNIV AVE SE MLPS	128,756	60	$2,050,000	0	0	13	33	110	156	1.11	1.52	Diamond
CSAH 52 HENNEPIN AVE	120,364	129	$1,365,333	0	1	10	17	61	89	0.67	0.98	Half Diamond
JOHNSON STNEMSAS183	90,050	172	$1,105,333	0	0	10	17	31	58	0.59	0.96	Partial Directional (3-leg)
TH 280 ROSEVILLE	124,750	105	$1,534,000	1	0	7	18	95	121	0.88	1.15	Partial Directional (4+ legs)
TH 36 CLEVELAND ROSEVILLE	185,500	65	$1,998,667	0	0	10	28	170	208	1.02	1.26	Complex
CR C LONGLK LT CLEVELNDAVRT	127,621	99	$1,586,000	0	0	7	27	109	143	1.02	1.32	Other Diamond
CR E2 CSAH73ARDENHILLS	110,060	190	$1,015,333	0	0	5	14	89	108	0.90	1.09	Diamond
I 694 ARDEN HILLS	200,000	6	$4,446,000	0	4	25	51	293	373	1.70	2.22	Cloverleaf
CSAH 96 ARDENHILLS	117,899	134	$1,318,000	0	0	7	21	88	116	0.90	1.17	Diamond
S JCT US 10 ARDEN HILLS	171,000	87	$1,712,000	1	1	8	15	116	141	0.75	0.96	Partial Directional (4+ legs)
CR I CSAH3 MOUNDSVIEW	133,074	50	$2,200,667	0	2	15	28	93	138	0.95	1.38	Folded Diamond Parclo AB
N JCT US 10 MOUNDSVIEW	140,000	106	$1,533,333	0	0	14	17	92	123	0.80	1.09	Full Directional
CR J 85THAVECSAH32 LAKE DR	97,293	168	$1,128,000	0	1	6	12	86	105	0.98	1.24	Other

K: Fatal Crash; A: Incapacitation Injury Crash; B: Non-Incapacitation Injury Crash; C: Possible or Unknown Injury Crash; PD: Property Damage Only Crash; TOT: Total Crashes within Intersection; CR: Intersection Crash Rate; SR: Severity Crash Rate; Crash period consists of 1,096 days (2008-2010)

Figure 3-10 I-35W Annual Crash Density[3]

downstream.





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[3] Twin Cities Metropolitan Area Freeway and Major Arterials Crash Summary for 2007 – 2009, April 2011, pg. 18

3.3 Existing Traffic Characteristics

General Travel Patterns

The I-35W north corridor generally carries commuter-oriented traffic from northern Twin Cities suburbs to employment centers in Minneapolis neighboring communities and destinations further south on I-35W, or east and west along I-94. This results in peak period travel patterns predominately southbound in the morning and northbound in the afternoon. The I-35W north corridor also connects to other principal arterial routes, including TH 10, I-694, TH 36, and TH 280. These connecting facilities serve different traffic movements and result in distinct shifts in measurable traffic characteristics from one side of these junctions to the other.

Directional Split

As stated, traffic demand is predominately southbound in the morning and northbound in the afternoon. The northern portion of the corridor has the most severe directional splits, with peak direction flows accounting for 75 to 80 percent of peak traffic. This is attributable to primarily residential land uses in these areas, with most employment centers located to the south. In the portion of the corridor between I-694 and TH 36, the peak splits were less severe and commonly in the 65 to 70 percent range. The southern portion of the corridor between TH 280 and downtown Minneapolis was the most balanced traffic directionality, not exceeding 60 to 65 percent in the peak direction.

Traffic directional splits were observed to be more balanced in the p.m. peak compared to the a.m. peak. This was a common trend since a greater variety of trip purposes occur in the afternoon, including shopping and other non-home based trips versus almost exclusively work trips in the morning.

Peak Hour Percent of Daily Traffic

Peak hour percent of traffic volumes along the I-35W north corridor were observed to be in the range of seven to eight percent in the a.m. peak hour and eight to 9.5 percent in the p.m. peak hour. The peak hour percent of daily traffic in the a.m. peak hour was quite consistent throughout the corridor, and only minor changes were observed to the north and south of I-694. The p.m. peak hour percent of daily traffic increases from the southern to northern portions of the corridor. Near downtown Minneapolis 7.5 percent is observed, increasing steadily to nine percent near I-694 and exceeding 9.5 percent north of TH 10.

Volumes Approaching Capacity

Peak hour traffic demand approaches and exceeds the capacity of I-35W in various locations. In the a.m. peak hour, southbound volumes are over 80 percent of capacity between CR I and CR C, and exceed capacity within this section between I-694 and CR 88. Peak hour demand also exceeded capacity near Hennepin Avenue. These locations correspond to congestion produced at bottlenecks observed on MnDOT's year *2010 Congestion Maps.*

In the p.m. peak hour, volumes approaching capacity were observed in similar locations for northbound traffic. Peak hour demand volumes were between 80 and 100 percent of capacity near Hennepin Avenue. Peak hour demand volumes exceeded 80 percent of capacity between CR 88 and 95th Avenue, and within that section were over capacity between I-694 and TH 10 to the west. Again, these over-capacity segments correspond to bottlenecks observed on MnDOT's year *2010 Congestion Maps.*

Duration of Peak

The duration of peak hour traffic conditions varies throughout the corridor. In the a.m. peak period, the duration of traffic demand within 85 percent of peak hour demand steadily increases from one hour forty-five minutes on the north end of the corridor to two hours forty-five minutes on the south end. A similar pattern was observed in the p.m. peak period with the duration steadily decreasing from four hours on the south end of the corridor to two and a half hours on the north end. These patterns were logical due to traffic volumes approaching capacity and lower peak percent of daily traffic in the southern portions of the corridor compared to the northern portions.

Time of Peak

Due to the length of the corridor, approximately 25 miles, the time of peak traffic varies. In the morning, the peak hour was observed to occur as follows throughout the corridor:

- 6:00 to 7:00 a.m. – North of TH 10 west
- 6:15 to 7:15 a.m. – TH 10 west to I-694
- 6:30 to 7:30 a.m. – I-694 to TH 36
- 6:45 to 7:45 a.m. – TH 36 to New Brighton Boulevard/Johnson Street
- 7:00 to 8:00 a.m. –New Brighton Boulevard/Johnson Street to downtown Minneapolis

This change in peak hour was due to the increased travel time needed for commuters from the northern portions of the corridor to reach their destinations.

The p.m. peak hour is observed to be more consistent throughout the corridor, occurring between 4:30 and 5:30 p.m. in all locations. This was attributable to some of the previous observations such as a greater variety of trip purposes, volumes approaching capacity, and longer duration of peak traffic demand in the afternoon.

3.4 Physical Characteristics

Physical characteristics of the corridor have been reviewed to identify potential obstructions for any managed lane alternative. These characteristics will also help guide the screening process of all alternatives considered. The corridor consists of three main cross sections; rural four-lane, rural six-lane and urban six-lane however, there are multiple locations along the corridor where auxiliary lanes exist and shoulder widths may vary. These cross sections are shown in Figure 3-11, Figure 3-12, and Figure 3-13 below.

Figure 3-11 Existing Rural Four-Lane Cross Section

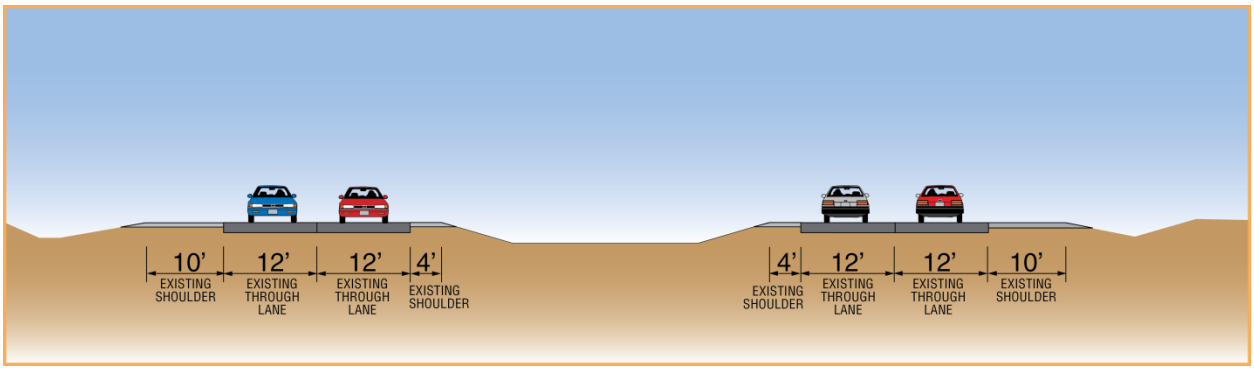


Figure 3-12 Existing Rural Six-Lane Cross Section

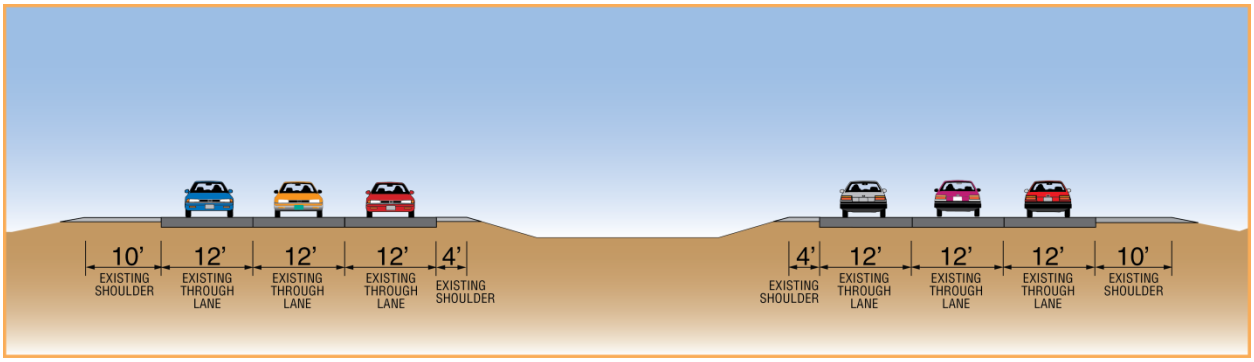
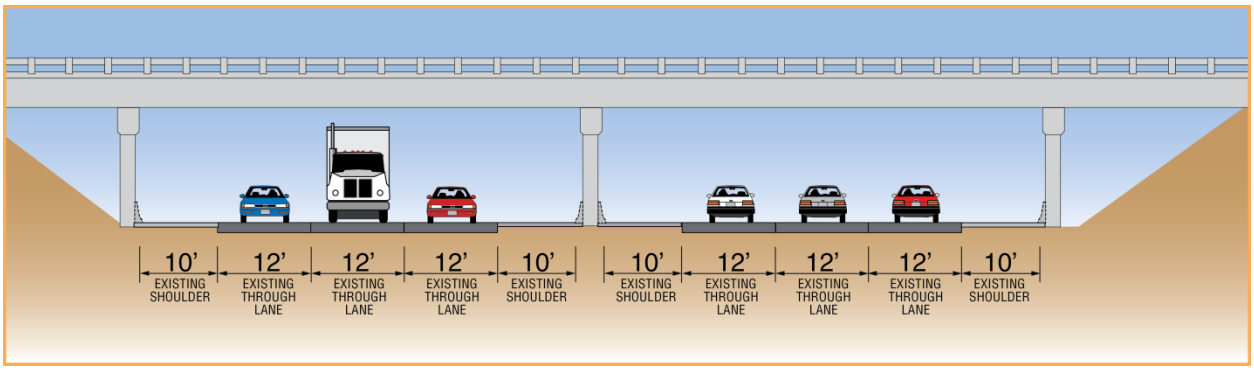


Figure 3-13 Existing Urban Six-Lane Cross Section



3.5 Existing Operations Model

Introduction

A traffic operations model was prepared for the I-35W North Managed Lanes Corridor Study area using Corridor Simulation (CORSIM) software. This model was used to perform preliminary operations analyses for managed lane alternatives and spot improvement options during peak period conditions. CORSIM is a microsimulation software, which means it simulates traffic flow using a one-to-one representation of each vehicle using the roadway system. Physical characteristics are coded to be consistent with real-world conditions and current traffic volumes are obtained and used within the model. Simulated vehicles in the software operate using realistic representations of vehicle dynamics and driver decision-making.

Model Limits

The modeling limits included in the model extended beyond the I-35W north corridor. The roadway segments in the model were defined as the study area, and included the following:

- I-35W/I-35: 3rd/4th Street near downtown Minneapolis to TH 97
- TH 36: I-35W to TH 51 (Snelling Avenue)
- I-694: Silver Lake Road to Lexington Avenue
- TH 10: TH 65 to I-35W

The inclusion of the intersecting roadways in the operations model was to capture potential traffic impacts on these facilities. For example, upstream bottlenecks on facilities entering the subject roadway may restrict entering traffic flows. Similarly, downstream bottlenecks on adjoining facilities may spill back onto I-35W if throughput was improved. These limits were selected based on a review of the corridor and existing traffic conditions.

Data Sources

The existing operations model was developed using the current roadway capacities and geometrics. Link geometrics were visually identified from aerial photos and manually updated in the model.

Traffic volumes were obtained from MnDOT loop detector counts. Magnetic induction loops are embedded in the pavement of each lane of the freeway and on entrance and exit ramps. The counts detected are logged at MnDOT's Regional Transportation Management Center (RTMC) and can be retrieved through a web interface. All count locations throughout the corridor from April 5, 2011 were downloaded and processed for use in the CORSIM model to represent typical traffic conditions.

Observations

The goal in developing an existing operations model was to reproduce the conditions observed in the field. Traffic throughput and vehicle speeds were observed from the loop detector data available from the RTMC. The data was used to calibrate the model to observed conditions. This was successfully achieved, and congestion was observed in the same locations described in earlier sections of this report, namely:

A.M. Peak Period

- I-35W southbound between 95th Avenue and CR E2
- TH 10 eastbound between 93rd Lane and I-35W
- I-694 eastbound near TH 10

P.M. Peak Period

- I-35W northbound between CR C and I-694
- TH 36 eastbound between I-35W and the end of the model
- I-694 eastbound between Long Lake Road and TH 51
- I-694 westbound between Lexington Avenue and TH 10
- TH 10 westbound between I-35W and 93rd Lane

As described, the congestion produced by the model was consistent with observed conditions. This demonstrates the preparation and calibration of the model was successful and suitable for use in evaluating managed lane and spot improvement concepts.

3.6 Transit and High Occupancy Vehicles

Overview

In 2008 Metro Transit conducted a *2030 Transit Master Study*[4] for the region, which identified the I-35W north corridor as a "transitway" based on the corridor's transit ridership. The Metropolitan Council defines "transitways" as follows:

> "Travel corridors that offer transit service using express buses with transit advantages, bus rapid transit, light rail or commuter rail."

The Twin Cities metropolitan region's *2030 Transportation Policy Plan*[5] is consistent with this study and recommended the corridor as a potential transitway by year 2030. The plan indicated the I-35W north corridor should undergo further mode and alignment studies to consider light rail transit (LRT), busway, bus rapid transit (BRT), and commuter rail enhancements.

[4] 2030 Transit Master Study
[5] 2030 Transportation Policy Plan

Routes and Park and Ride Facilities

Metro Transit currently operates nine fixed-route bus lines that serve the I-35W north corridor

- Route 118, downtown Minneapolis to Columbia Heights
- Route 250, downtown Minneapolis to Lino Lakes
- Route 252, downtown Minneapolis to Blaine
- Route 260, downtown Minneapolis to Roseville
- Route 261, downtown Minneapolis to Shoreview
- Route 264, downtown Minneapolis to Roseville
- Route 270, downtown Minneapolis to Maplewood
- Route 288, downtown Minneapolis to Forest Lake
- Route 860, downtown St. Paul to Coon Rapids

On average, 5,807 weekday transit riders[6] travel the I-35W north corridor on these nine routes. A total of 194 in-service buses traverse the corridor on these routes on a typical weekday. The vast majority of the service (86 percent) and ridership (90 percent) occur during the peak periods, between 6:00 a.m. and 9:30 a.m. and between 3:00 p.m. and 6:30 p.m., as defined by Metro Transit.

There are 14 Metro Transit park and ride lots located within the study area which service bus routes operating on the I-35W north corridor.

The nine fixed routes and park and ride locations are shown in Figure 3-14. Corresponding parking spaces and year 2010 occupancy for park and ride facilities are shown in Table 3-3.

[6] Figure calculated from April 2011 and October 2011 ridership data provided by Metro Transit. Information for Route 288 was provided by the Metropolitan Council.

Figure 3-14 Existing Park and Ride Locations

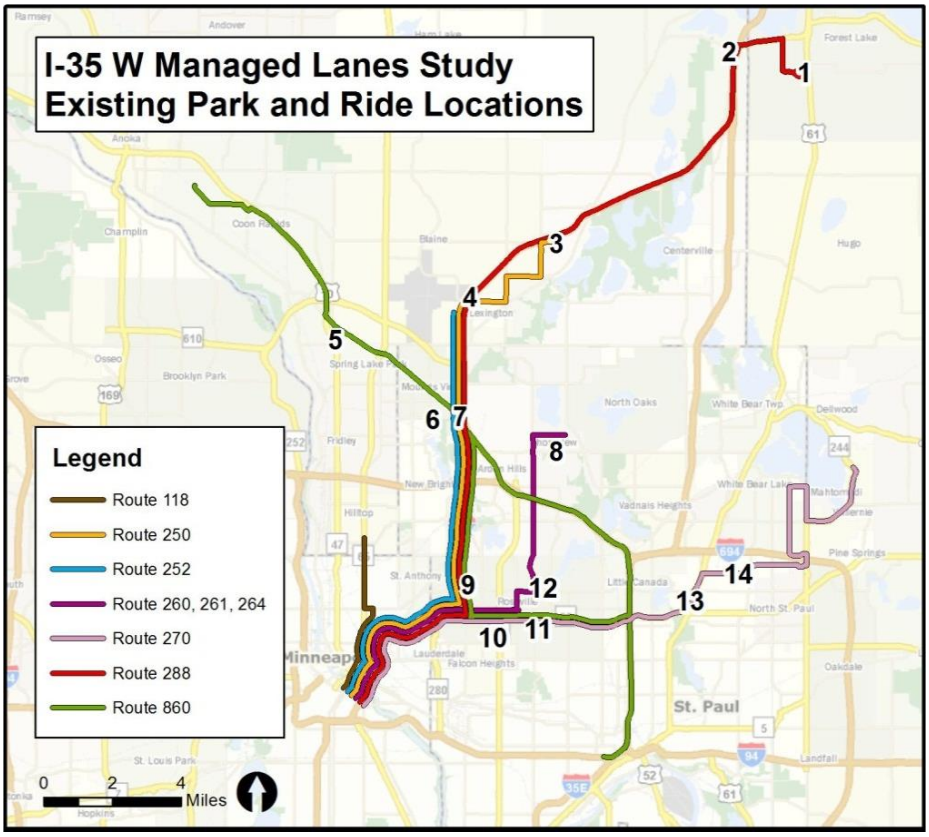


Table 3-3 Existing Park and Ride Location Table

#	Name	Location	Routes Served	Parking Spaces	Occupancy 2010
1	Forest Lake Transit Center	1955 Forest Rd. N	288	308	52
2	Running Aces	15201 Zurich St. NE	288	300	177
3	St. Joseph's Church	171 Elm St.	250	12	2
4	95th Avenue Park & Ride	3249 95th Ave. NE	250,252,262,288	1473	856
5	Northtown Transit Center	150 Northtown Dr. NE	10,25,824,852,854,860	366	210
6	Mermaid Supper Club	Hwy. 10 & CR H	860	60	67
7	I-35W & CR H	2146 Hwy. Ave.	250	211	87
8	Shoreview Community Center	4600 Victoria St. N	62,261	10	17
9	I-35W & CR C	2000 Lona Lane	264	460	68
10	Rosedale Transit Center	CR B2 & Snelling	32,65,84,87,260,272	375	239
11	Grace Church	1310 CR B2W	260,261	115	70
12	Roseville Skating Center	2661 Civic Center Dr.	260,261	50	41
13	Hmong American Alliance Church	2515 Maplewood Dr.	265,270,272	110	51
14	Maplewood Mall Transit Center	1793 Beam Ave.	64,80,219,265,270,272	420	360

Existing Route Profiles

All routes serving the I-35W north corridor provide weekday service only. There is no weekend or late night service in this corridor. The majority of the routes operate exclusively during the peak period with one route (264) providing midday service and one route (260) providing evening service. Table 3-4 provides the route type, span of service, frequency, number of daily trips, and passengers for each route.

Table 3-4 Route Profiles

Route	Type	Span of Service	Frequency	Daily Boarding	Daily Trips
118	Local/ Limited Stop	Peak	60 min.	137	8
250	Express	Peak	5-15 min.	2,064	61
252	Express	Peak	N/A (7 a.m. & 5 p.m.)	120	6
260	Express	Peak & Evening	15-30 min. (Peak) & 60 min. (Evening)	544	30
261	Express	Peak	15-30 min.	321	11
264	Express	Peak & Midday	15-30 min. (Peak) & 60 min. (Midday)	323	28
270	Express	Peak	5-15 min.	1,407	34
288	Express	Peak	15-30 min.	414	10
860 NB	Express	Peak	15-30 min.	477*	6
			Total	5,807	194

* This figure represents both NB and SB 860 ridership.

Five of these routes service more than one alignment. Route 250 has seven branches, Route 260 has a B branch, Route 261 has an S branch, Route 264 has three branches, and Route 270 has four branches.

An average daily 5,807 transit users ride routes that operate on the I-35W north corridor. As shown previously, not all routes use the full corridor. As such, transit ridership varies with different segments of the I-35W north corridor.

Average daily ridership throughout the corridor ranges from 414 in the northern portion to 5,330 in the southern portion. Average daily buses range from 10 buses in the northern portion to 188 buses in the southern portion.

Travel Time

The average speed for routes running along the I-35W north corridor during the peak periods is between 34 and 39 MPH. Table 3-5 and Table 3-6 provide travel time and speed averages for each route's travel along the I-35W north corridor.

Table 3-5 Southbound I-35W (a.m. peak) Route Travel Time and Speed

Route	On-Location	Off-Location	Average Miles	Average Travel Time (minutes)	Average Speed (mph)
118	Stinson Blvd & 18 Ave NE	Cedar Ave. S & Washington Ave.[7] University Ave. & Pleasant Ave.[8]	2.8	6-7	24-28
250	95th Ave. Park & Ride	Washington Ave. S & 11th Ave. S	14.3	19-22	39-45
252	95th Ave. Park & Ride	Cedar Ave. S & Washington Ave.[11] University Ave. & Pleasant[12]	14.2	28-41	21-30
260	Rosedale Transit Center	Central Ave. & University Ave. SE	6.2	11-12	31-34
261	Grace Church Park & Ride	Central Ave. & University Ave. SE	6.6	10-11	36-40
264	County Rd. C Park & Ride	Washington Ave. S & 11th Ave. S	6.3	10-11	34-38
270	County Rd. C Park & Ride	Central Ave. & University Ave. SE	11.8	21-24	29-34
288	Running Aces Park and Ride	Washington Ave. S & 11th Ave. S	26.5	30	53
		TOTAL/AVERAGE	88.7	135-158	34-39

*Note: Route 860 NB is not included in this table as it only operates along I-35W northbound.

Table 3-6 Northbound I-35W (p.m. peak) Route Travel Time and Speed

Route	On-Location	Off-Location	Average Miles	Average Travel Time (minutes)	Average Speed (mph)
118	Cedar Ave. S & Washington Ave.	Stinson Blvd & 18 Ave NE	2.9	6-11	16-29
250	Central Ave. & University Ave. SE	95th Ave. Park & Ride	15	23-25	36-39
252	Cedar Ave. S & Washington Ave. [9] 4th St. SE & Ridder Arena[10]	95th Ave. Park & Ride	15.1	21-27	34-43
260	Central Ave. & University Ave. SE	Rosedale Transit Center	6.2	14-15	25-27
261	Central Ave. & University Ave. SE	Grace Church Park & Ride	6.6	13-14	28-31
264	Central Ave. & University Ave. SE	County Rd. C Park & Ride	5.7	11-12	28-31
27	Central Ave. & University Ave. SE	County Rd. C Park & Ride	12.1	19-20	36-38
288	Central Ave. & University Ave. SE	Running Aces Park and Ride	26.8	34-37	43-47
860 NB	Grove St. & Lafayette Rd.	Mermaid Supper Club Park & Ride	15.5	25-26	36-37
		TOTAL/AVERAGE	105.9	166-187	34-38

Transit Advantages

[7] April 2011 location – reflects route change between April 2011 and October 2011
[8] October 2011 location – reflects route change between April 2011 and October 2011
[9] April 2011 location – reflects route change between April 2011 and October 2011
[10] October 2011 location – reflects route change between April 2011 and October 2011

Transit advantages along the I-35W north corridor include bus only shoulders and entrance ramp HOV bypass lanes. All routes may use the designated bus only shoulders along the corridor during periods of congestion. In the northbound direction, bus only shoulders are designated between Hennepin Avenue and Cleveland Avenue (CR 46) and between CR C and 95th Avenue (CR 52). In the southbound direction, bus only shoulders are designated between Lake Drive (CR 23) and 8th Street. Only transit buses are authorized to use the shoulder, and are subject to specific operating rules including a maximum speed of 35 MPH that is no more than 15 mph greater than the adjacent traffic.

Metro Transit bus operators that drive routes along the I-35W north corridor use the bus only shoulder primarily during the "peak of the peak period," which they indicate as between 6:45 a.m. and 8:00 a.m. and between 4:15 p.m. and 5:30 p.m. A number of factors go into a driver's choice to use the bus only shoulder, including traffic moving consistently below 30 mph, comfort using the shoulder, pressure from riders and other buses, and lack of operational challenges. Operational challenges associated with bus shoulder lane use include narrow shoulders, snow and inclement weather, pot holes/poor pavement condition, traffic merging onto I-35W north across the shoulder, and vehicles blocking the shoulder.

There are two metered entrance ramps along the corridor that include HOV bypass advantages. Both are in the southbound direction with one at Lake Drive (CR 23) and one at 95th Avenue (CR 52). Figure 3-15 provides a map of existing transit advantages.

Figure 3-15 Transit Advantages

3.7 Freight

Currently, limited freight data exists along the project corridor. To better understand existing freight characteristics, traffic classification counts were conducted on I-35W south of CR I and south of I-694 on April 18, 2012. Table 3-7 along with Figure 3-16, through Figure 3-19 represent the count data at each location and how the freight count compares to the other counts. Personal Car (PC) represents vehicle lengths up to 24 feet, typically accounting for motorcycles, cars, pickup trucks, SUV's and vans. Medium Truck (MT) represents vehicle lengths of 24 feet to 57 feet, typically accounting for buses, two plus-axle single units, heavy trucks with trailers and three-axle semi-trucks. Heavy Trucks (HT) represents vehicle lengths of 57 feet to 80 plus feet, typically accounting for four-axle and five-axle semi-trucks as well as twin trailers.

Available data suggests a significant percent of MT and HT volumes. The pattern suggests that the northbound truck volumes, especially MTs, follow a similar pattern to the daily northbound commuter volumes. Truck volumes in the southbound direction, especially MTs, also share a peak with commuter volumes in the morning hours. The largest truck volume occurs in the I-35W segment between T 36 and TH 10 N.

Table 3-7 Daily Corridor Vehicle Classification

Vehicle Class	Personal Car	Medium Truck	Heavy Truck
NB Percent	88% - 89%	7% - 9%	3%
SB Percent	89% - 91%	6% - 8%	3%

Figure 3-16 NB Passenger Cars, Medium Trucks, & Heavy Trucks South of CR I

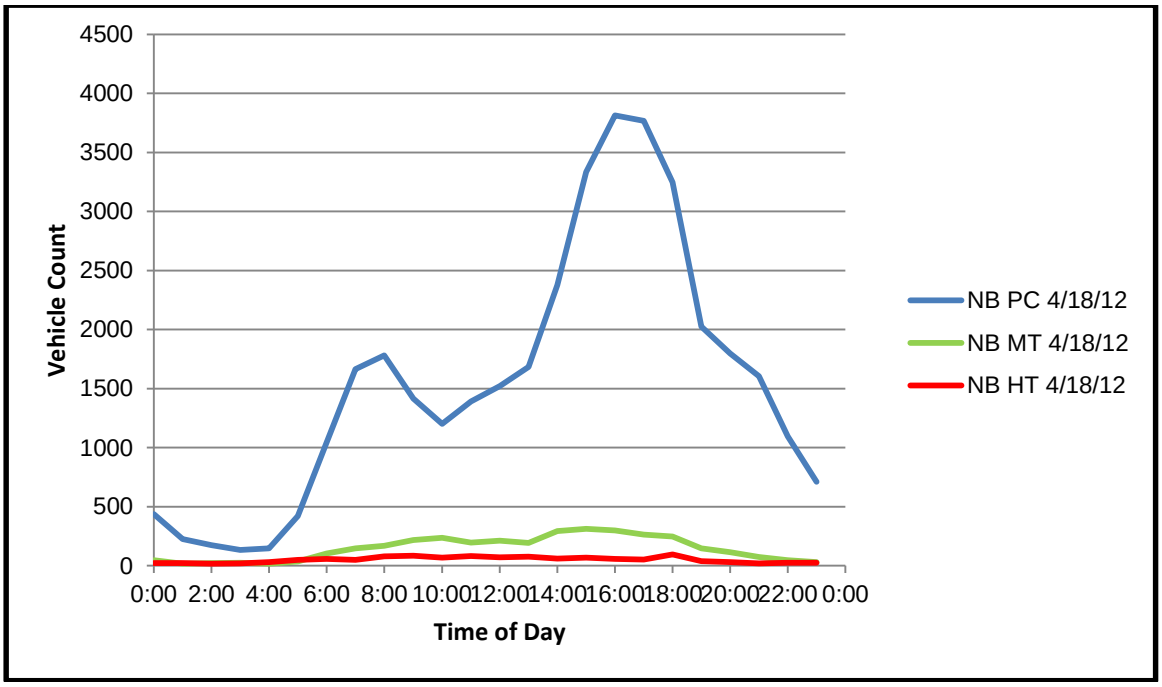


Figure 3-17 SB Passenger Cars, Medium Trucks, & Heavy Trucks South of CR I

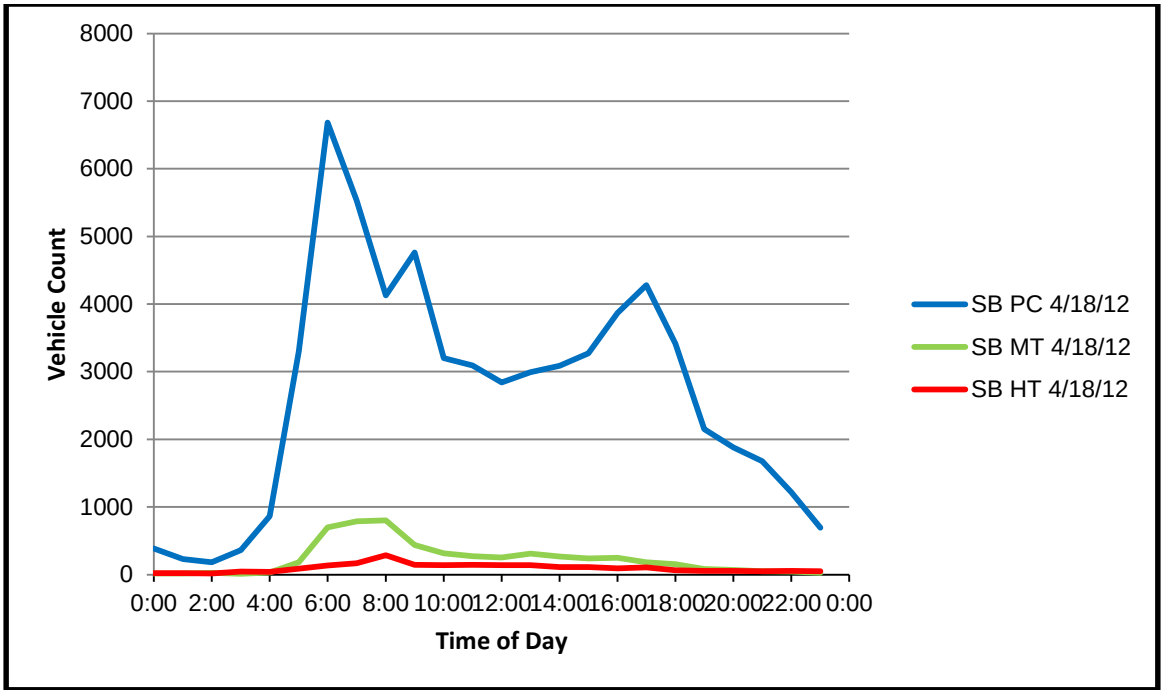


Figure 3-18 NB Passenger Cars, Medium Trucks, & Heavy Trucks South of I-694

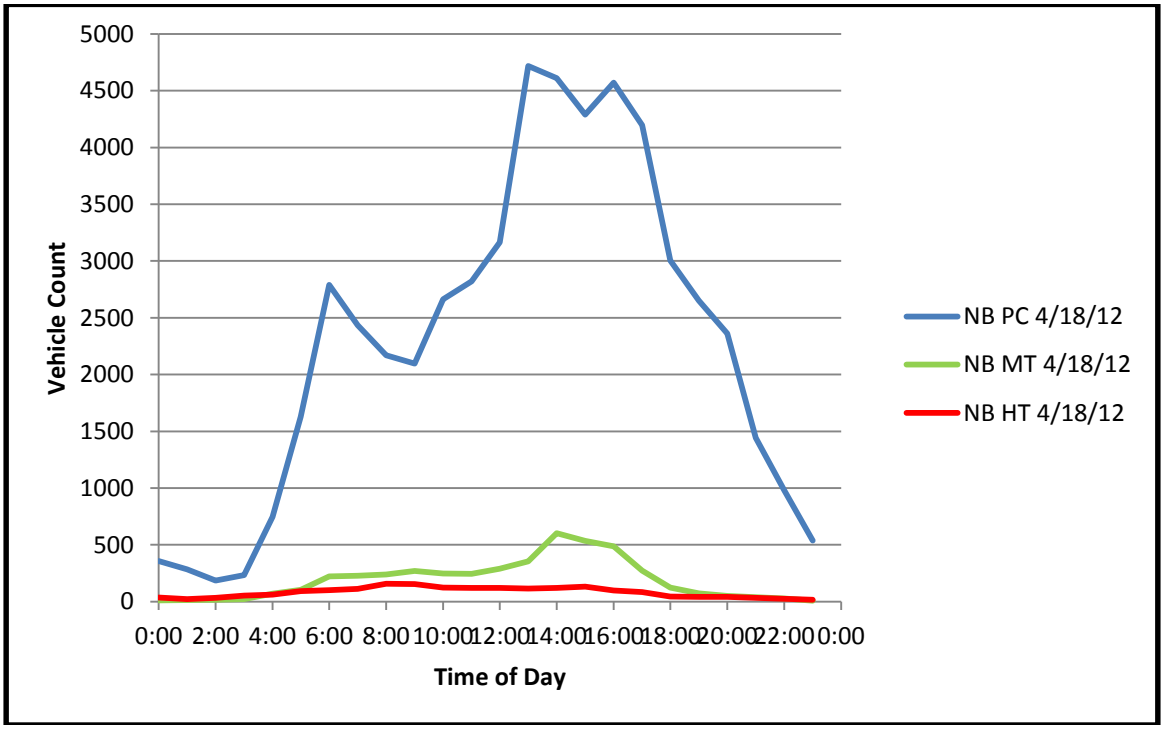
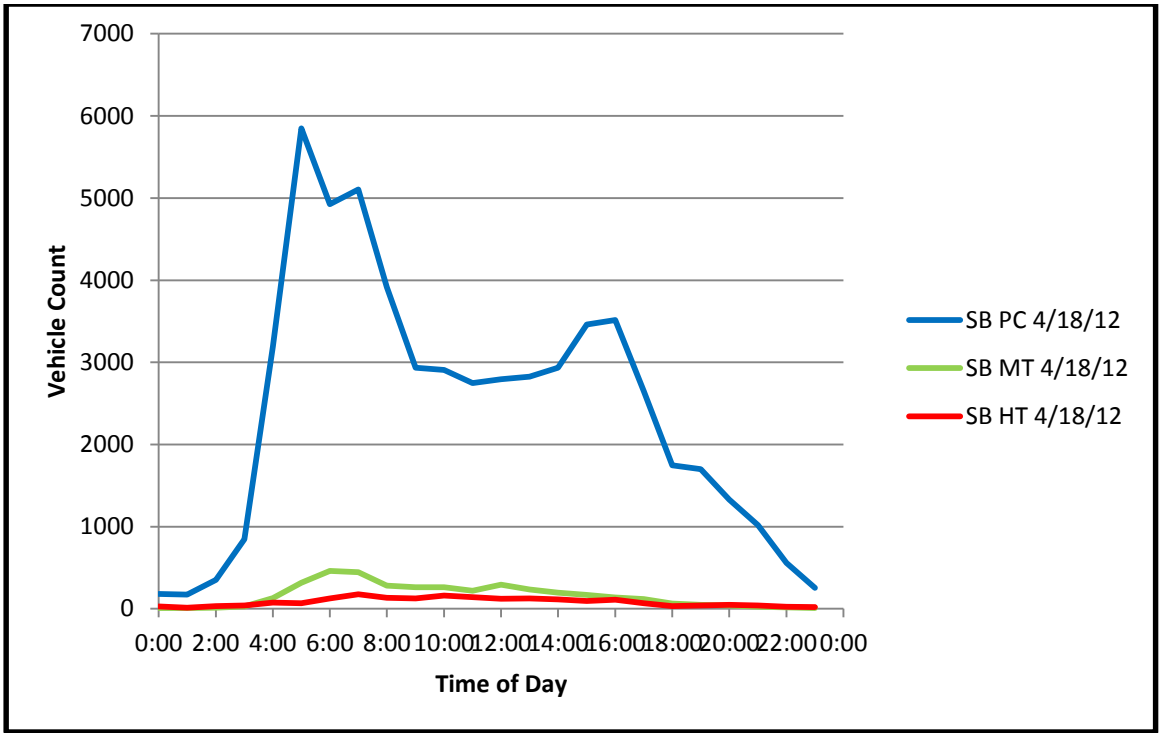


Figure 3-19 SB Passenger Cars, Medium Trucks, & Heavy Trucks South of I-694



4.0 Segmentation

The overall study corridor is 25 miles in length and has multiple variances in physical and traffic characteristics. Physical characteristic include; number of lanes and typical sections (median type and width). Traffic characteristic include peak hour duration, HT traffic, directional split and transit service. Based on these physical and traffic characteristics the I-35W north corridor was broken down into logical segments. This ensured the proper evaluation of the managed lane alternatives since a certain alternative may be a good option in one segment and not be adequate in another.

Existing traffic characteristics change throughout the I-35W north corridor. The most dramatic changes observed were at the system interchanges with TH 10, I-694, and TH 36 where large traffic volumes access I-35W. The traffic characteristics on these intersecting principal arterials were often different than I-35W to the north or south, resulting in shifts in peak hour percent of daily volumes, directional distribution, time of peak, and duration peak traffic. Detailed division of the corridor segments is shown in Figure 4-1.

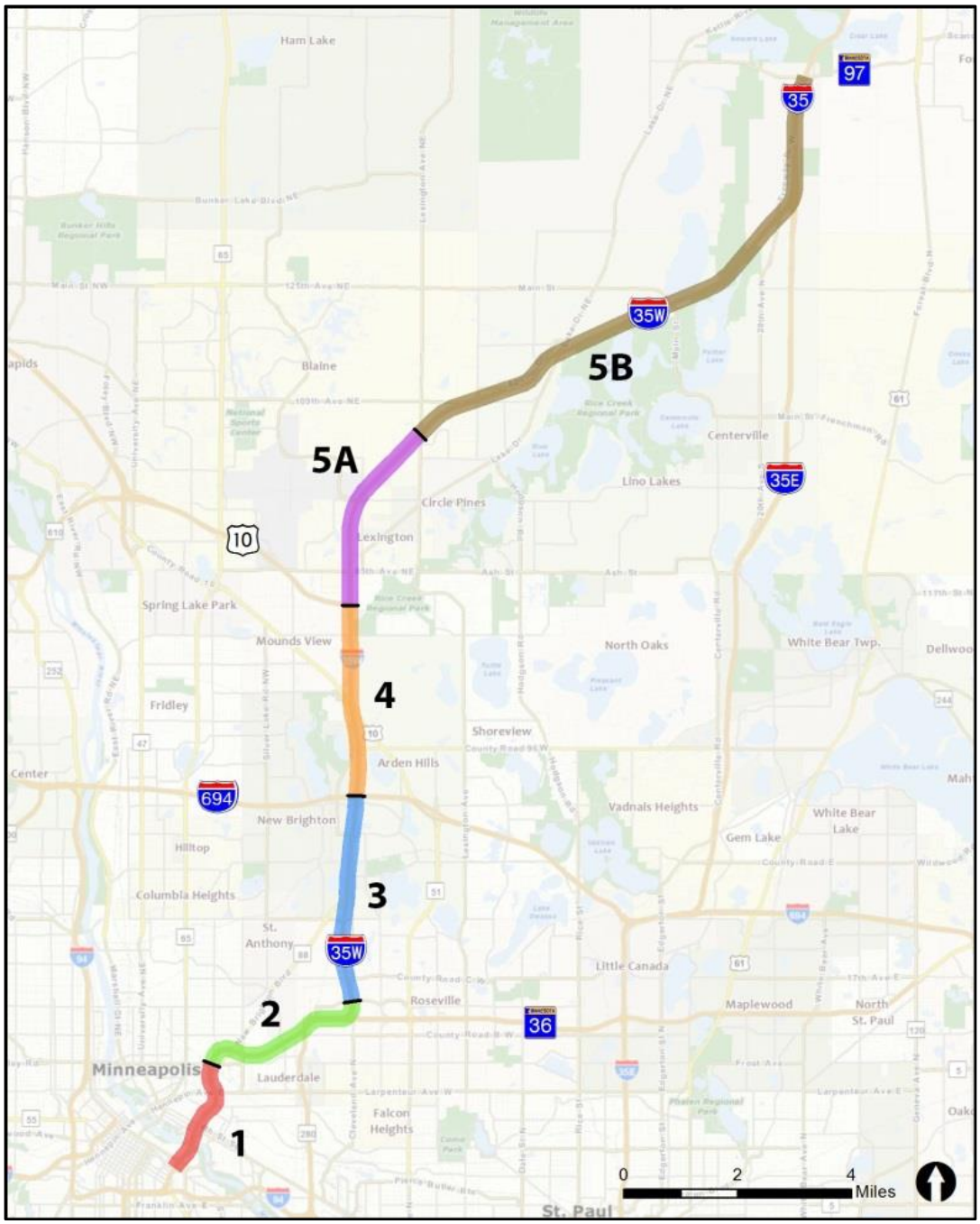
Table 4-1 provides the supporting data of physical and traffic characteristics on which the determination corridor segments were based. This data demonstrates each segment has a unique combination of existing physical and traffic characteristics.

During the initial primary screening process, it was determined that the southern portion of Segment 5 (TH 10 N to north of 95th Avenue) had different physical and traffic characteristics than the portion north of 95th Avenue. Segment 5 was divided into two segments 5A and 5B.

Table 4-1 Segmentation Characteristics

#	Length	Lanes	Section Type	Directional Split	Peak Hour Percent of Daily Volume	Time of Peak Hour	Duration of Peak Period	Daily Truck Volumes
1	~2 miles	6	Urban	a.m.: 65/35 p.m.: 55/45	a.m.: 7.5-7.8% p.m.: 7.6-8.5%	a.m.:7:00 p.m.: 4:30	a.m.: 2.5 hrs. p.m.: 3.0 hrs.	3,000-4,000
2	~2.5 miles	6	Urban	a.m.: 70/30 p.m.: 60/40	a.m.: 7.7-7.8% p.m.: 8.5-8.6%	a.m.: 6:45 p.m.: 4:30	a.m.: 2-2.5 hrs. p.m.: 2-2.5 hrs.	4,000-5,000
3	~3.8 miles	6	Urban	a.m.: 75/25 p.m.: 60/40	a.m.: 7.3-7.4% p.m.: 8.0-8.3%	a.m.: 6:30 p.m.: 4:30	a.m.: 2 hrs. p.m.: 2 hrs.	7,000-9,000
4	~3.3 miles	6	Rural	a.m.: 75/25 p.m.: 65/35	a.m.: 7.7-7.8% p.m.: 8.6-9.3%	a.m.: 6:15 p.m.: 4:30	a.m.: 2 hrs. p.m.: 2.5-3 hrs.	6,000-7,000
5A	~3.5 miles	4/6	Rural	a.m.: 80/20 p.m.: 70/30	a.m.: 6.8-7.5% p.m.: 9.3-9.7%	a.m.: 6:00 p.m.: 4:30	a.m.: 2-2.5 hrs. p.m.: 3-3.5 hrs.	3,000-4,000
5B	~10.2 miles	4	Rural	a.m.: 80/20 p.m.: 70/30	a.m.: 7.5-8.0% p.m.: 9.3-9.7%	a.m.: 6:00 p.m.: 4:30	a.m.:1.5-2.5 hrs. p.m.: 2.5 hrs.	3,000-4,000

Figure 4-1 Segmentation Map



Transit ridership also has multiple variances in usage characteristics throughout the corridor. Existing transit ridership characteristics divided by corridor segmentation is shown in Figure 4-2 and Table 4-2.

Figure 4-2 Corridor Transit Ridership

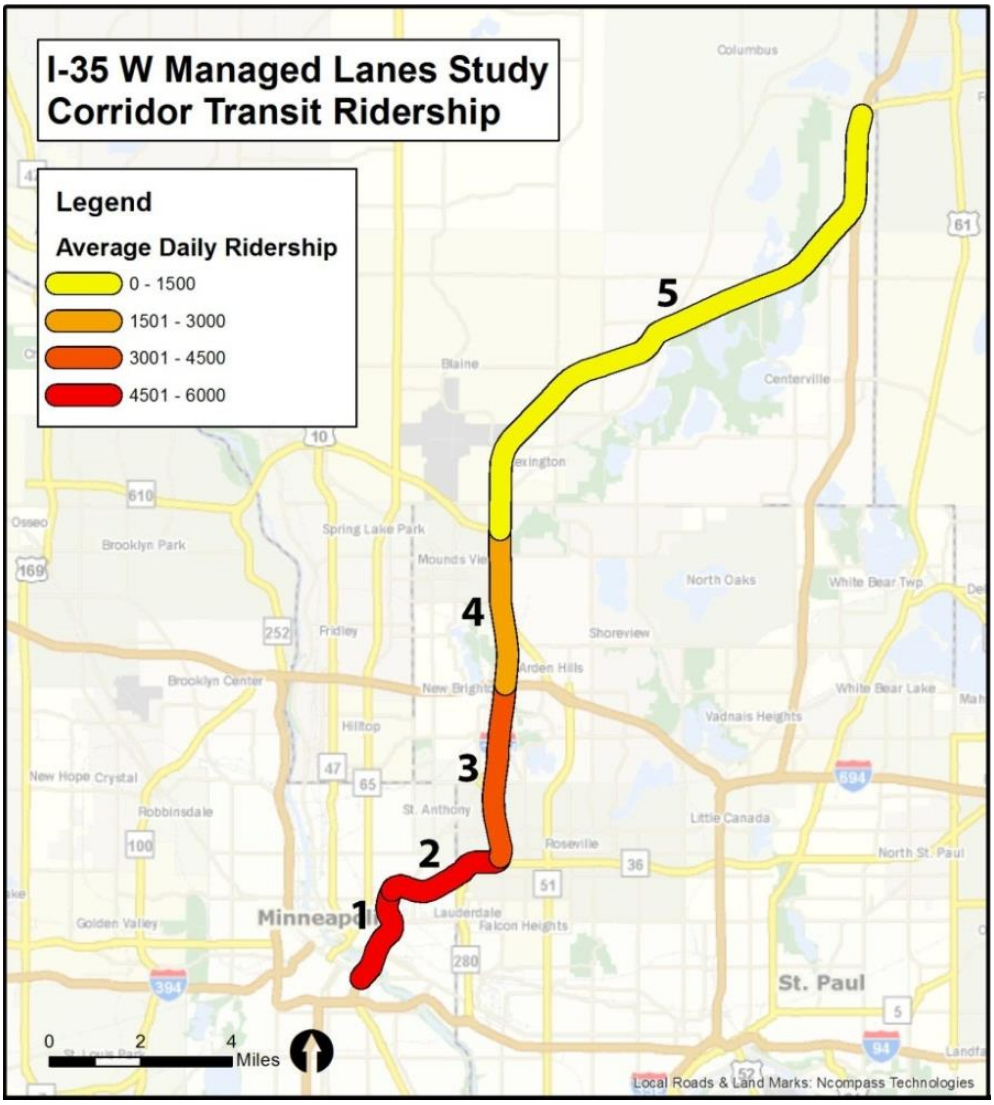


Table 4-2 Corridor Transit Ridership Table

Segment	South Limit	North Limit	Average Daily Ridership	Average Daily Buses
1	3rd/4th St	New Brighton Blvd.	5,330	188
2	New Brighton Blvd.	Cleveland Ave.	5,193	180
3	Cleveland Ave.	I-694	3,075	83
4	I-694	TH-10	2,598	77
5	TH-10	TH-97	414	10

5.0 Programmed Improvements

Introduction

It is important to understand how future plans for the project corridor function with potential recommendations from this study. Therefore, a review of MnDOT's STIP[11] identified the following improvements listed in Table 5-1.

Table 5-1 Study Area Highway Improvements from STIP

STIP Project Number	FY	Route	Location	Description
091-596-001	2011	I-35W	95th Ave Park and Ride	300 vehicle parking capacity expansion
6285-135AC	2012	I-694	TH 10/TH 51	Interchange Reconstruction and Bridge Replacements
6284-159	2012	TH 10	CSAH 10	Bridge Replacement and Approach Work
062-596-003UG	2012	TH 10	CSAH 96	Partial Interchange and Overpass Ramsey County Project
027-603-053	2013	I-35W	Lake Street (CSAH 3)	Lake St Access to I-35W, MPLS-Construction & CE
2783-136	2013	I-35W	3rd/4th Street	Northbound Entrance Ramp
6284-157	2014	I-35W	CSAH 96	Bridge Redeck
2783-128*	2014	I-35W	NB Hennepin to Stinson	Drainage Improvements - Mill and Overlay
6205-37	2014	TH 10	I-35W to I-694	Mill and Overlay, Drainage
6284-162	2015	I-35W	CR H	Bridge Replacement
6216-130	2015	TH 51	CR E	Bridge Replacement
0280-70	2016	I-35W	Lake Dr SB entrance	Parallel acceleration lane
2783-137	2016	I-35W	Minneapolis	Redeck bridges: 27885 (Johnson N), 27886 (Broadway), 27985 (pedestrian bridge), 27989 (Hennepin), 27994 (Johnson S)
6284-163	2016	I-35W	Arden Hills	Replace bridges: 9570 (CR E2), 9599 (CR F)

* 2783-128 Assumes a northbound auxiliary lane from University Avenue to Johnson Street and a revised exit geometry for Johnson Street/Stinson Avenue exit ramp.

5.1 Operational Model with Programmed Improvements

A number of improvements programmed for construction were identified along the study area highways as appropriate to be included in baseline conditions. These include projects underway or included in the 2012-2015 STIP. These projects include the following improvements:

- Northbound entrance ramp to I-35W from 3rd/4th Street in Minneapolis
- Northbound auxiliary lane from University Avenue to Johnson Street
- I-694/TH 10/Snelling Avenue interchange reconstruction
- TH 10/CSAH 96 grade separation

[11] State of Minnesota 2011-2014 State Transportation Improvement Program, September 2010; State of Minnesota 2012-2015 State Transportation Improvement Program, September 2011; Draft State of Minnesota 2013-2016 State Transportation Improvement Program, September 2012

These improvements were assumed to be in place as baseline conditions for all subsequent evaluations of managed lanes and spot improvement concepts. In order to account for these improvements as the modified baseline condition, updated traffic volumes and operations models were prepared. This chapter describes these processes and outcomes.

Traffic Volume Adjustments

The Regional Travel Demand Model (RTDM) was used to identify appropriate adjustments to existing traffic volumes to reflect the changes expected as a result of the programmed improvements. An existing conditions model was prepared for year 2010 conditions, using currently available roadway network and land use detail. Additional details of the forecast modeling process were provided in this report. However, for the purposes of this section, it should be noted the preparation of this model included a calibration process to ensure the model reproduced year 2010/2011 traffic volumes with acceptable accuracy.

Adjustments to existing traffic volumes were estimated by first adding the programmed improvements into the highway network of the year 2010 travel demand model. Trips were then re-assigned to the modified highway network. The results of the updated highway assignment were compared to the existing conditions assignment.

The comparison showed the major travel pattern changes expected as a result of the programmed improvements. The most significant change was an increase on TH 10 between I-35W and I-694 as a result of the grade separation at TH 10 and CSAH 96. This improvement was expected to improve travel time and reduce delay along this segment. In addition, the improvements to I-694 near the TH 10 and TH 51 interchanges also contributed to the increase.

The other noteworthy travel pattern change was associated with the improvements to northbound I-35W in Minneapolis. The northbound entrance ramp from 4th Street is expected to result in additional traffic entering northbound I-35W. This increase was offset somewhat by decreased entering traffic from the Washington Avenue and University Avenue entrances. Northbound volumes are expected to be slightly higher than existing conditions through the exit to Johnson Street where the auxiliary lane capacity was added.

The existing balanced freeway volume set was modified to reflect the changes in peak period traffic patterns observed in the model. The five-hour peak period and peak hour volumes are provided in Appendix B – Forecast Memorandum.

Operations Modeling

The existing conditions CORSIM operations model was also updated with the programmed improvements. The adjusted traffic volumes described previously were used in these models as well. The a.m. and p.m. peak period models were re-run with the programmed improvements and adjusted traffic volumes.

The results of the models show changes in congestion resulting from the highway improvements. During the a.m. peak period, existing congestion along I-694 eastbound near TH 10 is expected to be eliminated as a result of the improvements in that area. Similarly during the p.m. peak

period, all of the congestion along both eastbound and westbound I-694 between I-35W and Lexington Avenue is expected to be eliminated.

No meaningful changes to congestion were observed along mainline I-35W in the programmed improvements model. The only location with access and geometric changes along I-35W was along I-35W northbound between 4th Street and Johnson Street in Minneapolis. While no congestion was observed in this segment under either the existing or programmed improvements model, traffic speeds increased and densities decreased with the programmed improvements.

6.0 No-Build Forecasts – Travel Demand Forecasting

Introduction

This chapter summarizes the preparation of No-Build travel demand forecasts for the I-35W North Managed Lanes Corridor Study, full documentation can be found in Appendix B – Forecast Memorandum. Future year travel demand was evaluated for highway, transit, and freight modes. The study area included the following highway corridors:

- I-35W: downtown Minneapolis to I-35E north split
- I-35: I-35E/I-35W north split to TH 97/CSAH 2
- TH 36: I-35W to Snelling Avenue
- I-694: Silver Lake Road to Lexington Avenue
- TH 10 east: I-694 to I-35W
- TH 10 west: I-35W to TH 65

Travel demand results were developed for existing (year 2010/2011) conditions, year 2030 no-build and various build/managed lane alternatives. This chapter presents the assumptions and methods used to develop these forecasts and results.

6.1 Data Collection

Travel demand model validation and operations analysis used freeway volumes from April 2011, obtained from loop detector data available through the RTMC. Balanced daily and peak period traffic flows were generated from this data along all freeway segments and ramps along the corridors in the study area. In addition, annual average daily traffic (AADT) counts were obtained from MnDOT's year 2010 flow maps for non-freeway roadways.

A potential influencing impact to traffic patterns was identified as the TH 36/Rice Street interchange reconstruction. A review of TH 36 volumes between April 2009 and October 2011 showed April 2011 was within the normal range of traffic volumes along TH 36.

Existing vehicle classification counts were provided by MnDOT in April 2012 in conjunction with this study. These data provided additional detail regarding freight movements through the corridor.

6.2 Travel Demand Model Process

Forecasts for this project were developed using the Metropolitan Council's RTDM dated November 2011, with supplemental information from MnDOT's Collar County model updated by SRF to be consistent with the November 2011 Metropolitan Council model. Additional detail was added to the highway network in the study area to capture local travel patterns and replicate local conditions as part of this study.

6.3 Assumptions

To develop travel demand forecasts for the alternatives and analysis years, a set of future year inputs to the travel demand models was generated to reflect expected background roadway system and land development in the area.

Transportation Network

Background highway and transit assumptions (those assumed in all alternatives) were consistent with the Metropolitan Council's TPP, adopted November 30, 2010, and reflected in the Metropolitan Council's RTDM base network as of November 12, 2011. The following regionally significant transportation network improvements potentially affecting the study area were assumed to be constructed between years 2010 and 2030:

Regional Highway Improvements

- TH 36 St. Croix River Crossing
- TH 169/I-494 Interchange Reconstruction
- I-35E Cayuga Bridge and Interchange
- TH 36/English Street Interchange
- I-35W MnPASS Extension – Northbound from CSAH 42 to Burnsville Parkway
- I-35W MnPASS Lanes – Between Downtown St. Paul and Little Canada Road
- TH 36 Eastbound MnPASS Lane – From East of I-35W Split to I-35E

Study Area Highway Improvements

- Northbound Entrance ramp to I-35W from 3rd/4th Street in Minneapolis
- Northbound Auxiliary lane from University Avenue to Johnson Street
- I-694/TH 10/Snelling Avenue Interchange Reconstruction
- TH 10/CSAH 96 Grade Separation

Regional Transitways

- Cedar Avenue BRT
- I-35W South BRT
- Snelling Avenue Arterial BRT

Corridor Transit Improvements

- New route serving the planned TH 65 and CR 14 Park and Ride (Route 899)
- Increased peak and midday service for Route 250 serving the 95th Park and Ride
- Route 260 serves new park and ride at Rice Street, no stops at Rosedale Park and Ride

- Increased peak service for Route 270, no longer stops at I-35W and CR C Park and Ride
- Increased peak and midday service for Route 10
- Route 4 improved to Hi-Frequency Service Network standards

Land Use

Development inputs to the model (population, households, retail employment and non-retail employment) were from the Metropolitan Council's Transportation Analysis Zone (TAZ) database as of November 2011, reflecting the most current Metropolitan Council-accepted comprehensive plan information submitted by local communities.

Draft information was distributed to study area communities to provide an opportunity to review future land use patterns within their communities. Detailed zone-level maps and tables for each community are provided in Appendix B. No communities requested changes to information sent out for review. As a result, land use forecasts throughout the region were consistent with Metropolitan Council accepted totals.

As shown in Table 6-1, a significant amount of development was anticipated in the study area communities, particularly in the developing suburban communities in the northern portion of the I-35W north corridor. Development inputs to the model were based on an assumption that the current downturn in the development market was a cyclical condition and that year 2030 forecasts were reasonable in the context of the lack of certainty in a long-range forecast.

Table 6-1 Existing and Future Land Use Totals

City	Households			Employment		
	2010	2030	Percent Change	2010	2030	Percent Change
Arden Hills	2,957	4,600	56%	12,412	17,100	38%
Blaine	21,077	31,234	48%	20,548	28,496	39%
Circle Pines	2,006	2,200	10%	790	2,450	210%
Columbus	1,416	2,185	54%	1,172	2,000	71%
Forest Lake	7,014	15,001	114%	6,447	11,986	86%
Lexington	787	1,000	27%	467	1,120	140%
Lino Lakes	6,174	10,600	72%	3,336	8,000	140%
Minneapolis	163,394	189,397	16%	281,515	346,499	23%
Mounds View	4,954	6,000	21%	6,386	9,400	47%
New Brighton	8,915	10,000	12%	9,213	15,600	69%
Roseville	14,623	16,500	13%	35,082	46,100	31%
Shoreview	10,402	11,300	9%	11,648	16,800	44%

6.4 Model Validation

Model validation is the process of comparing model performance to real-world conditions, using known input and output data. For travel demand forecasting, the known input data include existing transportation network and land use information. The known output data was highway volumes and transit ridership. The results of model validation often lead to model adjustments that improve model performance.

Existing Highway Volumes

Baseline model results were generally found to reproduce existing highway volumes accurately along I-35W north of TH 36; however further model refinements were found necessary to more accurately reproduce existing highway volumes.

The validation results show that 79 percent of area links fall within accepted guidelines; where 14 percent of links were above and 7 percent of links were below the target range.

Existing Transit Ridership

Validation was also performed to confirm reasonable performance of the transit of the RTDM. The existing transit routes and frequencies were reviewed for consistency with existing transit operations in the study area. The following additional features were updated in the model to reflect existing conditions:

- Opening/expansion of the I-35W and 95th Park and Ride ramp (Total Capacity: 1,482)
- Opening of the I-35W and CR C Park and Ride ramp (Total Capacity: 460)

The model's base year of 2010 was reviewed for the I-35W corridor between downtown Minneapolis and Forest Lake using information provided by Metro Transit. Model validation was improved by the refinement of transit routes, stop nodes and the addition of transit support links. Upon updating the model, the model's base year transit ridership estimates were reviewed along the I-35W corridor. Table 6-2 provides the result of this analysis.

Table 6-2 Existing Transit Model Validation

Routes	2010	Modeled	Diff	% Diff
Corridor Routes	**4,941**	**4,931**	**-10**	**0%**
Parallel Routes	**17,226**	**19,358**	**2,132**	**12%**

“Corridor routes” were defined as those which use the I-35W corridor north of downtown Minneapolis, while a subgroup of these routes were identified that also serve the TH 36 corridor. Routes considered as “parallel routes” were those currently and/or in a future service plan, provide local service between downtown Minneapolis and surrounding communities to the north. Parallel routes were limited to routes located between TH 65 and TH 36, with the exception of the new route (Route 899) serving the planned TH 65 & CR 14 Park and Ride in Blaine.

Overall the Corridor routes estimated ridership was less than 1 percent low, while the parallel facilities were about 15 percent high.

6.5 Alternatives and Results

Travel demand forecasts have been prepared for a variety of year 2030 alternatives. No-build baseline forecasts included only the programmed improvements listed in the assumptions section of this chapter.

A build alternative was developed for the I-35W north corridor to evaluate the influence of managed lanes in the study area. Managed lane facilities were added to the RTDM along I-35W between University Avenue and Lexington Avenue (CSAH 17). The speed and capacities of these links were consistent with other managed lane facilities already included in the model, including I-394, I-35W south, I-35E, and TH 36 eastbound. Forecasts were prepared for the build scenario for both highway traffic volumes and transit ridership.

In addition to the build alternative, some additional investigation was performed for both highway and transit modes. For highway travel, improved access to downtown Minneapolis was considered. This included both direct access from the I-35W north managed lanes to the downtown Minneapolis street network for managed lane traffic and general purpose access for Hennepin Avenue to and from the north on I-35W.

For transit, a BRT scenario with a variety of station locations and types was considered that would provide enhanced all-day service between downtown Minneapolis and the 95th Avenue Park and Ride. Additional sensitivity tests were also performed to gauge the influence of station design on estimated daily ridership.

Year 2030 No-Build

No-build baseline forecasts included only programmed roadway improvements listed in the assumptions section. Figure 6-1, Figure 6-2 and Figure 6-3 show the results of the year 2030 No-Build scenario. Daily growth of highway volumes in the corridor was expected to be higher on the northern segments of I-35W compared to the southern segments. Approximate annual growth rates in the corridor are 0.5 percent south of TH 36, 0.5 percent to 1 percent between TH 36 and TH 10, and slightly more than 1 percent north of TH 10.

Figure 6-1 Daily Traffic Volumes, Existing and Year 2030 No-Build: Washington Avenue to I-694

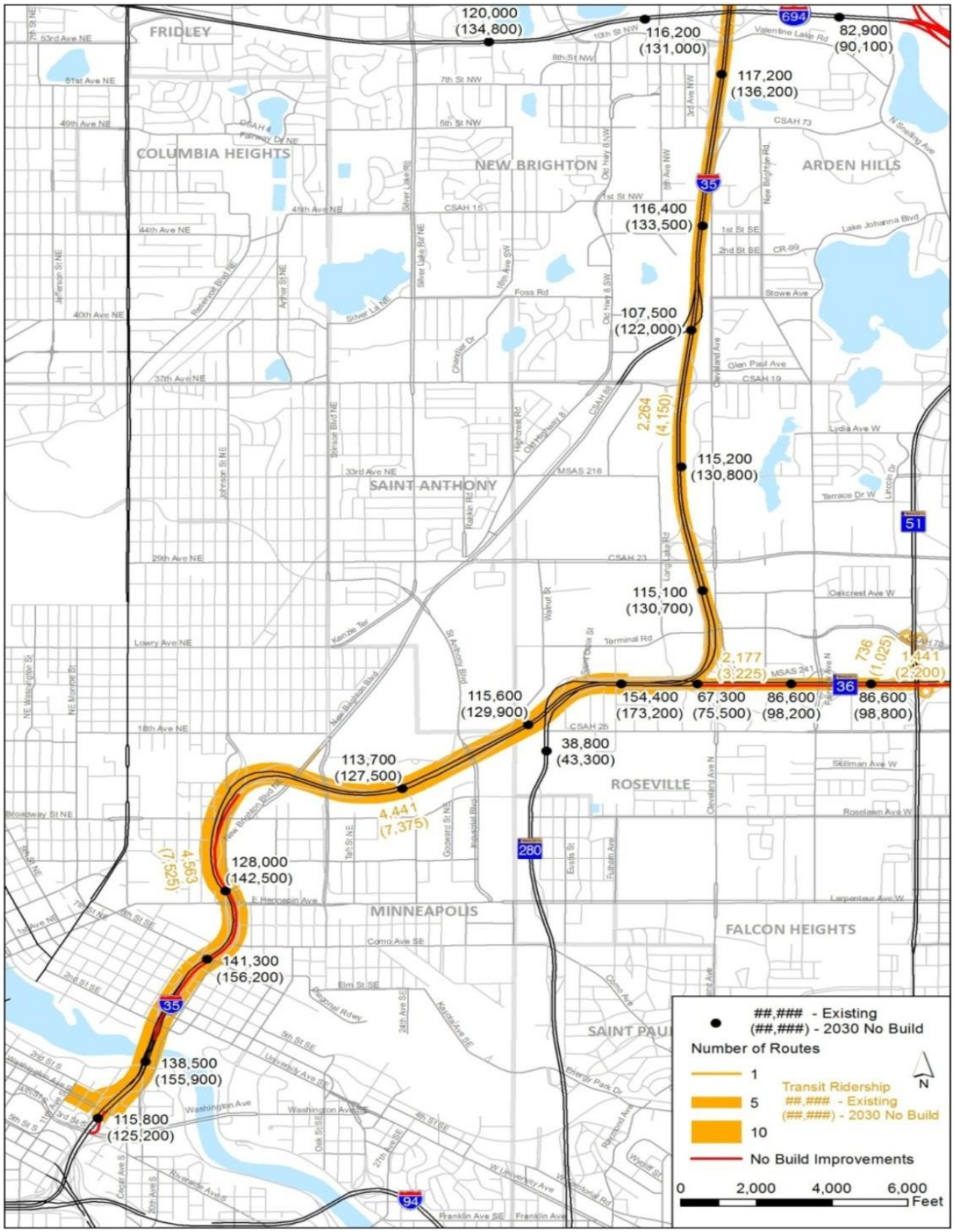


Figure 6-2 Daily Traffic Volumes, Existing and Year 2030 No-Build: I-694 to CR 52

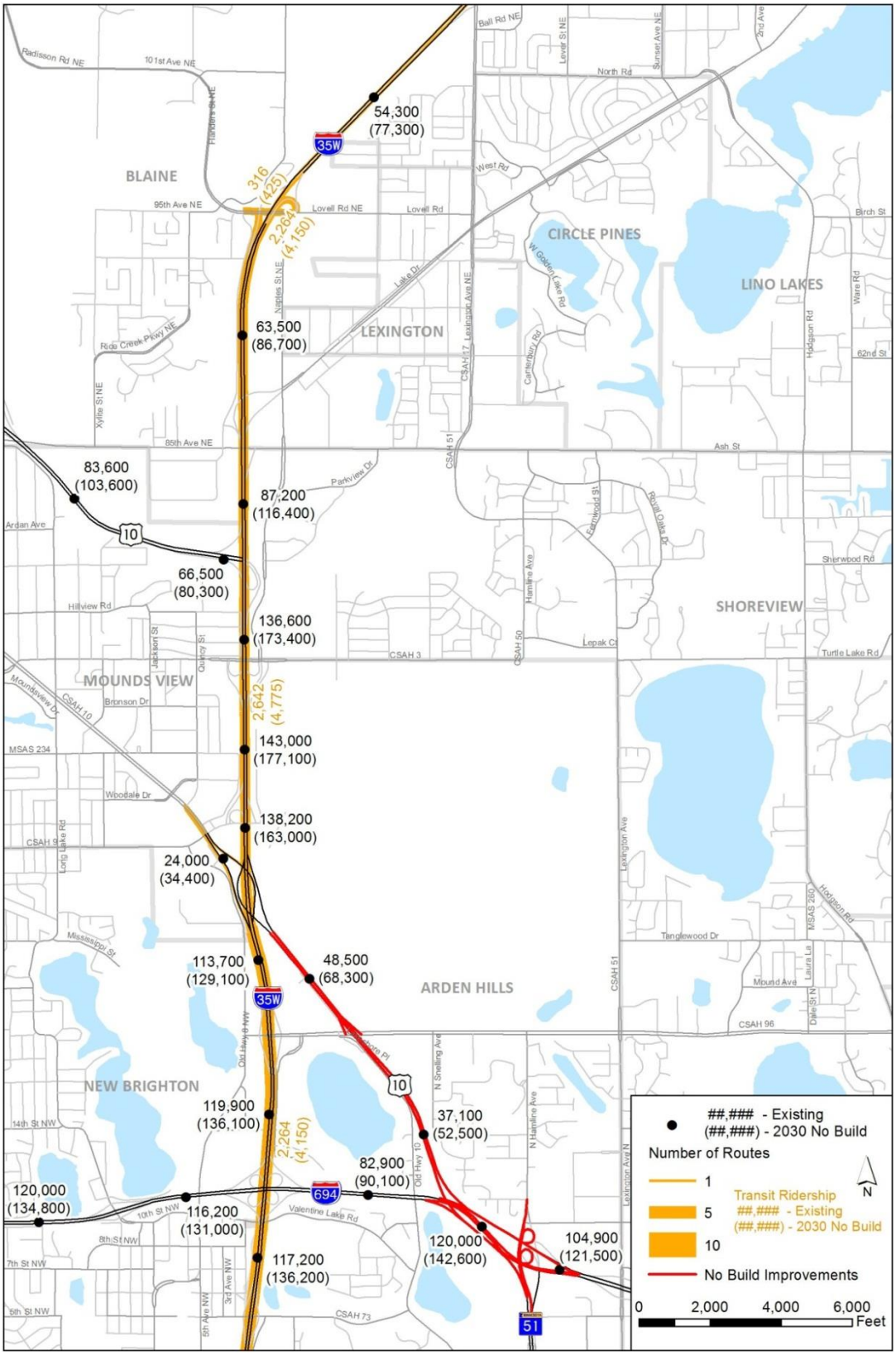
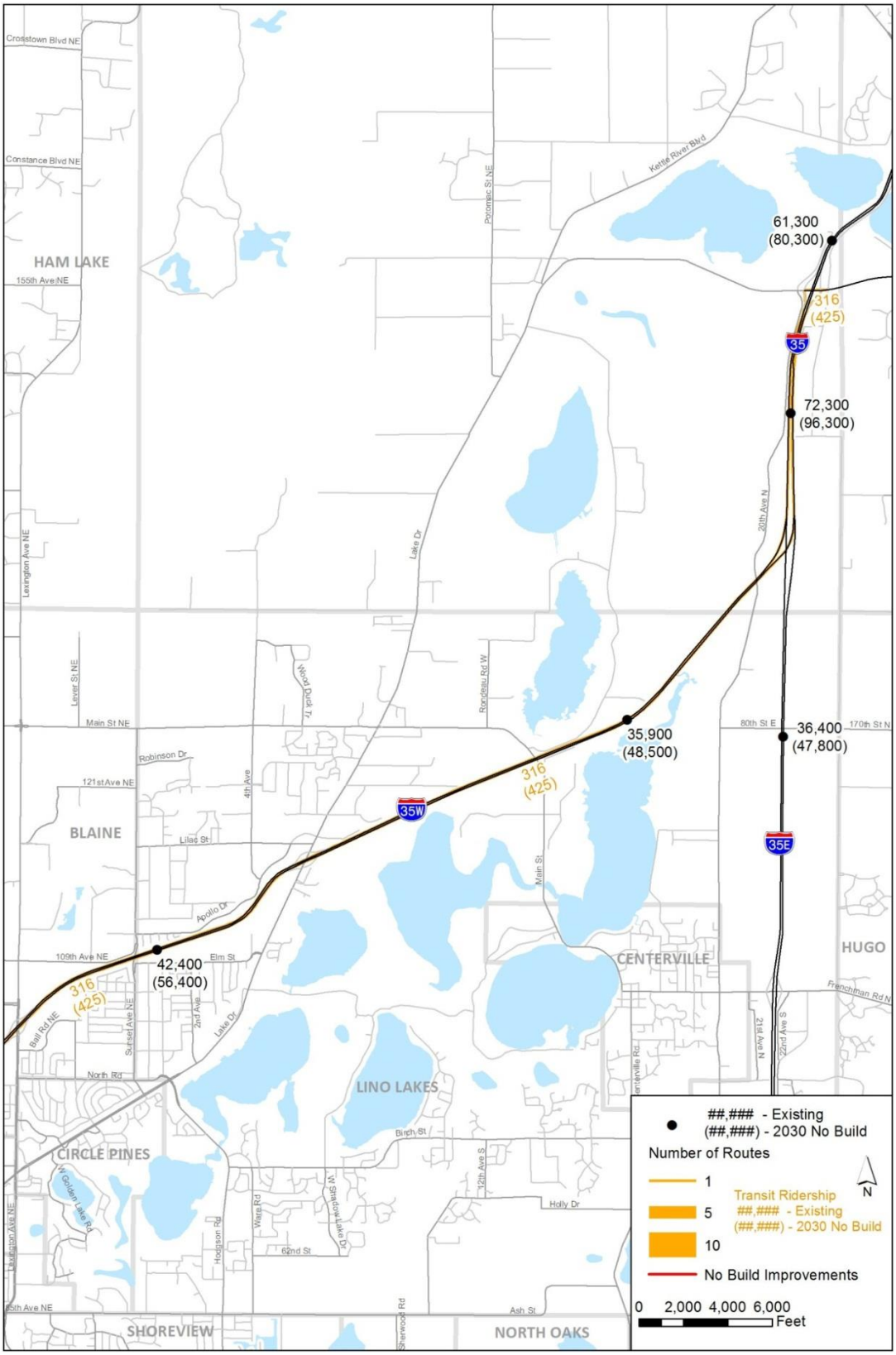


Figure 6-3 Daily Traffic Volumes, Existing and Year 2030 No-Build: CR 23 to CR 23



Highway Forecasts

Overall, traffic patterns in the study area are expected to remain similar to existing conditions. The exceptions to this relate to assumed highway improvements in the study area. The south 4th Street entrance ramp to northbound I-35W and northbound auxiliary lane from southeast 4th Street to the combined Johnson Street is expected to result in increased traffic on northbound I-35W between downtown Minneapolis and TH 280. The TH 10/CSAH 96 Grade Separation project is expected to attract more trips to TH 10 from I-35W and I-694.

The forecast reasonableness checks included a review of peak demand during the five-hour a.m. and p.m. peak periods. This review indicated that some freeway segments within the study area are expected to approach capacity across the five-hour peak period. During the a.m. peak this included southbound I-35W between TH 10 and CR 88 and eastbound TH 10 between 93rd Lane and I-35W. During the p.m. peak this included northbound I-35W between CR 88 and Lexington Avenue and westbound TH 10 between I-35W and TH 65. All these areas experienced peak period congestion under existing conditions, and the results showed the duration and extent of congestion is expected to grow under year 2030 no-build conditions. Forecast reasonableness tables are provided in Appendix B.

Transit Forecasts

Transit ridership forecasts were also prepared for year 2030 no-build conditions. These forecasts included the programmed transit improvements listed in the assumptions section. Major assumptions in the vicinity of the I-35W north corridor include the Green Line Transitway (Central Corridor LRT), and the West Broadway/Chicago Avenues and Snelling Avenue BRT arterial transitway services. Table 6-3 shows the transit ridership forecasts at the route and corridor level.

Transit ridership in the I-35W north corridor is expected to experience substantial growth by year 2030. I-35W corridor routes are expected to increase from 2,764 to 4,425 daily riders and TH 36 routes are expected to increase from 2,177 to 3,225 daily riders. These represent increases of 60 percent and 48 percent respectively, and 55 percent overall. These increases are attributable to a number of factors, including: increased highway congestion along I-35W results in mode shift to transit, increased park and ride capacity at stations in the I-35W north corridor, and increased frequency of transit routes serving the study area.

These transit forecasts do not reflect capacity constraints on the transit system, either in bus capacity or park and ride capacity.

Table 6-3 Route and Corridor Daily Transit Ridership Forecasts

Route	Description	Type	2010 Ridership	2030 Forecast
	Corridor Routes			
	I-35W Routes			
118	Downtown Minneapolis to Columbia Heights	Local	122	150
250[1]	Downtown Minneapolis to Lino Lakes	Express	1,844	3,050
252	Downtown Minneapolis to Blaine	Express	104	175
288	Downtown Minneapolis to Forest Lake	Express	316	425
860	Downtown St. Paul to Coon Rapids	Express	378	625
	TH 36 Routes			
260	Downtown Minneapolis to Roseville	Express	491	225
261	Downtown Minneapolis to Shoreview	Express	257	275
264	Downtown Minneapolis to Roseville	Express	245	800
270	Downtown Minneapolis to Maplewood	Express	1,184	1,925
	Parallel Routes			
4	New Brighton to Richfield	Local	6,549	9,575
10	Downtown Minneapolis to Mounds View	Local	7,904	11,300
25	St. Louis Park to Blaine	Local	1,155	1,550
59	Downtown Minneapolis to Blaine	Local	675	950
141	Downtown Minneapolis to New Brighton	Local	282	375
824	Downtown Minneapolis to Mounds View	Sub. Local	126	175
825	Downtown Minneapolis to Mounds View	Sub. Local	535	825
899[2]	Downtown Minneapolis to Blaine	Express	0	425
		Summary		
		Corridor Routes	**4,941**	**7,650**
		I-35W Corridor Routes Subtotal	*2,764*	*4,425*
		TH 36 Corridor Routes Subtotal	*2,177*	*3,225*
		Parallel Routes	**17,226**	**25,175**

1 - Estimated demand exceeds current park and ride lot capacity
2 - Route number not established

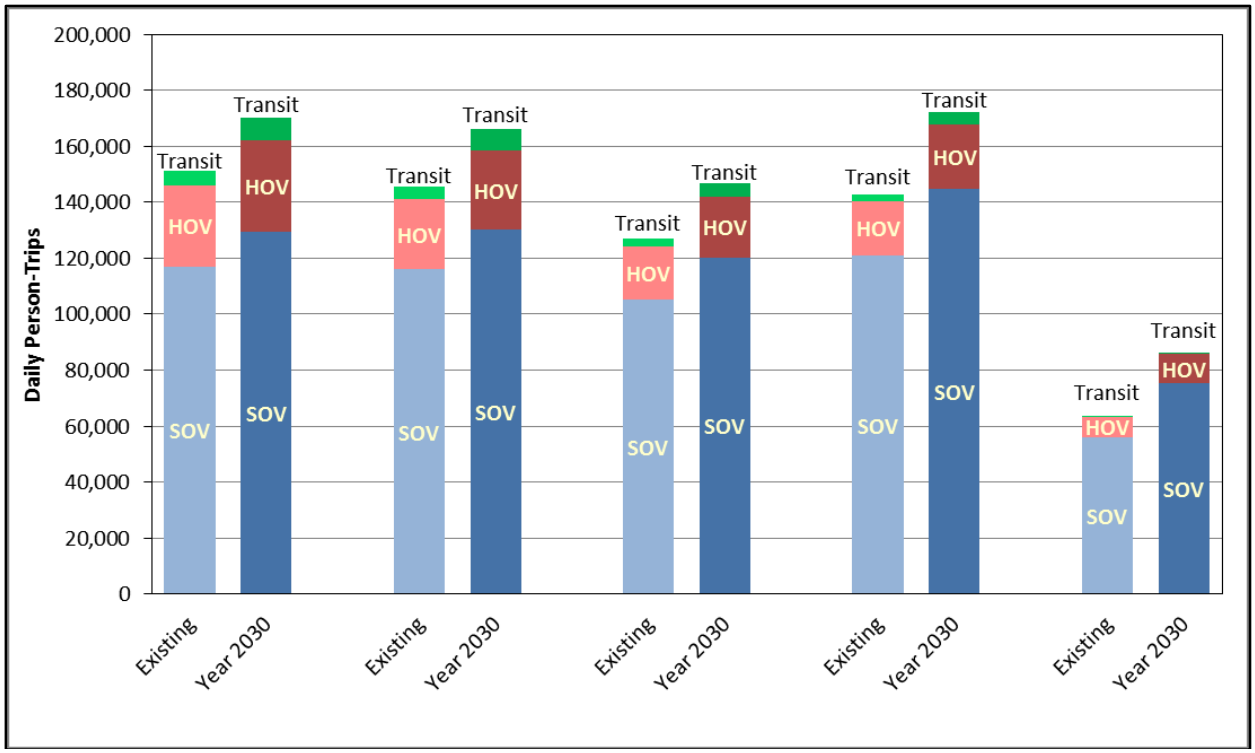
6.6 Additional Investigation

A number of issues related to regional travel patterns and demand segmentation were appropriate to address using travel demand modeling tools. In the case of the year 2030 no-build forecasts, specific issues were raised relating to the balance between SOV, HOV, and transit person-trips, and destinations of trips using the I-35W north corridor.

Travel Demand Modal Shares

Results from the travel demand model were summarized for each of the five segments in the I-35W north corridor. The number of person-trips was estimated based on assigned model highway and transit volumes and vehicle occupancy ratios. Figure 6-4 shows the results of this summary. These results show in addition to overall growth in person-throughput in the I-35W North Managed Lanes Corridor Study, the relative proportions of HOV and transit person-trips are expected to increase between existing and year 2030 no-build conditions.

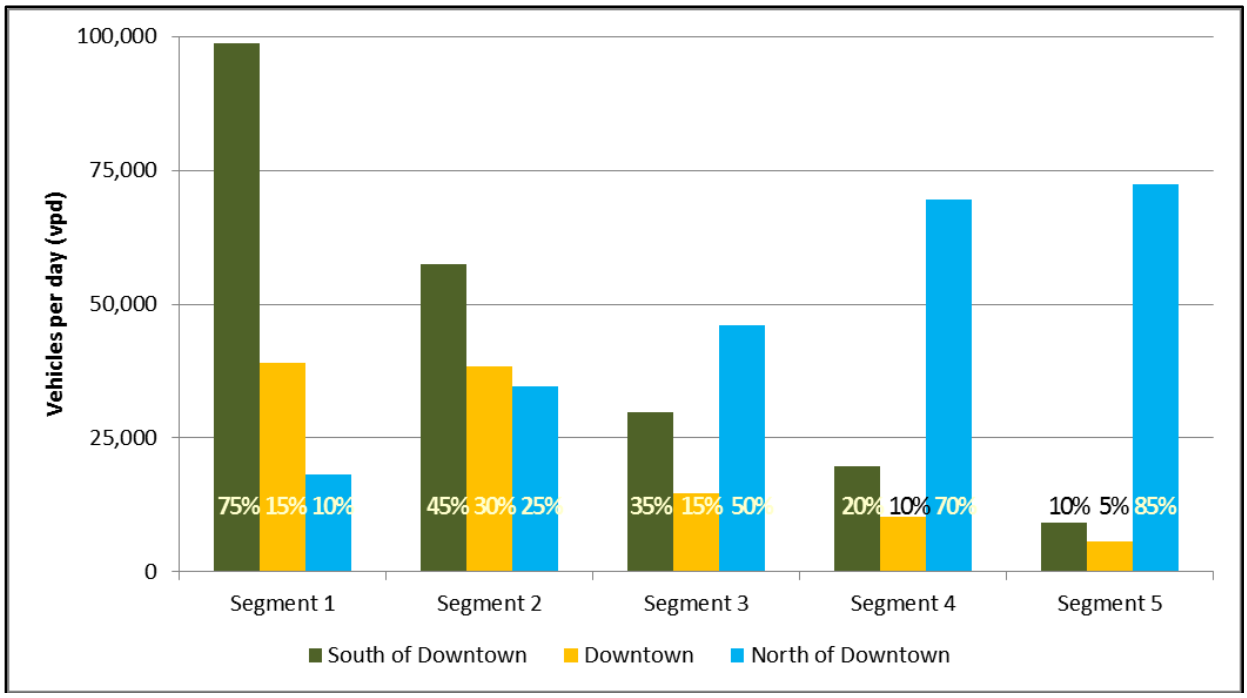
Figure 6-4 I-35W Person Throughput by Segment



Segment Destinations

Traffic within each segment of the I-35W north corridor was analyzed to identify the destinations of trips under year 2030 no-build conditions. The destinations, referenced to the south of each segment, were defined as "North of downtown", "Downtown Minneapolis", and "South of downtown." These definitions refer to trips that either access I-35W between the specified segment and downtown Minneapolis, travel to/from downtown Minneapolis, or continue on routes south of downtown Minneapolis such as TH 55, I-35W, and I-94 west. The results are illustrated in Figure 6-5.

Figure 6-5 I-35W Destinations by Segment for Year 2030 No-Build Conditions



The results of this investigation showed segments closer to downtown Minneapolis have higher proportions of trips south of downtown and to downtown Minneapolis. Conversely segments farther from downtown have higher proportions of trips north of downtown. These results were logical as more destinations are in the north of downtown category for Segments 4 and 5, for example, compared to Segments 1 and 2. In particular, TH 10, I-694, and TH 36 are the highest-volume access points for I-35W trips in Segments 3, 4, and 5.

Finally, trips to and from downtown St. Paul using the I-35W north corridor were also investigated. These results show the proportions of trips on I-35W with destinations in downtown St. Paul are more heavily dependent on the route connectivity than the basic travel distance. The results are shown in Table 6-4.

Table 6-4 Year 2030 No-Build I-35W Corridor Trips to/from Downtown St. Paul

Segment	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
Percent	<1%	1%	1%	3%	5%

Segment 5 is expected to have the highest proportion of downtown St. Paul trips because the I-35E split in Lino Lakes was included in this segment. Similarly, Segment 4 also has a higher proportion of downtown St. Paul trips due to connectivity provided by TH 10 and I-694 to I-35E. Segments 2 and 3 rely more heavily on TH 280 to access downtown St. Paul via I-94.

7.0 Localized Improvements to Address Existing Congestion

Introduction

Localized concepts to address congestion in the I-35W study corridor were developed. These localized concepts were developed to provide benefits independent of the managed lane alternatives; however they were also developed not to preclude managed lane alternatives. These concepts were evaluated based on operations. Localized concepts were developed using the study goal and objective: to better utilize existing and future infrastructure investments and develop lower cost/high benefit strategies. The localized concepts do not present access changes unless direction was given by the PMT and support committees. Localized improvements to address existing congestion were performed at the following locations:

- I-35W and I-694
- TH 10 interchange
- Eastbound TH 36
- Hennepin Avenue north ramps

For each option a cost was identified as a low, medium or high cost investment. Low, medium and high are defined as the following:

- Low cost investment = less than $7 Million
- Medium cost investment = between $7 Million and $20 Million
- High cost investment = greater than $20 Million

7.1 I-35W and I-694

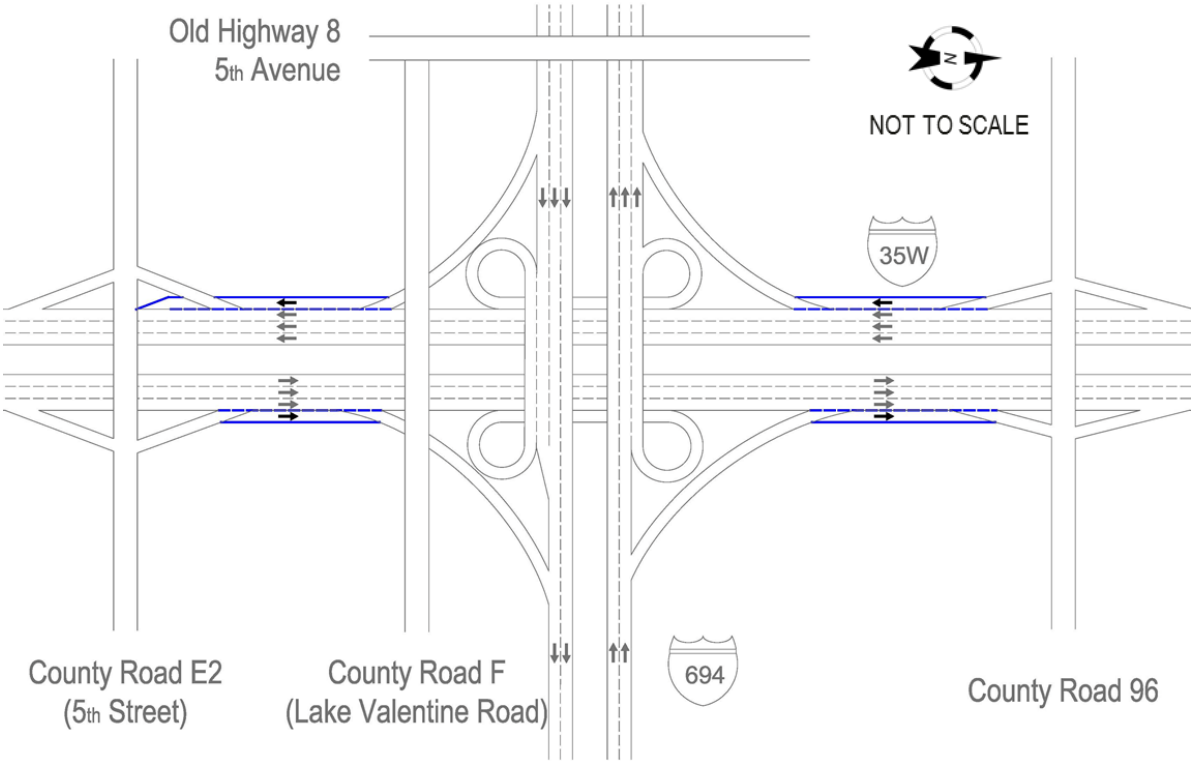
Two of the three major congestion causes presented in the existing conditions chapter of this report are located at this interchange area. For southbound I-35W, entering vehicles from CSAH 96 and vehicles existing to westbound I-694 created a weaving section in the right lane of southbound I-35W. Entering traffic from eastbound I-694 caused southbound mainline to reach capacity. The following options have been developed to address these concerns:

- I-35W and I-694 Auxiliary Lanes Option 1
- I-35W and I-694 Flyover Ramps Option 2
- I-35W and I-694 Bridge Braid Loops Option 3
- I-35W and I-694 Buffer Lanes Option 4
- I-35W and I-694 Turbine Ramps Option 5

I-35W and I-694 Auxiliary Lanes Option 1

Option 1 adds auxiliary lanes on northbound and southbound I-35W between CR E2 and I-694, and between I-694 and CR 96. These auxiliary lanes would provide additional weaving capacity between adjacent interchanges to I-694. This improvement could be split into individual auxiliary lane segments or be built as one project. Construction for this would include adding a right lane and shoulder. Striping and signing changes would also be required. During construction drivers may experience delays due to lanes narrowed and shifted but at least two lanes could be maintained, and for the majority of construction three lanes could be maintained. Construction for this option could be completed in one construction season. Figure 7-1 is a graphical description of this option. This improvement is considered a low cost investment.

Figure 7-1 Auxiliary Lanes Option 1



I-35W and I-694 Flyover Ramps Option 2

Option 2 adds flyover ramps to this interchange. Movements provided by these locations of flyover ramps are as follows:

- Option 2A: eastbound I-694 to northbound I-35W and westbound I-694 to southbound I-35W.
- Option 2B: Flyover ramps along with auxiliary lanes on northbound I-35W and southbound I-35W from CR E2 to I-694 and from I-694 to CR 96.

The flyover ramps would remove the loop-to-loop weaves for I-35W and I-694 and the auxiliary lanes would add more capacity to the mainline and provide an additional weaving lane for adjacent interchanges to I-694. This improvement could be split into individual flyovers as well as individual auxiliary lane segments.

Construction for this option would include adding a right lane and shoulder for the auxiliary lanes and bridges over the existing I-694 and I-35W lanes as well as the replacement of the CR F Bridge. Striping and signing changes would also be required to accommodate the auxiliary and flyover. During construction drivers may experience delays due to lanes narrowed and shifted but at least two lanes could be maintained throughout the construction. Weekend closures may be needed to set beams or to demolish the existing bridge. Construction for this option may take up to two construction seasons. Figure 7-2 and Figure 7-3 are graphical descriptions of these options. This improvement is considered a high cost investment.

Figure 7-2 Flyover Ramps Option 2A

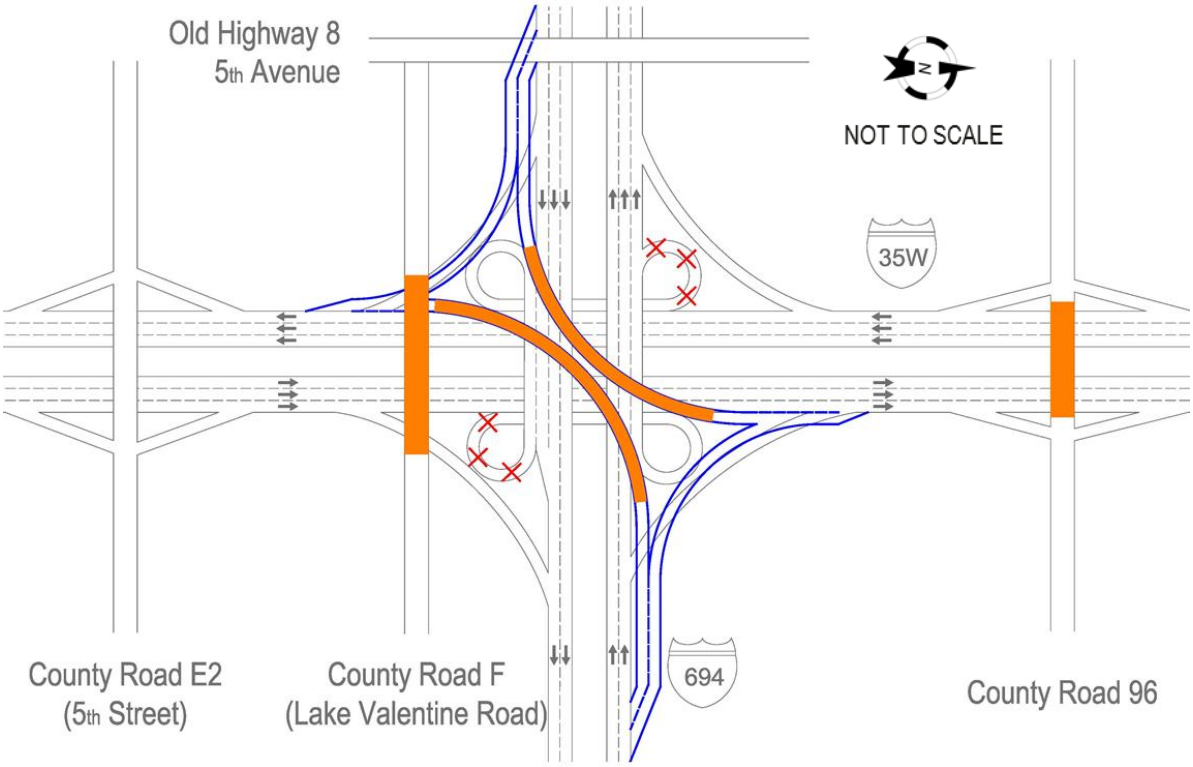
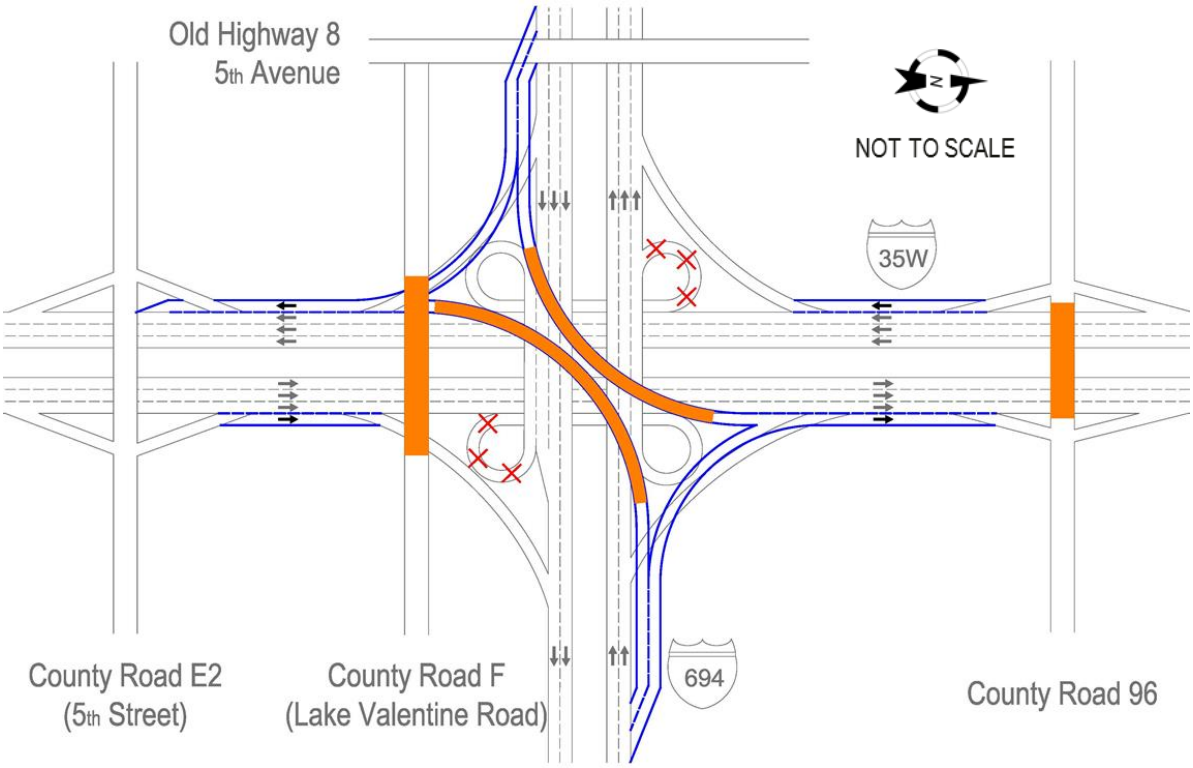


Figure 7-3 Flyover Ramps with Auxiliary Lanes Option 2B



I-35W and I-694 Bridge Braid Loops Option 3

Option 3 adds bridge braid loops to this interchange. Movements provided by these bridge braid loops are as follows:

- Option 3A: northbound I-35W to westbound I-694 and southbound I-35W to eastbound I-694.
- Option 3B: Bridge braid loops with auxiliary lanes.

The braided loops would remove the loop-to-loop weaves on northbound and southbound I-35W and the auxiliary lanes would add more capacity to the mainline and provide an additional weaving lane. This improvement could also be completed in conjunction with Option 1 auxiliary lanes south and north of the I-694 interchange. This improvement does not require both directions to happen at the same time, it could be done as one project or as two separate projects.

Construction for this option would include the use of soil nail walls under the existing I-694 bridges and remove the existing slope paving so the width for the braided lane and acceleration lane for the existing loop can be accommodated. All of the loops at the interchange would be impacted and would need to be replaced. The exit for the braided loop would occur at the same location as the exit ramp and would go under the modified loop. The grade on the loop going over the braid would need to be revised and a bridge would be constructed on the loop.

Construction for this option would require the loops to be closed during construction but I-35W and I-694 traffic will have minimal impacts during the construction. Construction for this option would take one construction season. Figure 7-4 and Figure 7-5 are graphical descriptions of these options. This improvement is considered a medium cost investment.

Figure 7-4 Bridge Braid Loops Option 3A

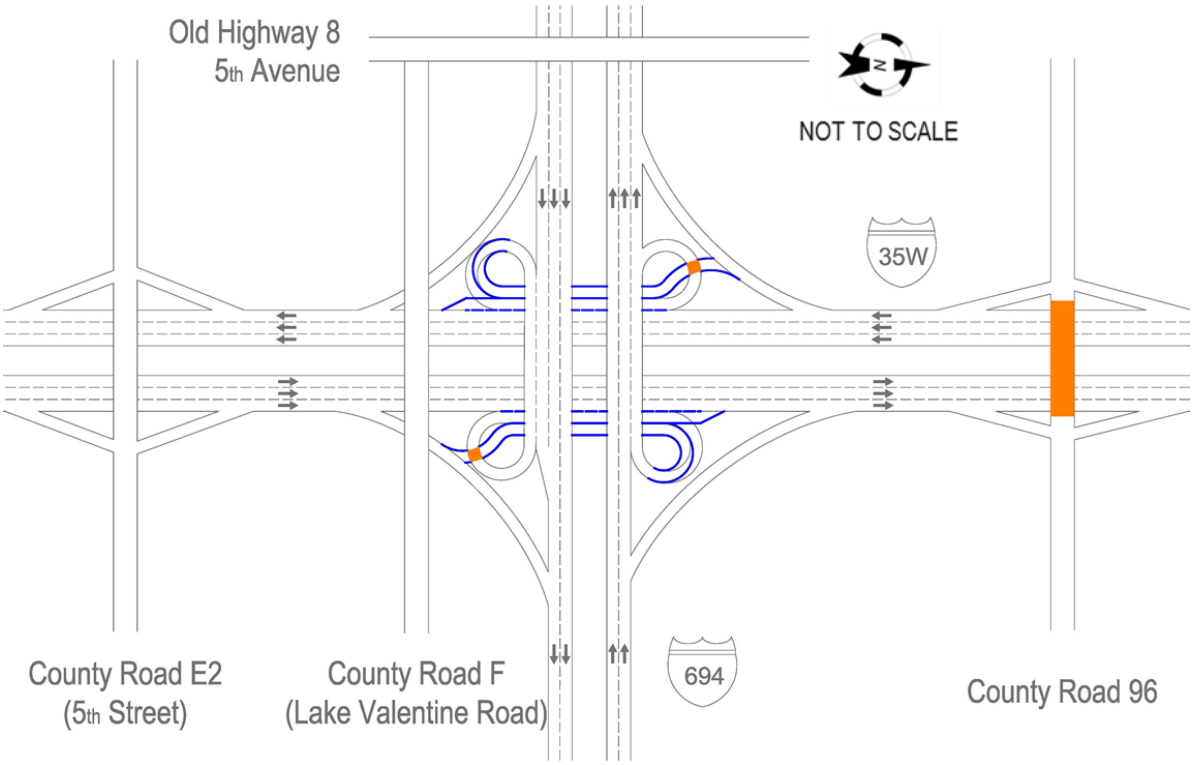
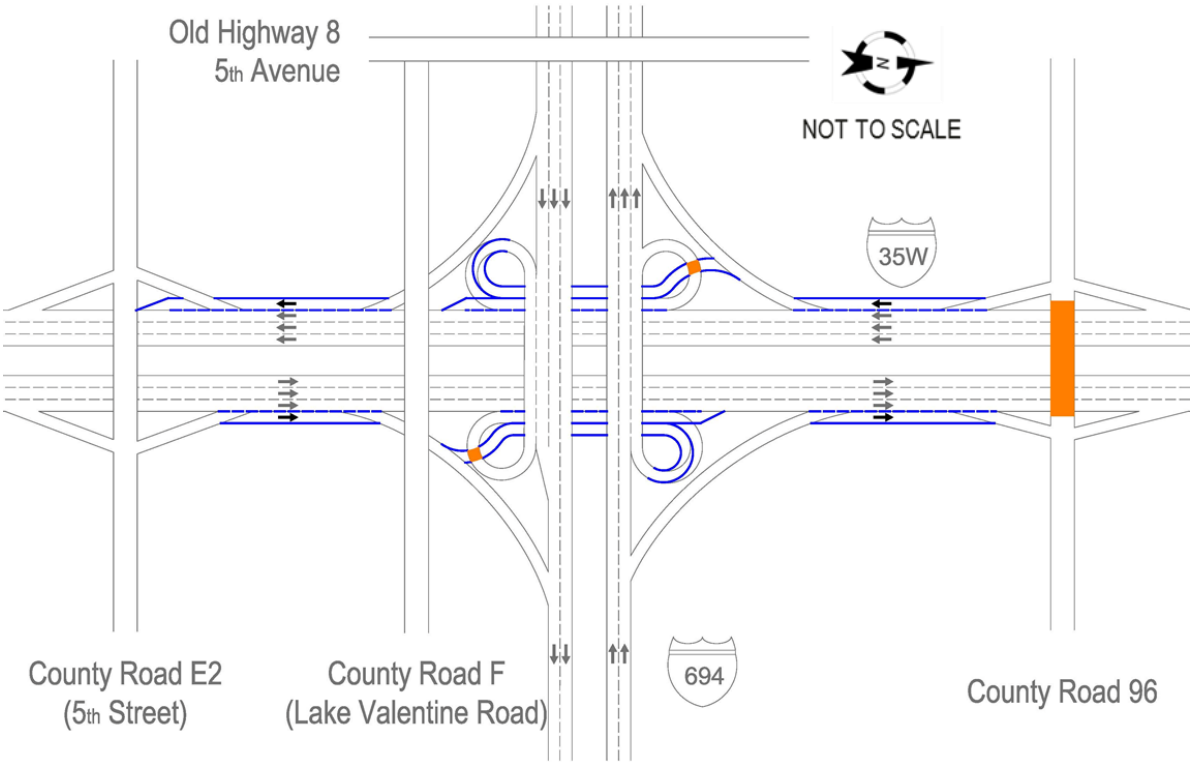


Figure 7-5 Bridge Brain Loops with Auxiliary Lanes Option 3B



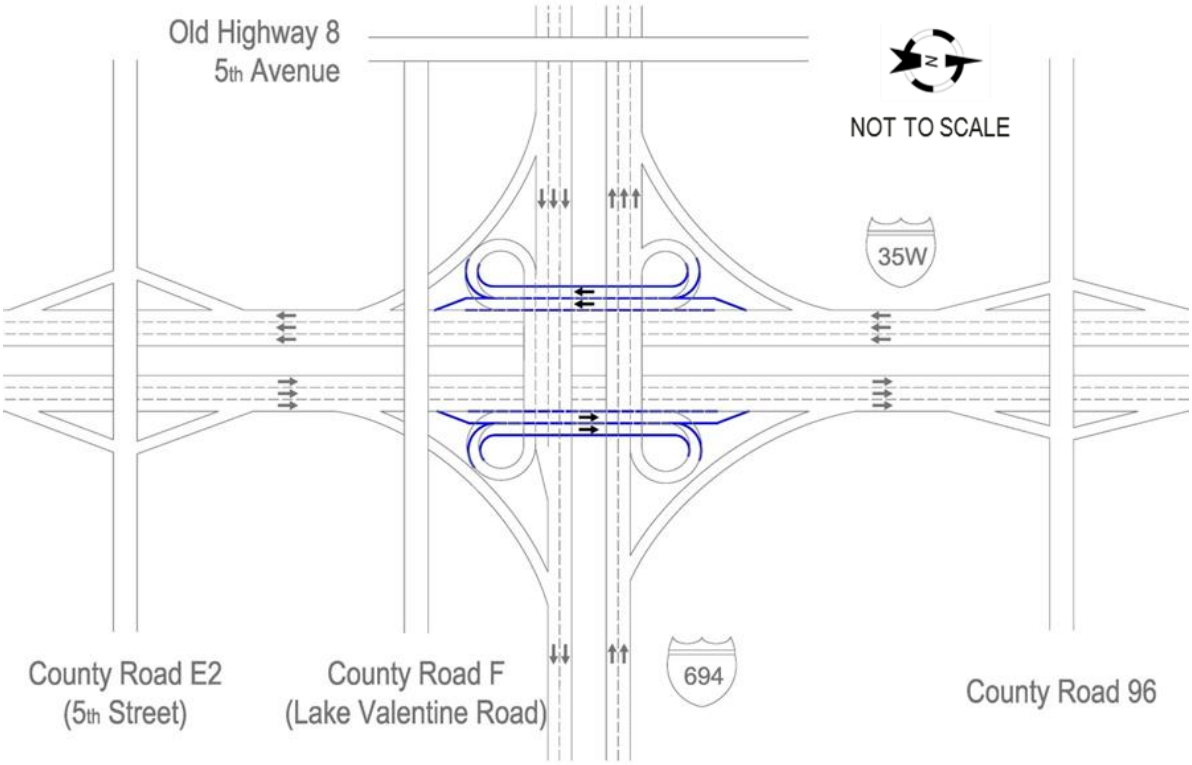
I-35W and I-694 Buffer Lanes Option 4

Option 4 adds buffer lanes for the I-35W loops. This option would provide a buffer lane for the loop-to-loop weave on northbound and southbound I-35W. Unlike the bridge braid option, a weave still occurs, however the weave would occur in the buffer lane rather than the mainline through lane. This improvement could also be completed in conjunction with Option 1 auxiliary lanes south and north of the I-694 interchange. This improvement does not require both directions to happen at the same time, it could be done as one project or as two separate projects.

Construction for this would include the use of soil nail walls under the existing I-694 bridges and remove the existing slope paving to allow for the width for the buffer lane. All of the loops at the interchange would be impacted and would need to be reconfigured.

Construction for this option would require the loops to be closed during construction but I-35W and I-694 traffic would have minimal impacts during the construction. Construction for this option would take one construction season. Figure 7-6 is a graphical description of this option. This improvement is considered a low cost investment.

Figure 7-6 Buffer Lanes Option 4



I-35W and I-694 Turbine Ramps Option 5

Option 5 adds turbine ramps to this interchange. Movements provided by these turbine ramps are as follows:

- Option 5A: eastbound I-694 to northbound I-35W.
- Option 5B: eastbound I-694 to northbound I-35W and westbound I-694 to southbound I-35W.
- Option 5C: Turbine ramps described in Option 5B along with auxiliary lanes on northbound I-35W and southbound I-35W from CR E2 to I-694 and from I-694 to CR 96.

The turbine ramps would remove the loop-to-loop weaves for I-35W and I-694 and the auxiliary lanes would add more capacity to the mainline and provide an additional weaving lane between adjacent interchanges to I-694. This improvement could be split into individual turbine ramps as well as individual auxiliary lane segments.

Construction for this option would include adding a right lane and shoulder for the auxiliary lanes and bridges over the existing I-694 and I-35W lanes as well as the replacement of the CR F Bridge. Striping and signing changes would also be required to accommodate the auxiliary and turbine ramps. During construction drivers may experience delays due to lanes narrowed and shifted but at least two lanes could be maintained throughout the construction. Weekend closures may be needed to set beams or demolishing the existing bridge.

Construction for this option may take up to two construction seasons. Figure 7-7 through Figure 7-9 are graphical descriptions of these options. This improvement is considered a high cost investment.

Figure 7-7 Turbine Ramps Option 5A

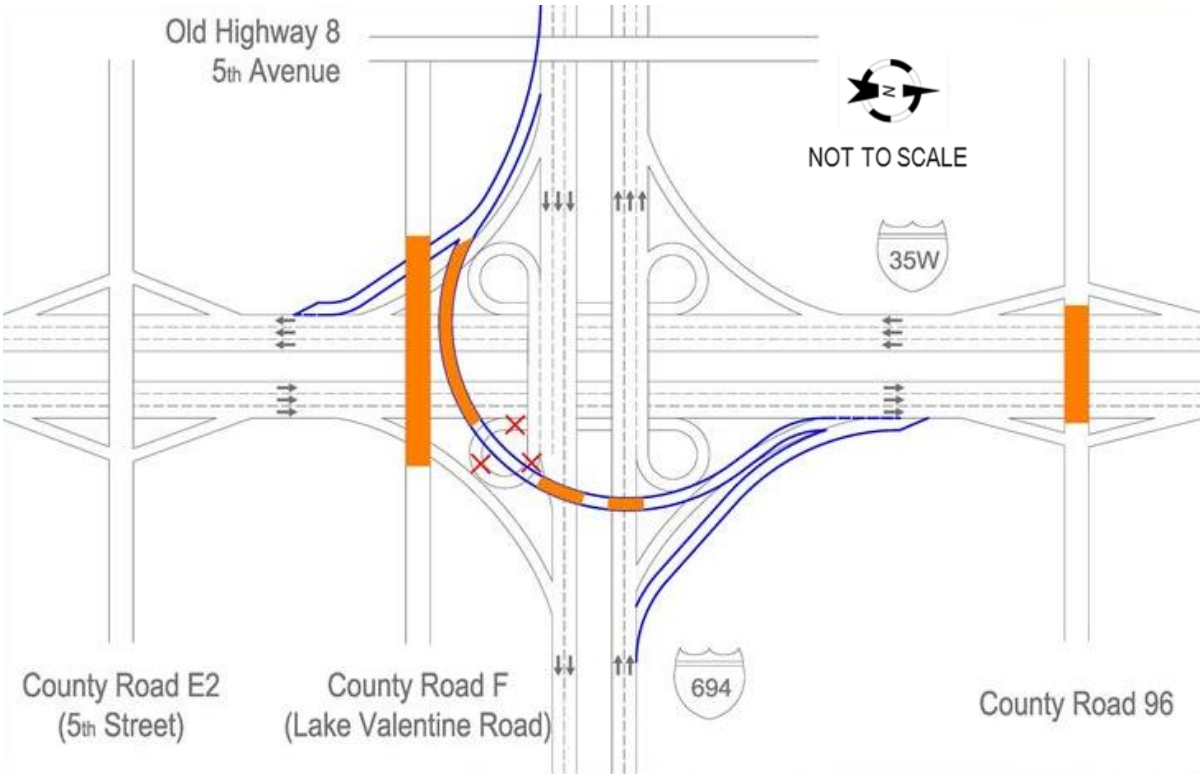


Figure 7-8 Turbine Ramps Option 5B

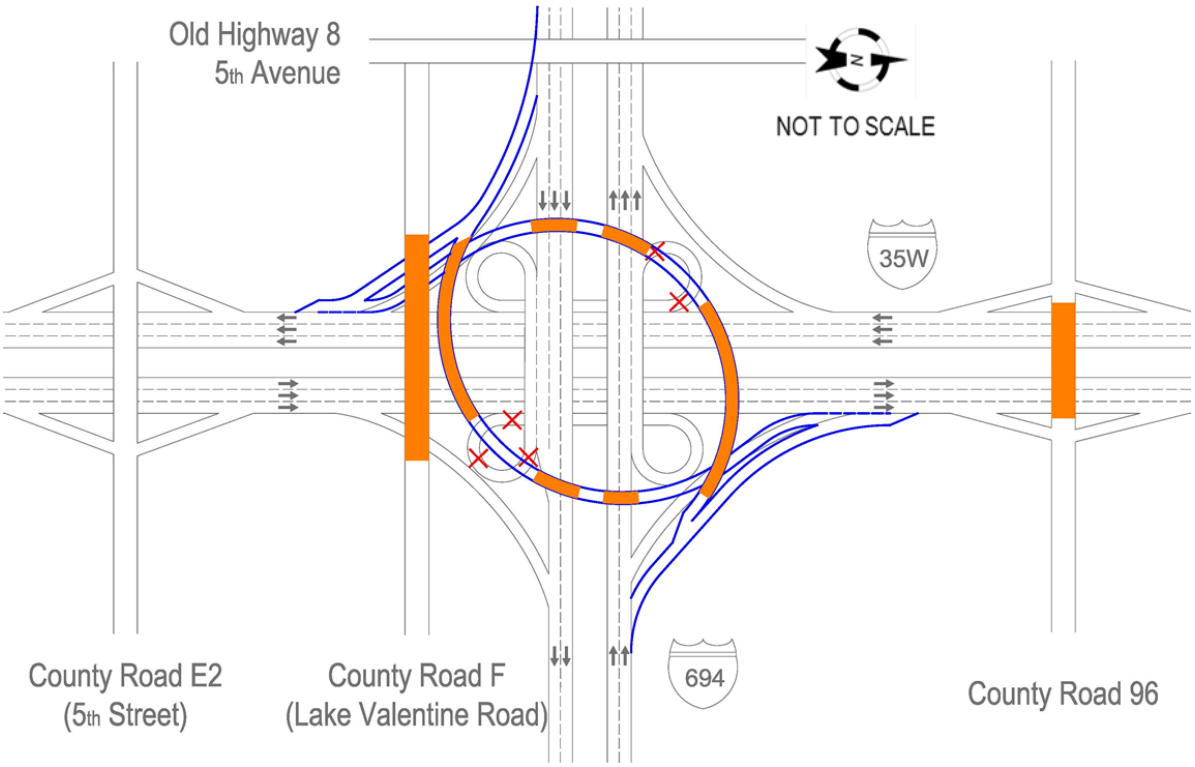
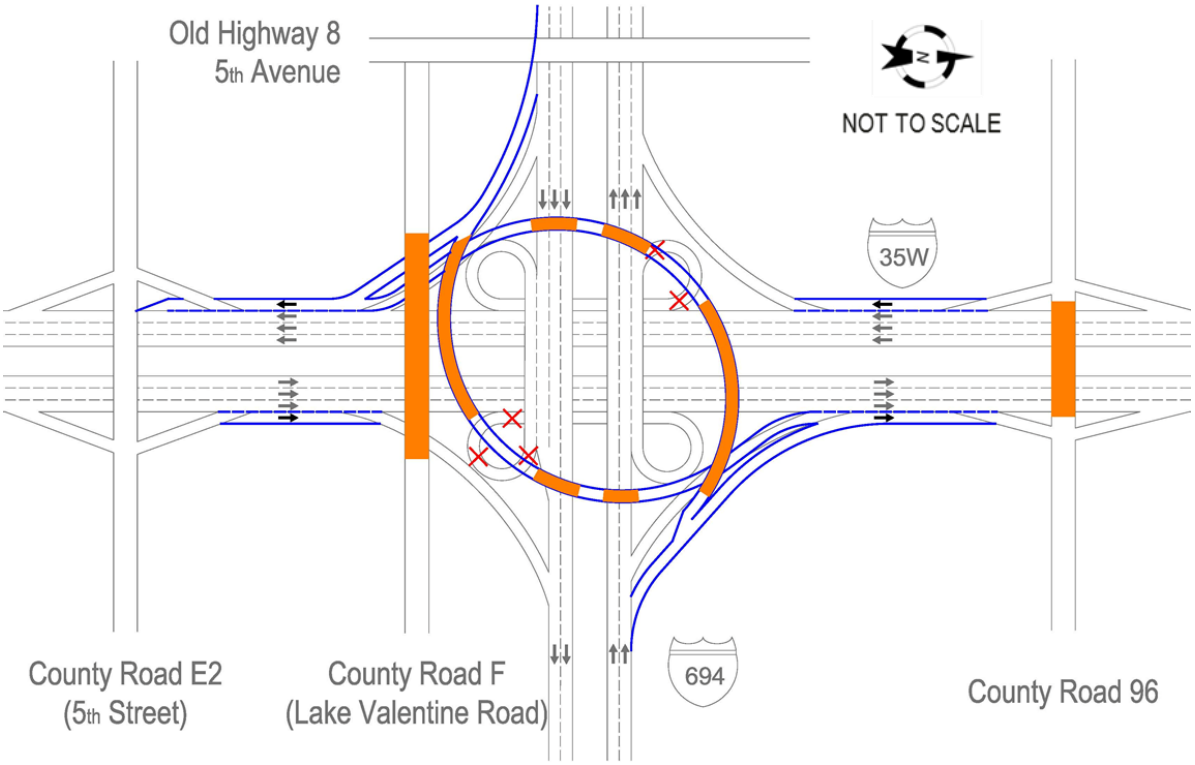


Figure 7-9 Turbine Ramps with Auxiliary Lanes Option 5C



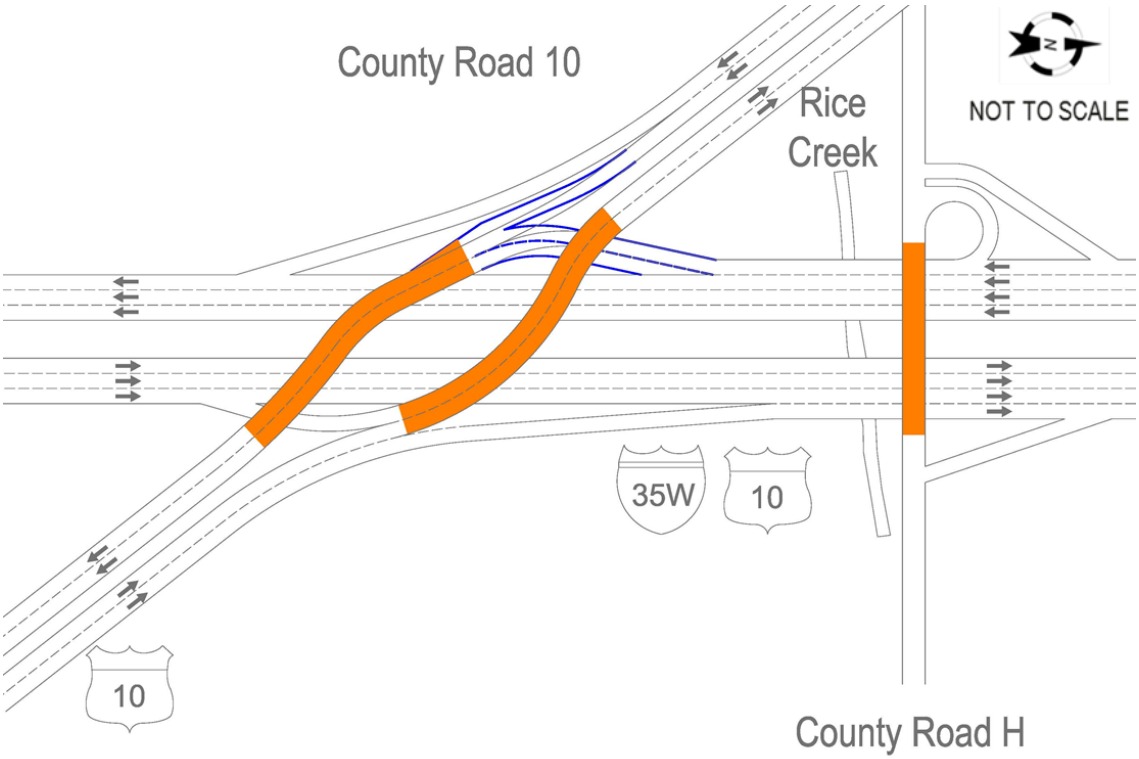
7.2 TH 10 South Interchange

The existing congestion presented in the existing conditions chapter of this report explained entering traffic from TH 10 and CR I caused southbound mainline to reach capacity. This along with downstream congestion compounds to create long queues. The following has been developed to address this concern.

This option would provide a two-lane exit from southbound I-35W to eastbound TH 10. The two bridges at the south TH 10/I-35W interchange were replaced in 2012 and the south bridge was rebuilt to accommodate a two-lane exit. Construction for this option would include reconfiguring the existing exit from one lane to two lanes and would impact the exit traffic and minimally impact the southbound I-35W traffic. During construction drivers may experience delays due to lanes narrowed and shifted but at least two lanes could be maintained. Traffic on southbound I-35W to eastbound TH 10 may need to be detoured to the I-694/I-35W interchange during construction.

Construction for this option could be completed in one construction season. Figure 7-10 is a graphical representation of this option. This improvement is considered a low cost investment as the bridge was recently replaced and can accommodate this configuration.

Figure 7-10 TH 10 South Interchange



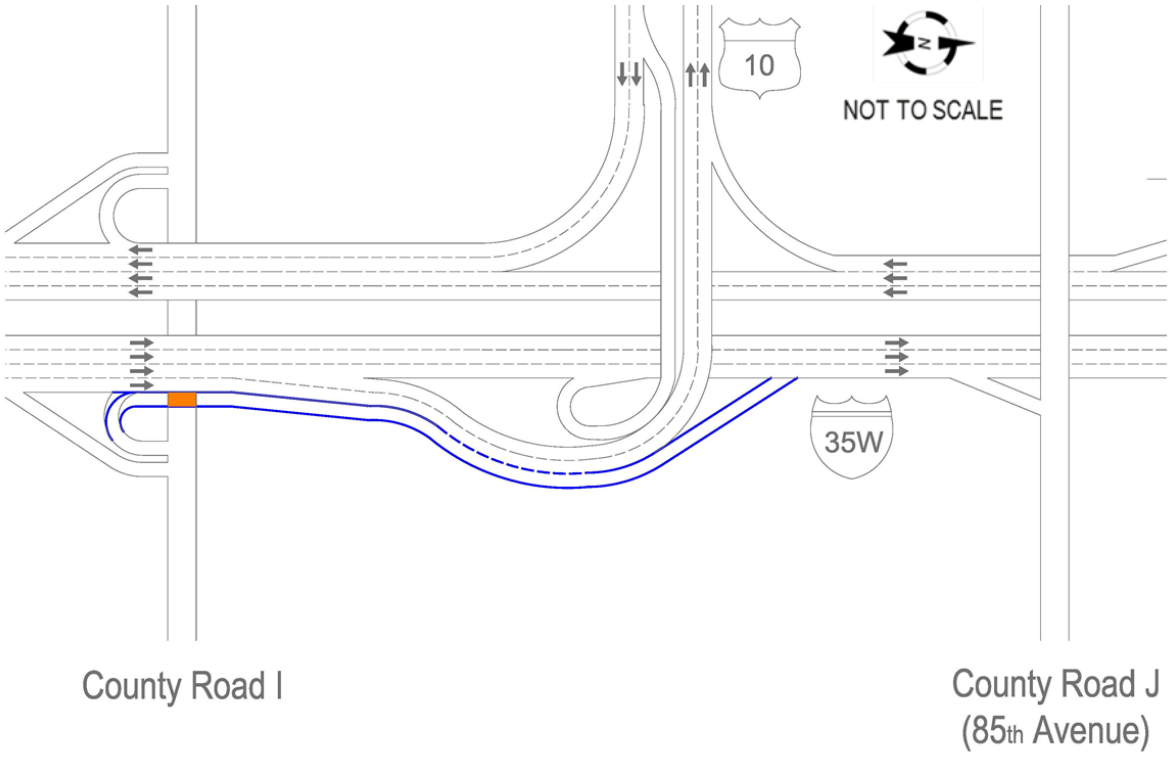
7.3 TH 10 North Interchange

The existing congestion presented in the existing conditions chapter of this report explained entering traffic from TH 10 and exiting traffic to CR I produced right-lane turbulence impacting northbound mainline speeds. The following has been developed to address this concern.

This option would remove the existing traffic weave by shifting the entrance for the CR I loop to north of the westbound TH 10 exit. Traffic from CR I would still have access to westbound TH 10 via a slip ramp. The bridge over CR I would be widened to accommodate the additional width needed to keep the CR I traffic separate from the I-35W traffic. During construction drivers may experience delays due to lanes narrowed and shifted but at least two lanes could be maintained on I-35W. Loop traffic may need to be detoured for several weeks as the tie-in into the new ramp connection is constructed.

Construction for this option could be completed in one construction season. Figure 7-11 is a graphical representation of this option. This improvement is considered a medium cost investment.

Figure 7-11 TH 10 North Interchange



7.4 Eastbound TH 36

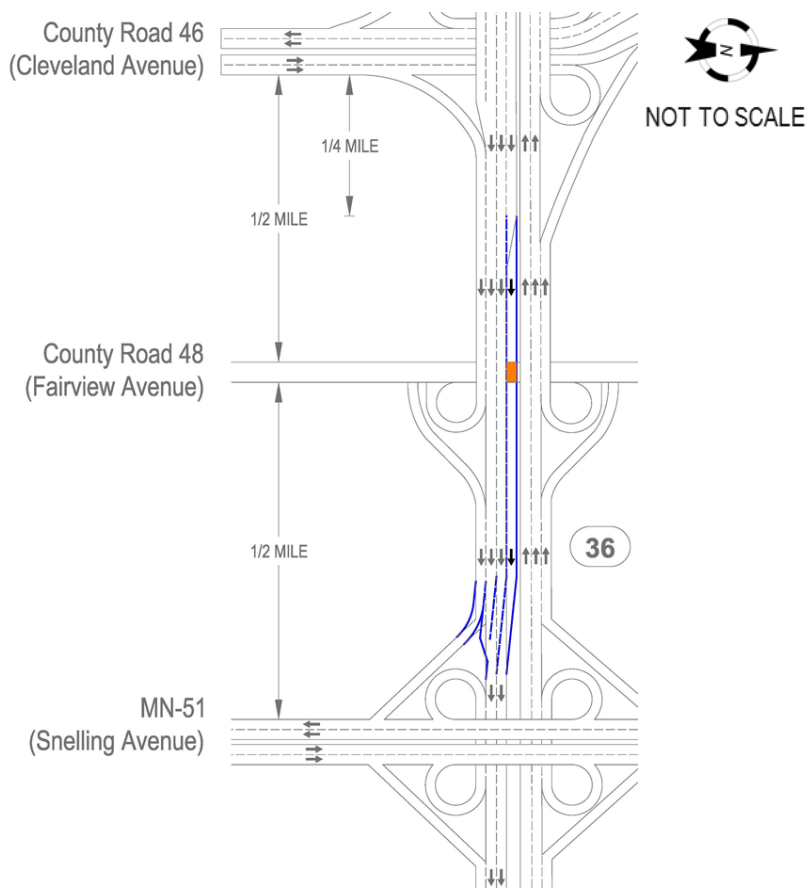
The existing congestion presented in the existing conditions chapter of this report explained the left lane drop on eastbound TH 36 at CR 46 caused the mainline of TH 36 to reach capacity. Traffic queues from TH 36 spill back onto northbound I-35W. Two options have been developed to address this concern:

- Eastbound TH 36 Extension Option 1
- Eastbound TH 36 Extension Option 2

Eastbound TH 36 Extension Option 1

This option would eliminate the left lane drop and drop the right lane after the exit ramp to southbound Snelling Avenue. Construction would include adding a left lane and shoulder in the existing grass median and expand the existing overpass at Fairview Avenue. Re-striping eastbound TH 36 will also be required in order to shift traffic after the southbound exit ramp to Snelling Avenue. During construction drivers may experience delays due to lanes narrowed and shifted but at least one lane could be maintained and for the majority of construction two lanes could be maintained. Construction for this option could be completed in one construction season. Figure 7-12 is a graphical description of this option. This improvement is considered low cost investment.

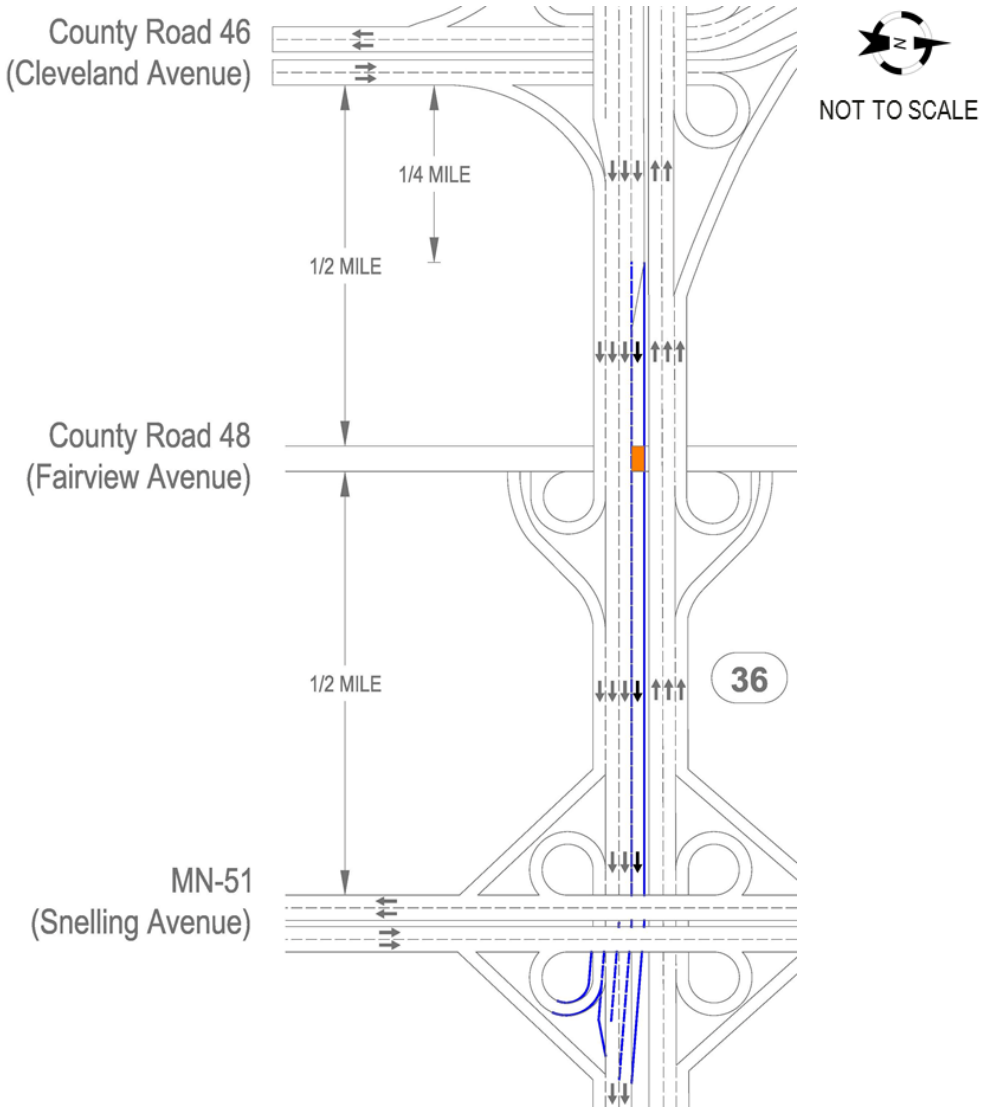
Figure 7-12 Eastbound TH 36 Extension Option 1



Eastbound TH 36 Extension Option 2

This option would eliminate the left lane drop and drop the right lane after the exit ramp to northbound Snelling Avenue. Construction for this option would include adding a left lane and shoulder in the existing grass median and expanding the existing overpass at Fairview Avenue. Re-striping of eastbound TH 36 would also be required in order to shift traffic after the northbound exit ramp to Snelling Avenue. During construction drivers may experience delays due to lanes narrowed and shifted but at least one lane could be maintained and for the majority of construction two lanes could be maintained. Construction for this option could be completed in one construction season. Figure 7-13 is a graphical description of this option. This improvement is considered a low cost investment.

Figure 7-13 Eastbound TH 36 Extension Option 2



7.5 New North Ramps at Hennepin Avenue

This study included an evaluation of the feasibility of providing north ramp access to and from I-35W at Hennepin Avenue. Currently, Hennepin Avenue has access to I-35W only to and from the south. Nearby interchanges providing north access to and from I-35W include Washington Avenue and University Avenue/4th Street. North ramps at these locations are currently congested or are approaching capacity. North ramp access at Hennepin Avenue was investigated as a potential means of relieving these existing interchanges and providing an alternate route for I-35W north traffic to access downtown Minneapolis. Two options were developed to provide north ramp access to and from I-35W at Hennepin Avenue:

- Hennepin Avenue North Ramps Option 1
- Hennepin Avenue North Ramps Option 2

Hennepin Avenue North Ramps Option 1

This concept would provide access to and from Hennepin Avenue to the north. For southbound I-35W, the exit would begin just south of the existing pedestrian bridge and tie into Hennepin Avenue at Lincoln Street. For northbound I-35W, the entrance would utilize Johnson Street and then tie into the Johnson Street/New Brighton Boulevard exit from I-35W, and then enters I-35W over the New Brighton Boulevard Bridge. These improvements can be done offline and would have minimal impacts to I-35W and local street traffic during construction. Construction for this option could be completed in one construction season. Figure 7-14 is a graphical description of this option. This improvement is considered medium cost investment.

Figure 7-14 Hennepin Avenue North Ramps Option 1

Hennepin Avenue North Ramps – Option 2

This concept would provide access to and from Hennepin Avenue to the north. For southbound I-35W, the exit would begin just south of the existing pedestrian bridge and would flyover southbound and northbound I-35W and tie into Johnson Street. For northbound I-35W, the entrance ramp would utilize Johnson Street and then would tie into the Johnson Street/New Brighton Boulevard exit from I-35W, and then enter I-35W over the New Brighton Boulevard Bridge. These improvements could be done offline and would have minimal impacts to I-35W and local street traffic during construction. A weekend closure may be necessary for setting beams on the southbound flyover bridge. Construction for this option could be completed in one construction season. Figure 7-15 is a graphical description of this option. This improvement is considered a medium cost investment.

Figure 7-15 Hennepin Avenue North Ramps Option 2

7.6 Operational Model for Localized Improvements to Address Existing Congestion

The CORSIM operations model was updated to evaluate the concepts developed to address the identified congestion. This was accomplished by updating the model with the concept geometrics. No changes were made to the traffic volumes for these simulations, as they were intended to be operational improvements and not regionally significant. The following section describes the concepts evaluated in the operations model and summarizes the observed results.

I-35W and I-694

Congestion causes were identified for both northbound and southbound I-35W near I-694. Five general concepts were developed for this area, which were previously described. All five concepts were evaluated using the CORSIM operations model. As the congestion in this area

occurred in the southbound direction in the a.m. peak and northbound direction in the p.m. peak, the results discussed for each direction are for these respective time periods. Quantitative results for throughput, speeds, and congestion are given in Table 7-1 for the southbound direction (a.m. peak) and in Table 7-2 for the northbound direction (p.m. peak).

Table 7-1 I-35W and I-694 Operations Results (Southbound I-35W at CSAH 96)

Scenario	Peak Hour Throughput (vehicles)	Peak Hour Speed (mph)	Hours of congestion*	Reduction in System VHT (hours)
Base Condition	5,600	20-25	1.75	15,400
Option 1 – Auxiliary Lanes on I-35W	6,100	55-60	0	800-900
Option 2A – Flyover Ramps	5,600	20-25	1.75	No Reduction
Option 2B – Flyover Ramps with Auxiliary Lanes	6,100	55-60	0	700-800
Option 3A – Bridge Braid Loops	5,600	20-25	1.75	No Reduction
Option 3B – Bridge Braid Loops with Auxiliary Lanes	6,100	55-60	0	800-900
Option 4A – Buffer Lanes	5,600	20-25	1.75	No Reduction
Options 4B – Buffer Lanes with Auxiliary Lanes	6,100	55-60	0	800-900
Option 5B – Turbine Interchange	5,600	20-25	1.75	No Reduction
Option 5C – Turbine Interchange with Auxiliary Lanes	6,100	55-60	0	600-700

* Congestion is defined when speeds fall below 45 MPH

Table 7-2 I-35W and I-694 Operations Results (Northbound I-35W at CR E2)

Scenario	Peak Hour Throughput (vehicles)	Peak Hour Speed (mph)	Hours of congestion*	Reduction in System VHT (hours)
Base Condition	5,100	20-25	2.75	18,500
Option 1 – Auxiliary Lanes on I-35W	5,400	30-35	1.75	400-500
Option 2 – Flyover Ramps	5,400	55-60	0.25	500-600
Option 2B – Flyover Ramps with Auxiliary Lanes	5,400	60-65	0	500-600
Option 3A – Bridge Braid Loops	5,100	20-25	3	No Reduction
Option 3B – Bridge Braid Loops with Auxiliary Lanes	5,400	35-40	0.75	500-600
Option 4A – Buffer Lanes	5,250	20-25	2.25	No Reduction
Option 4B – Buffer Lanes with Auxiliary Lanes	5,350	55-60	0	500-600
Option 5B – Turbine Interchange	5,400	50-55	0.5	500-600
Option 5C – Turbine Interchange with Auxiliary Lanes	5,400	60-65	0	500-600

* Congestion is defined when speeds fall below 45 MPH

I-35W and I-694 Auxiliary Lanes Option 1

Option 1 improvements were observed to provide only modest improvements to throughput and speeds in the northbound direction (p.m. peak) with these improvements. While the auxiliary

lanes do accommodate additional weaving and storage space, they do not address the root congestion cause in the northbound direction – the loop-to-loop weave at I-694.

In the southbound direction (a.m. peak) the auxiliary lanes relieved a significant portion of the area's congestion. The congestion caused in the southbound direction were the weaving areas between CSAH 96 and I-694 and between I-694 and CR E2, and not the loop-to-loop weave at I-694.

I-35W and I-694 Flyover Ramps Option 2

Option 2A improvements were observed to resolve nearly all congestion along northbound I-35W south of I-694, reducing the duration from 2.75 to 0.25 hours per day. Similarly speeds increased by approximately 35 mph. By providing the eastbound to northbound flyover, the loop-to-loop weave was eliminated and the bottleneck removed.

In the southbound direction, no operational changes were observed compared to the baseline condition. This was because the flyover ramps do not address the weaving and capacity issues between the adjacent interchanges.

Option 2B improvements were observed to further resolve congestion with the addition of these auxiliary lanes. While much of the congestion was eliminated with just the flyover, the auxiliary lanes provide some additional relief.

With the addition of auxiliary lanes, additional improvement was observed along southbound I-35W. Congestion was essentially resolved with the auxiliary lanes alone; therefore the addition of the flyovers has little effect on the operations.

I-35W and I-694 Bridge Braid Loops Option 3

Option 3A improvements were observed to provide no improvements to northbound I-35W operations. While the loop-to-loop weave has been eliminated, the concentration of traffic that must exit to the combined I-694 eastbound and westbound exit creates a new bottleneck.

Option 3A improvements were also observed to provide no improvements to southbound I-35W. Again, the issues in this direction were the weaves between interchanges and not the loop-to-loop weave. The bridge braid concepts were combined with the auxiliary lanes concept to evaluate whether this provided congestion relief.

Option 3B improvements were observed to improve operations along northbound I-35W south of I-694 significantly with both the bridge braid loops and auxiliary lanes in place. These combined concepts relieve both the loop-to-loop weave that was the original congestion cause and the right-lane congestion that resulted with only the bridge braid loops. The duration of congestion dropped from 2.75 to 0.75 hours; speed and throughput both increased.

Option 3B improvements were observed to provide southbound I-35W results that were very similar to the auxiliary lanes only concept and the flyover plus auxiliary lanes condition.

As noted previously, the auxiliary lanes were effective at relieving southbound congestion, and improvements addressing the loop-to-loop weave have little additional effect.

I-35W and I-694 Buffer Lanes Option 4

Option 4 improvements were observed to provide a minimal improvement to throughput in the northbound direction (p.m. peak). With the addition of the auxiliary lanes, a significant improvement in throughput and speed is expected while reducing hours of congestion from 2.75 to 0.0 hours.

In the southbound direction (a.m. peak) these buffer lanes provide no benefit to operations. This is because the operational issues in the southbound direction are not caused by the loop weave at I-694. With the addition of the auxiliary lanes, a significant improvement in throughput and speed is expected while reducing hours of congestion from 1.75 to 0.0 hours.

I-35W and I-694 Turbine Ramps Option 5

Option 5 improvements were observed to provide similar effects on northbound I-35W as the flyover concept, albeit with slightly less improvement. When the auxiliary lanes were added, congestion was essentially solved and speeds were at free-flow conditions.

The southbound direction was again similar to the flyover concept. The turbine design by itself does not improve the congested conditions, but the addition of auxiliary lanes basically relieves the issues.

Many of the improvement options evaluated near the I-35W and I-694 system interchange were effective at reducing congestion along northbound and southbound I-35W. Along with the reduction in congestion, increased throughput was also observed. As a result, there was additional traffic demand on southbound I-35W south of I-694 in the a.m. peak and on northbound I-35W north of I-694 in the p.m. peak. This increased traffic results in minor increases in congestion on southbound I-35W in the morning and more significant congestion on northbound I-35W in the afternoon. The effect of this increased downstream congestion was captured in the net reduction in vehicle-hours traveled (VHT) shown in Table 7-1 and Table 7-2. It also results in a need for subsequent improvements to be considered in these locations.

TH 10 Interchange

The two TH 10 interchanges with I-35W have a common section between the north and south interchanges. Two localized improvement concepts were developed in this area, one for the south interchange and one for the north interchange. Both concepts were evaluated in the operations model.

TH 10 South Interchange

This improvement was evaluated under a.m. peak period conditions, when congestion occurs on southbound I-35W. The results of the operations model did not indicate any conclusive evidence of improvement to congestion along southbound I-35W. This was because the downstream

bottleneck between CSAH 96 and I-694 caused queuing back to this area, and the configuration of the exit to TH 10 eastbound had little effect on improving congestion.

TH 10 North Interchange

The concept developed for the TH 10 north interchange would eliminate the weave between CR I and TH 10 along northbound I-35W by separating the CR I entrance and moving it to a new alignment to the east of the northbound I-35W to westbound TH 10 ramp and entering I-35W downstream of the loop entrance from eastbound TH 10. It would also provide an opportunity for traffic from CR I to access westbound TH 10. The operations results for this improvements show little change from the baseline conditions. While the weaving and lane changing for CR I entering traffic is reduced, much of the congestion in this area is due to traffic aligning for the split to northbound I-35W and westbound TH 10. Removing the CR I traffic is not sufficient to reduce this congestion.

Eastbound TH 36 Extension

One of the corridor congestion causes identified was the left lane drop on eastbound TH 36 near Fairview Avenue. As previously described, two concepts were developed to improve traffic in this area. Both options were evaluated in the operations model. Quantitative results for throughput, speeds, and congestion are given in Table 7-3.

Table 7-3 Eastbound TH 36 Operations Results (Northbound I-35W just west of TH 36)

Scenario	Peak Hour Throughput (vehicles)	Peak Hour Speed (mph)	Hours of congestion*	Reduction in System VHT (hours)
Base Condition	8,150	35-40	0.75	18,500
Option 1 – Additional Lane to Southbound Snelling Ave	8,150	45-50	0.25	No Reduction
Option 2 – Additional Lane to Northbound Snelling Ave	8,150	50-55	0	No Reduction

* Congestion is defined when speeds fall below 45 mph

Eastbound TH 36 Extension Option 1

Option 1 improvements were not observed to eliminate congestion on TH 36; it simply shifted the bottleneck further downstream. It was however, found to improve conditions along northbound I-35W in the TH 36 commons section. This is viewed as a positive outcome because the speed differential between the TH 36 exit lanes and the I-35W mainline lanes is reduced.

Eastbound TH 36 Extension Option 2

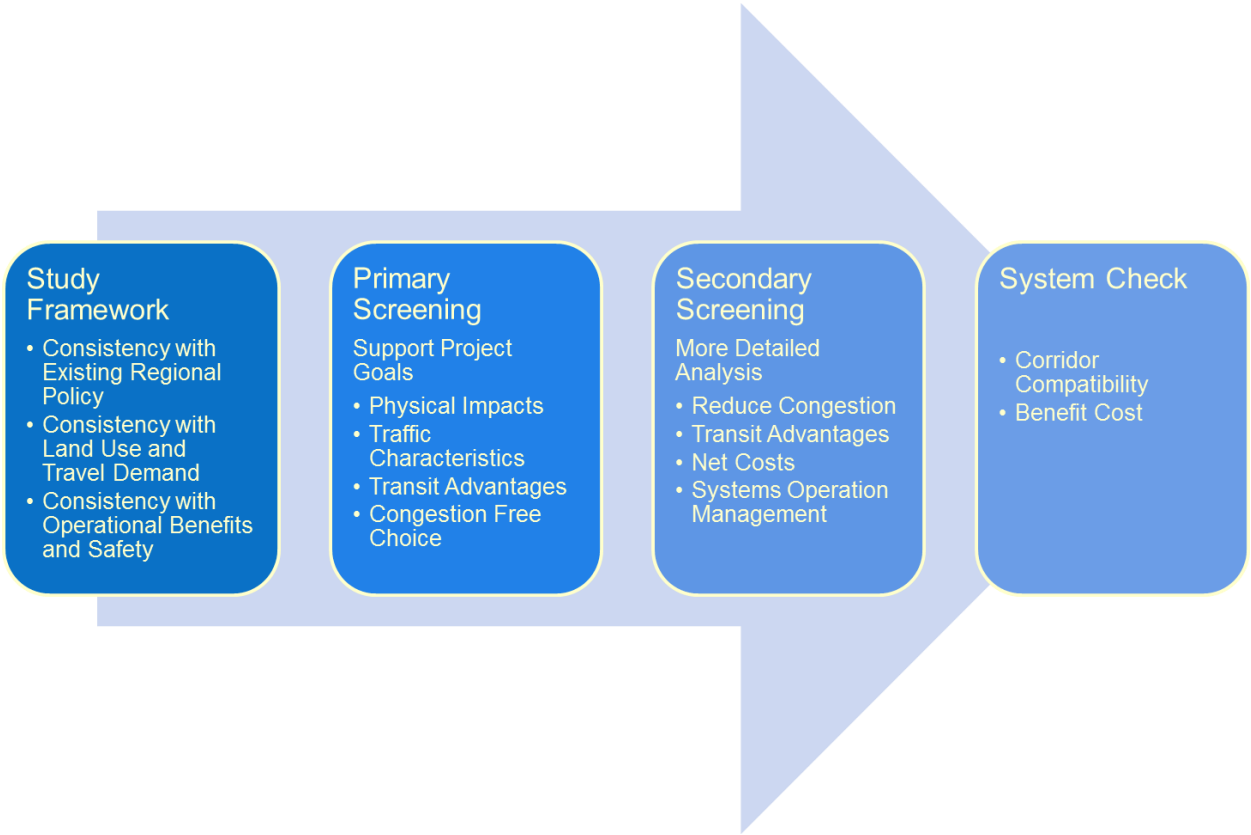
Option 2 improvements were not observed to eliminate congestion on TH 36 because the bottleneck remains at the lane drop location. However, the queue was moved further downstream from the I-35W commons section where congestion and speeds are further improved.

8.0 Corridor Alternative Evaluation

8.1 Overall Evaluation Process

The overall evaluation process is broken down into four distinct evaluation steps. First is the Study Framework which ensures that only alternatives that fit into regional policies and are feasible based on project demand. Second is the Primary Screening that evaluates the corridor alternatives at a high level and recommend alternatives to be carried forward into the more detailed secondary screening process. Third is the Secondary Screening that completes a detailed evaluation of the corridor alternatives that were carried forward from the primary screening analysis. Finally, a System Check is completed to ensure the viable alternatives for each segment are compatible with each other. A summary of the process can be seen in Figure 8-1 Process Chart.

Figure 8-1 Process Chart



8.2 Screening Criteria

Screening criteria were developed by careful analysis of the project goals and objectives. Screening criteria was divided into two parts - primary screening criteria and secondary screening criteria. Primary screening was developed to meet the project goals and objectives by performing a high-level screening resulting in a reduced number of alternatives. It focused on a high level analysis, a shorter duration analysis, and a reduction in the number of alternatives. Secondary screening was developed to meet the project goals and objectives by performing a

detailed screening resulting in an I-35W corridor managed lane vision. This screening focused on in-depth analysis, extended duration analysis and a reduction in the number of alternatives to develop a preferred vision.

Primary screening criteria:

- Physical Impacts
  - Bridge impacts
  - Right of way impacts
- Traffic Characteristics
  - Current congestion
  - Directionality
  - Peak hour percentages
  - Peak hour duration
- Transit Advantages
  - Provide advantage for transit user
- Congestion Free Choice
  - Offer congestion free choice for single occupancy vehicles (SOVs), high occupancy vehicles (HOVs), and transit users

Secondary screening criteria:

- Reduce Congestion
  - Increase person throughput (peak hour)
  - Increase vehicle throughput (peak hour)
  - Improve corridor travel time
  - Vehicle hours traveled
  - Vehicle miles traveled
- Transit Advantages
  - Improve travel time reliability
  - Increase transit ridership
  - Reduce transit travel time
- Systems Operations Management
  - Maintain transport of goods
  - Incident management
  - Enforcement
- Net Costs
  - Capital cost
  - Operations and maintenance cost
  - Annual revenue

9.0 Managed Lanes Study Framework

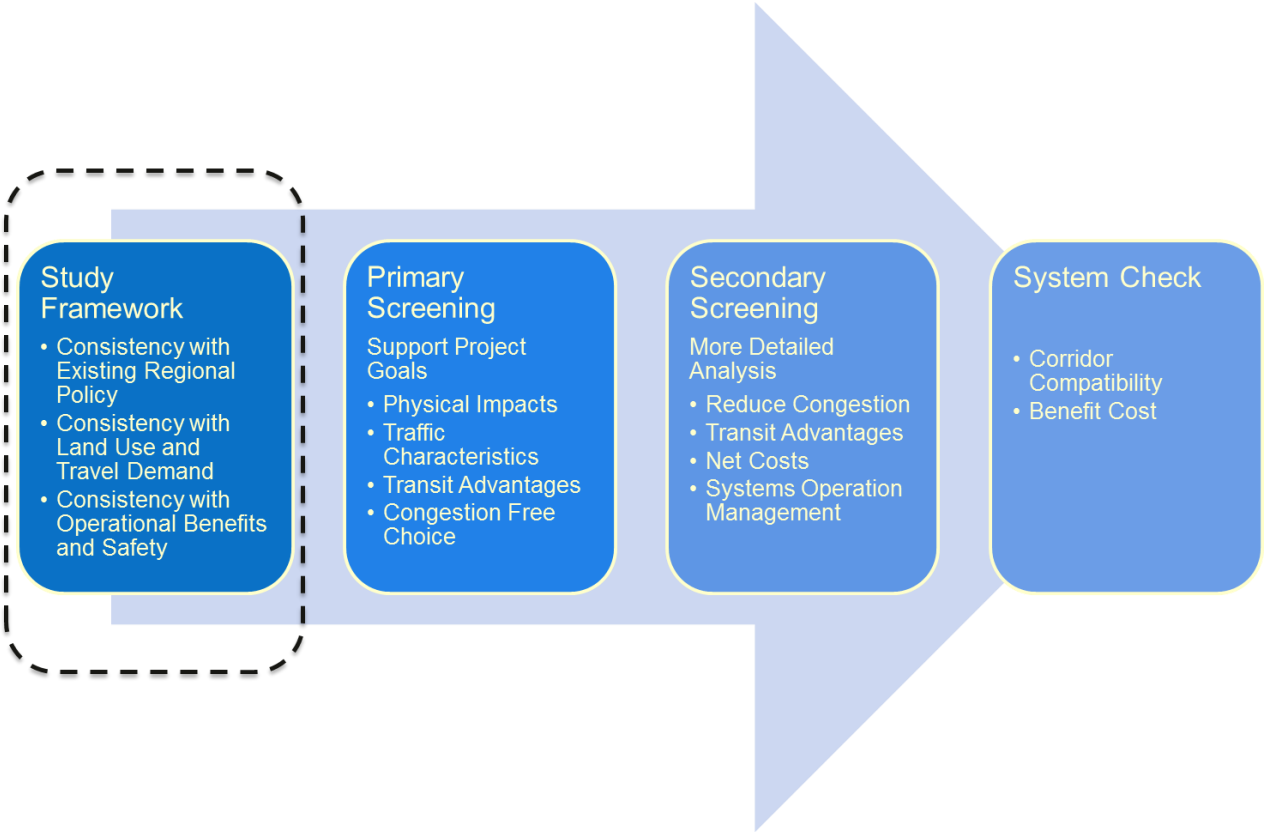
The I-35W North Managed Lanes Corridor Study is intended to identify and evaluate lower-cost/high-benefits options for improving traffic operations along I-35W as well as to evaluate options for providing a managed lane in the corridor. To accomplish this, the focus of the study was on lower-cost/high-benefit improvement opportunities, planned preservation and maintenance activities, and managed lane improvements in the corridor. To this end, the scope of the study is principally limited to the I-35W corridor right of way and transport modes associated with highway travel.

The study investigated a BRT scenario to ensure the development of a managed lane on I-35W would not preclude a potential BRT corridor in the future. Other transit modes, such as LRT and commuter rail were not developed or analyzed. Both LRT and commuter rail require an exclusive running-way and significant station infrastructure. Capital costs associated with both these modes are generally more significant than other transit modes such as BRT, particularly within a freeway right-of-way. Based on existing and previously developed transit forecast, transit ridership is not anticipated to be sufficient to warrant a rail transit-way within the I-35W freeway right-of-way. For these general reasons, only BRT was considered as a potential transit investment in the I-35W north corridor.

The context of this effort should be considered a pre-National Environmental Policy Act (NEPA) study. The anticipated results will assist in guiding potential future improvements in the corridor, but does not replace the NEPA process. Further study to fulfill NEPA requirements and develop more detailed roadway designs will need to be undertaken before any improvements considered in this study are implemented.

Study framework is the first step in the process chart. Study framework focused on consistency with existing regional policy, consistency with land use and travel demand, consistency with operation benefits and safety. Figure 9-1 provides the process chart.

Figure 9-1 Process Chart



I-35 Interregional Corridor (IRC) Management Plan (2005)

The I-35 IRC Management Plan was developed to preserve and enhance mobility and safety and to better plan for the future needs of I-35. The improvements and cost estimates identified in were reviewed as part of this project to provide a baseline. The recommended improvements and cost estimates from the IRC Plan are listed below as background information for the I-35W North Managed Lanes Corridor Study:

<u>I-35W Segment Improvements</u>

- 4th Street to CSAH 10 – 10 lanes
- CSAH 10 to TH 10 – 12 lanes
- TH 10 to Lexington Avenue – 8 Lanes
- Lexington Avenue to I-35 Split – 6 Lanes
- I-35 Split to TH 97 – 8 lanes

I-35W Cost Estimate

- 4th Street to I-694 = $870 million
- I-694 to TH 97 = $830 million
- Total Cost = $1.7 billion

Cost Estimates Include

- Additional lane construction
- Interchange and bridge replacements
- Noise and retaining wall construction
- Right of way costs – assumed to be 20 percent of construction costs

The recommendations made in the IRC Plan are no longer consistent with regional planning policies in the Twin Cities. For example, the IRC Plan's significant capacity expansion along I-35W is in the form of new general purpose lanes. The Metropolitan Council's year 2030 TPP states that new capacity constructed in the metropolitan area should be in the form of managed lanes. Furthermore, it would not be financially feasible, or prudent, to construct this magnitude of improvements recommended in the IRC Plan. As a result, the focus of the current study shifts away from significant capacity expansion and towards lower-cost/high-benefit improvement opportunities that can leverage planned preservation and maintenance activities to provide benefits in the near term.

10.0 Managed Lanes Forecasts

This chapter summarizes the build travel demand forecast for the I-35W North Managed Lane Study. Full documentation can be found in Appendix B. Updated forecasts were prepared for highway traffic and transit ridership assuming managed lanes along the I-35W north corridor. Managed lanes were assumed to be in place between University Avenue SE in Minneapolis and Lexington Avenue in Blaine. The managed lanes would be similar to existing MnPASS lanes along I-35W between Minneapolis and Burnsville, with one additional lane provided in each direction on the left side (inside) of the freeway. These lanes would be eligible for use by carpools and buses for free, and SOVs if they are willing to pay a dynamic toll that automatically adjusts to maintain free-flow conditions in the lane.

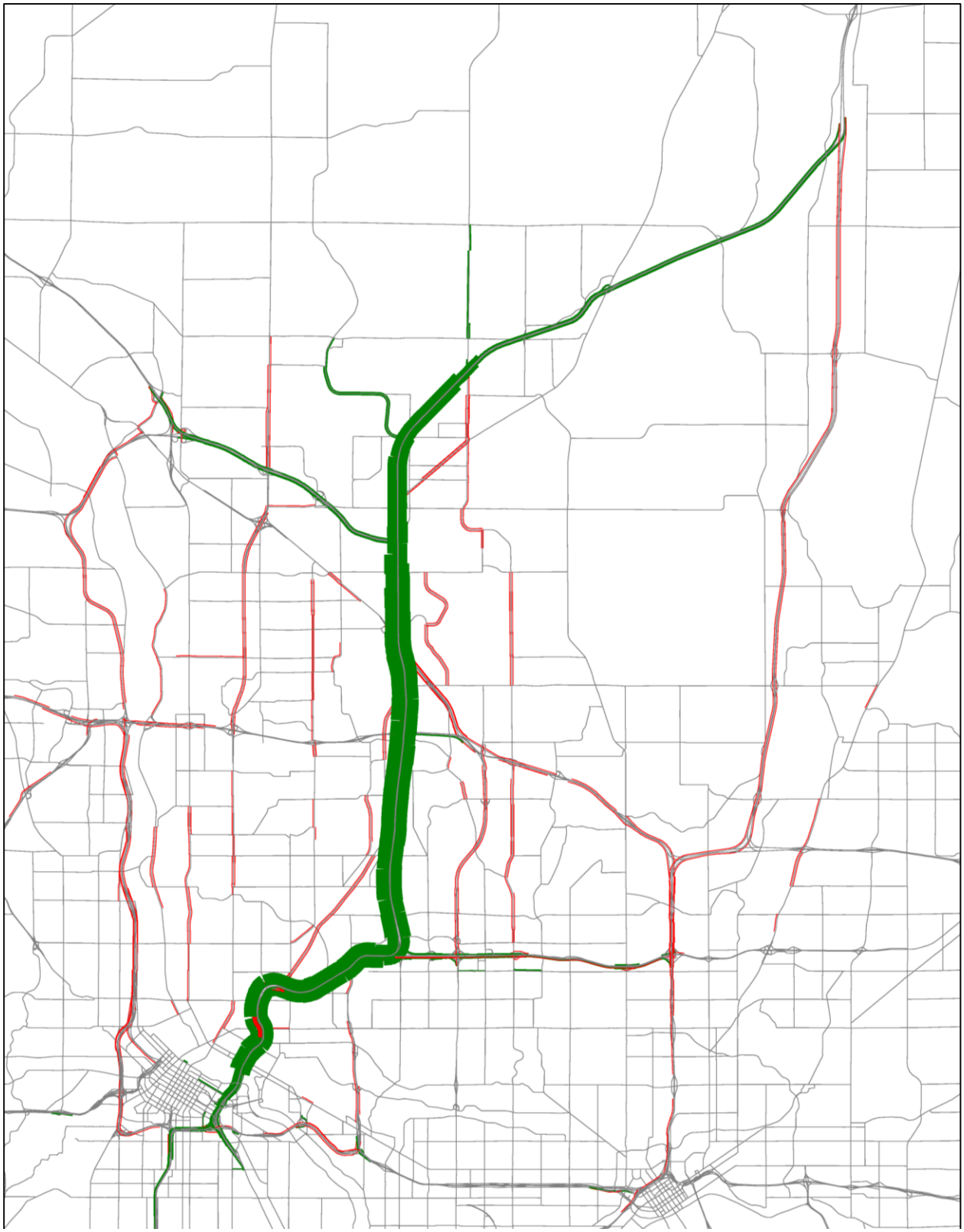
10.1 Highway Forecasts

Results of the build alternative model runs indicated the addition of managed lane capacity along the I-35W north corridor would result in increased traffic on this roadway (including both the general purpose and managed lanes). Figure 10-1 shows that increased traffic along I-35W compared to the no-build alternative. The roadways shown in green, specifically along I-35W between Lexington and downtown Minneapolis, illustrate where the largest traffic increases are expected. Other roadways expected to result in traffic increases include Lexington Avenue (CSAH 17) north of I-35W, 95th Avenue north/west of I-35W, TH 10 between TH 610 and I-35W, and TH 36 between I-35W and I-35E.

Traffic is expected to shift to I-35W from other freeway corridors and parallel arterial routes. Traffic decreases along I-35E and along the route including TH 610, TH 252, and I-94, shown in red, each account for approximately 10 percent of the increased traffic on I-35W. Other parallel arterial routes that would be expected to decrease by smaller amounts include TH 65, Snelling Avenue, Lexington Avenue, and New Brighton Boulevard. Each of these facilities would be expected to account for less than 5 percent of the increase on I-35W.

Table 10-1 shows the change in volume along all segments of the I-35W within the study area. It also shows the total daily traffic expected to use the managed lanes. Due to multiple factors, volumes in the table show the overall increase in traffic for each segment is less than the volumes using the managed lanes. For example, traffic shifting to the managed lanes from the general purpose lanes and other parallel routes reduced congestion in the general purpose lanes which in turn attracted backfill traffic from other parallel routes.

Figure 10-1 I-35W Managed Lanes Traffic Pattern Changes



Year 2030 traffic volumes expected to use the I-35W managed lanes range from approximately 4,500 to over 8,000 vpd. The heaviest use is expected in Segment 4 (I-694 to TH 10) with approximately 8,000 vpd, which is logical since it was observed this segment experiences the worst congestion along the corridor. Most of the increased traffic in the corridor is expected to occur during the peak periods, both for traffic using the managed lanes and for traffic backfilling the general purpose lanes. This is due to the existing and future congestion during the peak periods that limits corridor throughput without the managed lane capacity.

Table 10-1 Year 2030 Daily Traffic Forecasts with I-35W Managed Lane

Route	Segment	Location	No Build	Build	Change	Managed Lane Volume
I-35W	1	South of Washington Ave	125,200	127,300	2,100	
		Washington Ave to University Ave	155,900	158,500	2,600	
		4th St to Hennepin Ave	156,200	160,700	4,500	7,000
		Hennepin Ave to Johnson St	142,500	147,100	4,600	6,800
	2	New Brighton Blvd to Industrial Blvd	127,500	132,500	5,000	7,100
		Industrial Blvd to TH 280	129,900	135,000	5,100	7,100
		TH 280 to TH 36	173,200	178,100	4,900	7,800
	3	Cleveland Ave to CR C	130,700	136,700	6,000	7,600
		CR C to CR D	130,800	136,900	6,100	7,800
		CR D to CR 88	122,000	128,200	6,200	7,700
		CR 88 to CR E2	133,500	139,700	6,200	7,900
		CR E2 to I-694	136,200	142,400	6,200	7,900
	4	I-694 to CSAH 96	136,100	142,200	6,100	8,200
		CSAH 96 to CSAH 10	129,100	135,100	6,000	8,000
		CSAH 10 to CR H	163,000	168,600	5,600	7,900
		CR H to CR I	177,100	182,100	5,000	8,000
		CR I to TH 10	173,400	177,800	4,400	7,700
I-35	5	TH 10 to CR J	116,400	119,900	3,500	6,000
		Lake Dr to 95th Ave	86,700	90,000	3,300	5,500
		95th Ave to Lexington Ave	77,300	79,800	2,500	4,400
		Lexington Ave to CSAH 23	56,400	57,200	800	
		CSAH 23 to I-35E	48,500	49,100	600	
		I-35E/W to TH 97	96,300	96,400	100	
		North of TH 97	80,300	80,400	100	

10.2 Transit Forecasts

Transit ridership forecasts were also prepared for the build alternative to evaluate the effects of improved transit travel times on express bus ridership. The same background assumptions of planned and programmed transit improvements used in the no-build transit ridership forecasts carried forward into this scenario. The only change was a modification to the travel time of Route 250 service from the 95th Avenue Park and Ride to downtown Minneapolis. A travel time savings of approximately seven minutes was identified for this route based on the difference in peak hour travel times expected with the addition of managed lanes along the I-35W north corridor.

The results of the build scenario transit assignment showed improved travel time for Route 250 resulting from future managed lanes along I-35W which would increase ridership. The year 2030 daily ridership would be expected to increase from 3,050 to 3,450 compared to no-build

conditions, showing an increase of 13 percent. The forecast ridership for the entire study area's transit routes is shown in Table 10-2.

Table 10-2 Year 2030 Daily Transit Ridership Forecasts with I-35W Managed Lane

Route	Description	Type	2030 No Build	2030 Build
	Corridor Routes			
	I-35W Routes			
118	Downtown Minneapolis to Columbia Heights	Local	150	150
250	**Downtown Minneapolis to Lino Lakes**	**Express**	**3,050**	**3,450**
252	Downtown Minneapolis to Blaine	Express	175	175
288	Downtown Minneapolis to Forest Lake	Express	425	425
860	Downtown St. Paul to Coon Rapids	Express	625	625
	TH 36 Routes			
260	Downtown Minneapolis to Roseville	Express	225	225
261	Downtown Minneapolis to Shoreview	Express	275	275
264	Downtown Minneapolis to Roseville	Express	800	800
270	Downtown Minneapolis to Maplewood	Express	1,925	1,925
	Summary			
	Corridor Routes		**7,650**	**8,050**
	I-35W Corridor Routes Subtotal		*4,425*	*4,825*
	TH 36 Corridor Routes Subtotal		*3,225*	*3,225*

11.0 Bus Rapid Transit Evaluation

11.1 Introduction

The I-35W North Managed Lanes Corridor Study was undertaken to identify and evaluate lower-cost/high-benefits options for improving traffic operations along I-35W as well as to evaluate options for providing managed lanes in the corridor. One key feature of managed lanes is their ability to improve transit operations, as well as provide a congestion-free choice for drivers. Managed lanes are also capable of facilitating BRT service by providing transit vehicles with a free-flow trip along freeway corridors. An investigation was undertaken as part of this study to determine whether the I-35W north corridor has the potential to support future BRT service and to understand the impact this service has on managed lanes design. Furthermore, BRT was investigated so managed alternatives would not preclude potential BRT service which included station types.

The basic evaluation of BRT service on I-35W north to downtown Minneapolis analyzed the potential ridership, capital costs, and operations and maintenance (O&M) costs for this service. The evaluation did not constitute a transit alternatives analysis (AA) for the corridor. Specific assumptions used to evaluate possible BRT service were developed with input from Metro Transit staff. The BRT evaluation also considered service between downtown Minneapolis and the existing 95th Avenue Park and Ride in Blaine.

Various transit station types were considered in this evaluation, as BRT travel times are sensitive to different access configurations. Specifically, station types that required vehicles to depart the freeway mainline, or the entire corridor, will impose additional travel time on the overall transit route. Three types of stations were considered in this evaluation: online, inline, and offline stations. Figure 11-1 provides an example for each station type. The differences between these types of stations are described below:

- **Online stations** are located within the runningway, and BRT vehicles can access a station without leaving the runningway.
- **Inline stations** are located adjacent to the runningway and usually require BRT vehicles to exit the runningway to access a station. Few or no turns are required for inline stations.
- **Offline stations** require BRT vehicles to leave the runningway to access a station. Sometimes this is to access a nearby park and ride facility that is not directly adjacent to the runningway.

Figure 11-1 Station Examples

Online station(s)

Inline Station

Offline Station

11.2 Ridership Forecasting

All ridership analysis was conducted using the Twin Cities RTDM for year 2030 conditions. Socioeconomic and roadway network assumptions assumed in the evaluation were described in the No-Build Forecasts – Travel Demand Forecasting chapter.

The effect of providing managed lanes along the I-35W north corridor on express bus ridership was documented in the Managed Lanes Forecast chapter. Those results demonstrated the travel time improvement provided by the managed lanes would result in a year 2030 ridership increase

of 400 riders per day, an increase of 13 percent, on Route 250 between downtown Minneapolis and the 95th Avenue Park and Ride in Blaine.

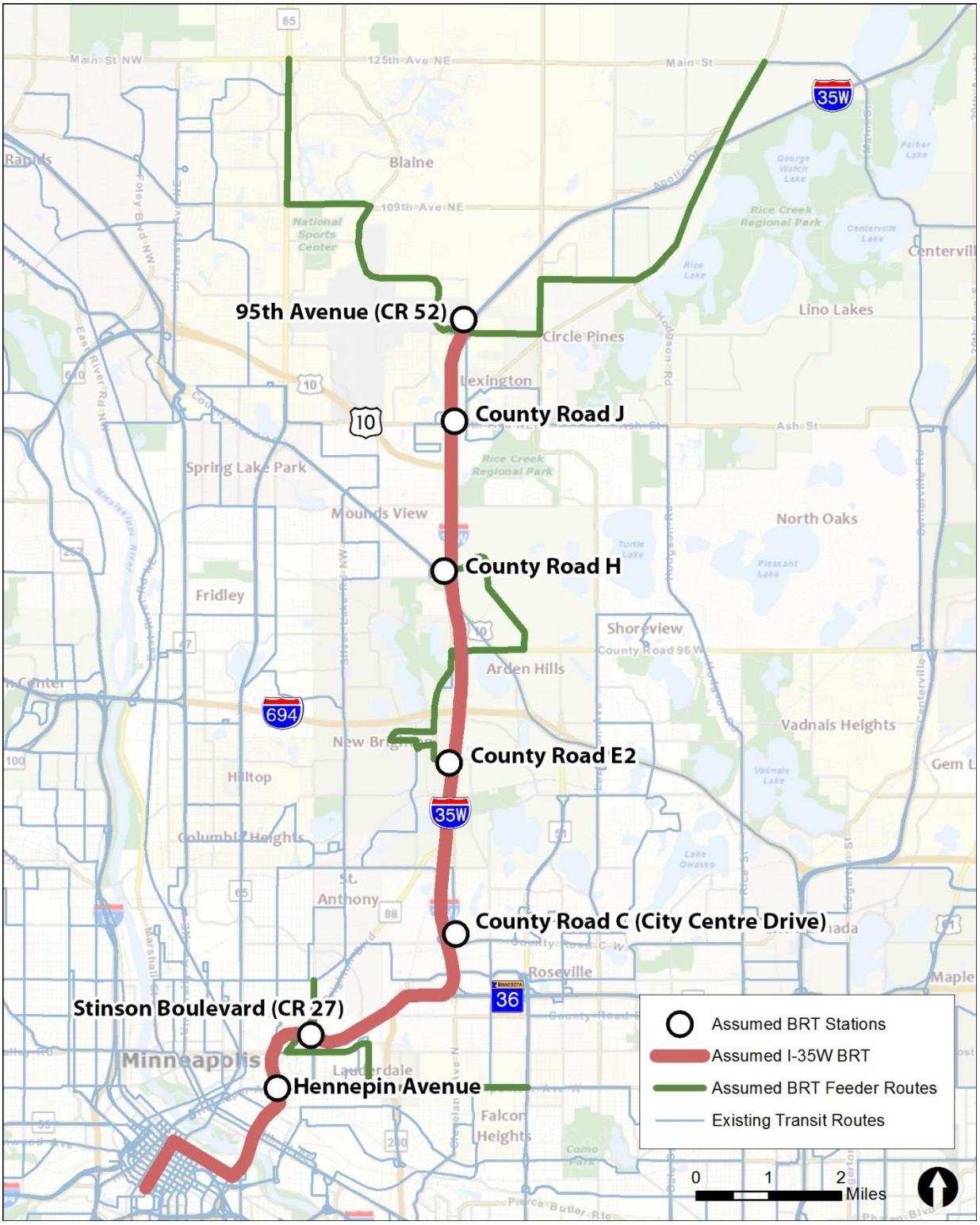
The BRT scenario developed for this evaluation built upon the managed lanes scenario by adding BRT service to the I-35W north corridor. Following transitway development guidelines and input from Metro Transit staff, the BRT service was assumed to provide station-to-station service in both directions throughout the day.

The base scenario developed for BRT in the corridor assumed all stations would be online, except for 95th Avenue, which would be offline due to an existing park and ride at this location. Since online stations do not require BRT vehicles to leave the runningway, transit travel times are generally shorter compared to inline or offline stations. For the purposes of this BRT evaluation, stations were assumed at the following locations:

- 95th Avenue (CR 52) (existing park and ride)
- CR J
- CR H
- CR E2
- CR C (City Centre Drive)
- Stinson Boulevard (CR 27)
- Hennepin Avenue

In addition to the assumed station locations, three feeder bus routes were assumed along the I-35W north corridor to provide better connectivity to and from the BRT service in underserved areas. The location of the BRT corridor, the assumed station locations, and the assumed feeder services are shown in Figure 11-2.

Figure 11-2 BRT – Assumed Route Alignments and Station Locations



The scenario developed to evaluate BRT service along I-35W did not assume any reduction in existing or programmed transit service; rather it was in addition to these services. A summary of the transit evaluation scenarios is provided in Table 11-1.

Table 11-1 I-35W Scenario Summary

Scenario	Highway Network	Transit Network	Bus Travel Times
No Build	2030 No Build	Existing route 250 with programmed service improvements	Bus travel times adjusted for future highway congestion
Managed Lanes	2030 Managed Lane	Existing route 250 with programmed service improvements	Bus travel times adjusted to account for managed lane
BRT	2030 Managed Lane	Existing route 250 with programmed service improvements + I-35W North BRT	Bus travel times adjusted to account for managed lane and station dwell time

The BRT scenario was assumed to provide frequency of 10 minutes during the a.m. and p.m. peak periods and 15 minutes in the off peak periods. The assumptions used in this evaluation - station type and service frequency - would be considered "ideal" BRT operating conditions, and were developed to maximize ridership potential without consideration of capital or O&M costs.

The results of the ridership forecasts are shown in Table 11-2. These results indicate that BRT service in this corridor could be expected to serve 7,225 riders per day in year 2030. This was accompanied by a decrease in ridership on Route 250; however the total shows a large increase over the year 2030 no-build or managed lane scenarios.

Table 11-2 BRT Ridership Forecast Results for Year 2030

Route/Service	Year 2030 No Build	Year 2030 Managed Lanes	Year 2030 BRT
Route 250 Express	3,050	3,450	2,850
	-	-	7,225
Total	3,050	3,450	10,075

11.3 Sensitivity Tests

A series of sensitivity tests were undertaken to further evaluate the effects of BRT service characteristics on projected ridership. The main variables in the sensitivity tests were run times, which are affected by station types, and frequency, which require additional transit vehicles and operators. Sensitivity tests are important for understanding the trade-offs between fast travel time, requiring capital-intensive online stations, and frequency which increases capital costs for additional vehicles and O&M costs to run them.

Travel Time Sensitivity Tests

Three sensitivity tests were completed to analyze the impact of different station types and associated travel time impacts. Sensitivity tests 2, 3, and 4 were performed to evaluate adjustments to BRT station configurations and run times. For the BRT scenario, all stations were assumed as online with the BRT service using the managed lane along the entire length of the I-35W corridor. With the revised station configurations, the sensitivity tests relied more on the use of the bus only shoulders for travel time savings between stations. Due to performance, existing geometrics, overlapping service and travel time savings, the Hennepin Avenue station was removed from sensitivity tests 2, 3, and 4. Non-freeway travel times were consistent with the BRT scenario, while freeway run times were adjusted based on station type and weave delay. Table 11-3 displays the assumptions for the run time sensitivity tests.

Table 11-3: BRT Run Time Sensitivity Tests

	I-35W North BRT	Sensitivity Test 2	Sensitivity Test 3	Sensitivity Test 4
Freeway Run Time (Minutes)	20.3	38.3	32.2	29.3
BRT Stations **On - Online** **In - Inline** **Off - Offline**	95th - Off CR J - On CR H - On CR E2 - On CR C - On Stinson - On	95th - Off CR J - Off CR H - In CR E2 - In CR C - Off Stinson - In	95th - Off CR J - Off CR H - In CR E2 - In CR C - On Stinson - On	95th - Off CR J - On CR H - On CR E2 - In CR C - Off Stinson - In

The following results were observed in the travel time sensitivity tests:

- Run time had modest impact on transitway ridership
- 100 percent increase in freeway travel time resulted in 17 percent reduction in transitway ridership
- 50 percent increase in freeway travel time resulted in 10 percent reduction in transitway ridership

Service Frequency Sensitivity Tests

Sensitivity tests 5 and 6 were performed to evaluate adjustments to BRT peak period frequency. These sensitivity tests tested reductions in peak period service, with all other assumptions consistent with the BRT scenario. Sensitivity test 5 included an adjustment in peak period frequency from 10 minutes to 15 minutes and test 6 included an adjustment in peak period frequency from 10 minutes to 30 minutes. Due to limited off-peak period ridership, sensitivity tests were not performed for the off-peak period. Table 11-4 depicts the assumptions for the frequency sensitivity tests.

Table 11-4: BRT Frequency Sensitivity Tests

Scenario	I-35W North BRT	Sensitivity Test 5	Sensitivity Test 6
Headway (Peak/Off-Peak)	10/15	15/15	30/15
Freeway Run Time (Minutes)	20.3	20.3	20.3
BRT Stations **On - Online** **In - Inline** **Off - Offline**	95th - Off CR J - On CR H - On CR E2 - On CR C - On Stinson - On Hennepin - On	95th - Off CR J - On CR H - On CR E2 - On CR C - On Stinson - On Hennepin - On	95th - Off CR J - On CR H - On CR E2 - On CR C - On Stinson - On Hennepin - On

The following results were observed in the service frequency sensitivity tests:

- Frequency reduction had a greater impact on transitway ridership than run time
- Changing frequency from 10 to 15 minutes resulted in 18 percent reduction in BRT ridership
- Changing frequency from 10 to 30 minutes resulted in 35 percent reduction in BRT ridership
- Transit becomes less attractive for "choice users" when peak period service is reduced
- Ridership on the Route 250 remains stable between alternatives

The assumptions made in the BRT scenario and sensitivity tests were important because they impact ridership as well as capital and O&M costs. The type of station constructed will impact the capital costs because each station configuration requires varying degrees of construction and roadway realignment including managed lanes. In addition, the station type also impacts transit travel time, thereby impacting the O&M costs and ridership projections. Typically, as travel times increase, O&M costs increase due to greater bus operator costs, higher fuel costs, and greater maintenance costs due to increased miles. Increased travel times also require more BRT vehicles to operate the service, again impacting both the capital and O&M costs.

11.4 Cost Estimates

The BRT evaluation also included a basic analysis of system costs. Two groups of costs were considered in these estimates: capital costs and O&M costs. The capital cost estimates were broken into five categories:

- Corridor improvements
- Stations
- Vehicles
- Right of way
- Soft costs (includes engineering, design, project management, etc.)

Additionally, the O&M cost estimates were grouped into five categories:

- Bus service operations
- Station maintenance
- Fare collection
- Police/fare enforcement
- Intelligent transportation systems

Table 11-3 summarizes the capital and O&M costs for the BRT scenario and the travel time sensitivity tests 2, 3, and 4 previously described.

Table 11-3 Capital and O&M Cost Summary

	I-35W North BRT	Sensitivity Test 2	Sensitivity Test 3	Sensitivity Test 4
Capital Costs (2011 $)	$346,128,000	$78,344,000	$167,753,000	$143,563,000
O&M Annual Costs (2010 $)	$7,461,000	$8,671,000	$8,091,000	$7,919,000
Forecast Ridership (2030)	10,075	8,325	9,250	9,050
Freeway Run Time (Minutes)	20.3	38.3	32.2	29.3
BRT Stations **On - Online** **In - Inline** **Off - Offline**	95th - Off CR J - On CR H - On CR E2 - On CR C - On Stinson - On	95th - Off CR J - Off CR H - In CR E2 - In CR C - Off Stinson - In	95th - Off CR J - Off CR H - In CR E2 - In CR C - On Stinson - On	95th - Off CR J - On CR H - On CR E2 - In CR C - Off Stinson - In

The cost estimate results in Table 11-3 show the BRT scenario has significantly higher capital costs than sensitivity tests 2, 3, and 4 (200 to 450 percent higher). This is largely due to the assumption of online stations at all of the stations throughout the corridor between Minneapolis and Blaine. Construction of these online stations would require significant realignment of mainline I-35W and interchanges near the stations. The sensitivity tests assuming inline or offline stations would have much lower capital costs.

Operations and maintenance costs for the sensitivity tests were somewhat higher than the BRT scenario due to additional run times; however these increases were proportional to the changes in capital costs (18 percent increase). As noted previously, ridership was observed to be lower for the sensitivity tests than the BRT scenario. The sensitivity tests showed decreases of 10 percent to 20 percent.

BRT technical memorandum is provided in Appendix C – BRT.

11.5 Conclusions

The purpose of the investigation was to determine whether the I-35W north corridor has the potential to support possible future BRT service and if so, the extent to which design of these managed lanes would be impacted by this service. A number of conclusions were drawn from the

results of the express bus and BRT evaluation which help to answer these questions and can guide subsequent transit and BRT studies along I-35W, as well as design of the roadway improvements.

- Managed lanes provide travel time benefits to express bus service, resulting in higher ridership, and would help facilitate possible BRT service.
- The I-35W north corridor may be able to support all-day, station-to-station BRT service in year 2030 under the conditions assumed in this evaluation.
- Ridership forecasts were more sensitive to service frequency than to differences in corridor travel times associated with providing online stations.
- Minor differences in forecasted ridership totals would not be expected to justify the high capital costs associated with a BRT system using online stations.
- Construction of managed lanes can proceed without precludung future development of a BRT system that utilizes inline and offline stations.

12.0 Corridor Managed Lane Alternatives

Introduction

For purposes of the I-35W North Managed Lanes Corridor Study, managed lanes were considered priced and restricted to only HOV, toll paying vehicles and transit vehicles. These lanes are expected to operate similar to current managed lanes in the Twin Cities which include MnPASS lanes and bus only shoulders.

Managed lane alternatives were developed considering various physical impacts to add a managed lane along the I-35W north corridor. A range of corridor alternatives allowed for a systematic evaluation of potential managed lanes. The developed corridor managed lane alternatives included the following:

- No-Build
- Alternative 1 - Managed Lane within Existing Pavement Width
- Alternative 2 - Bus only Shoulder
- Alternative 3 – Managed Lane with New Construction
  - Alternative 3A - Managed Lane with Full Shoulders
  - Alternative 3B - Managed Lane with Variable Inside Shoulder
- Alternative 4 – Reversible Managed Lane
  - Alternative 4A - One Reversible Managed Lane
  - Alternative 4B - Two Reversible Managed Lanes

Typical sections developed in CADD, physical impact and evaluation of segments is provided in Appendix D – Typical Sections and Physical Impact Evaluation Criteria.

No-Build - Existing Cross Section

I-35W study corridor existing cross sections are an:

- Urban six-lane existing cross section
- Rural six-lane existing cross section
- Rural four-lane existing cross section

The existing urban six-lane cross section has ten-foot shoulders on both the inside and outside and each through lane is a full twelve-foot width. Figure 12-1 represents the existing urban six-lane cross section. The existing rural cross section has a six-lane section and a four-lane section. Both rural cross sections have a ten-foot shoulder on the outside and a four-foot shoulder on the inside and each through lane is a full twelve-foot width. Figure 12-2 and Figure 12-3 represents the existing rural six-lane and four-lane cross sections.

Figure 12-1 Urban Six-Lane Existing Cross Section

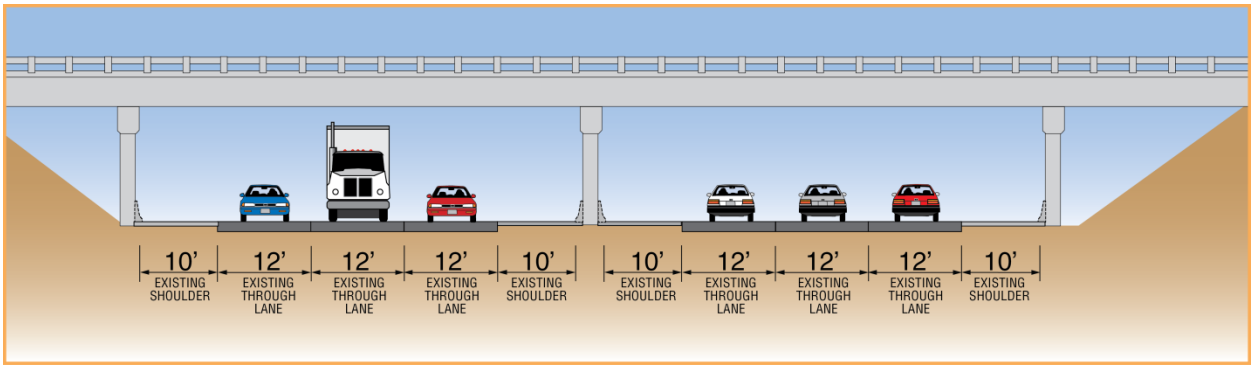


Figure 12-2 Rural Six-Lane Existing Cross Section

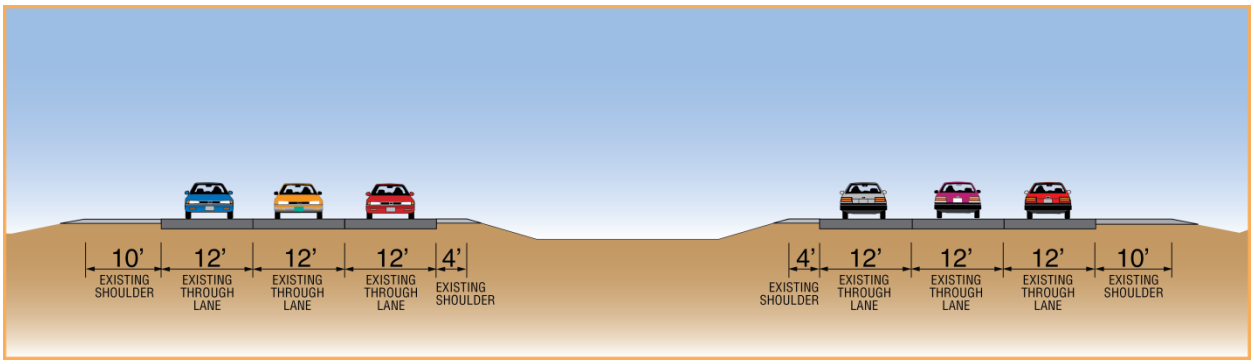
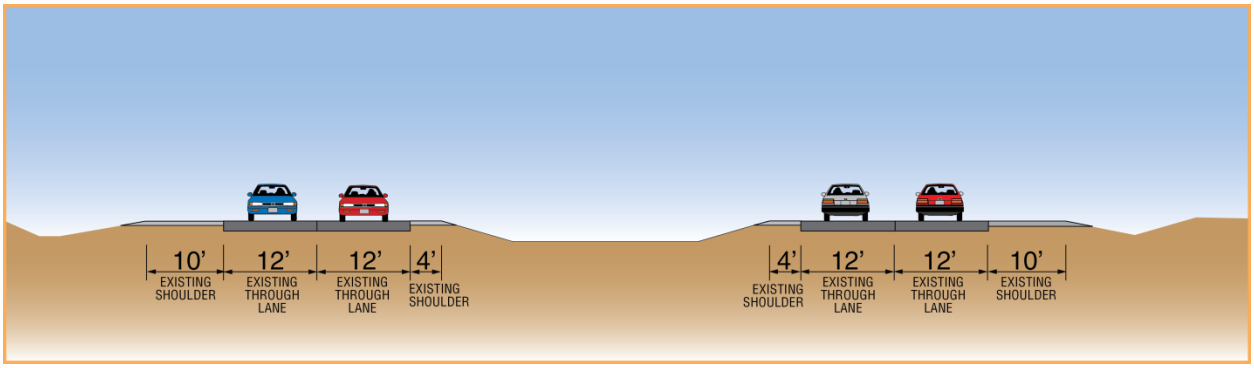


Figure 12-3 Rural Four-Lane Existing Cross Section



Alternative 1 – Managed Lane within Existing Pavement Width

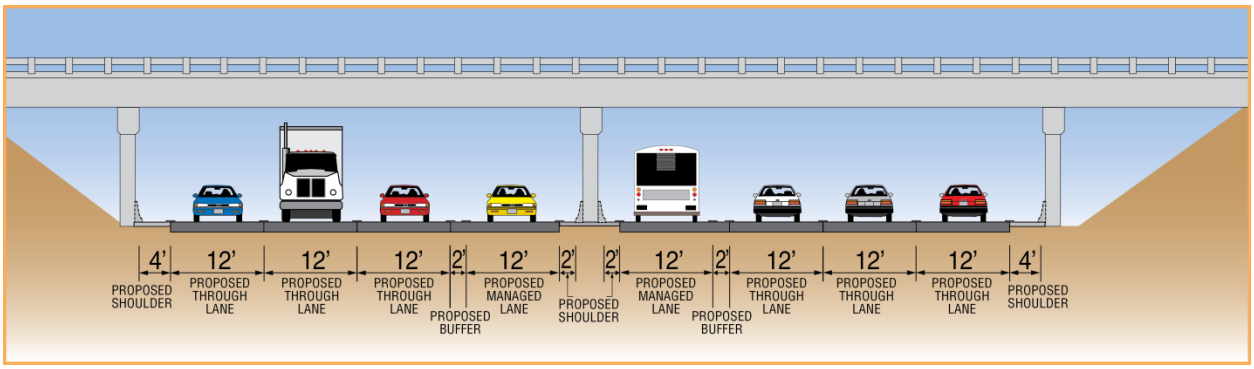
Alternative 1 adds a managed lane within the existing pavement width. This alternative provides a managed lane by reallocating the lane and shoulder widths to accommodate an inside managed lane.

<u>Alternative 1 - Urban</u>

In this alternative for the urban section, the outside shoulder was reduced from a ten-foot shoulder to a minimum of a four-foot shoulder in specific locations with minimum existing width

constraints. There were three twelve-foot through lanes, one two-foot buffer lane and a twelve-foot inside managed lane. The inside shoulder would be a minimum of two feet due to existing constraints. This alternative was consistent in both northbound and southbound directions. Figure 12-4 represents the urban Alternative 1.

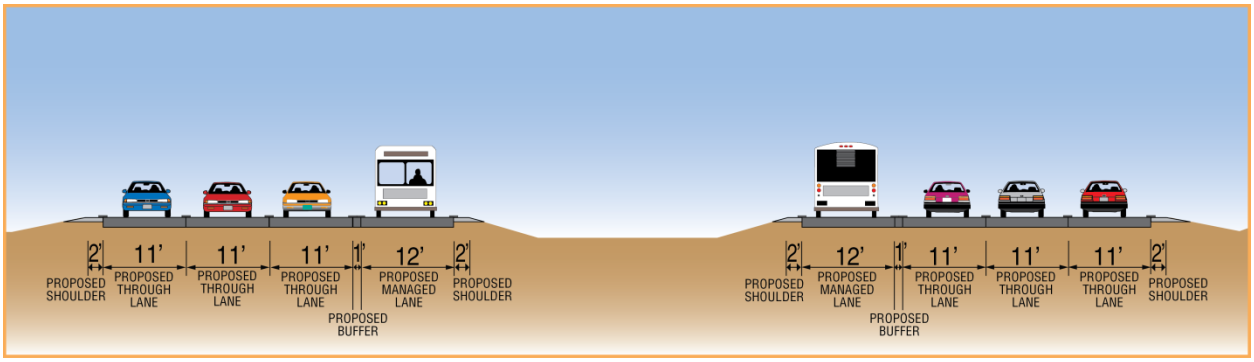
Figure 12-4 Alternative 1: Urban Six-Lane Facility with Added Managed Lane within Existing Pavement Width



Alternative 1 – Rural Six-Lane

In this alternative for the rural section, the outside shoulder is reduced from a ten-foot shoulder to a minimum of a two-foot shoulder. There were three eleven-foot through lanes, one 1-foot buffer lane and then a twelve-foot inside managed lane. The inside shoulder would be reduced to a minimum of two feet. This alternative was consistent in both northbound and southbound directions. Figure 12-5 represents the rural six-lane Alternative 1.

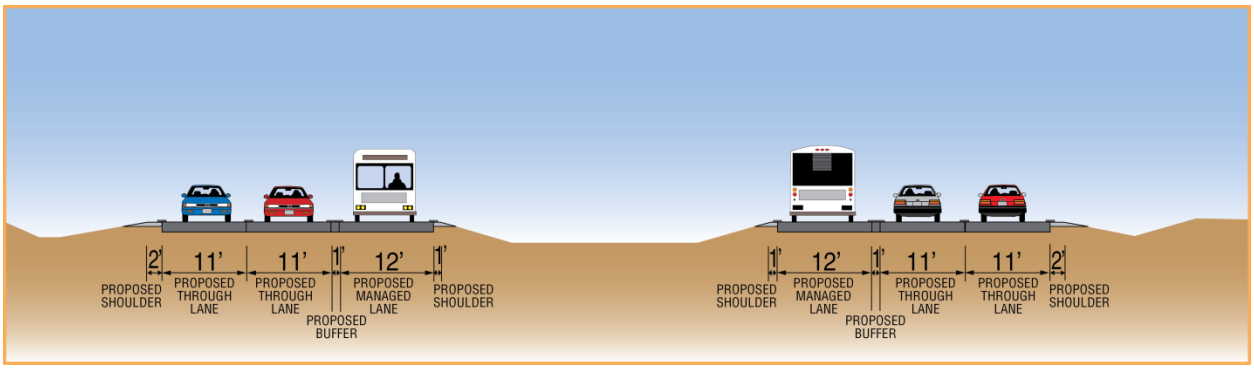
Figure 12-5 Alternative 1: Rural Six-Lane Facility with Added Managed Lane within Existing Pavement Width



Alternative 1 – Rural Four-Lane

In this alternative for the rural section, the outside shoulder is reduced from a ten-foot shoulder to a minimum of a two-foot shoulder. There were two eleven-foot through lanes, one 1-foot buffer lane and then a twelve-foot inside managed lane. The inside shoulder would be reduced to a minimum of one foot. This alternative was consistent in both northbound and southbound directions. Figure 12-6 represents the rural four-lane Alternative 1.

Figure 12-6 Alternative 1: Rural Four-Lane Facility with Added Managed Lane within Existing Pavement Width



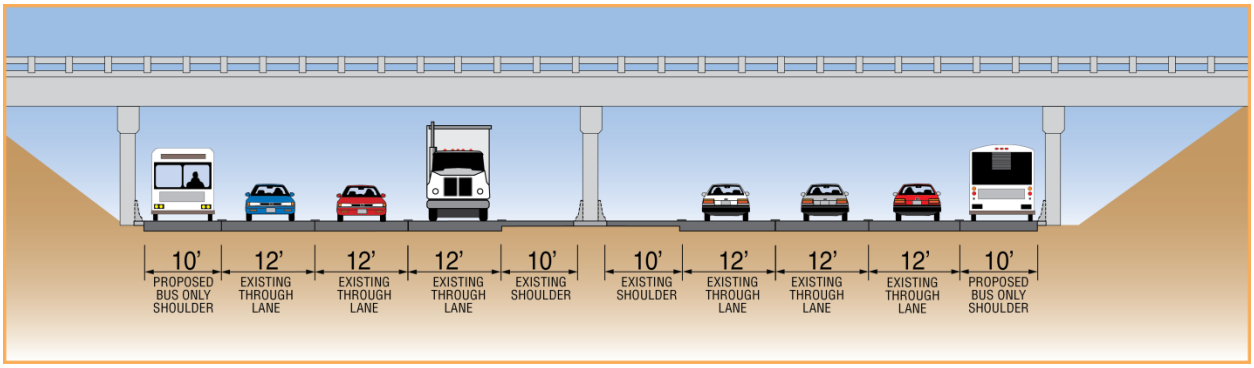
Alternative 2 – Bus Only Shoulder

Alternative 2 adds an outside bus only shoulder within the existing pavement. This alternative provides a continuous bus only shoulder lane through the study corridor.

<u>Alternative 2 - Urban</u>

In this alternative for the urban section, the existing outside ten-foot shoulder was designated as a bus only shoulder; maintaining the ten-foot width. The existing through lanes would remain as three twelve-foot through lanes, followed by the existing ten-foot inside shoulder. This alternative was consistent in both northbound and southbound directions. Figure 12-7 represents the urban Alternative 2.

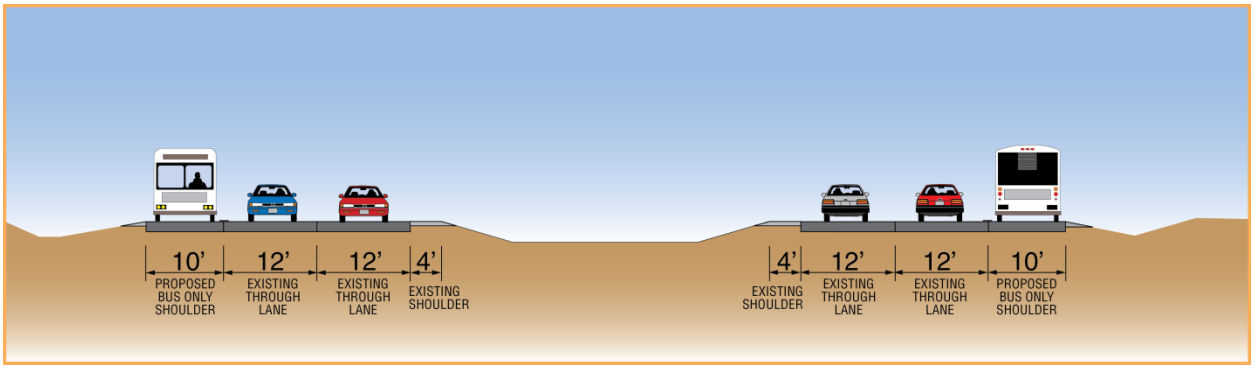
Figure 12-7 Alternative 2: Urban Six-Lane Facility with Bus Only Shoulder



<u>Alternative 2 – Rural</u>

In this alternative for the rural section, the existing outside ten-foot shoulder was designated as a bus only shoulder, maintaining the ten-foot width. The existing through lanes would remain as two twelve-foot through lanes, followed by the existing four-foot inside shoulder. This alternative was consistent in both the northbound and southbound directions. Figure 12-8 represents the rural Alternative 2.

Figure 12-8 Alternative 2: Rural Four-Lane Facility with Bus Only Shoulder



Alternative 3 – Managed Lane with New Construction

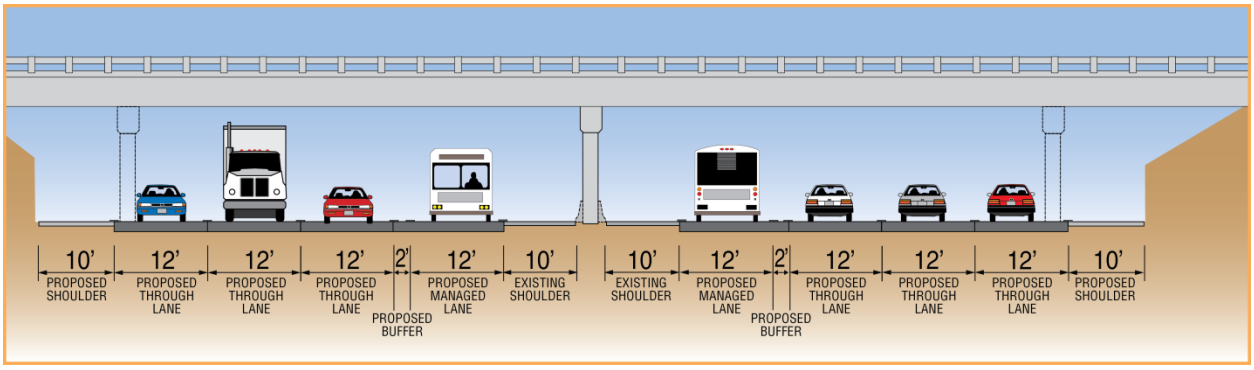
Alternative 3 consists of constructing new pavement for a managed lane and shoulder replacement. This alternative removed the existing shoulder and replaced the shoulder with a traffic lane and new shoulder. It also offers flexibility for various management types. Alternative 3 is divided into two sub-alternatives with varying shoulder widths.

- Alternative 3A – Managed Lane with Full Shoulders
- Alternative 3B – Managed Lane with Variable Inside Shoulder

<u>Alternative 3A – Urban - Managed Lane with Full Shoulder</u>

In this alternative for the urban section, full inside and outside shoulders were maintained. This was accomplished by new lane construction. The typical urban cross section would consist of a ten-foot outside shoulder, three twelve-foot through lanes, one two-foot buffer lane, one twelve-foot managed lane, and a ten-foot inside shoulder. This alternative would require localized improvements to accommodate the managed lane. Figure 12-9 represents the urban Alternative 3A.

Figure 12-9 Alternative 3A: Urban Six-Lane Facility with Added Managed Lane with Full Shoulders



Alternative 3A – Rural – Managed Lane with Full Shoulder

In this alternative for the rural section, both a four-lane facility and a six-lane facility needed to be developed. In the rural four-lane facility, the full outside shoulder and the two twelve-foot through lanes would be maintained. The existing four-foot shoulder would be replaced with a two-foot buffer lane, a twelve-foot managed lane and a ten-foot shoulder. This alternative would require the median to be filled along with the addition of a reinforced concrete median barrier. Figure 12-10 represents the rural four-lane Alternative 3A. The rural six-lane facility would have the same characteristics as the rural four-lane facility except for the presence of three twelve-foot through lanes. Figure 12-11 represents the rural six-lane Alternative 3A.

Figure 12-10 Alternative 3A: Rural Four-Lane Facility with Added Managed Lane with Full Shoulders

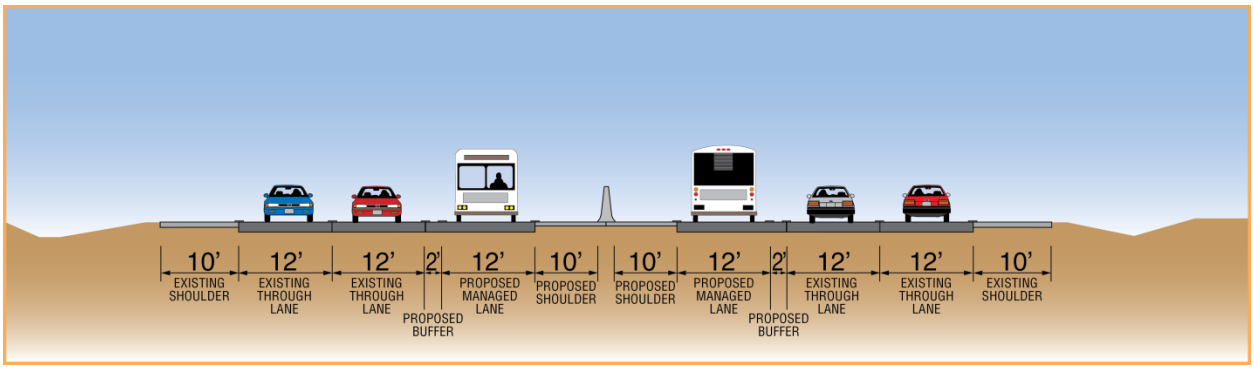
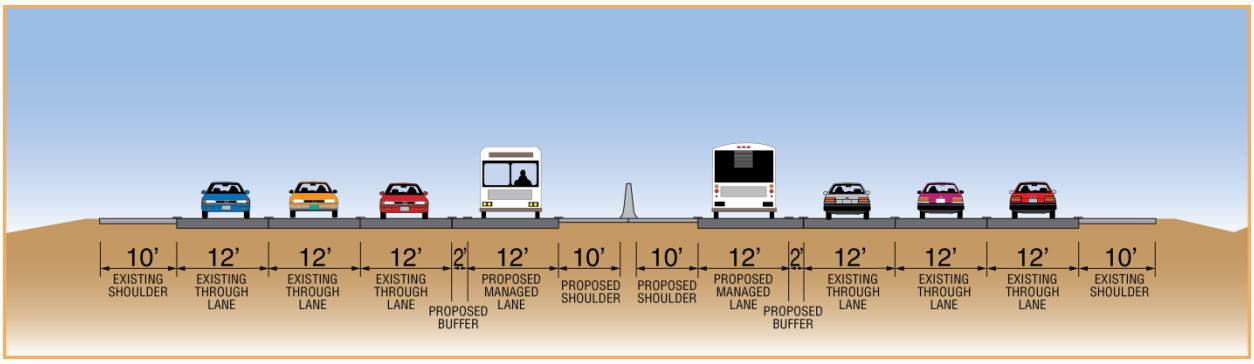


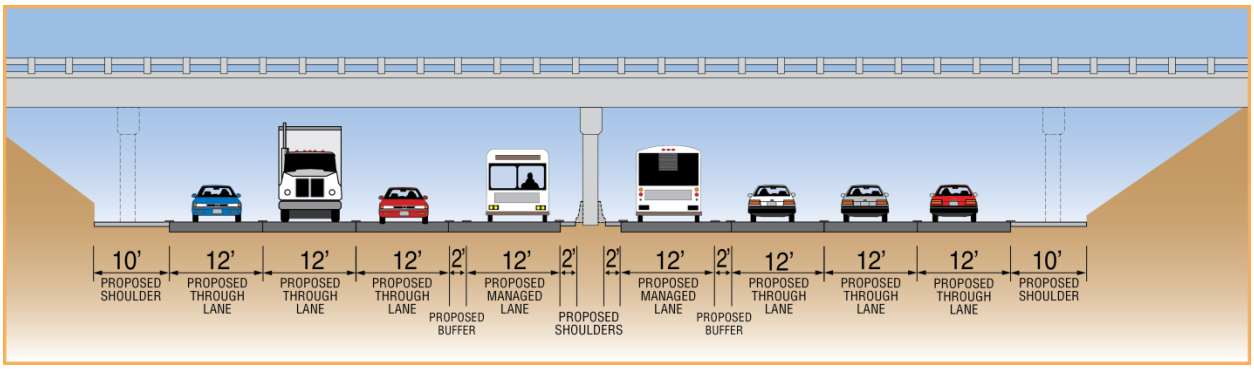
Figure 12-11 Alternative 3A: Rural Six-Lane Facility with Added Managed Lane with Full Shoulders



Alternative 3B – Urban - Managed Lane with Variable Inside Shoulder

In this alternative for the urban section, the inside shoulder would be reduced from 10 feet to a minimum of two feet. A 12-foot managed lane would be added as an inside side lane along with a 2-foot buffer lane, three 12-foot through lanes and a 10-foot outside shoulder. This alternative is a construction alternative and would also require localized improvements to accommodate the managed lane design. Figure 12-12 represents the urban six-lane Alternative 3B.

Figure 12-12 Alternative 3B: Urban Six-Lane Facility with Added Managed Lane with Variable Inside Shoulder



Alternative 3B – Rural – Managed Lane with Variable Inside Shoulder

In this alternative for the rural section, both a four-lane and a six-lane facility would need to be developed. In the rural four-lane facility, the full outside shoulder and two twelve-foot through lanes would be maintained. The existing four-foot shoulder would be replaced with a two-foot buffer lane, a twelve-foot managed lane and a four-foot shoulder. This alternative would require some fill of the median. Figure 12-13 represents the rural four-lane Alternative 3B. The rural six-lane facility would have the same characteristics as the rural four-lane facility except for the presence of three twelve-foot through lanes. Figure 12-14 represents the rural six-lane facility Alternative 3B.

Figure 12-13 Alternative 3B: Rural Four-Lane Facility with Added Managed Lane with Variable Inside Shoulder

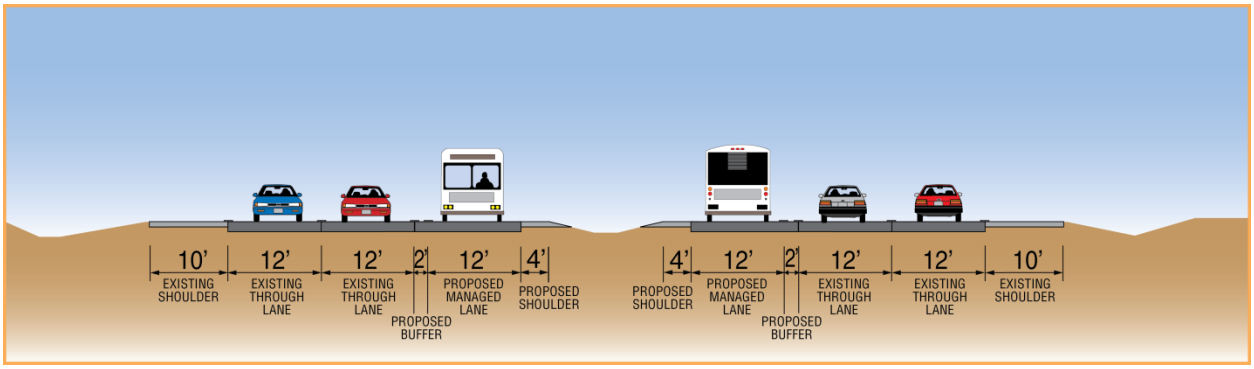
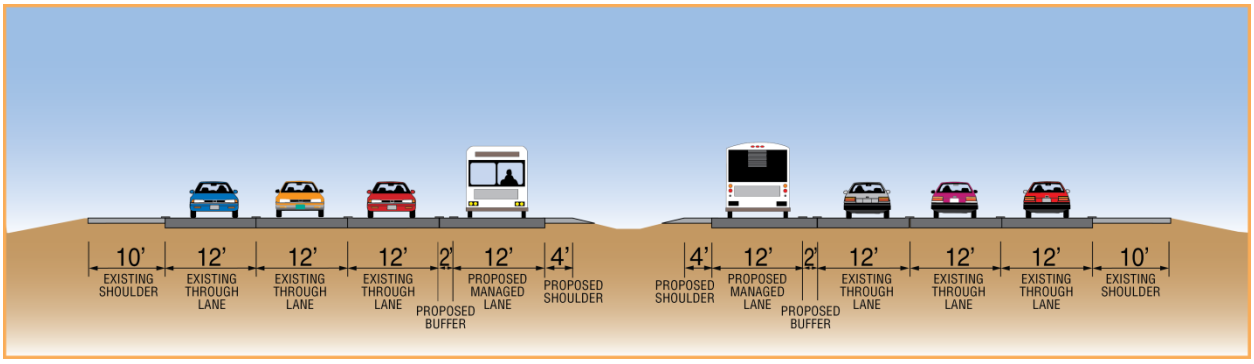


Figure 12-14 Alternative 3B: Rural Six-Lane Facility with Added Managed Lane with Variable Inside Shoulder



Alternative 4 - Reversible Managed Lane

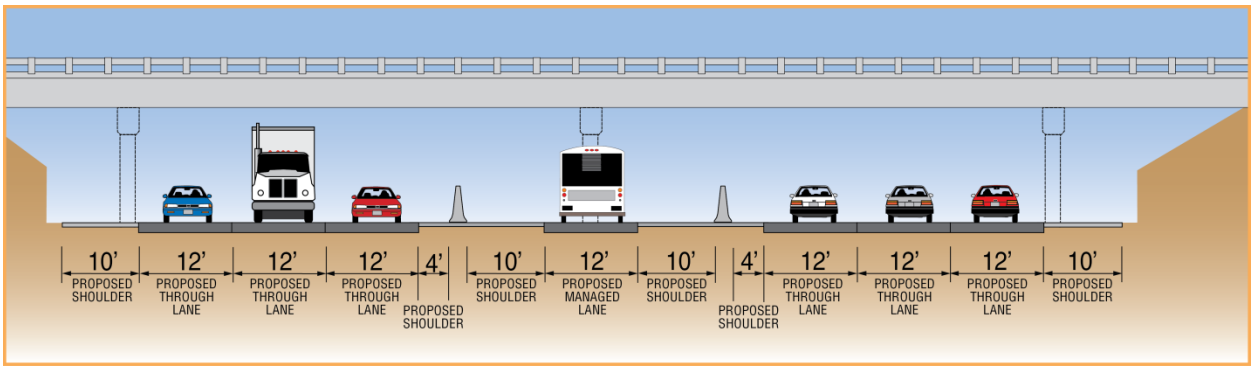
Alternative 4 consists of a barrier separated, one directional flow facility within the center of the corridor. This alternative would accommodate peak directional flow, meaning southbound in the morning and northbound in the afternoon. It would also offer flexibility for various management types. Alternative 4 is divided into two sub-alternatives:

- Alternative 4A – One Reversible Managed Lane
- Alternative 4B – Two Reversible Managed Lanes

<u>Alternative 4A – Urban – One Reversible Managed Lane</u>

In this alternative for the urban section, full outside shoulders were maintained and a single reversible managed lane was added to the center of the corridor. The typical urban cross section would consist of a ten-foot outside shoulder, three twelve-foot through lanes, one four-foot shoulder lane, a concrete barrier, one ten-foot shoulder, one twelve-foot reversible managed lane, and one ten-foot shoulder. The northbound and southbound through lanes would have the same typical cross section. This alternative is a construction alternative and would also require localized improvements to accommodate the managed lane design. Figure 12-15 represents the urban six-lane facility Alternative 4A.

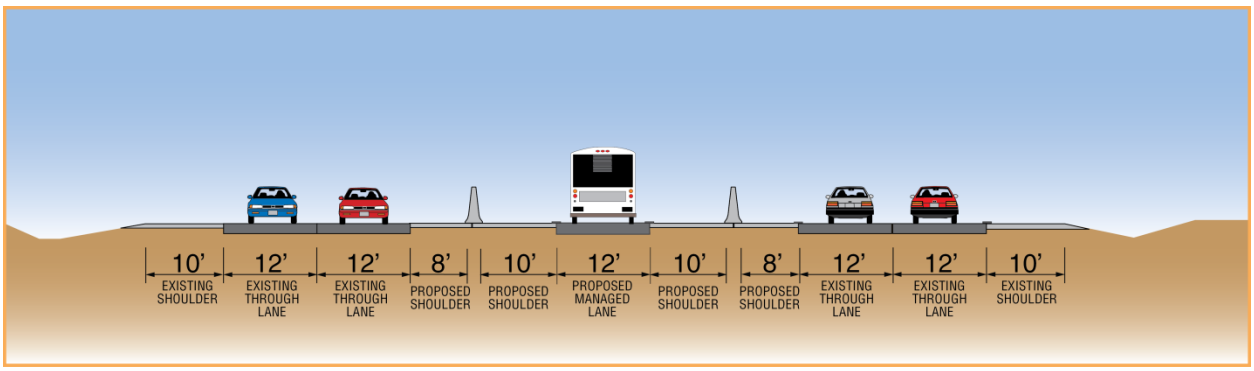
Figure 12-15 Alternative 4A: Urban Six-Lane Facility with One Reversible Managed Lane



Alternative 4A – Rural – One Reversible Managed Lane

In this alternative for the rural section, the full outside shoulder and the two twelve-foot through lanes would be maintained. The existing four-foot shoulder would be replaced with an eight-foot shoulder and a concrete barrier. The single reversible managed lane would then be added to the center of the corridor as a ten-foot shoulder, twelve-foot managed lane, ten-foot shoulder. The northbound and southbound through lanes would have the same typical cross section. This alternative is a construction alternative and would also require localized improvements to accommodate the managed lane design. Figure 12-16 represents the rural four-lane Alternative 4A.

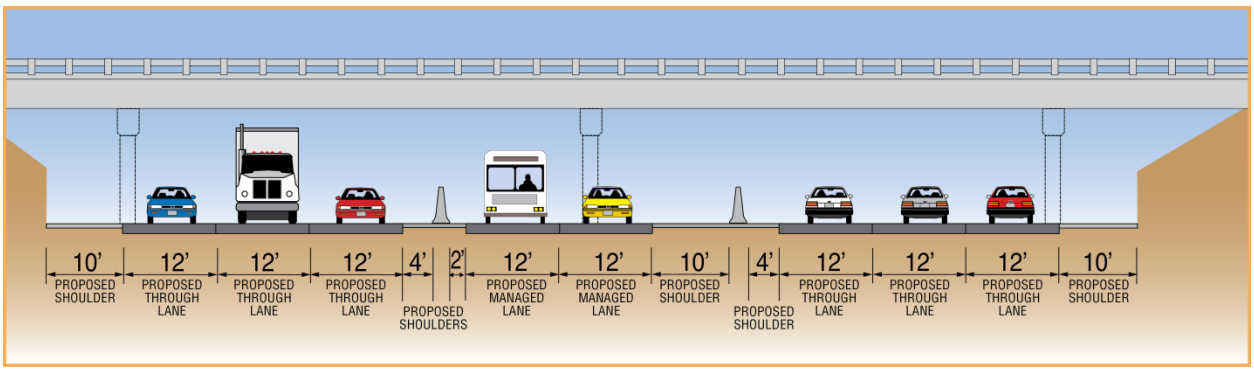
Figure 12-16 Alternative 4A: Rural Four-Lane Facility with One Reversible Managed Lane



Alternative 4B – Urban – Two Reversible Managed Lanes

In this alternative for the urban section, full outside shoulders were maintained and a dual reversible managed lane was added to the center of the corridor. The typical urban cross section would consist of a ten-foot outside shoulder, three twelve-foot through lanes, one four-foot shoulder lane, a concrete barrier, one two-foot shoulder, two twelve-foot reversible managed lanes, and one ten-foot shoulder. The northbound and southbound through lanes would have the same typical cross section. This alternative is a construction alternative and would require the addition of concrete median barrier and also localized improvements to accommodate the managed lane design. Figure 12-17 represents the urban six-lane facility Alternative 4B.

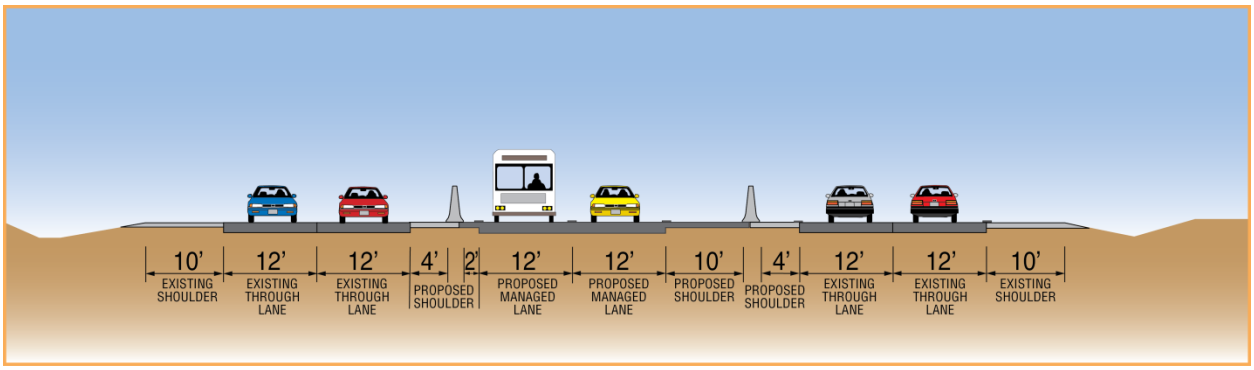
Figure 12-17 Alternative 4B: Urban Six-Lane Facility with Two Reversible Managed Lanes



Alternative 4B – Rural – Two Reversible Managed Lanes

In this alternative for the rural section, full outside shoulders were maintained and a dual reversible managed lane was added to the center of the corridor. The typical rural cross section would consist of a ten-foot outside shoulder, two twelve-foot through lanes, one four-foot shoulder lane, a concrete barrier, one two-foot shoulder, two twelve-foot reversible managed lanes, and one ten-foot shoulder. The northbound and southbound through lanes would have the same typical cross section. This alternative is a construction alternative and would require the addition of concrete median barrier, filling the median, and also localized improvements to accommodate the managed lane design. Figure 12-18 represents the rural four-lane facility Alternative 4B.

Figure 12-18 Alternative 4B: Rural Four-Lane Facility with Two Reversible Managed Lanes

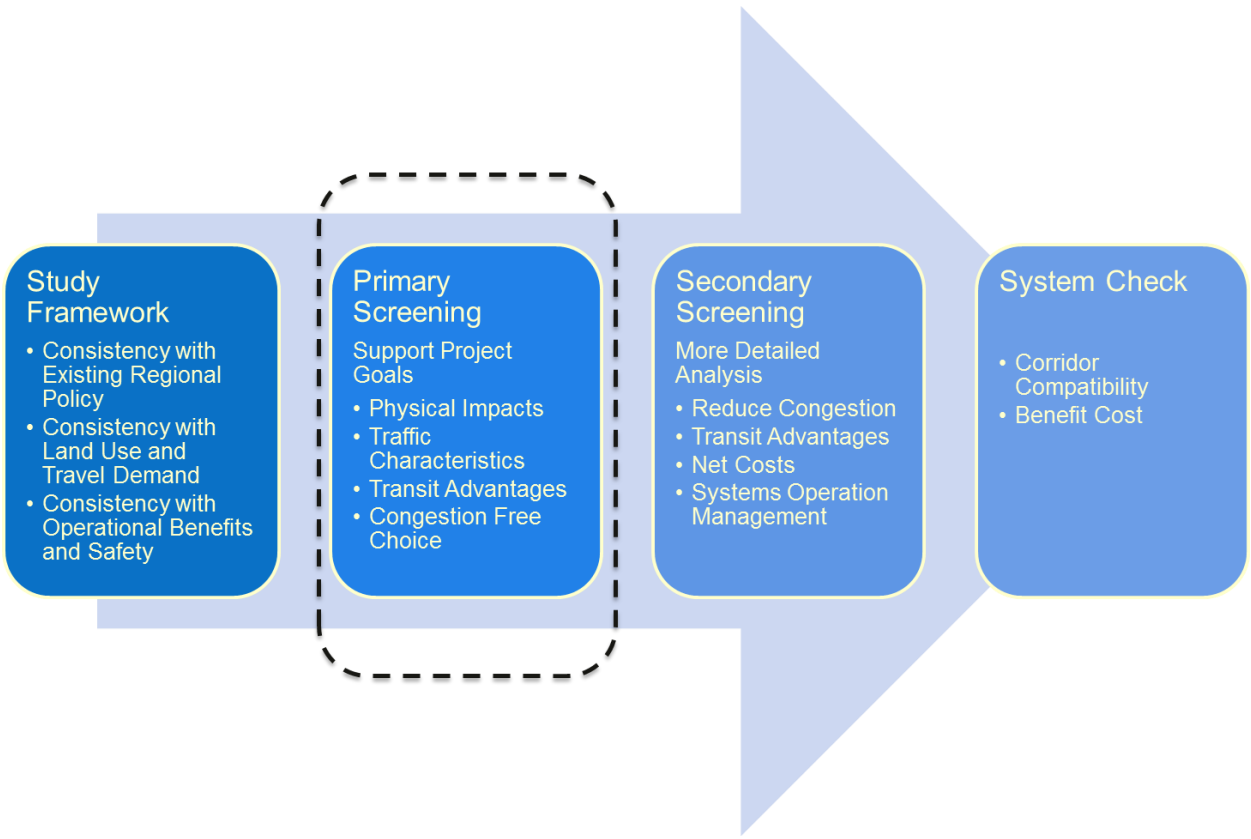


13.0 Primary Screening Analysis

Introduction

The purpose of the primary screening process was to evaluate the corridor alternatives at a high level and recommend alternatives to be carried forward into the more detailed secondary screening process. It is important to note, primary screening process evaluated the corridor alternatives for each segment independently of the other segments. The methodology and results of the primary screening is summarized below. Figure 13-1 identifies the primary screening in the process chart.

Figure 13-1 Process Chart



13.1 Background

The primary screening criteria were previously developed to evaluate how well the corridor alternatives support the project goals. The primary screening criteria consist of:

- Physical Impacts – The physical impact ranking takes into account: pavement replacement (replace shoulder pavement with full depth lane pavement), new pavement (widening), sign structure impacts, and bridge impacts. This information was used to develop an impact rating (1 = low, 3 = high) for each alternative. Each type of impact was weighed (i.e. a bridge impact is more significant than a sign structure impact). This score was used along with other information (length of corridor impacted and number of bridges impacted) to assign a physical impact ranking. It is important to note

that the physical impact ranking (good/fair/poor) is relative to the segment being analyzed. In addition, bridges already scheduled to be replaced were not included as impacts. Appendix D-Typical Sections and Physical Impact Evaluation Criteria provide detailed analysis.

- Traffic Characteristics – The traffic characteristics ranking takes into account the ability of the alternative to relieve congestion and the ability to provide peak and off peak service.
- Transit Advantages – does the alternative provide an advantage for transit users?
- Congestion Free Choice – does the alternative offer a congestion free choice for SOVs, HOVs, and transit users?

Corridor Alternatives

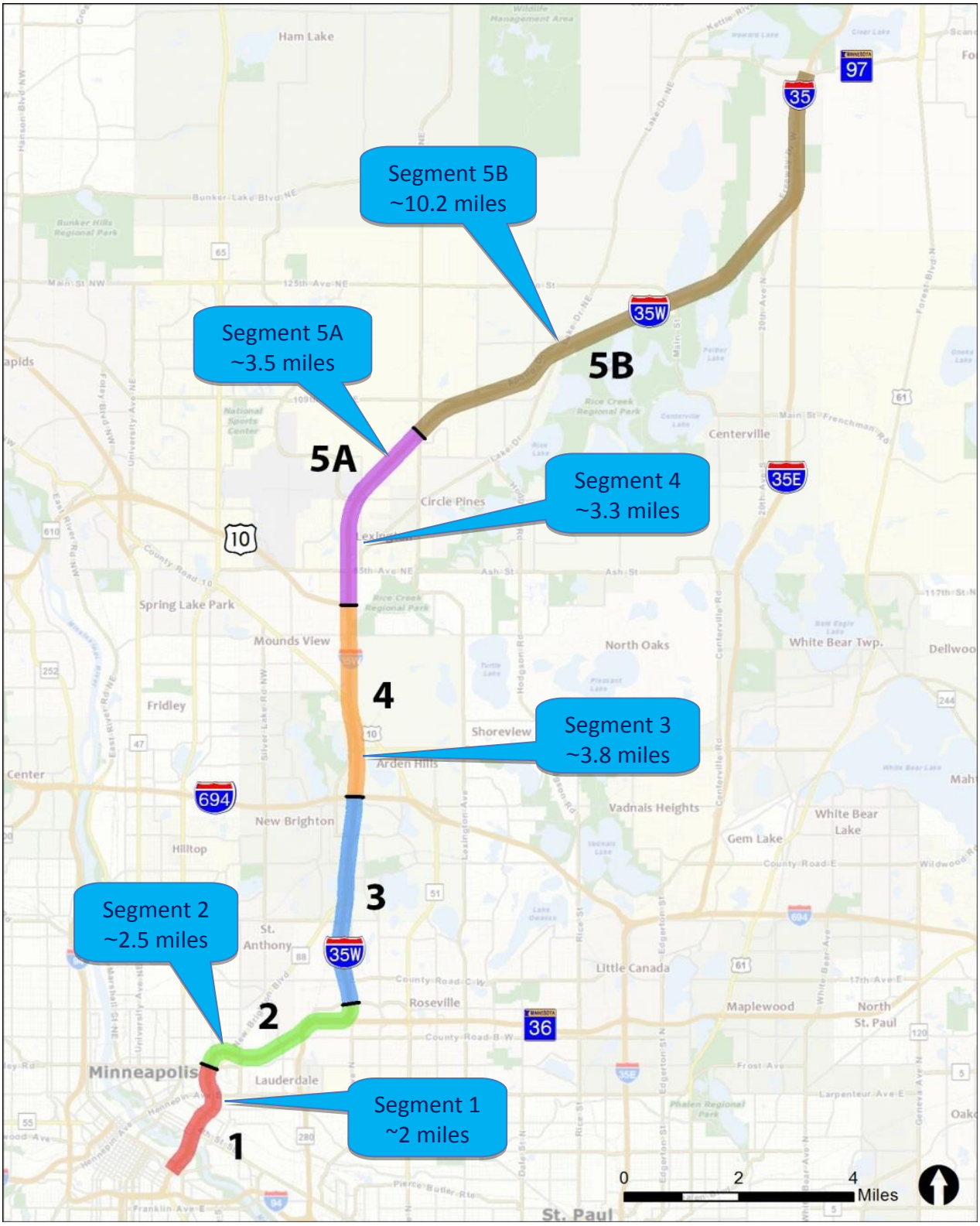
The corridor alternatives were developed to consider different scenarios to physically add a managed lane along the I-35W north corridor. They include the following:

- No-Build
- Alternative 1 - Managed Lane within Existing Pavement Width
- Alternative 2 - Bus Only Shoulder
- Alternative 3A - Managed Lane with Full Shoulders
- Alternative 3B - Managed Lane with Variable Inside Shoulder
- Alternative 4A - One Reversible Managed Lane
- Alternative 4B - Two Reversible Managed Lanes

Corridor Segments

During the study process, the project corridor was divided into five segments based on physical and traffic characteristics. Segment 5 was evaluated as two separate segments (5A and 5B). The exact transition point between segment 5A and B was determined during the secondary screening process. Figure 13-2 identifies these segments.

Figure 13-2 Segment Map



13.2 Segment 1 (3rd/4th Street to Johnson Street) Results

As each segment was evaluated, a summary matrix was populated with the rankings of poor, fair/poor, fair, good, and yes or no. Table 13-1 provides the summary matrix of the primary screening findings for Segment 1.

Table 13-1 Segment 1 (3rd/4th Street to Johnson Street) Results

Alternative	Physical Impacts	Traffic Characteristics	Transit Advantages	Congestion Free Choice	Carry Forward?
No-Build	**Good**	Poor	Fair/Poor	No	No
1 - Managed Lane within Existing Pavement Width	**Good**	**Good**	**Good**	**Yes**	**Yes**
2 - Bus Only Shoulder	**Good**	Fair	Fair	No	No
3A - Managed Lane with Full Shoulders	Fair	**Good**	**Good**	**Yes**	**Yes**
3B - Managed Lane with Variable Inside Shoulder	**Good**	**Good**	**Good**	**Yes**	**Yes**
4A – One Reversible Managed Lane	Poor	Fair	**Good**	**Yes**	No
4B – Two Reversible Managed Lanes	Poor	Fair	**Good**	**Yes**	No

Physical Impacts

The physical composition of Segment 1 is a six-lane urban section with additional auxiliary lanes.

- The no-build alternative will not have any physical impacts to the corridor.
- Alternative 1: Impact Rating = 1.0, 5 percent of segment, 0 bridges
- Alternative 2: Impact Rating = 1.0, 5 percent of segment, 1 bridge
- Alternative 3A: Impact Rating = 1.5, 10 percent of segment, 6 bridges
- Alternative 3B: Impact Rating = 1.2, 5 percent of segment, 4 bridges
- Alternative 4A: Impact Rating = 2.3, 20 percent of segment, 8 bridges
- Alternative 4B: Impact Rating = 2.9, 20 percent of segment, 8 bridges

Traffic Characteristics

The traffic characteristics of Segment 1 included two hours of peak period congestion and a 55/45 directional distribution.

- The no-build alternative consists of the current bus only shoulder service, which is not continuous through this segment. The no-build alternative will not improve current peak hour congestion in this segment.
- Alternative 1 will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 2 will improve from the no-build alternative by completing the bus only shoulder through the entire segment. However, the bus only shoulder maximum operating speed is below free flow conditions.
- Alternative 3A will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 3B will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 4A will improve current peak hour congestion issues, but will not provide both peak and off peak service.
- Alternative 4B will improve current peak hour congestion issues, but will not provide both peak and off peak service.

Transit Advantages

- The no-build alternative will not improve transit operations.
- Alternative 1 will provide free flow conditions for transit service.
- Alternative 2 will improve operations for transit vehicles. However, the bus only shoulder maximum operating speed is below free flow conditions.
- Alternative 3A will provide free flow conditions for transit service.
- Alternative 3B will provide free flow conditions for transit service.
- Alternative 4A will provide free flow conditions for transit service.
- Alternative 4B will provide free flow conditions for transit service.

Congestion Free Choice

- The no-build alternative will not provide a congestion free choice.
- Alternative 1 will provide a congestion free choice.
- Alternative 2 will improve operations for transit vehicles, but it will not provide a congestion free choice.
- Alternative 3A will provide a congestion free choice.

- Alternative 3B will provide a congestion free choice.
- Alternative 4A will provide a congestion free choice.
- Alternative 4B will provide a congestion free choice.

13.3 Segment 2 (Johnson Street to TH 36) Results

Table 13-2 provides the summary matrix of the primary screening findings for Segment 2.

Table 13-2 Segment 2 (Johnson Street to TH 36) Results

Alternative	Physical Impacts	Traffic Characteristics	Transit Advantages	Congestion Free Choice	Carry Forward?
No-Build	**Good**	Poor	Fair/Poor	No	No
1 - Managed Lane within Existing Pavement Width	**Good**	**Good**	**Good**	**Yes**	**Yes**
2 - Bus Only Shoulder	Fair	Fair	Fair	No	No
3A - Managed Lane with Full Shoulders	Fair/Poor	**Good**	**Good**	**Yes**	No
3B - Managed Lane with Variable Inside Shoulder	Fair	**Good**	**Good**	**Yes**	**Yes**
4A – One Reversible Managed Lane	Poor	Fair	**Good**	**Yes**	No
4B – Two Reversible Managed Lanes	Poor	Fair	**Good**	**Yes**	No

Physical Impacts

The physical composition of Segment 2 is a six-lane urban section with additional auxiliary lanes.

- The no-build alternative will not have any physical impacts to the corridor.
- Alternative 1: Impact Rating = 1.2, 5 percent of segment, 1 bridge
- Alternative 2: Impact Rating = 1.7, 30 percent of segment (only 2 feet wide), 5 bridges
- Alternative 3A: Impact Rating = 2.1, 15 percent of segment, 6 bridges
- Alternative 3B: Impact Rating = 1.6, 15 percent of segment, 5 bridges
- Alternative 4A: Impact Rating = 2.5, 10 percent of segment, 6 bridges
- Alternative 4B: Impact Rating = 2.6, 10 percent of segment, 6 bridges

Traffic Characteristics

The traffic characteristics of Segment 2 include one hour of peak period congestion and a 65/35 directional distribution.

- The no-build alternative consists of the current bus only shoulder service, which is not continuous through this segment. The no-build alternative will not improve current peak hour congestion in this segment.
- Alternative 1 will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 2 will improve the no-build alternative by completing the bus only shoulder through the entire segment. However, the bus only shoulder maximum operating speed is below free flow conditions.
- Alternative 3A will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 3B will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 4A will improve current peak hour congestion issues, but will not provide both peak and off peak service.
- Alternative 4B will improve current peak hour congestion issues, but will not provide both peak and off peak service.

Transit Advantages

- The no-build alternative will not improve transit operations.
- Alternative 1 will provide free flow conditions for transit service.
- Alternative 2 will improve operations for transit vehicles. However, the bus only shoulder maximum operating speed is below free flow conditions.
- Alternative 3A will provide free flow conditions for transit service.
- Alternative 3B will provide free flow conditions for transit service.
- Alternative 4A will provide free flow conditions for transit service.
- Alternative 4B will provide free flow conditions for transit service.

Congestion Free Choice

- The no-build alternative will not provide a congestion free choice.
- Alternative 1 will provide a congestion free choice.
- Alternative 2 will improve operations for transit vehicles, but it will not provide a congestion free choice.
- Alternative 3A will provide a congestion free choice.

- Alternative 3B will provide a congestion free choice.
- Alternative 4A will provide a congestion free choice.
- Alternative 4B will provide a congestion free choice.

13.4 Segment 3 (TH 36 to I-694) Results

Table 13-3 provides the summary matrix of the primary screening findings for Segment 3.

Table 13-3 Segment 3 (TH 36 to I-694) Results

Alternative	Physical Impacts	Traffic Characteristics	Transit Advantages	Congestion Free Choice	Carry Forward?
No-Build	**Good**	Poor	Fair/Poor	No	No
1 - Managed Lane within Existing Pavement Width	Poor	**Good**	**Good**	**Yes**	No
2 - Bus Only Shoulder	**Good**	Fair	Fair	No	No
3A - Managed Lane with Full Shoulders	Fair	**Good**	**Good**	**Yes**	**Yes**
3B - Managed Lane with Variable Inside Shoulder	**Good**	**Good**	**Good**	**Yes**	**Yes**
4A – One Reversible Managed Lane	Poor	Fair	**Good**	**Yes**	No
4B – Two Reversible Managed Lanes	Poor	Fair	**Good**	**Yes**	No

Physical Impacts

The physical composition of Segment 3 is a six-lane rural section with additional auxiliary lanes.

- The no-build alternative will not have any physical impacts to the corridor.
- Alternative 1: 95 percent of the segment would require widening, making this alternative not feasible
- Alternative 2: Impact Rating = 1.3, 5 percent of segment, 4 bridges
- Alternative 3A: Impact Rating = 1.8, 5 percent of segment, 3 bridges
- Alternative 3B: Impact Rating = 1.6, 5 percent of segment, 3 bridges
- Alternative 4A: Impact Rating = 2.2, 5 percent of segment, 8 bridges
- Alternative 4B: Impact Rating = 2.4, 5 percent of segment, 9 bridges

Traffic Characteristics

The traffic characteristics of Segment 3 include three plus hours of peak period congestion and a 60/4 directional distribution.

- The no-build alternative will consist of the current bus only shoulder service, which is not continuous through this segment. The no-build alternative will not improve current peak hour congestion in this segment.
- Alternative 1 will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 2 will improve the no-build alternative by completing the bus only shoulder through the entire segment. However, the bus only shoulder maximum operating speed is below free flow conditions.
- Alternative 3A will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 3B will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 4A will improve current peak hour congestion issues, but will not provide both peak and off peak service.
- Alternative 4B will improve current peak hour congestion issues, but will not provide both peak and off peak service.

Transit Advantages

- The no-build alternative will not improve transit operations.
- Alternative 1 will provide free flow conditions for transit service.
- Alternative 2 will improve operations for transit vehicles. However, the bus only shoulder maximum operating speed is below free flow conditions.
- Alternative 3A will provide free flow conditions for transit service.
- Alternative 3B will provide free flow conditions for transit service.
- Alternative 4A will provide free flow conditions for transit service.
- Alternative 4B will provide free flow conditions for transit service.

Congestion Free Choice

- The no-build alternative will not provide a congestion free choice.
- Alternative 1 will provide a congestion free choice.
- Alternative 2 will improve operations for transit vehicles, but it will not provide a congestion free choice.
- Alternative 3A will provide a congestion free choice.

- Alternative 3B will provide a congestion free choice.
- Alternative 4A will provide a congestion free choice.
- Alternative 4B will provide a congestion free choice.

13.5 Segment 4 (I-694 to TH 10 North) Results

Table 13-4 provides the summary matrix of the primary screening findings for Segment 4.

Table 13-4 Segment 4 (I-694 to TH 10 North) Results

Alternative	Physical Impacts	Traffic Characteristics	Transit Advantages	Congestion Free Choice	Carry Forward?
No-Build	**Good**	Poor	Fair	No	No
1 - Managed Lane within Existing Pavement Width	Poor	**Good**	**Good**	**Yes**	No
2 - Bus Only Shoulder	**Good**	Fair	Fair	No	No
3A - Managed Lane with Full Shoulders	Fair	**Good**	**Good**	**Yes**	**Yes**
3B - Managed Lane with Variable Inside Shoulder	Good/Fair	**Good**	**Good**	**Yes**	**Yes**
4A – One Reversible Managed Lane	Poor	Fair	**Good**	**Yes**	No
4B – Two Reversible Managed Lanes	Poor	Fair	**Good**	**Yes**	No

Physical Impacts

The physical composition of Segment 4 is a six-lane rural section with additional auxiliary lanes.

- The no-build alternative will not have any physical impacts to the corridor.
- Alternative 1: 55 percent of segment would require widening, making this alternative not feasible
- Alternative 2: Impact Rating = 1.0, less than 5 percent of segment, 2 bridges (both in STIP)
- Alternative 3A: Impact Rating = 1.8, less than 5 percent of segment, 3 bridges (1 in STIP)
- Alternative 3B: Impact Rating = 1.5, less than 5 percent of segment, 1 bridge (in STIP)

- Alternative 4A: Impact Rating = 2.0, less than 5 percent of segment, 6 bridges (4 in STIP)
- Alternative 4B: Impact Rating = 2.0, less than 5 percent of segment, 7 bridges (4 in STIP)

Traffic Characteristics

The traffic characteristics of Segment 4 include three hours of peak period congestion and a 65/35 directional distribution.

- The no-build alternative will consist of the current bus only shoulder service, which is not continuous through this segment. The no-build alternative will not improve current peak hour congestion in this segment.
- Alternative 1 will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 2 will improve the no-build alternative by completing the bus only shoulder through the entire segment. However, the bus only shoulder maximum operating speed is below free flow conditions.
- Alternative 3A will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 3B will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 4A will improve current peak hour congestion issues, but will not provide both peak and off peak service.
- Alternative 4B will improve current peak hour congestion issues, but will not provide both peak and off peak service.

Transit Advantages

- The no-build alternative will consist of the current bus only shoulders that cover the entire segment (same ranking as Alternative 2).
- Alternative 1 will provide free flow conditions for transit service.
- Alternative 2 will improve operations for transit vehicles. However, the bus only shoulder maximum operating speed is below free flow conditions.
- Alternative 3A will provide free flow conditions for transit service.
- Alternative 3B will provide free flow conditions for transit service.
- Alternative 4A will provide free flow conditions for transit service.
- Alternative 4B will provide free flow conditions for transit service.

Congestion Free Choice

- The no-build alternative will not provide a congestion free choice.
- Alternative 1 will provide a congestion free choice.
- Alternative 2 will improve operations for transit vehicles, but it will not provide a congestion free choice.
- Alternative 3A will provide a congestion free choice.
- Alternative 3B will provide a congestion free choice.
- Alternative 4A will provide a congestion free choice.
- Alternative 4B will provide a congestion free choice.

13.6 Segment 5A (TH 10 N to north of 95th Avenue) Results

Table 13-5 provides the summary matrix of the primary screening findings for Segment 5A.

Table 13-5 Segment 5A (TH 10 N to north of 95th Avenue) Results

Alternative	Physical Impacts	Traffic Characteristics	Transit Advantages	Congestion Free Choice	Carry Forward?
No-Build	**Good**	Fair	Fair	No	No
1 - Managed Lane within Existing Pavement Width	Poor	**Good**	**Good**	**Yes**	No
2 - Bus Only Shoulder	**Good**	Fair	Fair	No	No
3A - Managed Lane with Full Shoulders	**Good**	**Good**	**Good**	**Yes**	**Yes**
3B - Managed Lane with Variable Inside Shoulder	**Good**	**Good**	**Good**	**Yes**	**Yes**
4A – One Reversible Managed Lane	Fair	**Good**	**Good**	**Yes**	No
4B – Two Reversible Managed Lanes	Fair	**Good**	**Good**	**Yes**	No

Physical Impacts

The physical composition of segment 5A is a four-lane rural section with additional auxiliary lanes.

- The no-build alternative will not have any physical impacts to the corridor.

- Alternative 1: 85 percent of segment would require widening, making this alternative not feasible
- Alternative 2: Impact Rating = 1.0, less than 5 percent of segment, 0 bridges
- Alternative 3A: Impact Rating = 1.0, less than 5 percent of segment, 0 bridges
- Alternative 3B: Impact Rating = 1.0, less than 5 percent of segment, 0 bridges
- Alternative 4A: Impact Rating = 1.0, less than 5 percent of segment, 0 bridges
- Alternative 4B: Impact Rating = 1.3, less than 5 percent of segment, 1 bridge

Traffic Characteristics

The traffic characteristics of Segment 5A include two hours of peak period congestion and a 65/35 directional distribution.

- The no-build alternative will consist of the current bus only shoulder service, which is continuous through this segment (same ranking as Alternative 2).
- Alternative 1 will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 2 will improve the no-build alternative by completing the bus only shoulder through the entire segment. However, the bus only shoulder maximum operating speed is below free flow conditions.
- Alternative 3A will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 3B will improve current peak hour congestion issues and provide peak and off peak service.
- Alternative 4A will improve current peak hour congestion issues, but will not provide both peak and off peak service. However, off peak service is not needed based on current volumes and directional split.
- Alternative 4B will improve current peak hour congestion issues, but will not provide both peak and off peak service. However, off peak service is not needed based on current volumes and directional split.

Transit Advantages

- The no-build alternative will consist of the current bus only shoulders that cover the entire segment (same score as Alternative 2).
- Alternative 1 will provide free flow conditions for transit service.
- Alternative 2 will improve operations for transit vehicles. However, the bus only shoulder maximum operating speed is below free flow conditions.
- Alternative 3A will provide free flow conditions for transit service.
- Alternative 3B will provide free flow conditions for transit service.

- Alternative 4A will provide free flow conditions for transit service.
- Alternative 4B will provide free flow conditions for transit service.

Congestion Free Choice

- The no-build alternative will not provide a congestion free choice.
- Alternative 1 will provide a congestion free choice.
- Alternative 2 will improve operations for transit vehicles, but it will not provide a congestion free choice.
- Alternative 3A will provide a congestion free choice.
- Alternative 3B will provide a congestion free choice.
- Alternative 4A will provide a congestion free choice.
- Alternative 4B will provide a congestion free choice.

13.7 Segment 5B (North of 95th Avenue to TH 97) Results

Table 13-6 provides the summary matrix of the primary screening findings for Segment 5B.

Table 13-6 Segment 5B (North of 95th Avenue to TH 97) Results

Alternative	Physical Impacts	Traffic Characteristics	Transit Advantages	Congestion Free Choice	Carry Forward?
No-Build	**Good**	**Good***	**Good***	**Yes***	**Yes**
1 - Managed Lane within Existing Pavement Width	Poor	N/A	N/A	N/A	No
2 - Bus Only Shoulder	**Good**	N/A	N/A	N/A	No
3A - Managed Lane with Full Shoulders	**Good**	N/A	N/A	N/A	No
3B - Managed Lane with Variable Inside Shoulder	**Good**	N/A	N/A	N/A	No
4A – One Reversible Managed Lane	Fair	N/A	N/A	N/A	No
4B – Two Reversible Managed Lanes	Fair	N/A	N/A	N/A	No

* Since Segment 5B does not experience congestion or is expected to experience congestion in the future, all vehicles will travel at free flow speeds.

Physical Impacts

The physical composition of Segment 5B is mainly a four-lane rural section. The segment north of the I-35W/I-35E junction, is a six-lane rural section.

- The no-build alternative will not have any physical impacts to the corridor.
- Alternative 1: 85 percent of segment would require widening, making this alternative not feasible
- Alternative 2: Impact Rating = 1.2, less than 5 percent of segment, 1 bridge
- Alternative 3A: Impact Rating = 1.8, less than 5 percent of segment, 1 bridge
- Alternative 3B: Impact Rating = 1.5, less than 5 percent of segment, 1 bridge
- Alternative 4A: Impact Rating = 1.6, 5 percent of segment, 3 bridges
- Alternative 4B: Impact Rating = 2.2, 10 percent of segment, 4 bridges

Traffic Characteristics

The traffic characteristics of Segment 5B include occasional congestion on the southern portion during the a.m. peak hour and a 70/30 directional distribution.

- The no-build alternative satisfies the traffic characteristics criteria for this segment. Most of the segment is congestion free except for the extreme southern portion during the a.m. peak hour. This congestion is generated downstream in Segment 4 and the traffic queues spill back into Segment 5B. Therefore, the remaining alternatives are excessive and not needed.

Transit Advantages

- The no-build alternative satisfies the transit advantages criteria for this segment. Most of the segment is congestion free which will result in transit vehicles operating at free flow conditions. Therefore, the remaining alternatives are excessive and not needed.

Congestion Free Choice

- The no-build alternative satisfies the congestion free choice criteria for this segment. Most of the segment is congestion free which will result in all vehicles operating at free flow conditions. Therefore, the remaining alternatives are excessive and not needed.

13.8 Summary

Based on the primary screening, the following corridor alternatives are recommended and should be carried forward to the secondary screening process.

Segment 1 (3rd/4th Street to Johnson Street)

- Alternative 1 - Managed Lane within Existing Pavement Width
- Alternative 3A - Managed Lane with Full Shoulder
- Alternative 3B - Managed Lane with Minimal Shoulder

Segment 2 (Johnson Street to TH 36)

- Alternative 1 - Managed Lane within Existing Pavement Width
- Alternative 3B - Managed Lane with Minimal Shoulder

Segment 3 (TH 36 to I-694)

- Alternative 3A - Managed Lane with Full Shoulder
- Alternative 3B - Managed Lane with Minimal Shoulder

Segment 4 (I-694 to TH 10 North)

- Alternative 3A - Managed Lane with Full Shoulder
- Alternative 3B - Managed Lane with Minimal Shoulder

Segment 5A (TH 10 N to north of 95th Avenue)

- Alternative 3A - Managed Lane with Full Shoulder
- Alternative 3B - Managed Lane with Minimal Shoulder

Segment 5B (North of 95th Avenue to TH 97)

- No-Build

14.0 Additional Corridor Alternative

During the secondary screening process, it was determined that Alternative 1 should be broken into two sub-alternatives; one of these sub-alternatives would use intelligent transportation systems to achieve the study goals. Former Alternative 1 became Alternative 1A and Alternative 1B became formalized as a new alternative. The following are the alternative descriptions:

- Alternative 1A – Managed Lane within Existing Pavement Width
- Alternative 1B – Southbound Dynamic Managed Shoulder/Lane

Alternative 1A – Managed Lane within Existing Pavement Width

Alternative 1A retains all the characteristics of Alternative 1 previously presented. This alternative provides a managed lane by reallocating the lane and shoulder widths to accommodate an inside managed lane.

Alternative 1B – Southbound Dynamic Managed Shoulder/Lane

Alternative 1B is similar to Alternative 1A as it introduces a managed lane without pavement widening, however Alternative 1B affects the southbound direction only. This option introduces placing dynamic lane controls above each southbound lane at a set designated interval. The outside lane may be designated as a general purpose through lane or as a shoulder lane and the inside lane may be designated as a managed lane or a general purpose lane.

This alternative is applicable for the urban section only. The southbound urban cross section would include a four-foot outside shoulder, a 12-foot dynamic general purpose lane/shoulder lane, two 12-foot though lanes, a two-foot buffer lane, a 12-foot dynamic managed/general purpose lane and a two-foot shoulder.

Figure 14-1 represents Alternative 1B with the inside lane operated as a dynamic managed lane and the outside lane operating as a dynamic general purpose lane. Figure 14-2 represents Alternative 1B with the inside lane operated as a dynamic general purpose lane and the outside lane operated as a dynamic shoulder.

Figure 14-1 Alternative 1B - Southbound Dynamic Managed Shoulder/Lane

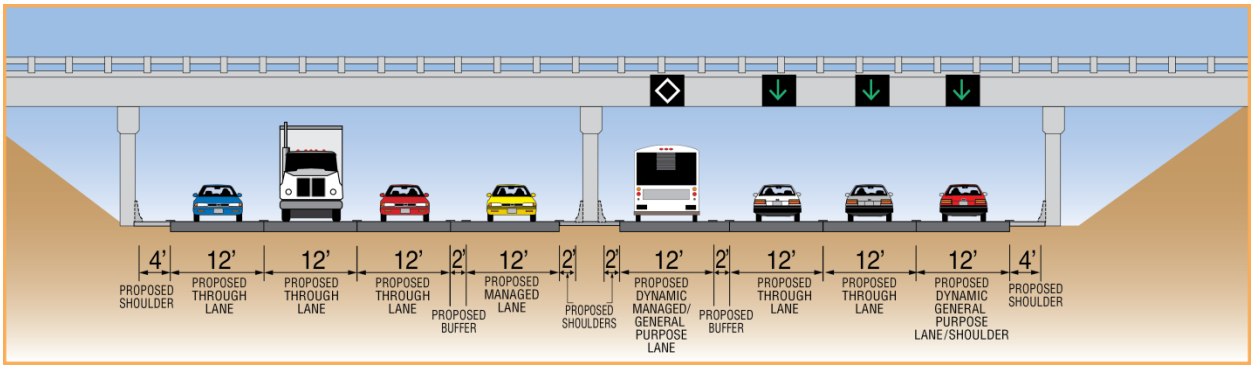
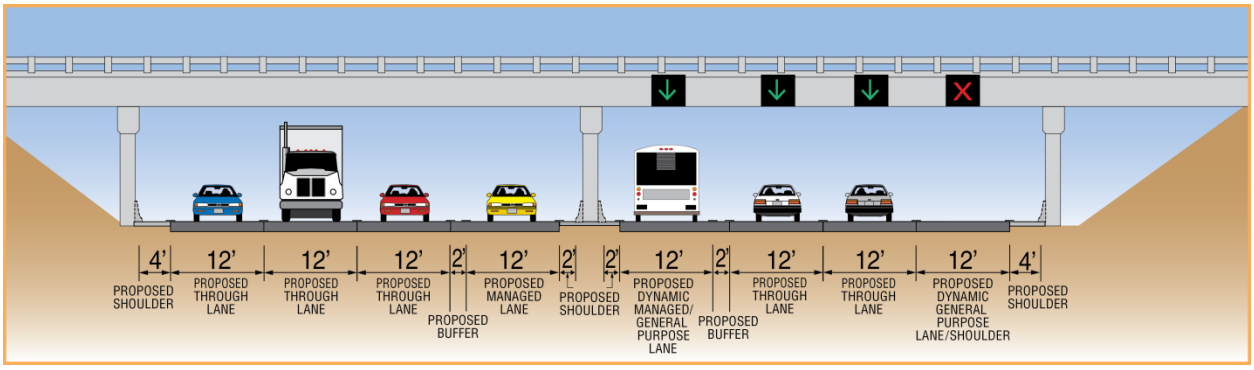


Figure 14-2 Alternative 1B - Southbound Dynamic Managed Shoulder/Lane

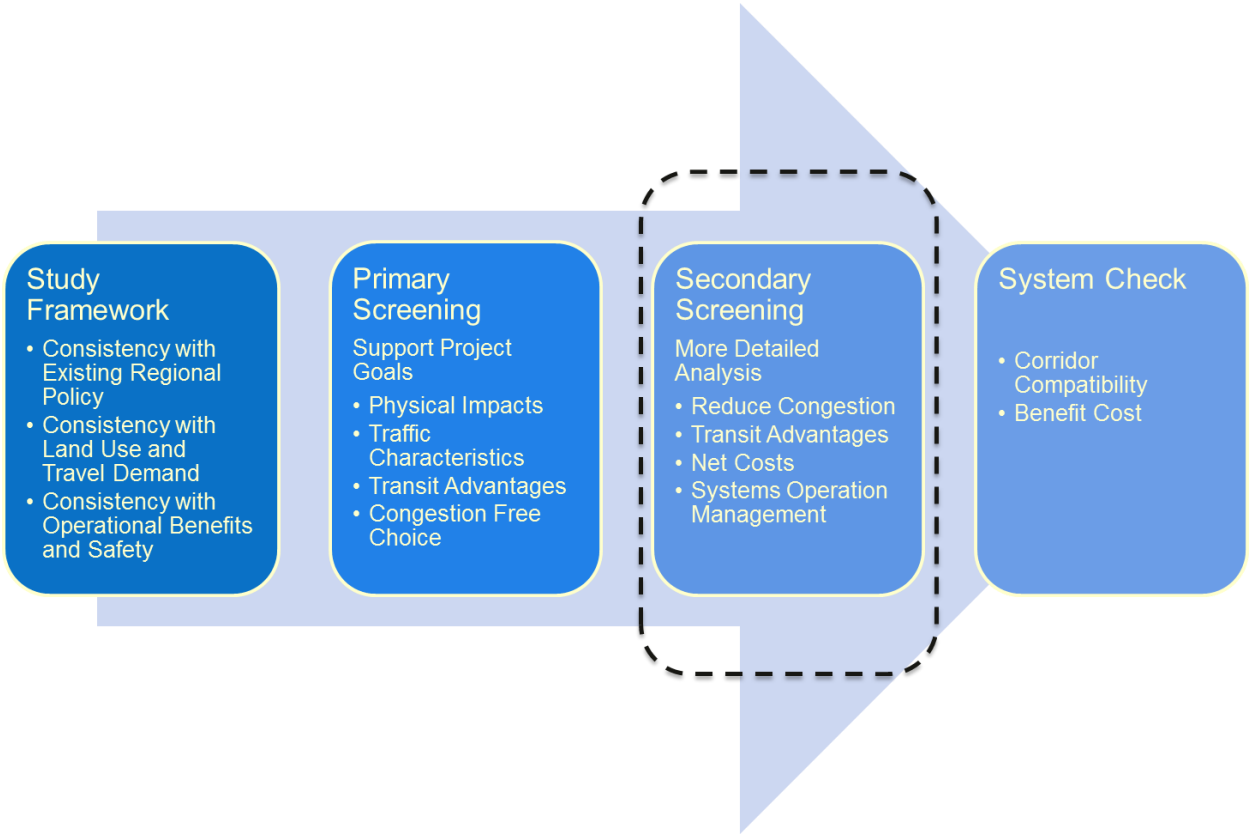


15.0 Secondary Screening Analysis

Introduction

The purpose of the secondary screening process was to complete a detailed evaluation of the corridor alternatives that were carried forward from the primary screening analysis. The methodology and results of the primary screening is summarized below. Figure 15-1 identifies the secondary screening in the process chart.

Figure 15-1 Process Chart



15.1 Background

The secondary screening criteria were developed to evaluate how well detailed evaluations of the corridor alternatives support the project goals. Evaluation of secondary screening alternatives included the following:

- Development of alternatives in Computer-Aided Design (CAD)
- Identification of geometric issues
- Development of cost estimates
- Development of traffic forecast
- Analysis of operations

Based on the primary screening and subsequent work that split Alternative 1 into Alternative 1A and Alternative 1B, the following alternatives were carried forward to the secondary screening analysis. Table 15-1 provides a summary of secondary screening alternatives.

Table 15-1 Secondary Screening Alternatives

Alternative	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
No-Build					
1 - Managed Lane within Existing Pavement Width	X	X			
2 - Bus Only Shoulder	X	X			
3A - Managed Lane with Full Shoulders					
3B - Managed Lane with Variable Inside Shoulder	X		X	X	X
4A – One Reversible Managed Lane	X	X	X	X	X
4B – Two Reversible Managed Lanes					
No-Build					

Development of Alternatives in CAD

The managed lane alternatives were prepared using CAD software to illustrate the concepts. This allowed engineers to determine how these concepts would properly tie into existing or proposed roadway configurations and understand associated impacts. It also provided an indication of where physical constraints impacted concept designs, potentially requiring additional construction or insurmountable obstacles. The CAD software was also able to provide construction quantities for the concepts such as new pavement surface area and bridge dimensions.

Identification of Geometric Issues

In some locations, implementation of the managed lane alternatives may require modifications to existing infrastructure along the corridor. The most common example of this condition was the need to widen freeway bridges over other various crossings or lengthen local roadway bridges over the freeway. Once these locations have been identified, the applicable improvements can be added to the concept design. Other examples include retaining walls, water bodies, and right of way boundaries.

Development of Cost estimates

Construction quantities were developed and then costs estimated by using unit costs. The total cost for the alternatives were then multiplied by a series of inflation factors, contingency costs,

and engineering allowances to produce the cost estimate. Complete cost estimate calculations for the managed lane alternatives and spot improvement options are provided in Appendix F – Cost Estimates.

Development of Traffic Forecasts and Assumptions

Traffic and transit forecasts were prepared for the secondary screening process using the Twin Cities RTDM, with additional detail incorporated specifically for the I-35W North Managed Lanes Corridor Study. A more extensive summary of the travel demand forecasting process is available in the Managed Lanes Forecasts chapter and complete details are documented in a separate technical memorandum located in Appendix B. Memorandum includes details on assumed roadway improvements, increased transit service, and future land use. Changes to existing and future traffic volumes and transit ridership discussed in the secondary screening process were produced as part of the travel demand forecasting effort.

The managed lane alternatives evaluated in the secondary screening differ based on their cross-sectional elements and construction impacts. For the purposes of the forecasting and operations analyses, the general characteristics of the managed lanes were consistent across all the alternatives. The northbound and southbound managed lanes were assumed to be in place along I-35W between University Avenue/4th Street in Minneapolis and Lexington Avenue in Blaine. These managed lanes were assumed to operate under the same conditions as existing MnPASS lanes along I-35W south of Minneapolis and along I-394, specifically that transit and HOVs are allowed to use the lanes for free and SOV trips are allowed access by paying a dynamic toll collected through in-vehicle transponders.

Operational Model for Secondary Screening

The CORSIM operations model was updated to evaluate the addition of managed lanes along the I-35W north corridor. This was accomplished by updating the model that included all the programmed improvements in the study area. To evaluate the alternatives, a managed lane was added to I-35W between University Avenue SE in Minneapolis and Lexington Avenue in Blaine, with access limited to HOVs and toll-paying SOVs. While Alternatives 1A, 1B, 3A, and 3B have slightly different physical cross sections, all of these alternatives provide the same capacity increase and have the same operating characteristics. The CORSIM operations model is not sensitive to changes in shoulder width; therefore only one CORSIM model was prepared for the managed lanes alternatives. Appendix E provides full CORSIM operation results.

Updated traffic volumes were used for the managed lanes operations model. The peak hour freeway volumes used in the operations model are provided in Appendix B. The following section describes the concepts that were evaluated in the operations model and summarizes the observed results.

The operations modeling with the managed lanes along I-35W showed significant differences in traffic conditions compared to the existing or programmed improvements conditions. Many locations with existing congestion were observed to have reduced congestion as a result of the increase capacity with the managed lane. There were also locations that do not currently experience congestion, but were observed to have increased congestion as a result of the

increased traffic delivered by the managed lane. Selected speed, level of service, and vehicle throughput results are provided in Table 15-2 and Table 15-3.

Table 15-2 Selected CORSIM Results for A.M. Peak Hour Managed Lanes Alternative

Southbound I-35W - AM Peak Hour	Programmed Conditions			Managed Lane Conditions		
Location	Speed	LOS	Throughput	Speed	LOS	Throughput
Segment 5 (95th Ave to Lake Dr)	38	F	3,525	60	C	3,700
Segment 4 (CR H to CSAH 10)	30	F	7,600	53	D	8,400
Segment 4 (CSAH 96 to I-694)	39	F	6,175	43	E	7,050
Segment 3 (CR D to CR C)	54	E	6,100	55	D	6,925
Segment 2 (Industrial Blvd to New Brighton Blvd)	63	C	5,575	63	B	6,050
Segment 1 (Johnson St to Hennepin Ave)	57	D	5,975	60	C	6,525

These results show all locations along I-35W are expected to have increased speed, improved level of service, and increased throughput with the addition of managed lanes. Model observations showed the addition of a managed lane provides relief for existing congestion occurring at the southbound I-35W bottleneck near I-694. No locations with increased congestion were observed along southbound I-35W during the a.m. peak hour with the addition of managed lanes.

Table 15-3 Selected CORSIM Results for A.M. Peak Hour Managed Lanes Alternative

Northbound I-35W - PM Peak Hour	Programmed Conditions			Managed Lane Conditions		
Location	Speed	LOS	Throughput	Speed	LOS	Throughput
Segment 1 (Hennepin Ave to Johnson St)	51	D	6,625	54	D	6,950
Segment 2 (New Brighton Blvd to Industrial Blvd)	64	B	6,050	64	B	6,350
Segment 3 (CR 88 to CR E2)	23	F	5,300	60	C	6,100
Segment 4 (I-694 to CSAH 96)	44	F	6,150	47	E	7,000
Segment 4 (CR I to TH 10)	47	E	8,050	45	E	8,600
Segment 5 (Lake Dr to 95th Ave)	59	E	4,150	61	C	4,475

Results for the p.m. peak hour show most locations along northbound I-35W are expected to have increased speed, improved level of service, and increased throughput with the addition of managed lanes. In particular, the existing congestion along northbound I-35W at I-694 that queues back to TH 36 is almost virtually eliminated with the addition of a managed lane. However, the effects of this traffic getting through the I-694 bottleneck results in new congestion extending south from the TH 10 north interchange. This was observed to occur due to increased volumes reaching the area and managed lane traffic making multiple lane changes to access the exit to TH 10 westbound.

Analysis of Operations - Secondary Screening Criteria

The secondary screening criteria were developed to evaluate how well the corridor alternatives support the project goals. The secondary screening criteria consisted of:

- Reduce congestion
- Transit advantages
- Systems operations management
- Net costs

Each criterion was comprised of multiple sub-criteria, some of which are quantitative and some qualitative. As the alternatives were evaluated against the criteria, a summary matrix was populated with rankings combining the elements. Quantitative rankings of alternatives used a five-point scale ranging from good to poor, with good having a rating value of five and poor having a rating value of one. The five point rating scale is summarized in Table 15-4.

Table 15-4 Five Point Rating Scale

Qualitative Rating	Good	Good-Fair	Fair	Fair-Poor	Poor
Rating Value	5	4	3	2	1

During the study process, the project corridor was divided into five segments based on physical and traffic characteristics. During the primary screening process, corridor alternatives were evaluated for each segment and some alternatives were eliminated from further study. The secondary screening evaluated all alternatives that were carried forward from the primary screening. It is important to note that the secondary screening process evaluated the corridor alternatives with the assumption that the entire corridor would be operated as a managed lane corridor.

15.2 Criterion 1: Reduce Congestion

Criterion 1 consists of five sub-criteria:

- Increase vehicle throughput (peak hour)
- Increase person throughput (peak hour)
- Improve corridor travel time
- Vehicle miles traveled
- Vehicle hours traveled

Tools used to evaluate alternatives against the sub-criteria consisted of the CORSIM model and the Twin Cities RTDM. The first two sub-criteria were evaluated by comparing the no-build condition to the managed lane build condition using year 2010 traffic volumes. The last three sub-criteria were evaluated by comparing the no-build condition to the managed lane build

condition using both year 2010 and year 2030 forecast traffic volumes. The results for this analysis were quantitative based on the availability of numeric results from the models. The results for this criterion do not vary from segment to segment, as it was necessary to assume the managed lanes were in place for the full length of the corridor. The following explains each sub-criteria and the results for each alternative.

Increase Vehicle Throughput

Increase vehicle throughput was a quantitative analysis resulting in a fair rating for all alternatives. Under no-build conditions the existing congestion was limiting the vehicle throughput, in build condition a slight increase was seen, due to congestion limiting throughput in the general purpose lanes and free-flow conditions in the managed lane. The estimated peak hour throughput and difference for existing demand in vehicle throughput is summarized in Table 15-5.

Table 15-5 Increase Vehicle Throughput – Existing Peak Hour

	No Build		All Alternatives			
	Total Cars		Total Cars		Difference	
Segment	SB (AM)	NB (PM)	SB (AM)	NB (PM)	SB (AM)	NB (PM)
Segment 1	6,200	6,650	6,775	7,375	575	725
Segment 2	6,275	7,875	6,875	8,575	600	700
Segment 3	6,175	5,350	7,225	6,125	1,050	775
Segment 4	7,575	8,125	8,650	8,875	1,075	750
Segment 5	4,500	5,175	4,725	5,675	225	500
Overall Result	Fair					

Increase Person Throughput

Increase person throughput was a quantitative analysis resulting in a good rating for all alternatives. Person throughput in the build condition was high, due to higher vehicle occupancies in HOVs using the managed lane and an increase in transit ridership expected for the build condition. Analysis was performed for both the existing a.m. peak hour (southbound) and the existing p.m. peak hour (northbound). Existing peak hour increase person throughput is summarized in Table 15-6, Table 15-7 and Table 15-8.

Table 15-6 Increase Person Throughput – Existing AM Peak Hour (Southbound)

	No-Build			All Alternatives					
	General Purpose			General Purpose	Managed Lane				
Segment	In Cars	Transit Riders	Total	In Cars	In Cars	Transit Riders	Total	Total	Change
Segment 1	6,925	825	7,750	6,375	2,075	875	2,950	9,325	1,575
Segment 2	6,850	800	7,650	6,400	1,925	850	2,775	9,175	1,525
Segment 3	6,675	425	7,100	6,400	2,475	475	2,950	9,350	2,250
Segment 4	8,150	475	8,625	7,725	2,700	525	3,225	10,950	2,325
Segment 5	4,800	425	5,225	4,200	1,400	475	1,875	6,075	850

Table 15-7 Increase Person Throughput – Existing PM Peak Hour (Northbound)

	No-Build			All Alternatives					
	General Purpose			General Purpose	Managed Lane				
Segment	In Cars	Transit Riders	Total	In Cars	In Cars	Transit Riders	Total	Total	Change
Segment 1	7,425	925	8,350	6,925	2,350	1,000	3,350	10,275	1,925
Segment 2	8,575	900	9,475	8,175	2,150	975	3,125	11,300	1,825
Segment 3	5,775	475	6,250	5,525	2,000	550	2,550	8,075	1,825
Segment 4	8,725	550	9,275	8,100	2,575	625	3,200	11,300	2,025
Segment 5	5,525	475	6,000	5,275	1,350	550	1,900	7,175	1,175

Table 15-8 Increase Person Throughput – Existing Combined Peak Hour Demand

Segment	No-Build		All Alternatives		Change	
	SB (AM)	NB (PM)	SB (AM)	NB (PM)	SB (AM)	NB (PM)
Segment 1	7,750	8,350	9,325	10,275	1,575	1,925
Segment 2	7,650	9,475	9,175	11,300	1,525	1,825
Segment 3	7,100	6,250	9,350	8,075	2,250	1,825
Segment 4	8,625	9,275	10,950	11,300	2,325	2,025
Segment 5	5,225	6,000	6,075	7,175	850	1,175
Overall Result					**Good**	

Improve Corridor Travel Time

Improve corridor travel time was a quantitative analysis resulting in a good rating for all alternatives. The travel demand model was used to obtain average daily corridor travel times for the no-build and build conditions in years 2010 and 2030 for each alternative. The results for the year 2010 conditions and year 2030 conditions, shown in parentheses, are summarized in Table 15-9.

Table 15-9 Improve Corridor Travel Time – Average Daily Corridor Travel Times

Travel Time (minutes)	No-Build	Alt. 1A	Alt. 1B	Alt. 3A	Alt. 3B
Average Travel Time – All Lanes 2010 (2030)*	36.2 (45.6)	35.5 (44.2)	35.5 (44.2)	35.2 (43.7)	35.2 (43.7)
Travel Time Savings – All Lanes		0.7 (1.4)	0.7 (1.4)	1.0 (1.9)	1.0 (1.9)
Average Travel Time – Managed Lanes		30.9 (35.2)	30.9 (35.2)	30.9 (35.2)	30.9 (35.2)
Travel Time Savings – Managed Lanes		5.3 (10.4)	5.3 (10.4)	5.3 (10.4)	5.3 (10.4)
Overall Result		**Good**	**Good**	**Good**	**Good**

Vehicle Miles Traveled (VMT)

VMT was a quantitative analysis that used modeling, which resulted in a good rating for all alternatives. With modeling, a change in total VMT, freeway VMT and non-freeway was determined, comparing no-build and build conditions for years 2010 and 2030. Results showed net increases in VMT as trips shifted to I-35W corridor from other routes, which may be a longer route but provides travel time savings due to higher speeds. The results also show increased freeway VMT from increased travel in managed lanes and decreased non-freeway VMT which results in safety benefits. Crash statistics indicate that freeway travel is safer than non-freeway travel.

The VMT results are measured regionally, rather than by specific segment and they do not vary between alternatives. These results were obtained from the Twin Cities RTDM and are consistent across all. The VMT is summarized in Table 15-10.

Table 15-10 Vehicle-Miles Traveled (VMT)

Measure	Existing	Year 2030
Change in Total VMT	+20,000	+32,000
Change in Freeway VMT	+42,000	+61,000
Change in Non-Freeway VMT	-22,000	-29,000
Overall Result	**Good**	

Vehicle Hours Traveled (VHT)

VHT analysis was again quantified using modeling tools. Results varied from good-fair for Alternative 1A and Alternative 1B to good for Alternative 3A and Alternative 3B. Narrow shoulders in Alternative 1A and Alternative 1B contributed to a good-fair rating as the *Highway Capacity Manual* states narrow shoulders result in slightly slower speeds; resulting in a slightly less change in VHT. Two study events were also evaluated, the VHT change with both a Target Field event and a Metrodome event. Change in daily VHT along with the change in VHT for two downtown Minneapolis events are summarized in Table 15-11.

Table 15-11 Vehicle-Hours Traveled (VHT)

Measure	Alternative 1A	Alternative 1B	Alternative 3A	Alternative 3B
Change in Daily VHT 2010 (2030)	-2,200 (-5,900)	-2,200 (-5,900)	-2,600 (-6,500)	-2,600 (-6,500)
VHT Change (Target Field Event)	-575	-575	-575	-575
VHT Change (Metrodome Event)	-625	-625	-625	-625
Overall Result	**Good-Fair**	**Good-Fair**	**Good**	**Good**

Risk Assessment

Risks associated with the results for Criterion 1 pertain to potential inaccuracies of the travel demand and CORSIM modeling tools used for the evaluation. While these tools are accepted industry wide, the assumptions regarding projected population and job growth, development patterns, and traffic characteristics pose sources of uncertainty and risk.

15.3 Criterion 2: Transit Advantages

Criterion 2 consists of three sub-criteria:

- Improve transit time reliability
- Increase transit ridership
- Reduce transit travel time

Alternatives were evaluated against these sub-criteria using results from the travel demand and CORSIM models. The results for the analysis were both quantitative and qualitative. The results for this criterion do not vary from segment to segment but do exhibit variability between alternatives.

BRT was not assumed in this analysis. If online stations were provided, BRT results would follow the same pattern as the express bus results. If inline or offline stations were provided, BRT results would follow the same pattern as the limited stop service results because BRT would likely not weave over to use the managed lanes between stops. The early analysis concluded that managed lanes would not preclude the provision of BRT service if desired. Please see the section on BRT for more information.

Improve Transit Time Reliability

Transit time reliability was evaluated by considering transit impacts for non-recurring events such as accidents and severe weather. These results were qualitative. Results expressed are for a managed lane build condition. Express service reliability was given a good rating for all

alternatives due to the expectation that an express bus would use a managed lane. Limited stop bus service reliability was given a fair-poor rating for Alternative 1A, a fair rating for Alternative 1B and a good Alternative for 3A and 3B. Limited stop service would not be expected to use a managed lane, but rather a bus only shoulder as provided and as the driver deems appropriate.

Alternative 1A was rated fair-poor due to the absence of bus only shoulders. Alternative 1B was rated fair as the lane control signals would have the ability to designate a bus only shoulder should the conditions necessitate it. This was slightly higher than Alternative 1A due to the increased flexibility for lane utilization. Alternatives 3A and 3B were rated good. Full right-side shoulders were provided in these alternatives which allow the use of bus only shoulders.

For the purpose of this study, limited stop service is a bus route that uses I-35W to travel from bus stop-to-bus stop. Limited stop service is a small percent of transit use; Route 118 running between the University of Minnesota and Columbia Heights represents the limited stop service. Transit time reliability improvement projections are summarized in Table 15-12.

Table 15-12 Improve Transit Time Reliability

Qualitative Assessment	Alternative 1A	Alternative 1B	Alternative 3A	Alternative 3B
Express Service Reliability	Good	Good	Good	Good
Limited Stop Service Reliability*	Fair-Poor	Fair	Good	Good
Overall Reliability	**Fair**	**Good-Fair**	**Good**	**Good**

Increase Transit Ridership

Increase in transit ridership was evaluated using the transit component of the travel demand model. Increase in transit ridership resulted in a good-fair rating as express bus ridership increased by 13 percent in all alternatives and limited stop bus ridership was projected to have minimal change. The increase in transit ridership for express bus service is expected based on the improved travel time for buses using the managed lanes. The increase in transit ridership projections are summarized in Table 15-13. BRT service was not included in the express bus ridership assessment.

Table 15-13 Increase in Transit Ridership

Year 2030 Conditions	All Alternatives
Express Bus Ridership	+400 (+13%)
Limited Stop Bus Ridership	Minimal Change
Overall Result	**Good-Fair**

Reduce Transit Travel Time

Reduced transit travel time was measured using a process similar to evaluation of VHT for highway forecasts. Specifically, the travel time for each route in the corridor was estimated for no-build and build conditions. These travel times were then multiplied by the number of riders on each route. The total travel times for all riders on all routes are summed. The travel time improvement for all alternatives compared to no-build conditions resulted in a good rating for all alternatives. Results were evaluated comparing no-build year 2010 passenger hour conditions with managed lane year 2030 passenger hour conditions. Reductions in transit travel time for a managed lane build condition are summarized in Table 15-14.

Table 15-14 Reduce Transit Travel Time

Criteria	No Build	Alternative 1A	Alternative 1B	Alternative 3A	Alternative 3B
Express Bus Travel Time		Good	Good	Good	Good
Limited Stop Bus Travel Time		Minimal Change	Minimal Change	Minimal Change	Minimal Change
Daily Passenger Hours 2010 (2030)	830 (1,780)	680 (1,230)	680 (1,230)	680 (1,230)	680 (1,230)
Passenger Hour Savings 2010 (2030)		-150 (-550)	-150 (-550)	-150 (-550)	-150 (-550)
Overall Result		**Good**	**Good**	**Good**	**Good**

Risk Assessment

Similar to the uncertainties in Criterion 1, the evaluation of transit travel time and ridership is built on a series of assumptions regarding future land use changes and traffic conditions. The results presented carry some risk in that real-world conditions may not match these assumptions. This may result in changes to the transit travel times and forecast ridership.

The transit travel time reliability was evaluated qualitatively and is subject to risk associated with the analysts' interpretation of the associated influence factors.

15.4 Criterion 3: Systems Operations Management

Criterion 3 consists of three sub-criteria:

- Maintain transport of goods
- Incident management
- Enforcement

Tools used to evaluate the sub-criteria consisted of assessing no-build conditions compared to managed lane conditions for each alternative. The results for the analysis were qualitative. Results varied from fair-poor for Alternative 1A, fair for Alternative 1B, to good-fair for Alternative 3A and Alternative 3B. The results for this criterion do not vary from segment to segment but do vary among the alternatives.

Maintain Transport of Goods

Maintain transport of goods was evaluated by assessing two important characteristics:

- Improve freight travel time
- Improve corridor reliability

Improve freight travel time focused on the overall corridor travel time as it pertains to large freight vehicles, with lower segment travel times receiving a higher rating. The improve corridor reliability criteria focused on the overall corridor travel time, with improvements in the number of lanes and the width or presence of shoulders providing a higher rating. Important components to determine the ratings were assessed with the gauges presented in Table 15-15.

Improvements to freight travel time were referenced from the corridor travel times shown in Table 15-9 Improve Corridor Travel Time – Average Daily Corridor Travel Time, for the evaluation of corridor travel times. It is expected that heavy trucks would have the same travel times as stated for general purpose lanes under the managed lane conditions, since large and multi-unit trucks are not eligible to use the managed lanes. All of the alternatives have similar results. The addition of managed lanes was not expected to eliminate all congestion in the corridor, so improvements to travel times in the general purpose lanes are modest. As a result, all alternatives have been assigned a fair rating.

Corridor reliability for freight was evaluated qualitatively based on potential conditions under a non-recurring congestion scenario, such as a crash or severe weather. Alternative 1A was rated poor because the lack of shoulders could cause severe traffic impacts under these types of conditions. Alternative 1B was rated fair because the lane control signals provide increased flexibility for responding to these types of events, even though there was no geometric difference compared to Alternative 1A. Alternatives 3A and 3B were rated good because the full right-side

shoulders included in these alternatives would provide the highest level of corridor reliability. Results for maintaining transportation of goods are presented in Table 15-15.

Table 15-15 Maintain Transport of Goods

Qualitative Assessment	Alternative 1A	Alternative 1B	Alternative 3A	Alternative 3B
Improve Freight Travel Time	Fair	Fair	Fair	Fair
Improve Corridor Reliability	Poor	Fair	Good	Good
Overall Result	**Fair-Poor**	**Fair**	**Good-Fair**	**Good-Fair**

Incident Management

Incident management was evaluated by assessing three important characteristics:

- Disabled vehicle safety
- Snow storage
- Emergency responder accessibility

The ratings assigned to each alternative for incident management criteria were comparative, such that alternatives with relatively higher performance were rated higher than those with lower performance.

Disabled vehicle safety focused on the overall safety of disabled vehicles when stopped along the roadway, therefore wider shoulders and the installation of lane control signals provided a higher rating. Alternative 1A provides the lowest level of performance for disabled vehicle safety since only minimal shoulders are provided on the right and left sides of the road. As a result, any disabled vehicle in the corridor would be in an unsafe environment by blocking at least part of a travel lane. Alternative 3A provides the highest level of performance because full shoulders on both sides of the roadway provide maximum refuge area for disabled vehicles.

Alternatives 1B and 3B were both assigned a fair rating, as their performance falls in between Alternatives 1A and 3A. Alternative 1B provides a dynamic right shoulder when the managed lane is not in use. Additionally, the presence of lane control signals in this alternative allows additional flexibility to close lanes for disabled vehicles. Alternative 3B performs somewhat better than Alternative 1A but more poorly than Alternative 3A because a full right shoulder is provided, but only a minimal left shoulder.

Snow storage focused on the amount of storage available with improvements in the width or presence of shoulders and the presence of lane control signals providing a higher rating. The urgency and intensity of snow clearance activities was also considered for this evaluation. Alternatives 1A and 1B were both assigned a poor rating because minimal right and left shoulders provide little to no space for snow storage. Snow would need to be physically removed

from the roadway area and be done rapidly to avoid lane blockages. Despite the ability to temporarily close the right lane under alternative 1B, input from MnDOT staff indicates snow would also need to be immediately removed from the dynamic lane to avoid pavement icing.

Alternative 3A was assigned a good rating because the presence of full right and left shoulders provide maximum snow storage flexibility and also allows snow to be plowed both to the left and to the right from the center of the roadway, reducing the number of passes required. Alternative 3B performs somewhat poorer than Alternative 3A because snow may only be plowed from the left to the right, thus requiring additional passes. Alternative 3B was assigned a fair rating.

Emergency responder accessibility focused on the overall accessibility for emergency responders, with improvements in the number of lanes, the width or presence of shoulders, and the presence of lane control signals providing a higher rating. Results of this evaluation were consistent with those for disabled vehicle safety, as emergency responders face similar risks when responding to incidents as disabled vehicles face. Similar to the disabled vehicle evaluation, alternatives providing full shoulders and lane control signals resulted in higher ratings than those without those features. Results for incident management in the build managed lane condition are presented in Table 15-16.

Table 15-16 Incident Management

Qualitative Assessment	Alternative 1A	Alternative 1B	Alternative 3A	Alternative 3B
Disabled Vehicle Safety	Poor	Fair	Good	Fair
Snow Storage	Poor	Poor	Good	Fair
Emergency Responder Accessibility	Poor	Fair	Good	Fair
Overall Result	**Poor**	**Fair-Poor**	**Good**	**Fair**

Enforcement

Enforcement was evaluated by assessing two important characteristics:

- Violation monitoring
- Pulling-over vehicles safely

Violation monitoring focused on the ability of law enforcement vehicles to monitor violators. Law enforcement personnel often position their vehicles near the roadway providing a clear line of sight to monitor for violations, while maintaining safety for themselves and their vehicles. Pulling-over vehicles safely focused on the overall safety of law enforcement when pulling-over a violating vehicle. It should be noted that this included all violations, not just managed lane

violations, such as speeding and drunk driving. The presence of shoulders was the critical feature associated with this evaluation.

Alternative 3A was assigned the highest rating for the enforcement criteria, as full left and right shoulders were provided under this alternative. Alternative 3B was assigned a "fair" rating since only the right shoulders would be suitable for violation monitoring and safely pulling-over vehicles. Alternative 1A provided the poorest performance for these activities because neither the left or right shoulders would provide adequate width for enforcement. Alternative 1B has a slightly better performance than Alternative 1A because a full right shoulder would be provided when the managed lane is not in use. Results for enforcement are summarized in Table 15-17.

Table 15-17 Enforcement

Qualitative Assessment	Alternative 1A	Alternative 1B	Alternative 3A	Alternative 3B
Violation Monitoring	Poor	Fair-Poor	Good	Fair
Pulling Over Vehicles Safely	Poor	Fair-Poor	Good	Fair
Overall Result	**Poor**	**Fair-Poor**	**Good**	**Fair**

Risk Assessment

A variety of risk elements were associated with the systems operations management criteria evaluated for these corridor alternatives. The ratings assigned to the alternatives under consideration were developed qualitatively and were assigned using comparative analysis between the alternatives. The actual performance of these alternatives cannot be known with certainty at this time, and the relative differences between alternatives may not fully reflect real-world conditions.

15.5 Criterion 4: Net Costs

Criterion 4 consists of three sub-criteria:

- Capital costs
- O&M costs
- Annual revenue

Tools used to evaluate the sub-criteria consisted of comparative rankings. Capital costs along with O&M costs were calculated. In addition, CORSIM and the Twin Cities RTDM were used to calculate the annual revenue. Capital costs per-mile for each alternative within each segment were calculated and compared to one another. Modeling results along with pricing structure algorithms were used to calculate annual revenue. The results for this analysis were quantitative.

Results vary by segment and by alternatives. Ratings for capital costs ranged from poor to good. Ratings for O&M costs varied from fair to good-fair and annual revenue was fair.

Capital Costs

Capital costs were compared using a per-mile cost for each alternative within each segment. Total construction costs were calculated for the entire segment length and as an all-encompassing high level cost including depth and width expansion, retaining walls, drainage, and a percent increase for future build (inflation). Segment lengths vary from 1.5 miles to 13.7 miles; this adds to the difference in the construction cost dollars.

Bridge preservation needs through 2034 were also considered. With careful planning and coordination; bridge preservation needs may reduce overall capital costs. The resulting construction costs are also shown and given ratings using the same procedure as the complete construction costs. A summary of the cost assessment is presented in Table 15-18. All dollar values are in millions.

Table 15-18 Cost Assessment Summary

Cost Assessment	Segment 1				Segment 2			Segment 3		Segment 4		Segment 5	
	Alt. 1A	Alt. 1B	Alt. 3A	Alt. 3B	Al. 1A	Alt. 1B	Alt. 3B	Alt. 3A	Alt. 3B	Alt. 3A	Alt. 3B	Alt. 3A	Alt. 3B
Total Construction Costs	$24.4	$32.8	$174.1	$152.5	$84.5	$101.3	$220.9	$134.6	$111.1	$105.9	$85.4	$63.7	$51.5
Total Rating	Good	Good	Poor	Poor	Good-Fair	Good-Fair	Poor	Good-Fair	Good-Fair	Good-Fair	Good-Fair	Good	Good
Coordinated with Bridge Preservation Needs through 2034*	$24.4	$32.8	$53.8	$32.2	$61.6	$78.4	$80.9	$120.5	$97.0	$83.0	$62.5	$63.7	$51.5
Coordinated Rating	Good	Good	Fair-Poor	Fair	Good	Good-Fair	Good-Fair	Good-Fair	Good-Fair	Good	Good	Good	Good
Overall Result	Good	Good	Poor	Fair-Poor	Good	Good-Fair	Fair	Good-Fair	Good-Fair	Good	Good	Good	Good

All dollar values are in millions. Alt. = Alternative

O&M Costs

Operation and maintenance costs were evaluated by assessing four important characteristics:

- Pavement maintenance
- Snow removal
- Roadway operations
- RTMC - tolling and lane control

Comparative ranking along with calculations were used for evaluation. Pavement maintenance was calculated by assuming a $666.67 pavement cost per linear-foot mile. A good rating was assigned to the lowest calculated pavement maintenance costs, a good-fair rating was assigned for an increase by 20 percent and continuing this trend for a poor rating increase by 80 percent.

Snow removal, roadway operations and tolling and lane control was rated based on qualitative measurements. The evaluation of snow removal follows a similar pattern to the snow storage evaluation performed for Criterion 3. Roadway operations addressed the reliability of the roadway and its ability to continue operating acceptably under non-recurring event scenarios. In this context, alternatives providing full shoulders and lane control signals were assigned higher ratings than alternatives without these features.

The RTMC evaluation attempted to capture the ongoing cost commitments required of MnDOT to operate the roadway under each alternative. In this case Alternative 1A received a lower rating than the others because operation of the lane control signals would require additional resources. All of the ratings are summarized in Table 15-19.

Table 15-19 Operations & Maintenance

Measure	All Segments			Segment 1	Segment 2 - 5
	Alternative 1A	Alternative 1B	Alternative 3A	Alternative 3B	Alternative 3B
Pavement Maintenance	Good-Fair	Good-Fair	Poor	Fair-Poor	Fair-Poor
Snow Removal	Poor	Poor	Fair	Fair-Poor	Good-Fair
Roadway Operations	Poor	Fair-Poor	Good	Fair	Fair
RTMC (Tolling & Lane Control)	Good	Fair	Good	Good	Good
Overall Result	**Fair**	**Fair**	**Good-Fair**	**Fair**	**Good-Fair**

Annual Revenue

Annual revenue was calculated using both the CORSIM model and Twin Cities RTDM. These tools are not able to account for differences between alternatives, nor would use of managed lanes be expected to vary between alternatives. Traffic forecasts developed for the managed lane alternative using the travel demand model were used in the CORSIM model based on the anticipated use of managed lane. The actual managed use observed in the CORSIM model was recorded to establish the managed lane volumes and densities.

Managed lane traffic volumes and user types (HOV vs. toll-paying SOV) predicted by the traffic models were obtained for all segments of the corridor. Traffic densities were used to compute toll rates based on current MnPASS tolling procedures. The toll rates were multiplied by the toll-paying SOV users to compute the corridor revenue. This analysis produced anticipated annual revenue of $775,000 in year 2012 dollars. This was rated as fair based on a comparison with the two MnPASS corridors in operation today, which each take in $1 million to $1.4 million annually. Projected annual revenue is presented in Table 15-20.

Table 15-20 Annual Revenue

Existing Conditions	All Alternatives
Annual Revenue	$775,000
Overall Result	**Fair**

The revenue projections were developed based on a highly generalized evaluation. More detailed analysis of revenue forecasts may be undertaken in future study of managed lanes in this corridor.

Risk Assessment

Cost calculations involve a number of risks as a result of the many assumptions necessary to produce these estimates. For example, the capital costs include an inflation factor for future conditions. These factors may over- or underestimate future construction costs. Operations and maintenance costs were generally evaluated qualitatively, and relative differences between alternatives may not have been fully captured. Finally, annual revenue calculations were produced based on modeled results and existing operational protocols. Future conditions may vary from the assumed operational characteristics.

15.6 Alternative Risk Assessment

Assessment of risks is becoming an increasingly important tool in transportation infrastructure evaluation. This approach seeks to capture the recognized hazards associated with each potential course of action. While not a formal component of the secondary screening process, a qualitative risk assessment is presented for each alternative to enumerate potential consequences.

Alternative 1A has the potential to expose Segments 1 and 2 to risks associated with narrow shoulders. First, disabled vehicles may not have adequate refuge from travel lanes, thereby blocking lanes and reducing roadway capacity. Second, few locations were suitable for law enforcement activities, which in the context of managed lane eligibility could lead to higher violation rates over the long-term. Third, snow may need to be fully removed from the corridor if it is unable to be stored on the right of way, thus exposing MnDOT to higher long-term maintenance costs.

Alternative 1B has the same geometric characteristics but adds lane control signals along southbound I-35W to provide greater operational flexibility to mitigate impacts associated with the minimal shoulders. This alternative exposes the same risks described for Alternative 1A, namely disabled vehicle storage, enforcement opportunities, and snow removal. Additionally, Alternative 1B may require commitment of additional resources to operate the lane control signals.

Alternative 3A provides full shoulders on the inside and outside of the travel lanes. The geometric design of this alternative addressed many of the risks associated with the narrower shoulders in Alternatives 1A and 1B. Alternative 3B, however, involves much more intensive reconstruction of the roadway. This might be expected to result in additional construction seasons, longer construction periods, and more lane closures to complete the project.

Alternative 3B would provide standard outside shoulders and variable inside shoulders along with the addition of managed lanes. This design may be expected to expose fewer risks associated with disabled vehicle storage and snow removal. Enforcement of managed lane violations may still be difficult as vehicles may not be able to pull-over on the left and would therefore need to cross numerous lanes to the right shoulder. Construction impacts for Alternative 3B would likely be more significant than Alternatives 1A and 1B, and perhaps somewhat less than Alternative 3A.

15.7 Segment Summaries

Segment summaries are represented in the following tables. Each summary contains a capital cost versus rating graph. The graphs provide a quick tool to look at how each alternative compares to the other alternatives for the segment. The slope of the line represents benefits compared to investments; in essence, the steeper the slope of the line, the greater the benefit for the given level of investment. The graph also displays how coordinating with bridge preservation projects will aid in the total capital cost. These graphs relate to one of the original goals for the project: to better utilize existing and future infrastructure investments. The following five figures provide a segment-by-segment summary and include a capital cost versus rating graph.

- Figure 15-2 Segment 1 Secondary Screening Summary
- Figure 15-3 Segment 2 Secondary Screening Summary
- Figure 15-4 Segment 3 Secondary Screening Summary
- Figure 15-5 Segment 4 Secondary Screening Summary
- Figure 15-6 Segment 5 Secondary Screening Summary

Figure 15-2 Segment 1 Secondary Screening Summary

Criteria	Alternative 1A	Alternative 1B	Alternative 3A	Alternative 3B
Reduce Congestion	**Good-Fair**	**Good-Fair**	**Good**	**Good**
Increase Person Through-Put	Fair	Fair	Fair	Fair
Increase Vehicle Through-Put	Good	Good	Good	Good
Improve Corridor Travel Time	Good	Good	Good	Good
Vehicle-Miles Traveled (VMT)	Good	Good	Good	Good
Vehicle-Hours Traveled (VHT)	Good-Fair	Good-Fair	Good	Good
Transit Advantages	**Good-Fair**	**Good-Fair**	**Good**	**Good**
Improve Transit Time Reliability	Fair	Good-Fair	Good	Good
Increase Transit Ridership	Good-Fair	Good-Fair	Good-Fair	Good-Fair
Reduce Transit Travel Time	Good	Good	Good	Good
Systems Operations Management	**Poor**	**Fair-Poor**	**Good**	**Fair**
Maintain Transport of Goods	Fair-Poor	Fair	Good-Fair	Good-Fair
Incident Management	Poor	Fair-Poor	Good	Fair
Enforcement	Poor	Fair-Poor	Good	Fair
Net Costs	**Good-Fair**	**Good-Fair**	**Fair**	**Fair**
Capital Costs	Good	Good	Poor	Fair-Poor
Operations & Maintenance Costs	Fair	Fair	Good-Fair	Fair
Revenue	Fair	Fair	Fair	Fair
Overall Rating	**13**	**14**	**18**	**16**

Figure 15-3 Segment 2 Secondary Screening Summary

Criteria	Alternative 1A	Alternative 1B	Alternative 3B
Reduce Congestion	**Good-Fair**	**Good-Fair**	**Good**
Increase Person Through-Put	Fair	Fair	Fair
Increase Vehicle Through-Put	Good	Good	Good
Improve Corridor Travel Time	Good	Good	Good
Vehicle-Miles Traveled (VMT)	Good	Good	Good
Vehicle-Hours Traveled (VHT)	Good-Fair	Good-Fair	Good
Transit Advantages	**Good-Fair**	**Good-Fair**	**Good**
Improve Transit Time Reliability	Fair	Good-Fair	Good
Increase Transit Ridership	Good-Fair	Good-Fair	Good-Fair
Reduce Transit Travel Time	Good	Good	Good
Systems Operations Management	**Poor**	**Fair-Poor**	**Fair**
Maintain Transport of Goods	Fair-Poor	Fair	Good-Fair
Incident Management	Poor	Fair-Poor	Fair
Enforcement	Poor	Fair-Poor	Fair
Net Costs	**Good-Fair**	**Fair**	**Fair**
Capital Costs	Good	Good-Fair	Fair
Operations & Maintenance Costs	Fair	Fair	Good-Fair
Revenue	Fair	Fair	Fair
Overall Rating	**13**	**13**	**16**

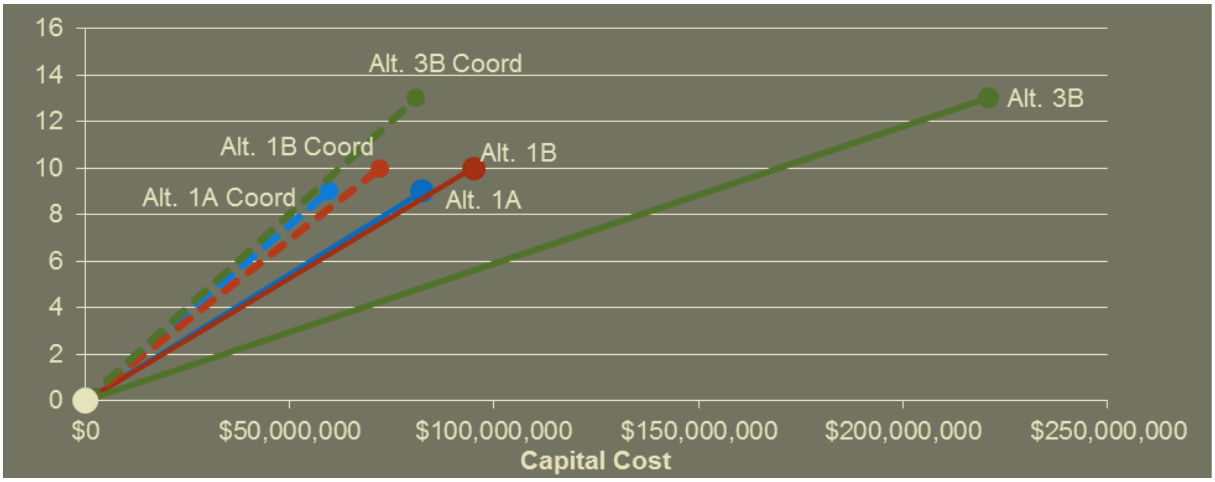


Figure 15-4 Segment 3 Secondary Screening Summary

Criteria	Alternative 3A	Alternative 3B
Reduce Congestion	**Good**	**Good**
Increase Person Through-Put	Fair	Fair
Increase Vehicle Through-Put	Good	Good
Improve Corridor Travel Time	Good	Good
Vehicle-Miles Traveled (VMT)	Good	Good
Vehicle-Hours Traveled (VHT)	Good	Good
Transit Advantages	**Good**	**Good**
Improve Transit Time Reliability	Good	Good
Increase Transit Ridership	Good-Fair	Good-Fair
Reduce Transit Travel Time	Good	Good
Systems Operations Management	**Good**	**Fair**
Maintain Transport of Goods	Good-Fair	Good-Fair
Incident Management	Good	Fair
Enforcement	Good	Fair
Net Costs	**Good-Fair**	**Good-Fair**
Capital Costs	Good-Fair	Good-Fair
Operations & Maintenance Costs	Good-Fair	Good-Fair
Revenue	Fair	Fair
Overall Rating	**19**	**17**

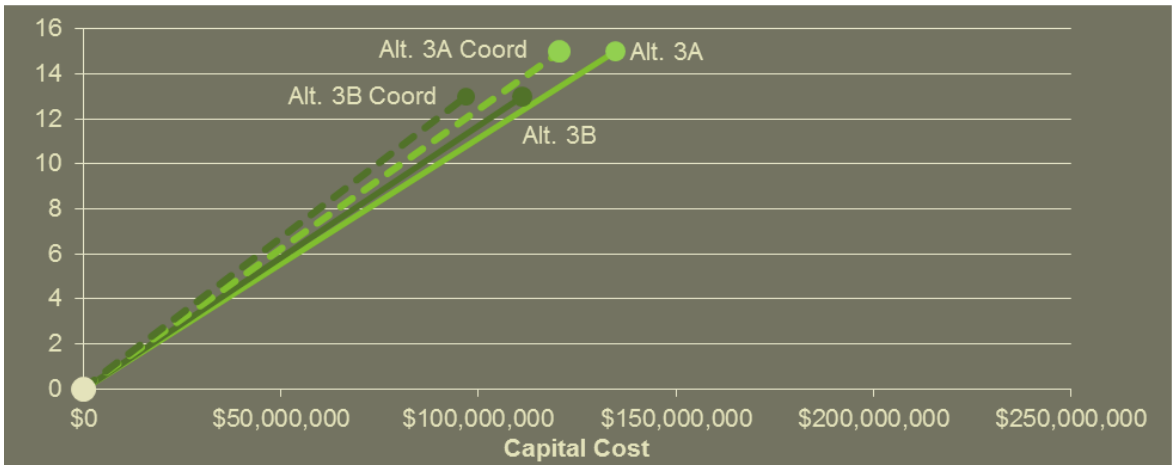


Figure 15-5 Segment 4 Secondary Screening Summary

Criteria	Alternative 3A	Alternative 3B
Reduce Congestion	**Good**	**Good**
Increase Person Through-Put	Fair	Fair
Increase Vehicle Through-Put	Good	Good
Improve Corridor Travel Time	Good	Good
Vehicle-Miles Traveled (VMT)	Good	Good
Vehicle-Hours Traveled (VHT)	Good	Good
Transit Advantages	**Good**	**Good**
Improve Transit Time Reliability	Good	Good
Increase Transit Ridership	Good-Fair	Good-Fair
Reduce Transit Travel Time	Good	Good
Systems Operations Management	**Good**	**Fair**
Maintain Transport of Goods	Good-Fair	Good-Fair
Incident Management	Good	Fair
Enforcement	Good	Fair
Net Costs	**Good-Fair**	**Good-Fair**
Capital Costs	Good	Good
Operations & Maintenance Costs	Good-Fair	Good-Fair
Revenue	Fair	Fair
Overall Rating	**19**	**17**

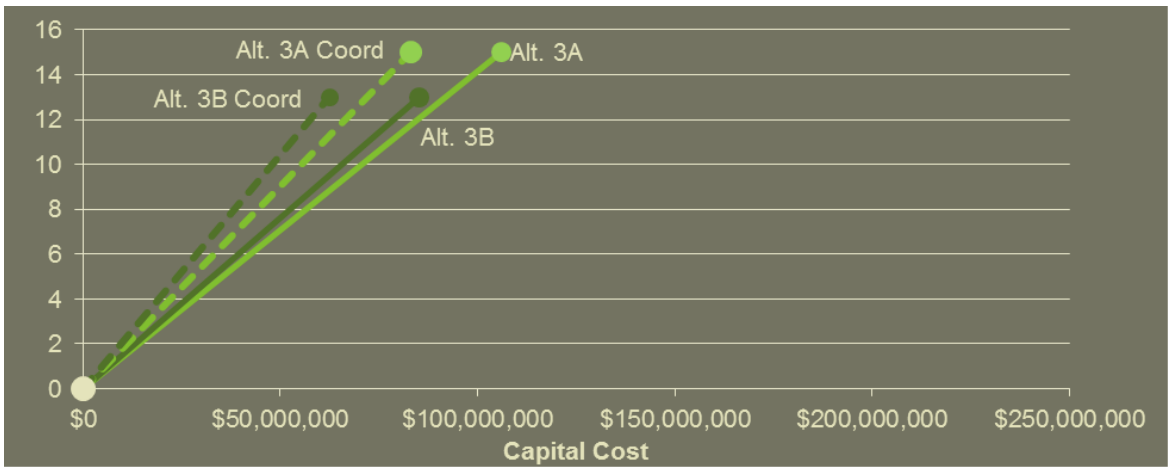
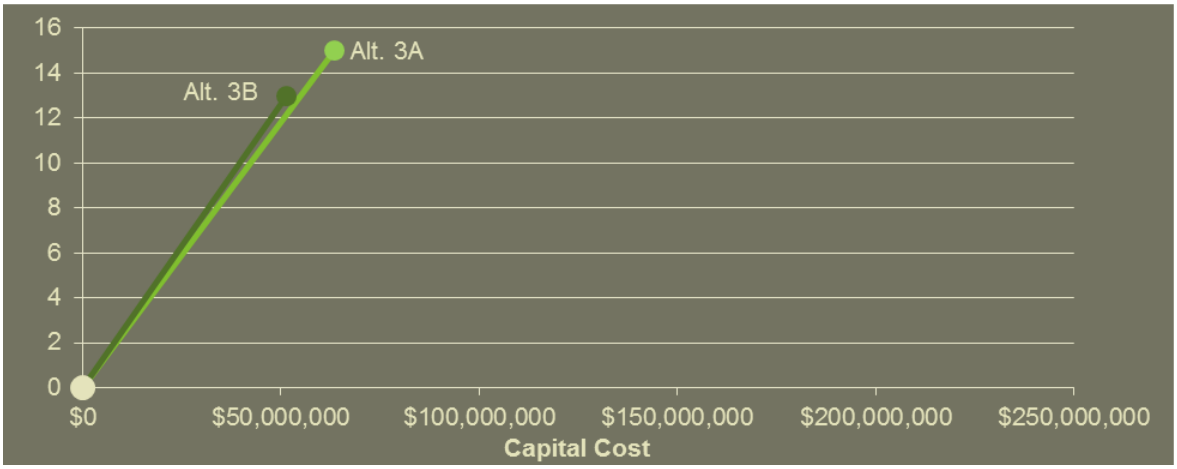


Figure 15-6 Segment 5 Secondary Screening Summary

Criteria	Alternative 3A	Alternative 3B
Reduce Congestion	**Good**	**Good**
Increase Person Through-Put	Fair	Fair
Increase Vehicle Through-Put	Good	Good
Improve Corridor Travel Time	Good	Good
Vehicle-Miles Traveled (VMT)	Good	Good
Vehicle-Hours Traveled (VHT)	Good	Good
Transit Advantages	**Good**	**Good**
Improve Transit Time Reliability	Good	Good
Increase Transit Ridership	Good-Fair	Good-Fair
Reduce Transit Travel Time	Good	Good
Systems Operations Management	**Good**	**Fair**
Maintain Transport of Goods	Good-Fair	Good-Fair
Incident Management	Good	Fair
Enforcement	Good	Fair
Net Costs	**Good-Fair**	**Good-Fair**
Capital Costs	Good	Good
Operations & Maintenance Costs	Good-Fair	Good-Fair
Revenue	Fair	Fair
Overall Rating	**16**	**17**



16.0 Localized Improvements to Facilitate a Managed Lane

Several additional localized concepts were developed on the I-35W study corridor. These concepts were developed to specifically facilitate a manage lane. Localized concepts were developed using the study goal: to better utilize existing and future infrastructure investments, and to develop lower-cost/high-benefit strategies. Localized concepts to facilitate a managed lane were developed at the following locations:

- I-35W exit to southbound Cleveland Avenue
- Minneapolis connection
- TH 36 managed lane direct connection

16.1 I-35W Exit to Southbound Cleveland Avenue

This improvement created a standard two-lane right exit from southbound I-35W to Cleveland Avenue rather than the left lane exit that currently exists. It would also include the replacement of the two-lane exit bridge and the construction of a new bridge over the realigned southbound I-35W. The Cleveland Avenue exit and TH 280 westbound exit would occur together under this configuration. During construction drivers may experience delays due to lanes narrowed and shifted but at least two lanes would be maintained on I-35W. Weekend closures will be needed for staging traffic, bridge demolition and beam setting. Construction for this option could be completed in one construction season. Figure 16-1 and Figure 16-2 are graphical representations of this option.

Figure 16-1 I-35W Exit to Cleveland Avenue

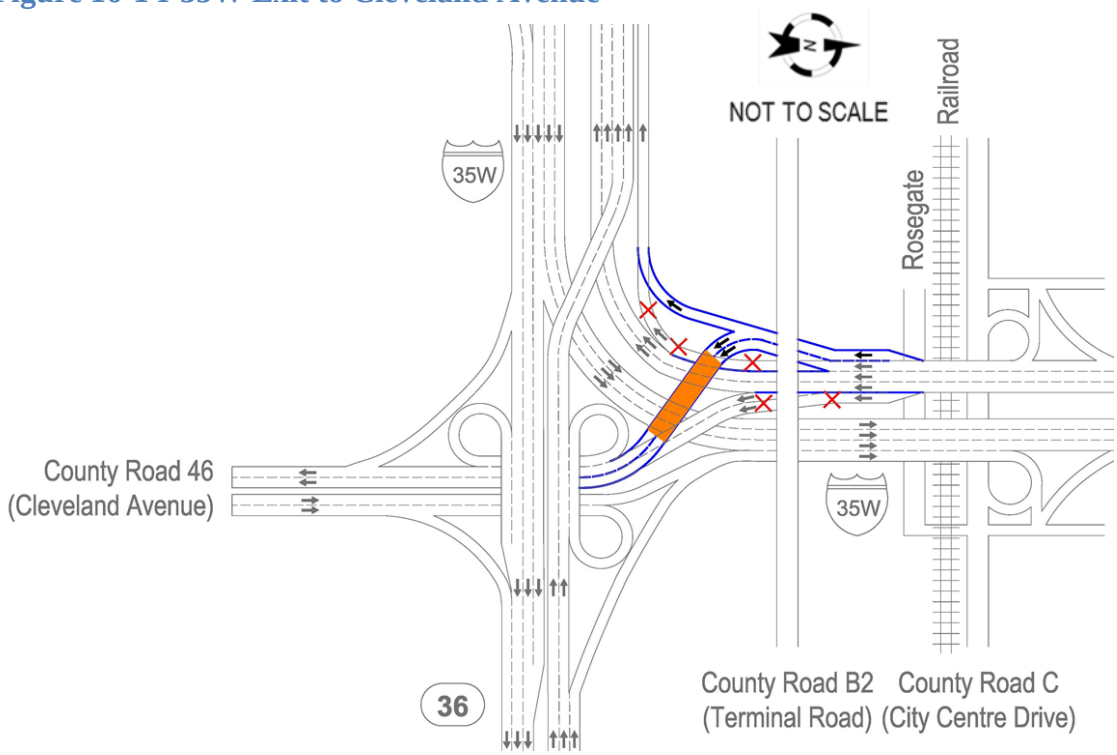
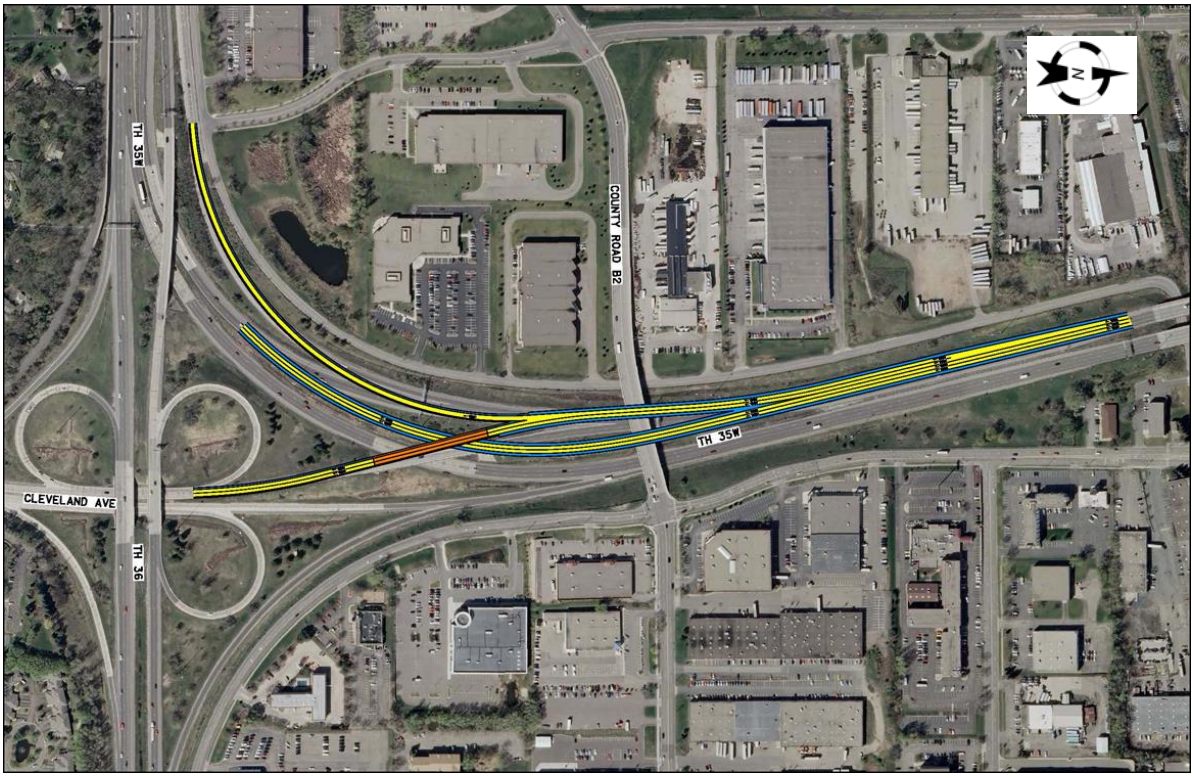


Figure 16-2 I-35W Exit to Cleveland



16.2 Direct Managed Lane Connection to Downtown Minneapolis

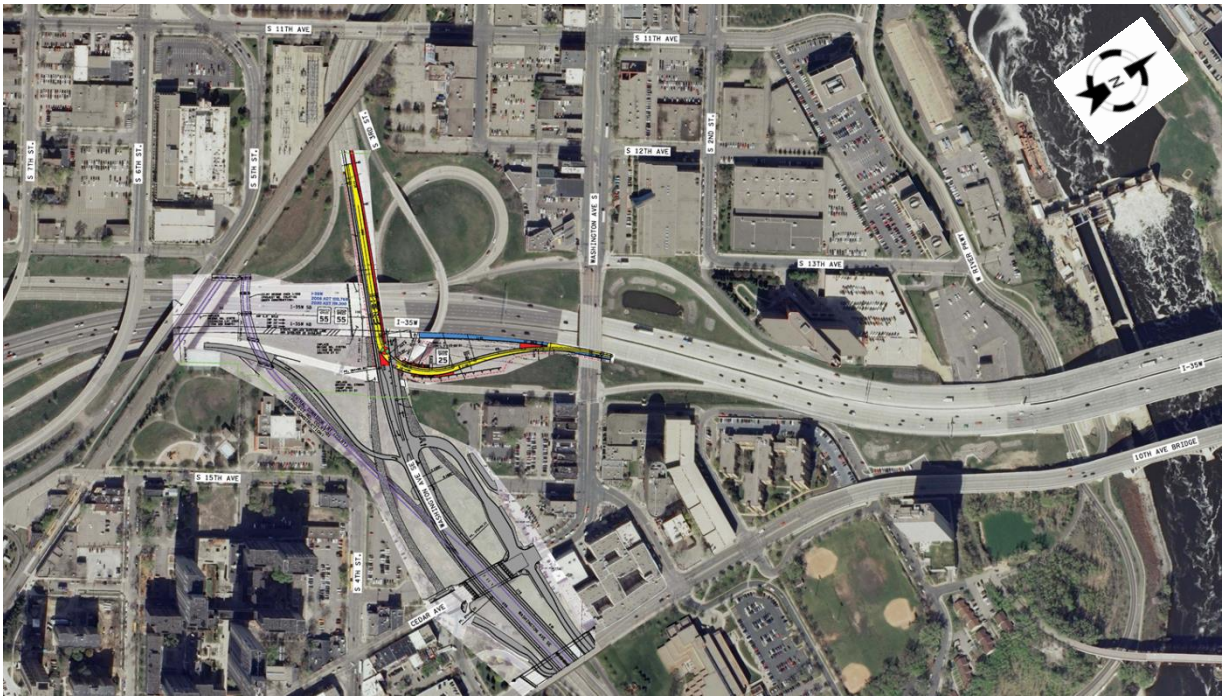
Several design concepts were developed for providing a direct connection to/from the I-35W managed and downtown Minneapolis. The following direct Minneapolis connections were developed:

- 2nd Street Managed Lane Direct Connection
- 3rd Street Managed Lane Direct Connection
- 3rd / 4th Street Managed Lane Direct Connection

Each connection has a set of positives and negatives which will be presented with each concept. Each concept has been presented to MnDOT staff and representatives from the City of Minneapolis, Hennepin County, and the Metropolitan Council.

To develop these connection concepts the 4th Street Access Project was assumed to be in place as shown in Figure 16-3.

Figure 16-3 Assumed 4th Street Access Improvements



2nd Street Managed Lane Direct Connection

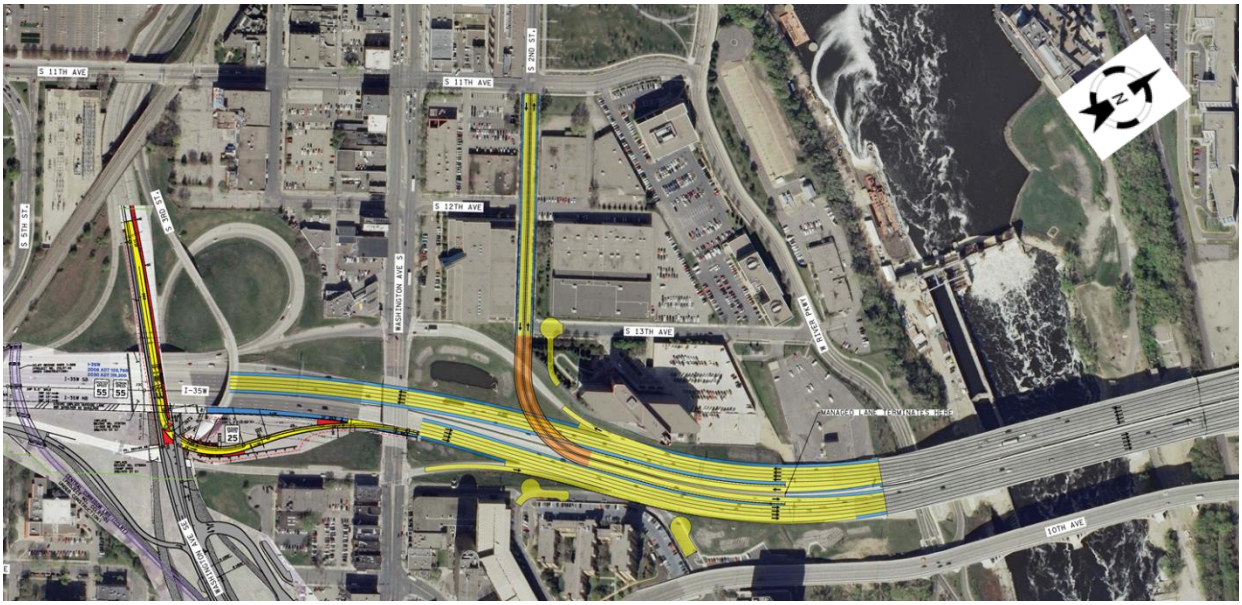
This option will provide a direct connection in and out of downtown Minneapolis using a flyover bridge over southbound I-35W to 2nd Street South. This would result in 13th Avenue no longer connecting to 2nd Street, and 12th Avenue would no longer cross 2nd Street due to the grades coming down from the flyover ramp. In addition, 14th Avenue would be closed at the I-35W pinch point. The City of Minneapolis stated its desire to maintain the grid system. It was also acknowledged that this concept will benefit transit as it allows buses to access 2nd Street and Marquette Avenue at a more northerly location and adding buses and additional traffic along the corridor does not fit into the residential character of the corridor. A bike lane on 2nd Street is intended to connect to a tunnel under I-35W.

Positive outcomes for this option provide east-west connectivity via 11th Street and it provides good bus service options. Negative outcomes are that 2nd Street is not planned by the City of Minneapolis to carry high volumes of traffic; it does not maintain the City street grid system, and it negatively impacts the existing bike lanes. However this concept could be revised to have the ramp turn south and directly connect into Washington Avenue.

The construction for this concept would include shifting the existing I-35W northbound and southbound out to provide a gap to accommodate building the walls and bridge affiliated with the flyover. At least two lanes of traffic could be maintained during construction; however weekend closures would be necessary for shifting traffic and beam settings along with temporary ramp closures to connect the ramps to the reconfigured mainline.

Construction for this option would take up to two construction seasons. Figure 16-4 is a graphical description of this option.

Figure 16-4 2nd Street Managed Lane Direct Connection



3rd Street Managed Lane Direct Connection

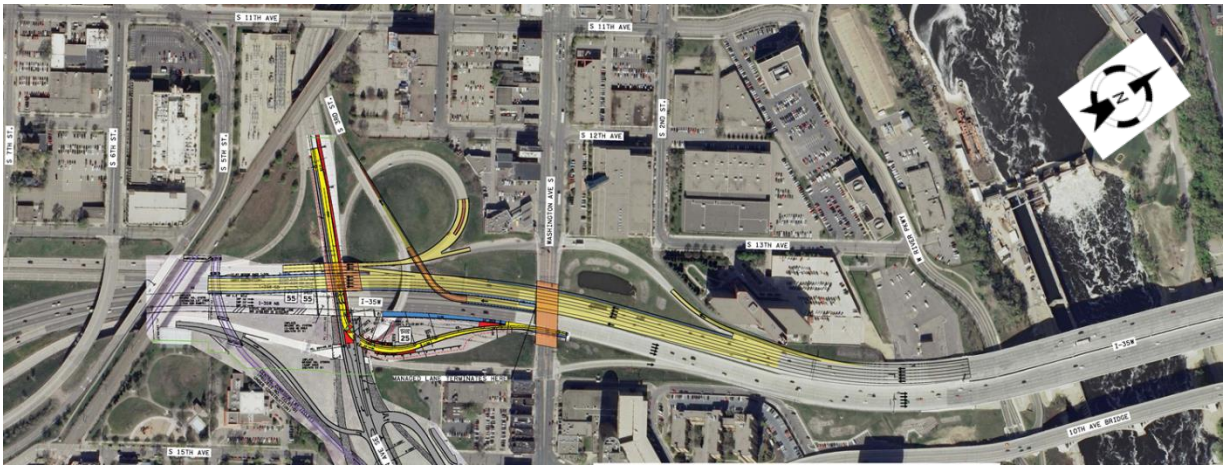
This concept will provide a direct connection to westbound 3rd Street from the southbound managed lane. Under this option, there will be no direct connection from downtown to the northbound managed lane. This concept takes advantage of underutilized capacity on 3rd Street. This option does not include a complementary northbound entrance connection to the managed lane; therefore northbound traffic would enter I-35W using the future 4th Street entrance and merge left into the managed lane.

Positive outcomes for this option utilize 3rd Street to carry high traffic volumes as planned by the City of Minneapolis. Negative outcomes for this option provide no direct connection from downtown to the northbound I-35W managed lane and it does not provide good east-west connectivity. It is questionable if any transit benefits will be realized under this option, as busses would have to travel further south to access downtown. It also requires reconstruction of the Washington Avenue Bridge.

The construction for this concept would include shifting the existing southbound lanes out towards the west to make room for the retaining walls and bridge for the flyover. The Washington Avenue Bridge would also need to be replaced as part of this concept since the existing center pier is in the same location as the planned managed lane and the side piers do not allow for the southbound lanes to shift far enough to the west. At least two lanes of traffic could be maintained during construction; however weekend closures would be necessary for shifting traffic and beam settings along with temporary ramp closures to connect the ramps to the reconfigured mainline.

Construction for this option would take up to two construction seasons. Figure 16-5 is a graphical description of this option.

Figure 16-5 3rd Street Managed Lane Direct Connection



3rd / 4th Street Managed Lane Direct Connection

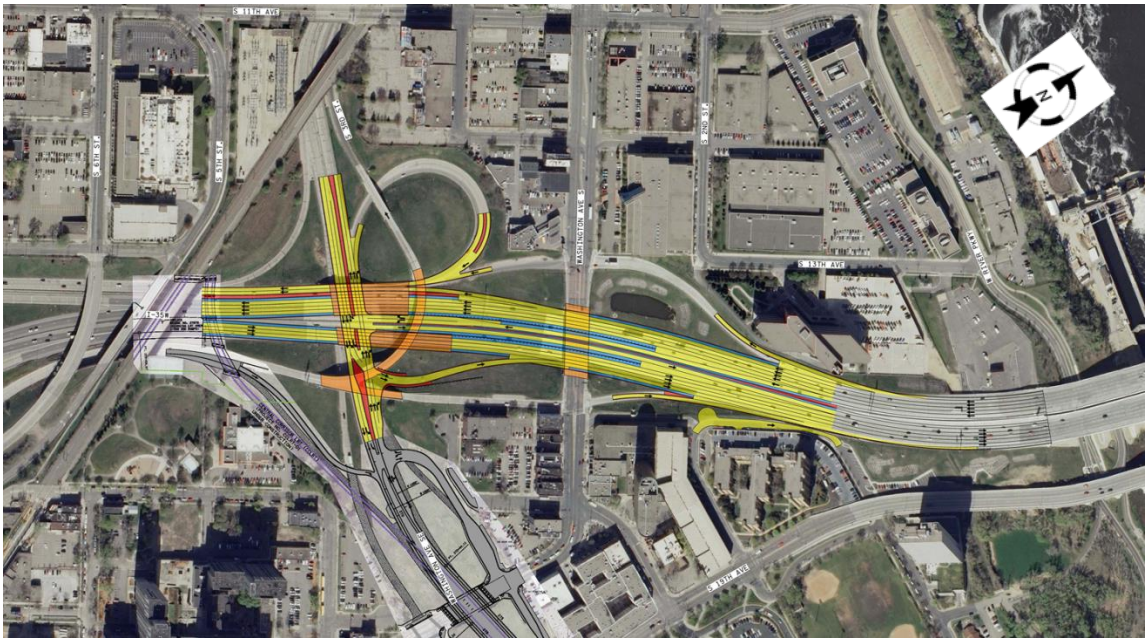
This option will provide a direct connection from the managed lane to 3rd/4th Street via a signal on 3rd/4th Street. This option would require the replacement of the northbound and southbound I-35W Bridges over 3rd/4th Street, the 3rd Street Flyover Bridge and the Washington Avenue Bridge.

Positive outcomes for this option provide more options to access managed lanes and it provides access to the University of Minnesota West Bank campus. Negative outcomes for this option require replacement of the northbound and southbound I-35W Bridges over 3rd/4th Street, the 3rd Street Flyover Bridge, and the Washington Avenue Bridge (higher costs). It is questionable if any transit benefits will be realized under this option, as busses would have to travel further south to access downtown.

The construction for this concept would include shifting the existing northbound and southbound I-35W out to provide a gap so the walls and managed lane can be built between existing lanes of I-35W. At least two lanes of traffic could be maintained during construction on I-35W; however weekend closures would be necessary for shifting traffic and beam settings along with temporary ramp closures to connect the ramps to the reconfigured mainline. Long term closures may also be required for the 3rd Street parking ramp since the proposed bridge would be in the same location as the existing bridge.

Construction for this option would take two construction seasons. Figure 16-6 is a graphical description of this option.

Figure 16-6 3rd / 4th Street Managed Lane Direct Connection

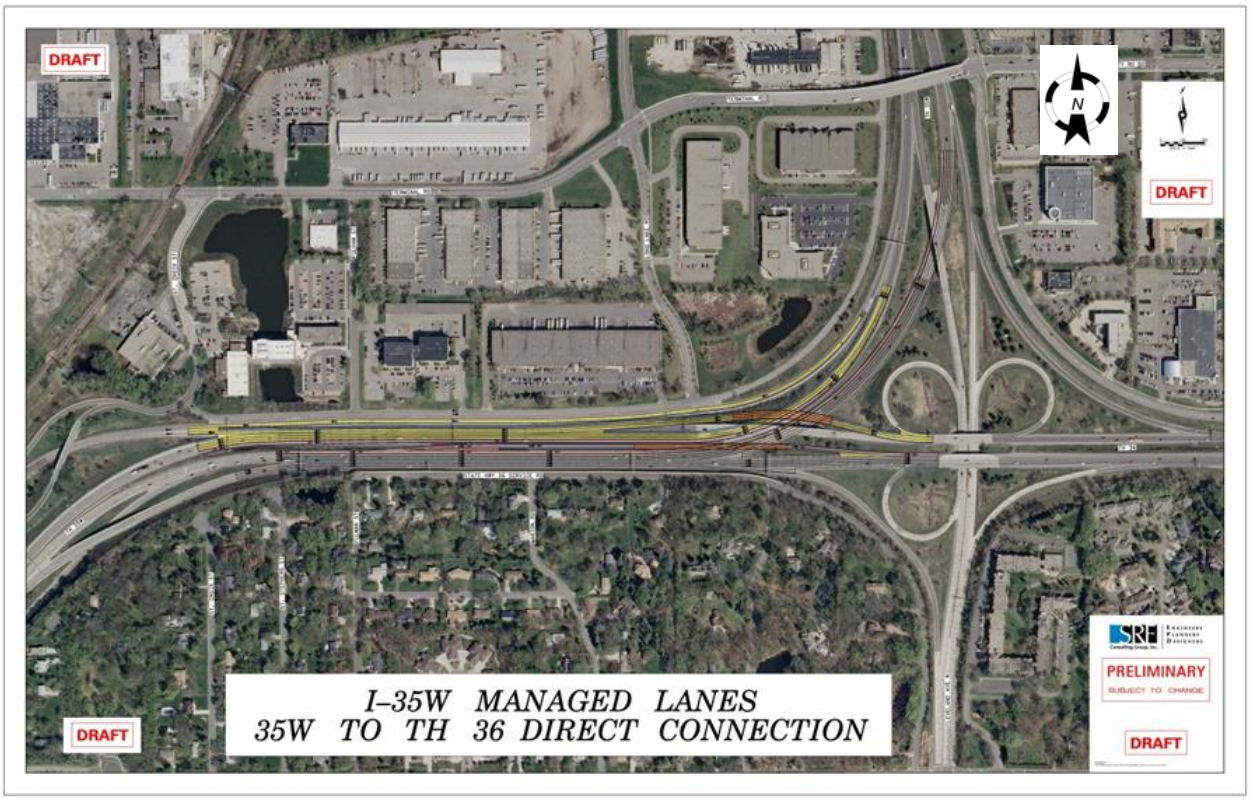


16.3 TH 36 Managed Lane Direct Connection

This option provides a direct connection to the future managed lane on eastbound TH 36 from the I-35W northbound managed lane. This stays within the existing right of way and would require replacement of the westbound TH 36 to southbound I-35W Bridge and adds a flyover bridge for the direct connection. The westbound I-35W lane would need to be reconstructed and pushed to the north to provide room for the retaining wall and bridge affiliated with the flyover in the eastbound direction. At least two lanes of traffic could be maintained during construction; however weekend closures would be necessary for shifting traffic and beam settings along with temporary ramp closures to connect the ramps to the reconfigured mainline.

Construction for this option would take two construction seasons. Figure 16-7 is a graphical description of this option.

Figure 16-7 I-35W to TH 36 Managed Lane Direct Connection



16.4 Operational Model for Localized Improvements to Facilitate a Managed Lane

The CORSIM operations model was updated to evaluate the southbound Cleveland Avenue managed lane concept. The model was updated using the concept geometrics for the programmed improvements conditions. No changes were made to the traffic volumes for these simulations since they are intended to be operational improvements and not regionally significant. The following section describes the concept evaluated in the operations model and summarizes the observed results.

I-35W Exit to Southbound Cleveland Avenue

The existing exit from southbound I-35W to TH 36 and Cleveland Avenue is a two-lane exit on the left side of the roadway. Although this location does not specifically cause congestion under existing conditions, the potential addition of a managed lane on the inside of the roadway would complicate this location. The concept developed determined the operational consequences of moving the exit to the right side of the roadway.

The operations model was updated with this change by combining the exit to TH 36/Cleveland Avenue with the exit to TH 280. The configuration at this point would be four southbound lanes that split into two lanes for I-35W and two lanes for the combined exits. The four lanes feeding

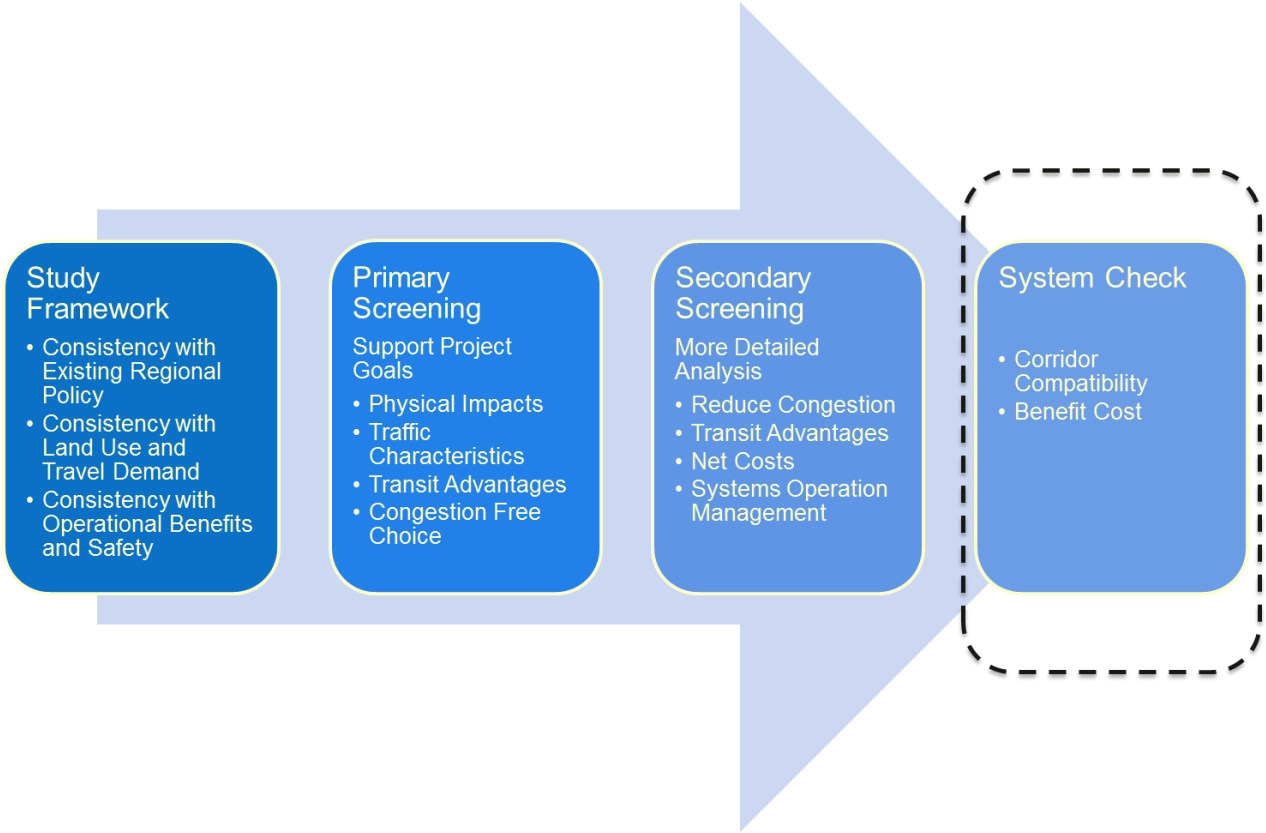
this location would include three lanes from mainline I-35W southbound and an auxiliary lane added at the entrance from CR C.

The results of the operations model indicated this configuration would not be significantly different from the baseline condition. There is no current congestion in this area, and there would be none expected to occur as a result of this change. Similarly, conditions upstream and downstream of this location along southbound I-35W would not be expected to be impacted.

17.0 System Check

Following the completion of the secondary screening process, there was a need to identify a viable managed lanes alternative for the remaining steps in the study and perform a System Check on the viable managed alternative. The secondary screening provided a comparison of the managed lanes alternatives, in terms of construction costs and operational impacts, but it did not eliminate any alternatives. The remaining steps in the study included a benefit-cost analysis, establishing a managed lanes vision, and developing an implementation plan. This phase represents the system check as presented in Figure 17-1 process chart.

Figure 17-1 Process Chart



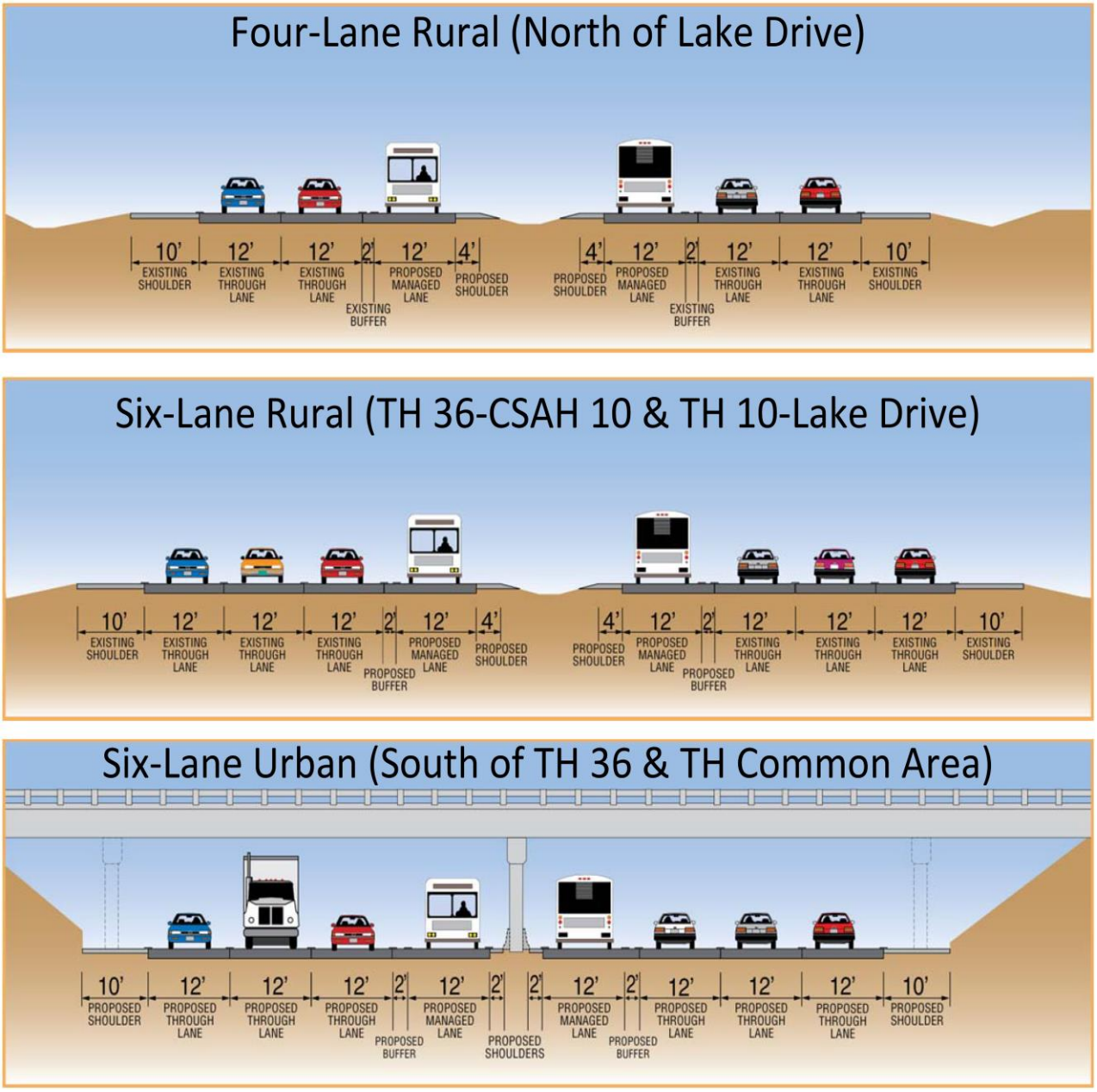
17.1 Identification of Viable Alternative

The secondary screening process evaluated the managed lane alternatives across four criteria: reduce congestion, transit advantages, systems operations management, and net costs. This evaluation showed each of the alternatives involved trade-offs among these criteria, particularly between the performance criteria and cost.

The PMT carefully considered trade-offs regarding a viable managed lanes alternative. The group elected to move forward with Alternative 3B for completing the remaining steps in the I-35W North Managed Lanes Corridor Study.

Alternative 3B is characterized by the addition of a managed lane on the inside of the existing lanes in both directions between University Avenue SE in Minneapolis and Lexington Avenue in Blaine. It has full, ten-foot outside shoulders and two to four-foot inside shoulders. In locations where space is available, the width of the shoulder could be increased. Figure 17-2 illustrates the proposed cross-sections of this alternative.

Figure 17-2 Viable Alternative Cross-Sections



The selection of Alternative 3B as a viable alternative balances construction costs with design standards and operational trade-offs. The specific rationales for selection of Alternative 3B include:

- Fulfills the study goals and objectives
- Provides competitive construction costs when coordinated with preservation needs
- Provides operational benefits
- Provides a full outside shoulder and a variable inside shoulder

In addition to these critical considerations, a number of other characteristics make this viable alternative a strong candidate for managed lane construction. First, it received good scores in primary and secondary screening and no fatal flaws were identified in the screening process. Next, it provides a consistent design through the corridor, resulting in favorable conditions for driver expectations and maintenance strategies. Finally, the inclusion of a full outside shoulder can be utilized as a bus only shoulder for shorter-distance transit service not using managed lanes. Even though Alternative 3B was used as a basis to complete the study, further evaluation and confirmation will be conducted during future environmental process.

17.2 Benefit-Cost Analysis

A series of benefit-cost analyses were performed for various improvements considered in this study. These included the construction of managed lanes throughout the corridor and localized improvements that address existing congestion and/or facilitate managed lanes. The results of the benefit-cost analyses provided decision-makers an additional source of information regarding the desirability of improvements under consideration.

A benefit-cost analysis seeks to bring all of the direct effects of a transportation investment into a common measure, in this case dollars, to enable useful comparisons with costs. The benefit-cost analyses were completed with methods consistent with MnDOT standard methodologies. The analysis covered a 20-year timeframe, using a base year of 2011 and a horizon year of 2030 for the computation of costs and benefits. Benefit-cost ratios are computed by dividing the sum of project benefits by the net project costs. A ratio of 1.0 is considered the minimum for economically justifying an improvement. The larger the ratio number, the greater the benefits per unit cost.

Benefits calculated for these analyses are derived from VMT and VHT which were estimated for existing and year 2030 conditions using the RTDM. This process is described in greater detail later in this chapter. The VMT and VHT results can be helpful in understanding the effects of improvements using the following measures:

- VHT changes show travel time savings for alternative
- VMT changes show differences in vehicle and fuel costs
- VMT shifts between different facility types show safety impacts

The analyses performed for this study were to be conservative because benefit calculations do not account for any transit benefits that may be realized by the improvement. Clearly managed lanes would be expected to provide significant benefits for transit users, but they have not been included here. Inclusion of these additional benefits would be expected to result in higher benefit-cost ratios for applicable alternatives.

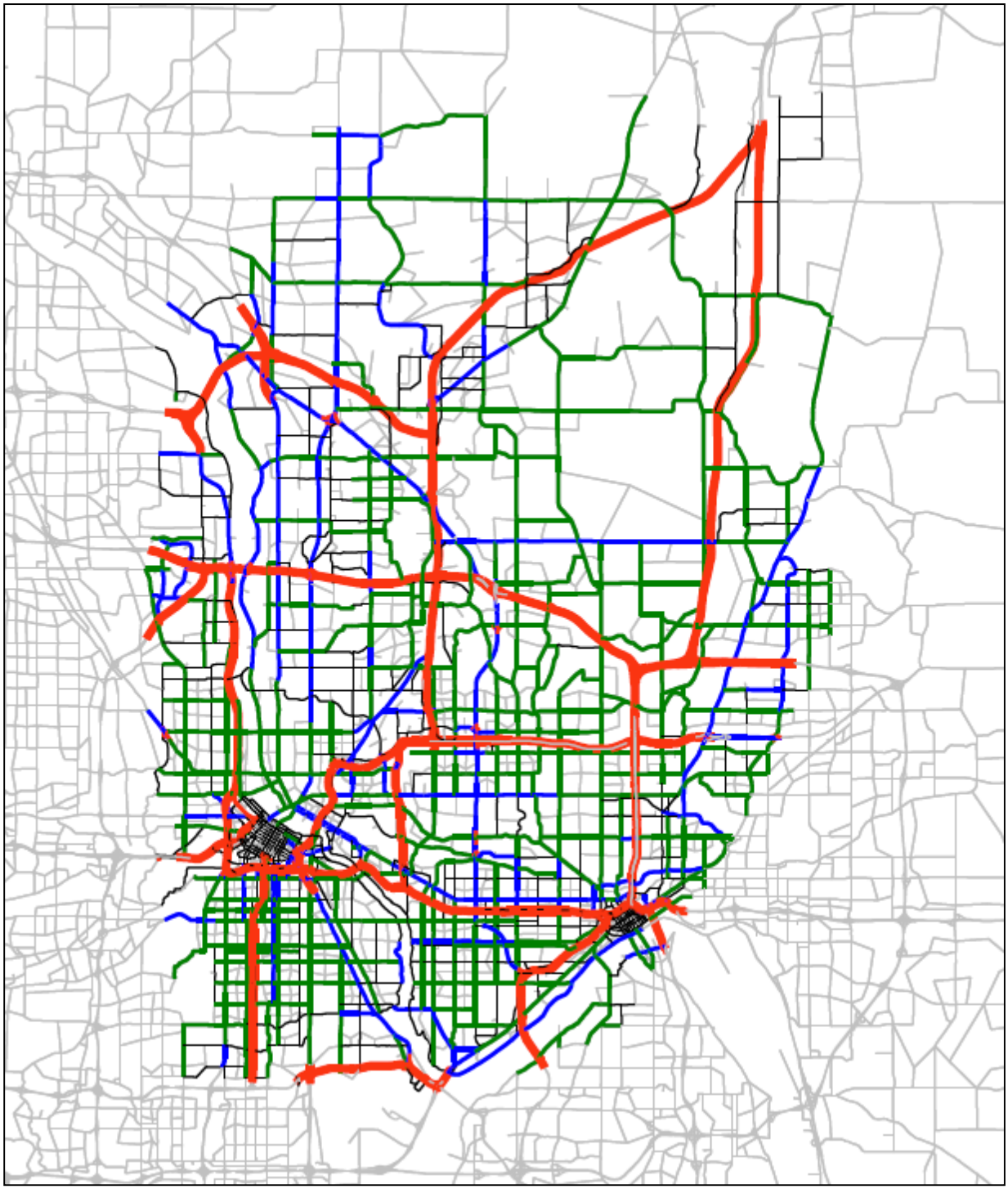
Benefit-cost analyses were completed for three general types of improvements under consideration in this study. The first is the addition of managed lanes in the corridor. This was performed for the viable alternative (Alternative 3B) described in the previous section. The other two types of improvements evaluated were north ramp access at Hennepin Avenue and direct connections between managed lanes and downtown Minneapolis. These categories included multiple options in the analysis.

VMT and VHT Evaluation

An evaluation of VMT and VHT was performed for use in the benefit-cost analysis. This evaluation was conducted using the Twin Cities RTDM, as modified for this study and documented in the travel demand forecast chapter.

To focus the results on the area of influence for the proposed improvements, a subarea within the model was defined for this analysis. The subarea is approximately bounded by, but includes, I-35E on the east, I-94 and TH 252 on the west, TH 62 on the south, and CSAH 14 on the north. An illustration of the subarea is provided in Figure 17-3. Appendix G provides the complete Benefit Cost memorandum.

Figure 17-3 Travel Demand Model Subarea



VMT and VHT results were summarized for both year 2010 and year 2030 conditions. Five scenarios were evaluated in the VMT and VHT analysis. Each of the build scenarios reflected managed lane or other improvements along the I-35W north corridor. The following sections describe each scenario considered and other scenarios it was paired with for a build and no-build comparison.

Programmed Scenario

The programmed scenario included all future improvements identified for construction in the coming years. These were fully documented in the No-Build Forecast – Travel Demand Forecasting chapter and include the 4th Street entrance and northbound auxiliary lane, the I-694 and TH 51 interchange, the TH 10 and CSAH 96 grade separation, the TH 36 eastbound MnPASS lane, and the I-35E MnPASS lanes.

Base Scenario

The base scenario included all improvements described in the programmed scenario and adds managed lanes along I-35W between University Avenue SE in Minneapolis and Lexington Avenue in Blaine. These managed lanes would function using current guidelines for MnPASS lanes, where buses and HOVs would be allowed to use the lanes for free, and SOVs would be allowed to use it if willing to pay a congestion-sensitive toll. The results of the base scenario were compared to the programmed scenario.

Hennepin Avenue North Access

A scenario was evaluated that included access to and from north I-35W at Hennepin Avenue in Minneapolis. This access will serve general purpose traffic. While two geometric options were developed for north access at Hennepin Avenue, these are not differentiated in the travel demand model. The VMT and VHT analysis was completed for north access at Hennepin Avenue both with and without the managed lanes described in the base scenario. The Hennepin Avenue access without managed lanes was compared to the programmed scenario. The results with managed lanes were compared to the base scenario.

2nd Street Direct Connection

This scenario included a direct connection from the I-35W managed lanes in the base scenario to 2nd Street in downtown Minneapolis. This would be accomplished by designating the left lanes on northbound and southbound I-35W as managed lanes across the Mississippi River Bridge and constructing a flyover from the median of I-35W to 2nd Street on the west side of I-35W. Connections will be provided from the southbound managed lane to westbound 2nd Street and from eastbound 2nd Street to the northbound managed lane. These connections will be limited to eligible managed lane users as described in the base scenario. The 2nd Street direct connection results were compared to the base scenario.

3rd Street Direct Connection

This scenario included a direct connection from the southbound managed lane to westbound 3rd Street in downtown Minneapolis. This scenario included the managed lanes in the base scenario, and would be accomplished by designating the left lane of southbound I-35W as a managed lane between University Avenue and the direct connection. This connection would be limited to eligible managed lane users. The 3rd Street direct connection results were compared to the base scenario.

3rd/4th Street Direct Connection

This scenario included direct connections from the northbound and southbound managed lanes on I-35W to a new intersection constructed on 3rd/4th Street under I-35W in Minneapolis.

Similar to the other direct connections, the existing left lanes would be designated as managed lanes south of University Avenue to the proposed direct connections. The managed lane connections will both provide access to the east and west along 3rd/4th Street and would be limited to eligible managed lane users. The 3rd/4th Street direct connection results were compared to the base scenario.

The VMT and VHT results are provided in the summary tables in Appendix B. In addition to VMT and VHT, average speed is provided for each facility type. Average speed was computed by dividing VMT by VHT, and expressed in units of MPH. Each build scenario was compared with a no-build scenario by computing the arithmetic difference of build minus no-build for VMT, VHT, and average speed.

Viable Managed Lane Alternative Benefit-Cost Analysis

A benefit-cost analysis was completed for the viable managed lane alternative described in the previous section. The viable alternative selected was Alternative 3B. The project cost for this alternative is $341 million with a remaining capital value of $72 million giving an overall project net cost of $269 million. The results of the benefit-cost analysis are presented in Table 17-1 and Table 17-2.

Table 17-1 Project Cost

Project Cost	Remaining Capital Value	Project Net Cost
$341M	$72M	$269M

Table 17-2 Benefit-Cost Ratio

Project Net Cost	Present Value of Benefits	Benefit-Cost Ratio
$269M	$389M	1.45

The $341 million cost represents the full cost of the project if it was constructed on its own and not coordinated with other preservation needs. The present value of the benefits that would be received from the project is $389 million giving a benefit-cost ratio of 1.45. Since this benefit-cost ratio is greater than 1.0, it indicates managed lanes through the I-35W north corridor are economically justifiable. Therefore, the analysis demonstrated the viable managed lanes alternative as an attractive improvement which could be carried forward for further investigation.

Hennepin Avenue North Ramp Access Benefit-Cost Analysis

A benefit-cost analysis was performed for two options providing north ramp access at Hennepin Avenue. The first option has a diamond interchange with general purpose ramps connecting directly to Hennepin Avenue. The second option develops a new intersection along Johnson Street north of Hennepin Avenue serving both movements. It also includes a flyover bridge for the southbound exit. Both options utilize the northbound CD road to access I-35W.

The first option at Hennepin Avenue has a project cost of $7.5 million with a remaining capital value of $1.5 million. This yields a project net cost of $6.0 million. The present value of the benefits is $15.1 million without managed lanes along the I-35W north corridor, and $12.5 million with managed lanes. This results in benefit-cost ratios of 2.52 and 2.09, respectively.

The second option at Hennepin Avenue has a project cost of $6.7 million with a remaining capital value of $1.5 million for a project net cost of $5.2 million. The benefits were consistent with those estimated for the first option. This results in benefit-cost ratios of 2.88 and 2.39, respectively. The benefit-cost analyses for the Hennepin Avenue north ramp access is presented in Table 17-3 and Table 17-4.

Table 17-3 Project Cost

Hennepin Avenue North Ramp Access	Project Cost	Remaining Capital Value	Project Net Cost
Option 1	$7.5M	$1.5M	$6.0M
Option 2	$6.7M	$1.5M	$5.2M

Table 17-4 Benefit-Cost Ratio

Hennepin Avenue North Ramp Access	Project Net Cost	Present Value of Benefits No Managed Lanes	Benefit-Cost Ratio No Managed Lanes	Present Value of Benefits Managed Lanes	Benefit-Cost Ratio Managed Lanes
Option 1	$6.0M	$15.1M	2.52	$12.5	2.09
Option 2	$5.2M	$15.1M	2.88	$12.5	2.39

All the benefit-cost ratios computed for the north ramp access at Hennepin Avenue were found to be greater than 1.0. This indicates the access is economically justifiable. Therefore north ramp access at Hennepin Avenue could be carried forward for further investigation.

Downtown Minneapolis Direct Connection Benefit-Cost Analysis

A benefit-cost analysis was performed for three options to provide direct downtown connections from the managed lanes. These included the 2nd Street connection, 3rd Street connection, and the 3rd/4th Street connection. These options were compared against the viable managed lanes alternative, in which the southern terminus of the managed lanes is near University Avenue SE.
The 2nd Street connection includes a flyover ramp that ties into 2nd Street north of Washington Avenue and serves north and southbound manage lane movements. Construction of these connections would require realignment of north and southbound I-35W. This option has a project cost of $29.8 million with a remaining capital value of $6.7 million for a project net cost of $23.1 million. The present value of the benefits is $41.2 million resulting in a benefit-cost ratio of 1.78.

The 3rd Street connection includes a new flyover ramp from the southbound managed lane to westbound 3rd Street. Construction of this option would require realignment of southbound I-35W and reconstruction of the Washington Avenue Bridge. It has a project cost of $22.3 million with a remaining capital value of $5.3 million for a project net cost of $17.0 million. The present value of the benefits is $21.3 million resulting in a benefit-cost ratio of 1.26.

The 3rd/4th Street connection includes a new intersection along 3rd and 4th Streets serving both eastbound and westbound traffic. Construction of this option will require realignment of north and southbound I-35W and reconstruction of the Washington Avenue Bridge. It has a project cost of $54.8 million with a remaining capital value of $13.1 million for a project net cost of $41.7 million. The present value of the benefits is $28.8 million resulting in a benefit-cost ratio of 0.69. The benefit-cost analysis for the downtown Minneapolis direct connection options are presented in Table 17-5 and Table 17-6.

Table 17-5 Project Cost

Option	Project Cost	Remaining Capital Value	Project Net Cost
2nd Street	$29.8M	$6.7M	$23.1M
3rd Street	$22.3M	$5.3M	$17.0M
3rd/4th Street	$54.8M	$13.1M	$41.7M

Table 17-6 Benefit-Cost Ratio

Option	Project Net Cost	Present Value of Benefits	Benefit-Cost Ratio
2nd Street	$23.1M	$41.2M	1.78
3rd Street	$17.0M	$21.3M	1.26
3rd/4th Street	$41.7M	$28.8M	0.69

Options providing direct connections between the managed lanes at 2nd Street and 3rd Street were found to have benefit-cost ratios greater than 1.0. This indicates they are economically justifiable. Benefit-cost of direct connections at 3rd/4th Street resulted in a ratio less than 1.0. This is principally due to a project cost much larger than the other two options. This option requires more substantial reconstruction of I-35W, including replacement of the bridges over 3rd/4th Street. There was potential cost saving opportunities for this option, if construction were coordinated with future preservation activities in the area. Furthermore, these benefit-cost analyses were considered conservative since transit benefits were not included, as previously noted. It is possible that including the cost-savings and additional transit benefits could change the benefit-cost ratio to exceed 1.0. For the purposes of this study, all three options providing direct connections between the managed lanes and downtown Minneapolis could be carried forward for further consideration.

17.3 Managed Lanes Vision

Introduction

The I-35W North Managed Lanes Vision is the set of all improvements selected for the corridor as a result of the I-35W North Managed Lanes Corridor Study. These improvements included additional managed lane capacity through the corridor, localized improvements to relieve existing congestion, and localized improvements to facilitate the addition of managed lanes. The completion of the Managed Lanes Vision is intended to fulfill the study's goals and objectives listed.

I-35W North Managed Lanes Vision was developed by utilizing the project goals and objectives. The four goals and objectives as previously described in this report are:

- Reduce congestion and improve safety along the corridor
- Better utilize existing and future infrastructure investments
- Increase transit ridership and the use of high occupancy vehicles by providing travel time advantages
- Provide a choice for commuters during the peak periods

It is understood that the full Managed Lanes Vision cannot be completed as a single project. It will take many years of separate phases to be realized. The purpose of identifying the Managed Lanes Vision was to ensure that as improvements are made through the corridor, they support and build toward the vision while providing benefits to corridor users with each new improvement. Specific details of the chronological order of these improvements are described in the Implementation Plan chapter.

The improvements included in the I-35W North Managed Lanes Vision were identified through a number of steps in the study evaluation process. First, localized improvements to address existing congestion were developed and evaluated with traffic modeling. The strongest-performing and most cost effective concepts were included in the vision. The viable managed lanes alternative (Alternative 3B) was evaluated in the secondary screening process and included in the vision based on the evaluation results and input from the PMT. Finally, localized improvements to facilitate the managed lanes were developed based on a variety of needs, such as access reconfiguration, roadway realignment, or future congestion issues.

Overview

The I-35W North Managed Lanes Vision developed for the I-35W north corridor includes the following elements:

- Managed lanes between downtown Minneapolis and Lexington Avenue
- Interchange improvements at the I-35W and TH 10 north junction
- Interchange improvements along I-35W at I-694
- Managed direct connections to downtown Minneapolis

- Left lane extension to Snelling Avenue along TH 36 eastbound (other potential concept)
- North ramp access at Hennepin Avenue (other potential concepts)

These improvements were evaluated using a number of screening and analyses tools. These tools included traffic simulation modeling, Microstation layout development, and benefit-cost analysis. The results of the analyses indicated these are beneficial improvements that will cost-effectively deliver the goals and objectives established for the I-35W North Managed Lanes Corridor Study.

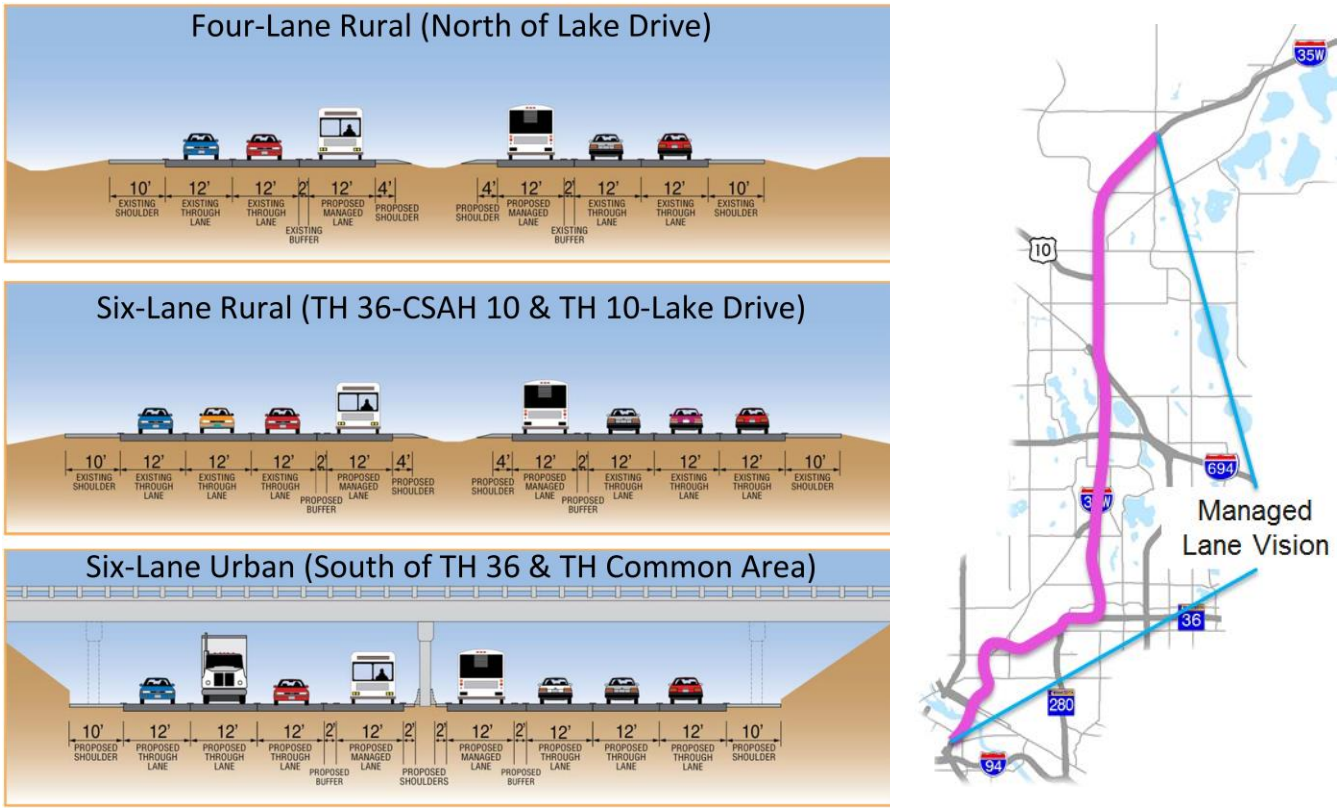
Managed Lanes

The primary element of the vision for the I-35W north corridor is the addition of managed lanes between downtown Minneapolis and Lexington Avenue in Blaine. These managed lanes would be constructed on the left side (inside) of existing northbound and southbound I-35W. These lanes will be operated consistently with existing MnPASS lanes along I-394 and I-35W south of Minneapolis. Specifically, HOVs and buses would be allowed to use the lanes for free, and SOVs will use the lane if they pay a dynamic toll that automatically adjusts to maintain free-flow conditions in the lane.

Following the secondary screening process, managed lane Alternative 3B was identified as the viable managed lane design to be included in the vision. This alternative was determined to provide the greatest degree of balance between capital costs, operating considerations, transit benefits, and safety. It also provides a consistent design throughout the corridor.

Most of the managed lanes included in the I-35W North Managed Lanes Vision will be constructed as new capacity along the corridor. North of Lake Drive, I-35W currently has a four-lane rural cross section. From TH 36 to the TH 10 south junction and from the TH 10 north junction to Lake Drive, I-35W currently has a four-lane rural cross section. Managed lanes will be constructed in these segments by widening the roadway to the inside to provide one additional lane for each direction. South of TH 36 and between the TH 10 south and north junctions, I-35W currently has six-lane and eight-lane urban cross-sections, respectively. Managed lanes would be constructed in these segments by shifting the existing lanes to the outside and providing managed lanes on the inside with narrow inside shoulders and a median barrier. Illustrations of these managed lane designs are shown in Figure 17-4 Managed Lanes Vision.

Figure 17-4 Managed Lanes Vision



There are exceptions to the managed lanes being constructed as new capacity. MnDOT is currently planning to construct an additional lane along northbound I-35W between University Avenue and a combined exit to Johnson Street/Stinson Boulevard/New Brighton Boulevard in Minneapolis. As part of the vision, the left lane would be converted to a managed lane through this segment. Also, from the terminus of the managed lanes near downtown Minneapolis to University Avenue, including the Mississippi River Bridge, the existing left lanes would be redesignated as managed lanes.

The addition of managed lanes through the I-35W corridor fulfills the goals and objectives established for this study by providing a congestion free choice and by providing advantages for buses and carpools.

I-35W and TH 10 North Junction

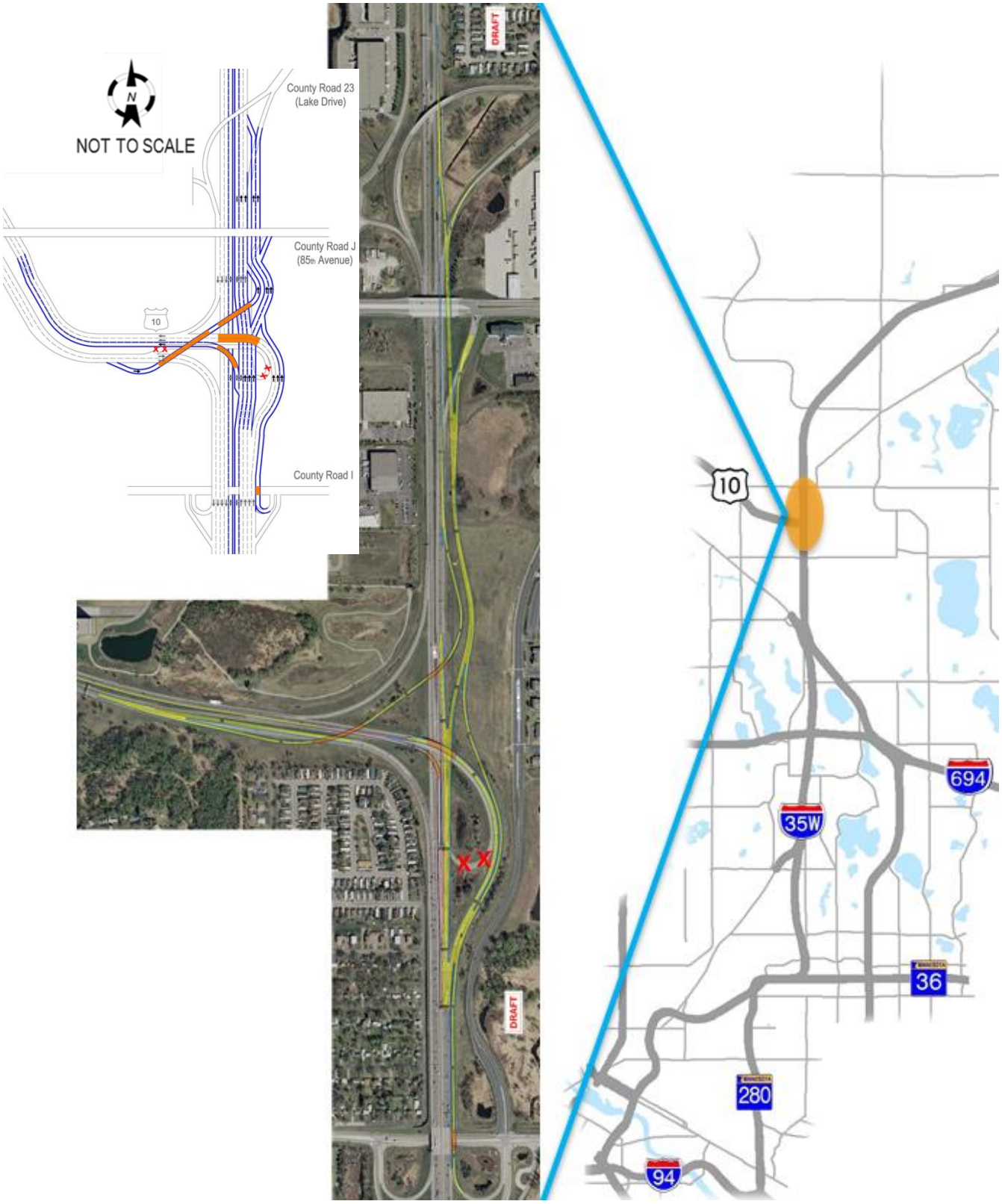
Interchange improvements at I-35W and the TH 10 north junction are also included as part of the I-35W North Managed Lanes Vision. This is a localized improvement to facilitate the addition of managed lanes. The need for an improvement was identified based on the operational analysis of the managed lanes. The TH 10 exit is the single largest exit on the corridor. With the added managed lane and localized improvements near I-694, more traffic is expected at the TH 10 north junction, driving the need for further refinement. In order to maintain the operations of the managed lane, a direct connection from the managed lane to westbound TH 10 is needed. This improvement also eliminates two weaving movements along northbound mainline I-35W

and relieves an existing safety issue on the loop from eastbound TH 10 to northbound I-35W. The interchange concept includes the following features:

- Construct a flyover ramp from eastbound TH 10 to northbound I-35W; close the existing loop ramp provided for this movement
- Construct a new exit ramp and CD road for traffic from I-35W northbound to CR J and Lake Drive
- Connect the CR I entrance to the CR J/Lake Drive CD road by rerouting the traffic along the east side of the I-35W northbound to TH 10 westbound ramp
- Construct a direct connection from the northbound managed lane to westbound TH 10 in the median of I-35W
- Construct an auxiliary lane on westbound TH 10 from the direct connection entrance to the right lane add near 93rd Lane

An illustration of this concept and a schematic showing the lane geometry is shown in Figure 17-5.

Figure 17-5 I-35W and TH 10 North Junction



The interchange improvements accomplish a number of positive outcomes with respect to the goals and objectives established for this study. First, a direct connection is provided for managed lane traffic from northbound I-35W to westbound TH 10. This will provide time savings for the large share of managed lane users, primarily buses and carpools that wish to access westbound TH 10. It also reduces the numerous lane changes for traffic making this movement. If this connection were not provided, it could potentially cause disruptions to the general purpose lane of I-35W northbound.

Second, two weaving movements along mainline northbound I-35W will be removed: one between the CR I entrance and westbound TH 10 exit and the other between the eastbound TH 10 entrance and the CR J exit. These weaves will be moved onto a separate CD roadway. This will provide improved mobility and safety along northbound I-35W.

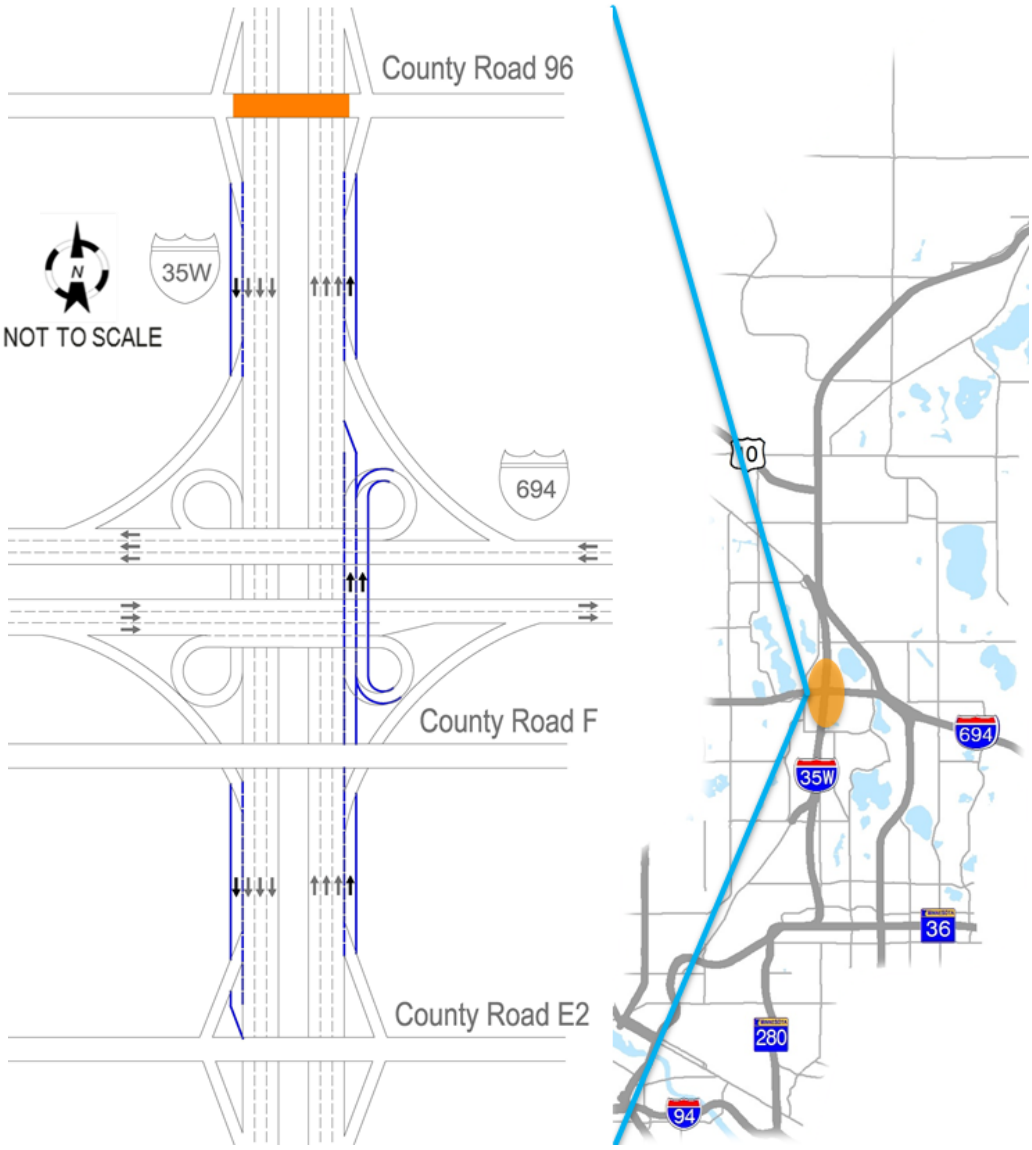
Finally, an existing safety issue on the loop ramp from TH 10 eastbound to I-35W northbound is eliminated by providing a flyover ramp for this movement. This concept will be safer and able to accommodate future traffic growth.

I-35W and I-694

The I-35W North Managed Lanes Vision also includes improvements along I-35W near the I-694 system interchange. These localized improvements will relieve existing congestion. Currently, the area experiences significant recurring congestion, along southbound I-35W in the morning and northbound I-35W in the afternoon. The concept would help to alleviate these issues for general purpose traffic and would be fully compatible with managed lanes.

The improvements along I-35W include northbound and southbound auxiliary lanes between CR E2 and I-694, northbound and southbound auxiliary lanes between I-694 and CSAH 96, and a buffer lane providing enhanced capacity and storage for the northbound loop-to-loop weave at I-694. These improvements are illustrated schematically in Figure 17-6.

Figure 17-6 I-35W and I-694



These improvements fulfill the goals and objectives established for this study to better utilize existing and future infrastructure investments and by reducing congestion and improving safety along the corridor. The buffer lane concept, for example, may not solve congestion completely, but it provides substantial benefit and is much less expensive than the flyover or bridge braid alternatives considered in this location.

The southbound auxiliary lanes will help relieve congestion during the a.m. peak period by providing additional weaving capacity for traffic entering from CSAH 96 and traffic exiting to I-694 westbound, and for traffic entering from I-694 eastbound and traffic exiting to CR E2. As discussed in the Existing Conditions chapter, the loop-to-loop weave is not a bottleneck for southbound I-35W.

The northbound buffer lane will help relieve congestion along I-35W northbound during the p.m. peak period. The buffer lane will be connected to the auxiliary lane starting at the entrance ramp

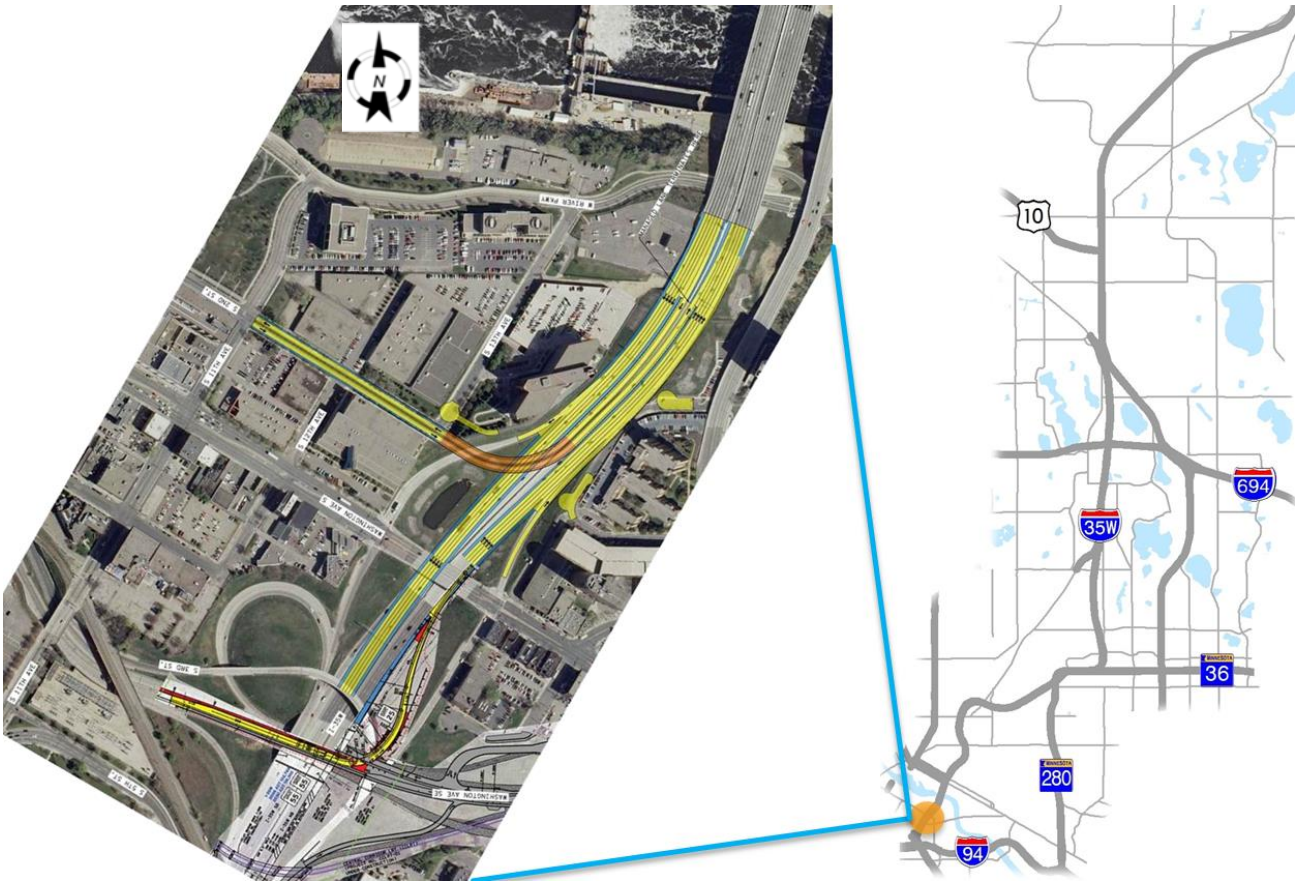
from CR E2. This will provide additional capacity and storage for traffic exiting to westbound I-694. The auxiliary lane north of I-694 will provide additional weaving capacity for traffic entering from westbound I-694 and traffic exiting to CSAH 96.

Downtown Direct Connections

The final component included in the I-35W North Managed Lanes Vision is direct connections from the managed lanes to downtown Minneapolis. These connections are intended to facilitate the addition of managed lanes in the corridor. It is expected these connections will operate consistently with the managed lanes themselves, by restricting use to buses, HOVs, and SOVs that pay a toll.

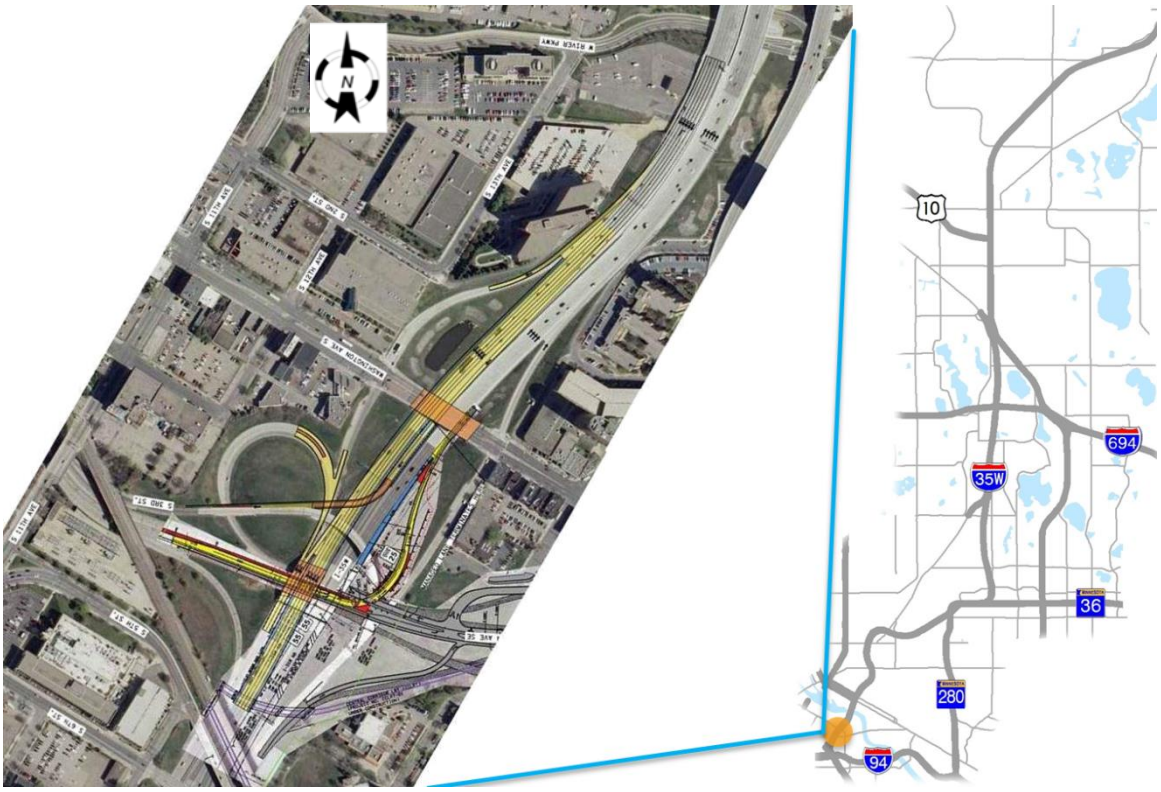
Three options were considered for managed lane direct connections to downtown Minneapolis. The first would provide northbound and southbound connections from the managed lanes to 2nd Street, just north of Washington Avenue. Under this option the managed lanes will end just north of Washington Avenue by connecting to a flyover bridge from the median of I-35W to 2nd Street west of I-35W. This option is shown in Figure 17-7.

Figure 17-7 2nd Street Option



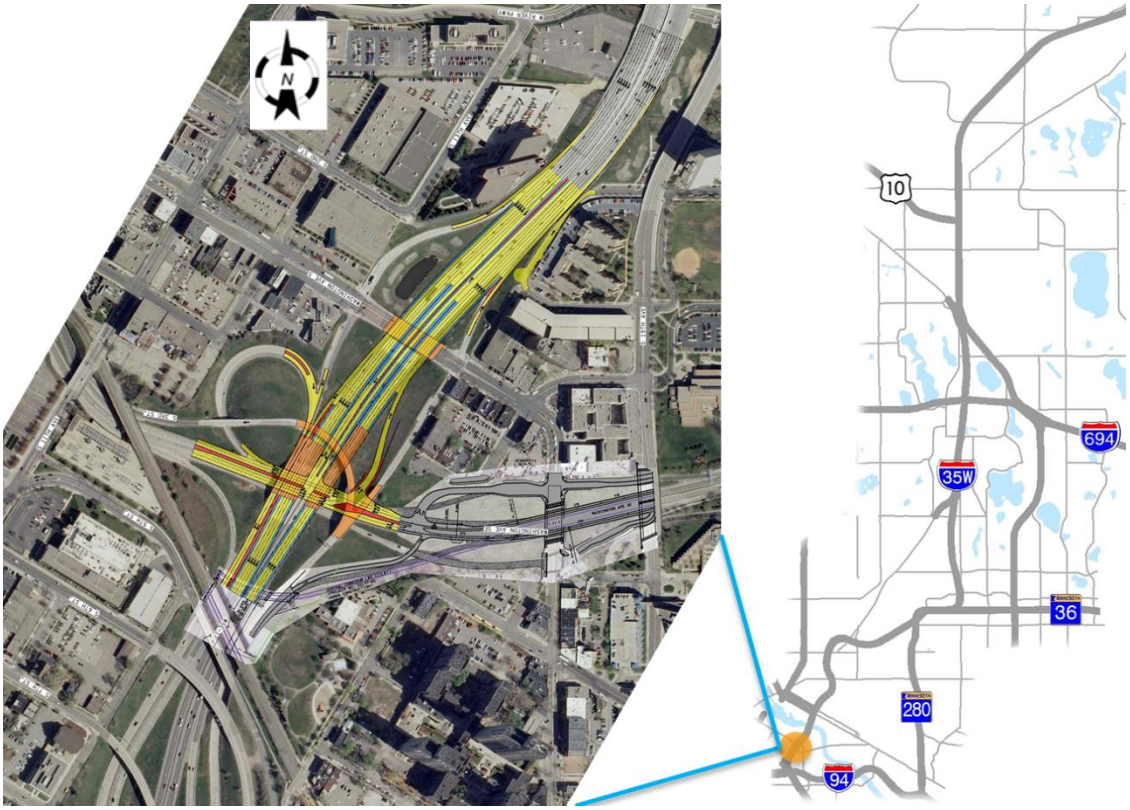
The second option provides a direct connection from the southbound managed lane to 3rd Street westbound west of I-35W. Similar to the 2nd Street option, the southbound managed lane will end by connecting to a flyover bridge from the median of I-35W to 3rd Street, this time just to the south of Washington Avenue. This option does not provide a managed lane direct connection for traffic entering northbound I-35W; however this movement will be served by the 4th Street general purpose entrance ramp programmed for construction. Traffic will then have an opportunity to access the northbound managed lane which would be added on the left side of I-35W near Washington Avenue. The 3rd Street option is shown in Figure 17-8.

Figure 17-8 3rd Street Option



The third option considered to provide managed lanes direct connections to downtown Minneapolis is at 3rd/4th Street. This option provides a direct connection for both the northbound and southbound managed lanes. Additionally, this option provides access to both the east and west along 3rd and 4th Streets by creating a new intersection underneath the I-35W overpass. Similar to the other options, the managed lanes would end near Washington Avenue by connecting ramps providing access to and from 3rd/4th Street. This option is shown in Figure 17-9.

Figure 17-9 3rd/4th Street Option

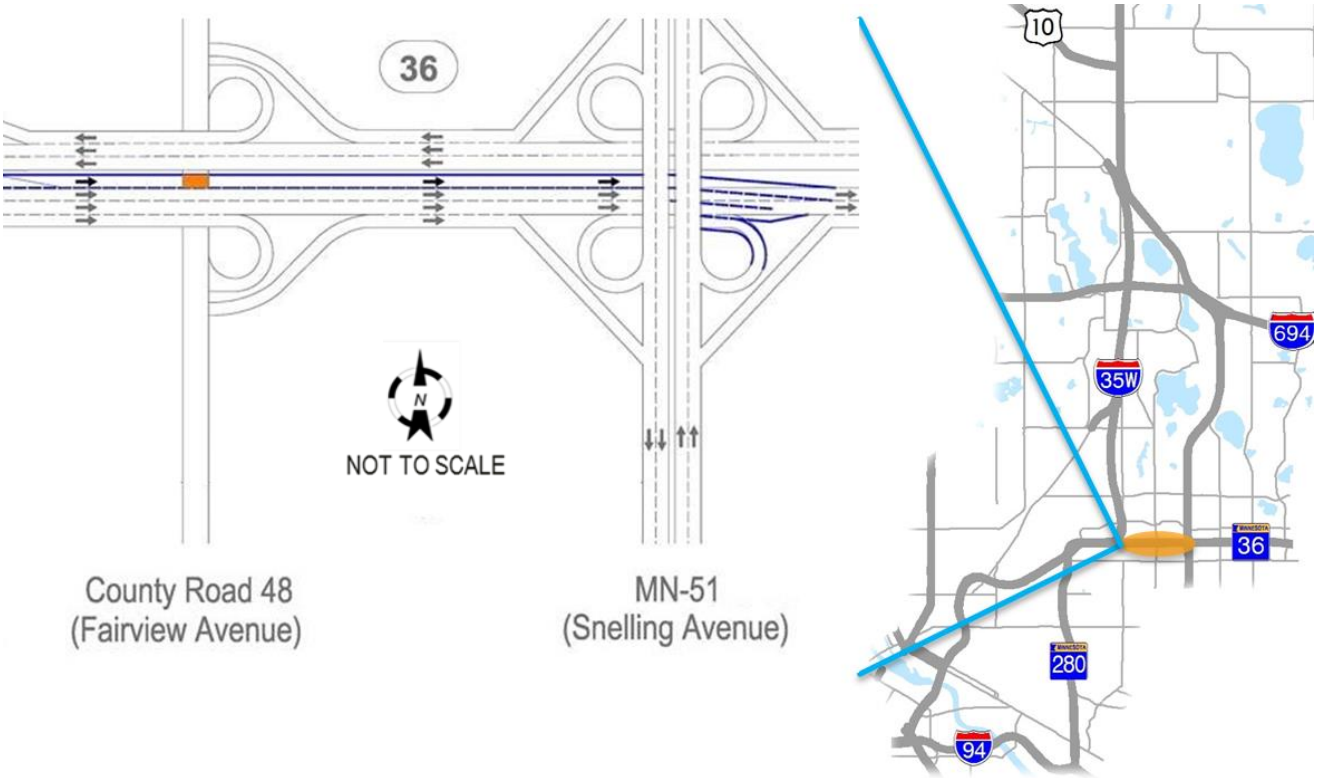


The managed lane direct connections to downtown Minneapolis satisfy many of the goals and objectives established for this study. For example, they will specifically be utilized by managed lane users, thus encouraging transit and carpools by providing travel time advantages and providing choice for commuters during peak periods. In addition, they address existing congestion by relieving traffic volumes using the Washington Avenue interchange to access I-35W to and from the north. These connections will also help to improve safety by reducing the number of lane changes needed for managed lane users to access downtown Minneapolis.

TH 36 Eastbound (Other Potential Concept)

Extension of the left lane along eastbound TH 36 was included in the I-35W North Managed Lanes Vision to address existing congestion. Currently, the left lane drops between Cleveland Avenue and Fairview Avenue resulting in congestion that extends back into the I-35W commons area. The concepts included in the vision address this issue as it will reconfigure this section of TH 36 by eliminating the left lane drop and connecting the left lane upstream of the lane drop with the left through lane beyond this point. The right lane from the I-35W commons section would be extended to end at the exit to the loop to TH 52 northbound. This reconfiguration and lane extension are depicted schematically in Figure 17-10.

Figure 17-10 TH 36 Eastbound



The improvement utilizes existing infrastructure and reduces congestion along the I-35W corridor. Congestion extending back from the existing bottleneck extends back to the I-35W commons section, resulting in unsafe conditions. These unsafe conditions have the potential to intensify with the addition of a managed lane along northbound I-35W, resulting in greater speed shear. This improvement is not expected to resolve congestion along eastbound TH 36. Rather, it will result in the bottleneck shifting downstream, thereby reducing the queuing onto I-35W. Another benefit of this improvement is it builds towards future infrastructure improvements for TH 36, which has been identified as a future MnPASS corridor. The corridor's capacity expansion will be accomplished through the addition of a managed lane along eastbound TH 36 between I-35W and I-35E. The lane extension improvement in the I-35W North Managed Lanes Vision would build towards the future MnPASS lane.

North Ramp Access at Hennepin Avenue (Other Potential Concept)

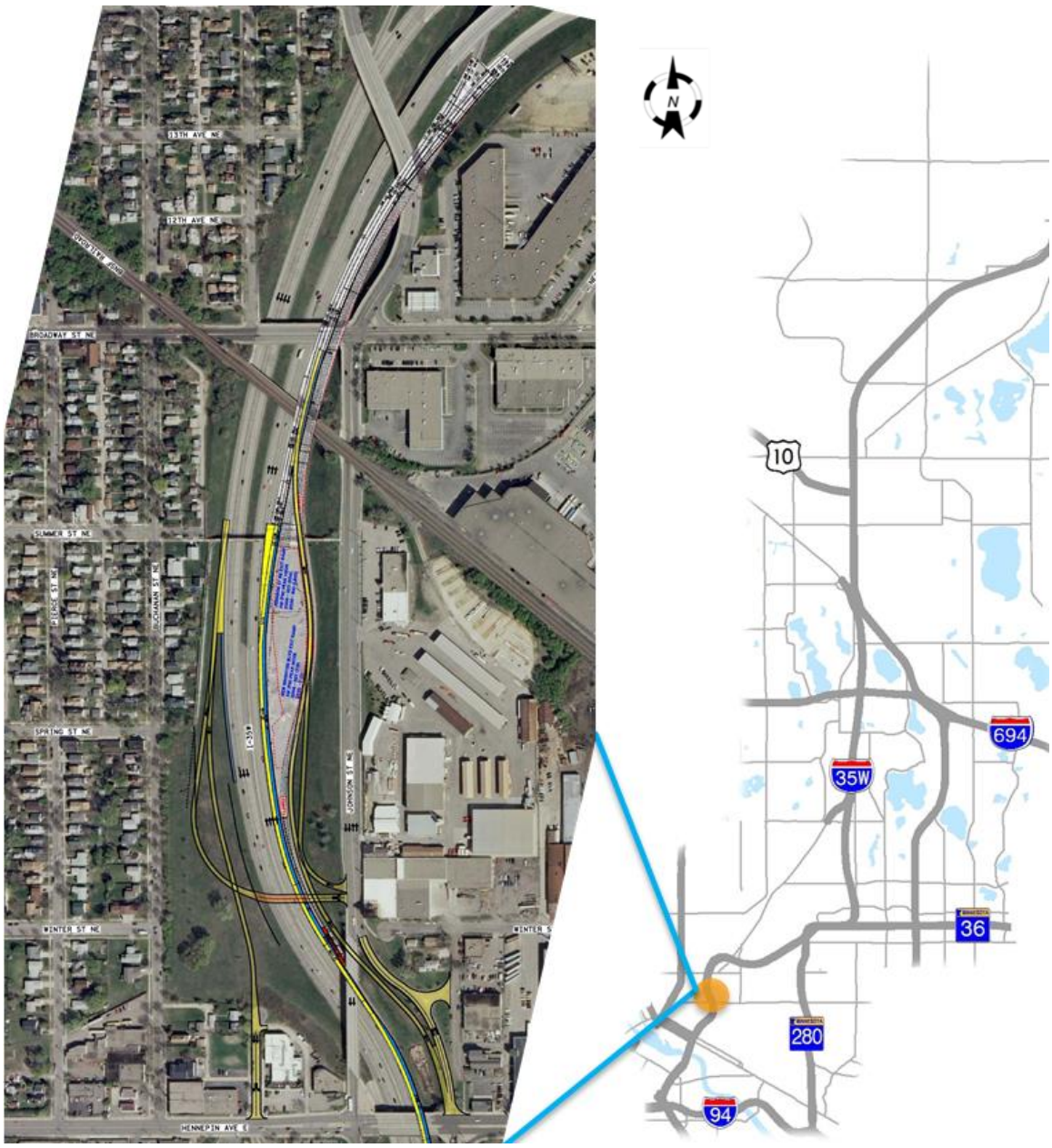
New access to and from I-35W north of Hennepin Avenue in Minneapolis was included in the I-35W North Managed Lanes Vision. Currently, only south ramp access is provided to and from I-35W at Hennepin Avenue. The improvement will provide all movements to and from I-35W at this location. The localized improvement will provide some congestion relief on I-35W but it will result in increased traffic volumes on Hennepin Avenue.

Two concepts were considered to provide north ramp access at Hennepin Avenue. Option 1 provides diamond interchange-type ramps that will connect directly to Hennepin Avenue on the east and west sides of I-35W. Option 2 creates a new intersection along Johnson Street north of the I-35W overpass. This new intersection will connect to the new northbound entrance ramp

and southbound exit ramp that would cross I-35W with a flyover bridge. Both options are considered viable and should be investigated further as this improvement advances towards implementation.

Under both Options 1 and 2, the extended parallel acceleration lane for the Johnson Street southbound entrance ramp will be converted to an auxiliary lane ending at the new exit ramp to Hennepin Avenue. Also under both options, the new northbound entrance ramp will tie into the existing CD roadway serving the northbound exits to Stinson Boulevard and New Brighton Boulevard. Traffic making this movement will enter northbound I-35W using the existing transit entrance just upstream of the Stinson Boulevard overpass. Figure 17-11 illustrates these improvements for the north ramp access at Hennepin Avenue.

Figure 17-11 North Ramp Access at Hennepin Avenue



Providing north ramp access to and from I-35W at Hennepin Avenue addresses the study goals and objectives: to better utilize existing and future infrastructure investments, and reducing congestion in the corridor. The north ramps described take advantage of existing MnDOT right of way north on Hennepin Avenue and deliver cost savings by tying into existing pavement on the southbound auxiliary lane and the northbound CD road. Under existing conditions there is recurring congestion at the southbound entrance from Johnson Street during the a.m. peak period that will be relieved with this improvement. In addition, the Washington Avenue interchange is congested many hours each day since there are very few access points for downtown Minneapolis to and from I-35W north. This access would help relieve the congestion by providing additional access to Minneapolis.

18.0 Implementation Plan

The purpose of the implementation plan is to provide an explicit systematic blueprint for the implementation of the I-35W North Managed Lanes Vision over time in a series of smaller projects. The plan coordinates the improvements with operational need and scheduled infrastructure investments such as MnDOT's STIP, MnDOT's pavement preservation needs and MnDOT's bridge preservation needs. This is important as it looks to satisfy the study goal of better utilize existing and future infrastructure investments. Early stages or phases of the implementation plan were intended to provide transit benefits and congestion free choices as early as possible. In addition, localized improvements were developed to reduce congestion and to improve safety. Focusing on these characteristics, the implementation plan helped accomplish the study goals and objectives.

Unknown Influences

As noted, the implementation plan was developed based on operational need and future pavement and bridge preservation needs identified by MnDOT. Nonetheless, other factors could influence and modify the implementation plan. Some of these factors could include:

- Vikings stadium development
- Minneapolis access to the I-35W north corridor
- TCAAP redevelopment
- TH 610 completion
- Funding sources and opportunities

These factors could affect the implementation plan by driving the need for localized improvements to address changes in traffic and congestion. They may also present opportunities for funding partnerships to accelerate various elements in the implementation plan. Conversely, funding limitations or resource allocations to other corridors could delay elements of the plan. The list of factors is provided to notify decision-makers of the potential issues and it is recommended they remain up to date on the status of these factors and be aware as new factors arise.

Assumed Improvements

Several planned and assumed improvements along the corridor for the years 2013 through 2016 were used to establish the initial planning for implementation. These projects were identified from the STIP. The assumed improvements include:

<u>2013</u>

1. Construct entrance ramp from 3rd/4th Street South to northbound I-35W.

<u>2014</u>

2. Construct auxiliary lane along northbound I-35W from University Avenue SE to revised exit to Johnson Street/Stinson Boulevard/New Brighton Boulevard.
3. Redeck CSAH 96 bridge over I-35W.

2015

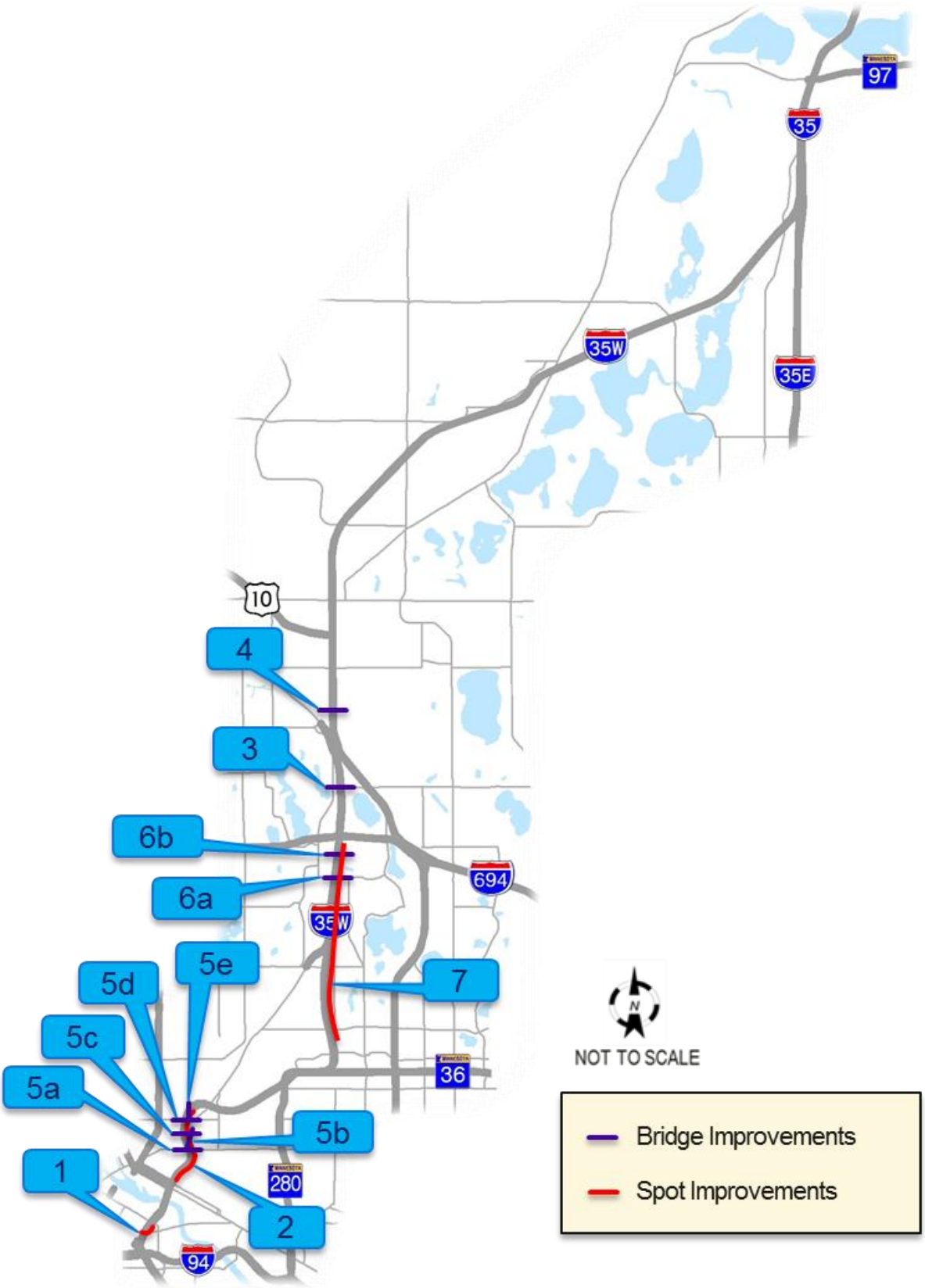
4. Replace CR H bridge over I-35W (lengthen to accommodate managed lanes).

2016

5. Redeck bridges over I-35W at:
    a. Hennepin Avenue
    b. Johnson Street southbound (north of Hennepin Avenue)
    c. Summer Street Pedestrian Bridge
    d. Broadway Avenue
    e. Johnson Street (north of Broadway Avenue)
6. Replace bridges over I-35W at:
    a. CR E2
    b. CR F
7. Rehabilitate pavement along I-35W between CR C and I-694.

These improvement locations are shown in Figure 18-1.

Figure 18-1 Assumed Improvements



As the current STIP extends through 2016, it is assumed that further construction of the I-35W North Managed Lanes Vision improvements will take place after this time. Therefore the improvements listed above are assumed to be in place when remaining elements of the Vision are implemented. An important note regarding the replacement of the CR H Bridge over I-35W in 2015 is it must be widened from its existing design to accommodate future managed lanes. MnDOT and Ramsey County have been informed of this condition and are expecting to propose a compatible design.

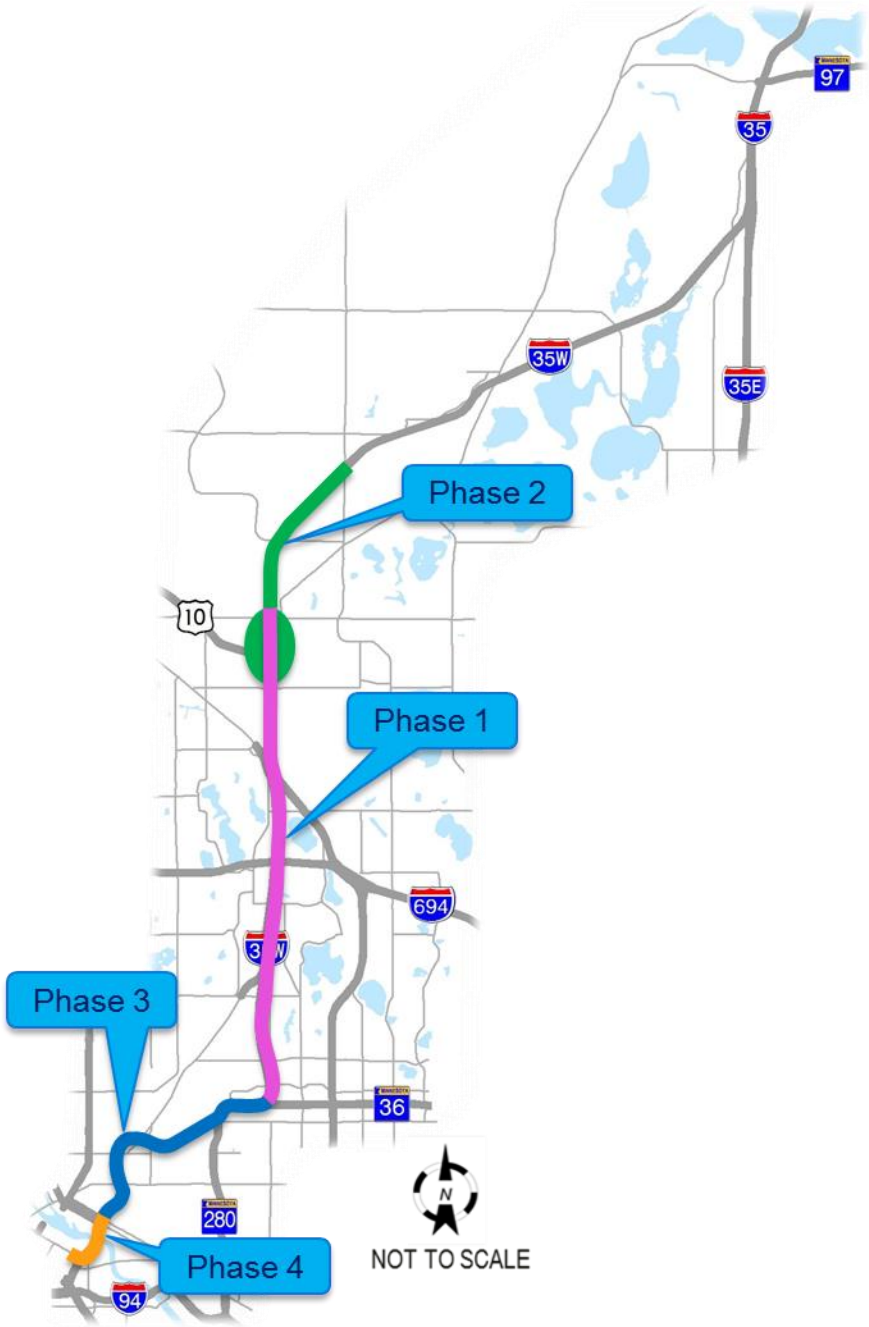
18.1 Managed Lane Phases

Recognizing the I-35W North Managed Lanes Vision will be implemented in a series of smaller stages, the benefits of managed lanes along the I-35W north corridor can still be provided along shorter portions of the corridor. The desirable managed lane termini for these conditions were identified and classified into four phases based on existing and projected congestion issues throughout the corridor. Each of these phases represents a stand-alone managed condition that will provide operational improvement, transit benefits, and a congestion free choice within the corridor. The four phases are:

- Phase 1: TH 36 through TH 10 north
- Phase 2: TH 10 to Lexington Avenue
- Phase 3: University Avenue/4th Street to TH 36
- Phase 4: Downtown Minneapolis direct connection to University Avenue/4th Street

These four phases are illustrated in Figure 18-2. The sequence of these phases not only allows for cost effective implementation through synergies with other corridor preservation investments, the sequencing also addresses the more immediate operational needs of the corridor earlier on. It should be noted the interchange improvements at I-35W and the TH 10 north junction described in the Managed Lanes Vision chapter would be a part of the Phase 2 managed lane conditions. These interchange improvements include the direct connection from the northbound managed lane to TH 10 westbound.

Figure 18-2 Managed Lane Phases



18.2 Implementation Plan

The implementation plan defines 11 stages that contain elements that could realistically be constructed in a one to four-year period. As noted previously, the implementation plan was developed to capitalize on bridge and pavement preservation needs that have been identified by MnDOT. The bridge preservation needs were laid out in three timeframes: 2012 to 2018, 2019 to 2027, and 2028 to 2034, which were taken into consideration when developing the

implementation plan. Fewer pavement preservation needs were identified and the timeframe for these were less specific.

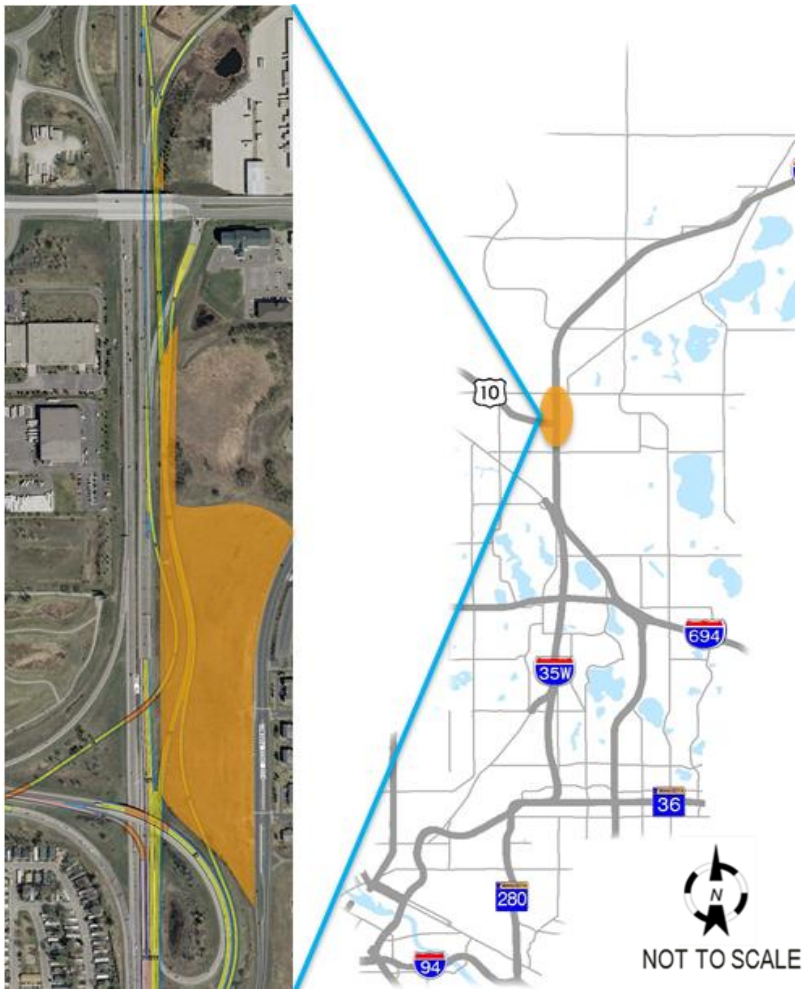
The managed lane phases also provide an orderly approach to addressing corridor congestion with the addition of managed lanes. The projects identified in each stage were based on a combination of these factors and grouped by location and/or consideration of construction impacts.

The following section documents the stages of the implementation plan. While the implementation stages have been separated into explicit systematic groups, it may be determined lump several stages together for the final project design and development.

Initial Stage

The initial stage for the implementation plan will be to purchase the right of way needed for the interchange improvements at the TH 10 north junction. This is not one of the 11 stages that include construction of physical improvements. However, it is a critical element to the completion of later stages in the implementation plan. This should be carried out at a time that provides adequate lead time for construction of the interchange improvements. It is recommended this be pursued sooner rather than later to maximize the potential for a successful outcome and avoid future increases in land acquisition costs. Figure 18-3 highlights the areas of land that will likely need to be acquired for the TH 10 north junction interchange improvements.

Figure 18-3 Initial Stage



Stage A

Stage A includes the following projects that are preservation needs only and independent of the managed lane vision:

1. Reconstruction of the bridge from westbound TH 36 to southbound I-35W

Stage A also includes the following projects that are preservation needs and provide synergy with the managed lane vision:

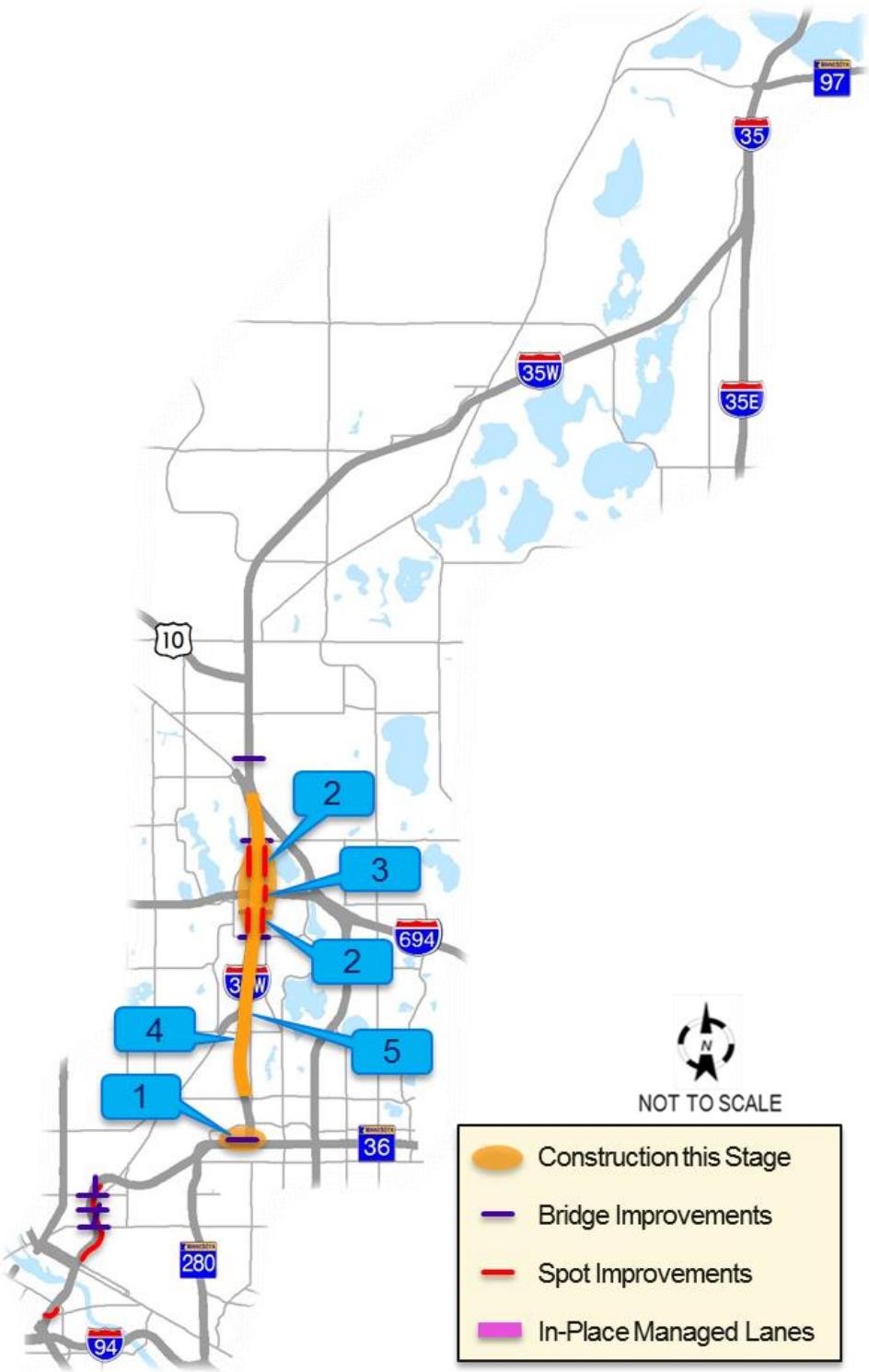
2. Northbound and southbound auxiliary lanes between CR E2 and I-694 and between I-694 and CSAH 96
3. Northbound buffer lane for I-694 loop-to-loop weaving movements

Finally Stage A includes the following projects that are not preservation needs but support the managed lane vision:

4. Southbound managed lane starting at the TH 10 south interchange ending at the CR C exit
5. Northbound managed lane starting at the CR C interchange ending at the CSAH 10 exit

All Stage A projects are shown in Figure 18-4.

Figure 18-4 Stage A



The improvements in Stage A will help to address existing congestion in the corridor. The area near the I-694 interchange currently causes significant congestion. The addition of managed

lanes through this area and the localized improvements will provide significant congestion relief. Lane schematics are provided in Figure 18-5 through

Figure 18-7 showing the conditions that will be in place following Stage A. It is expected the managed lane designation will end for the northbound and southbound managed lanes approximately one mile upstream of the managed lane termini to allow traffic to make any necessary lane changes in preparation for downstream destinations.

Figure 18-5 Stage A I-35W and I-694

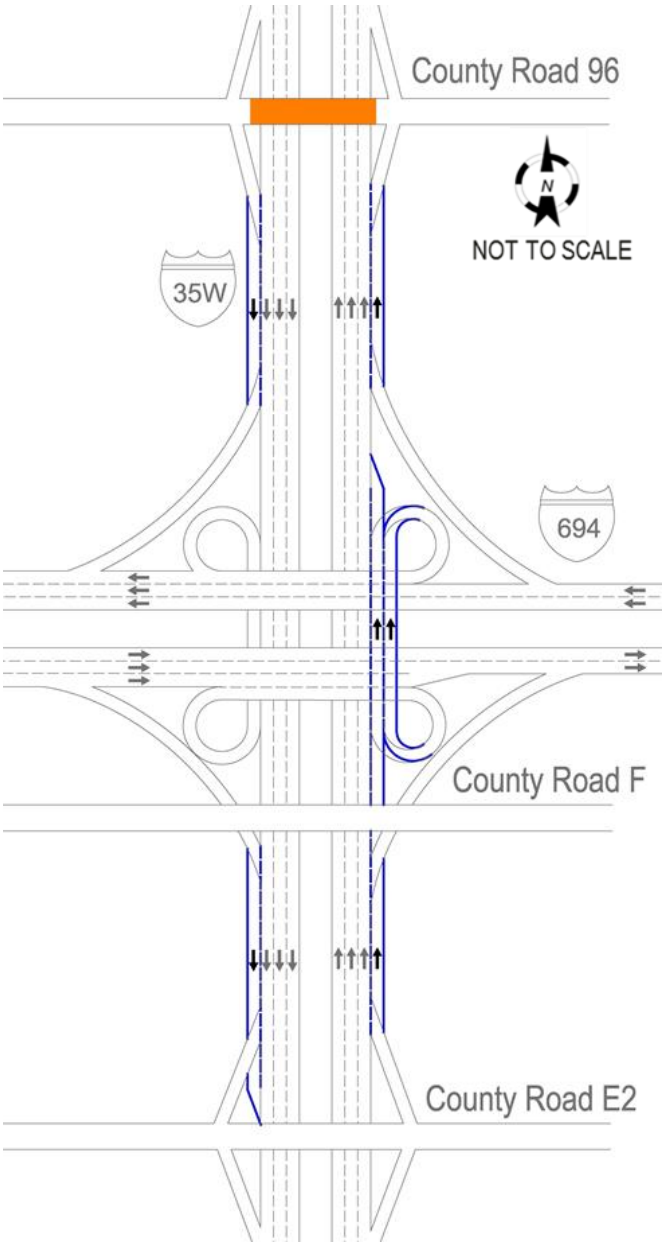


Figure 18-6 Stage A Managed Lane Terminus

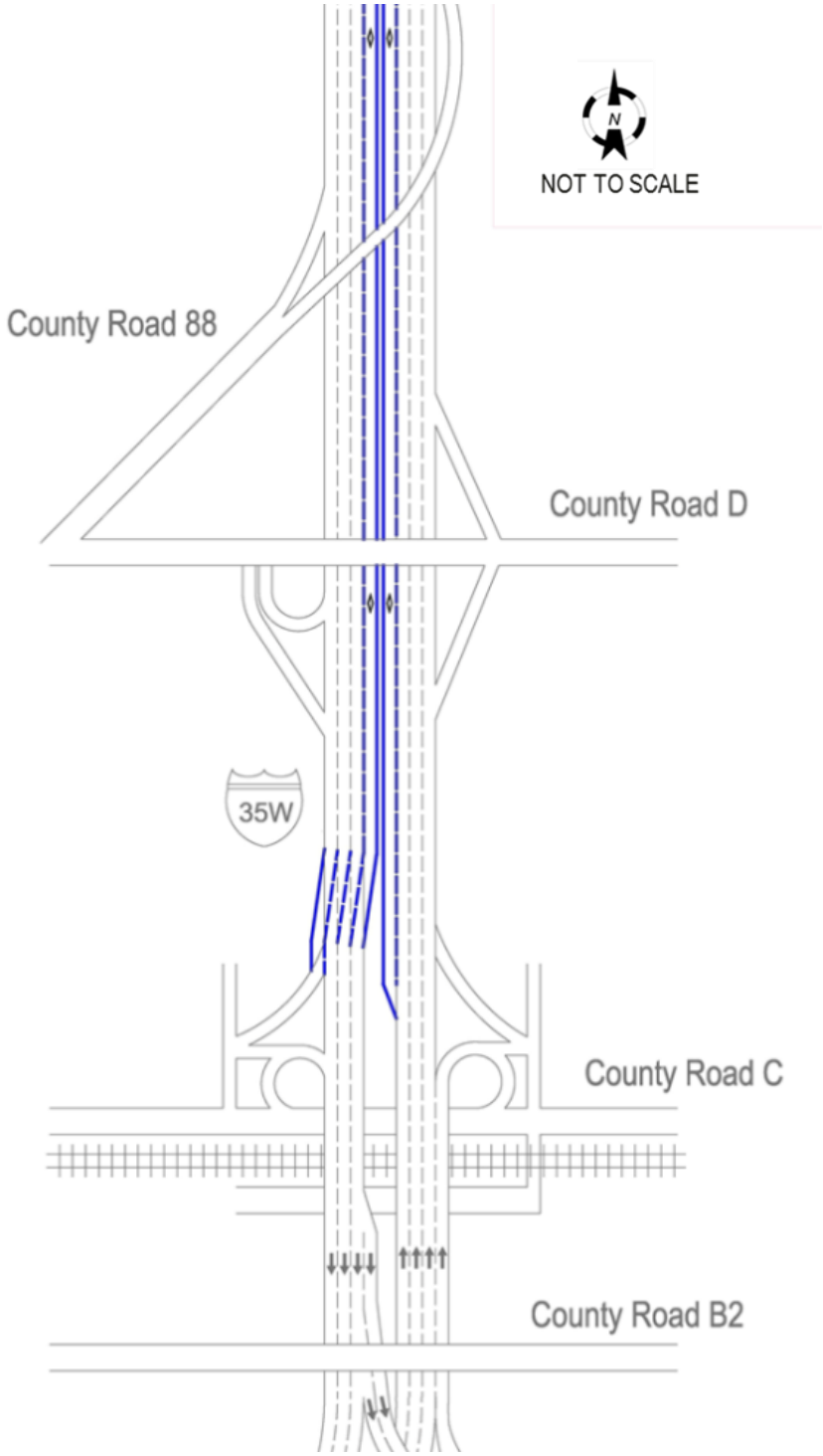
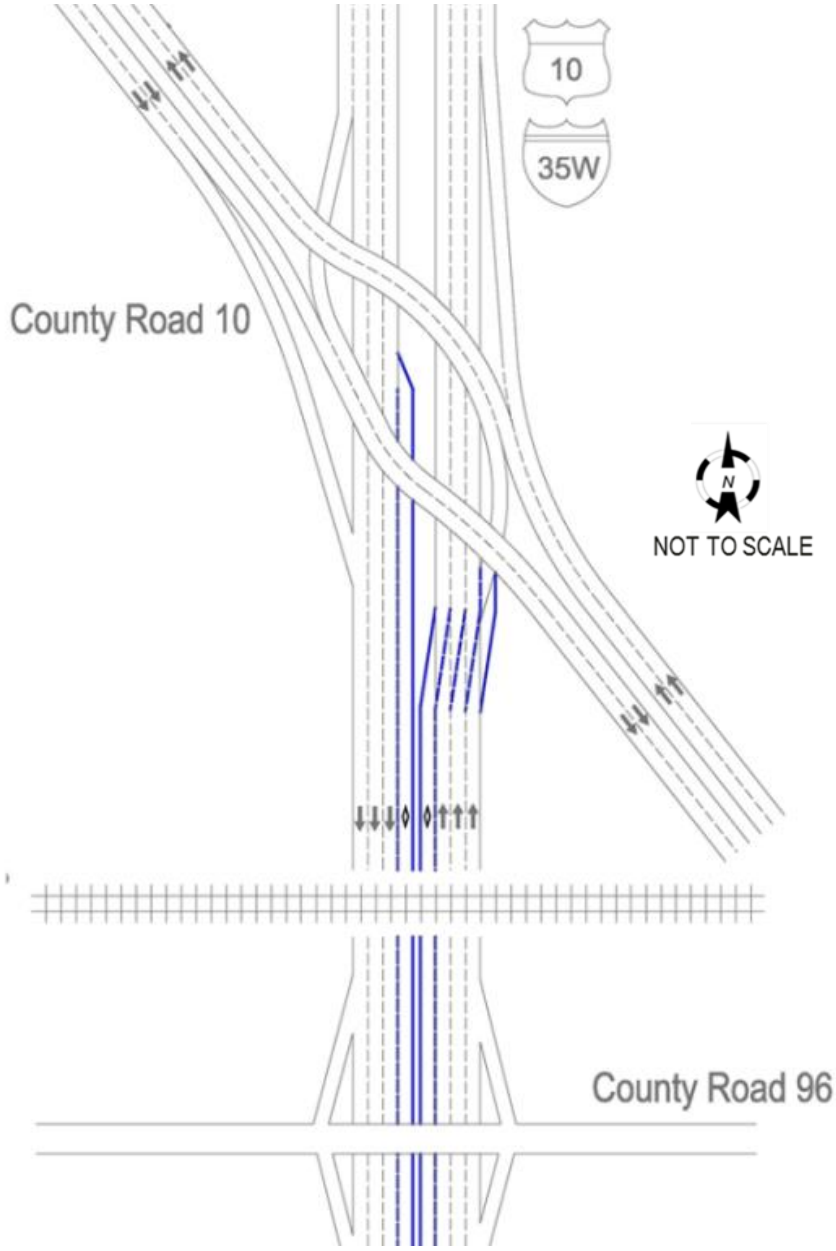


Figure 18-7 Stage A Managed Lane Terminus



The bridge from westbound TH 36 to southbound I-35W is primarily being reconstructed based on preservation needs, however the design of this bridge will depend on future consideration of a TH 36 managed lane direct connection. Figure 18-8 shows how the alignment of this bridge would change when a connection is provided from the northbound I-35W managed lane to westbound TH 36. An additional benefit to the proposed bridge realignment and construction staging is that the proposed bridge is able to be built while the existing remains in operation.

Figure 18-8 Stage A I-35W and TH 36

Stage B

Stage B includes the following projects that are preservation needs only and independent of the managed lane vision:

1. None

Stage B also includes the following projects that are preservation needs and provide synergy with the managed lane vision:

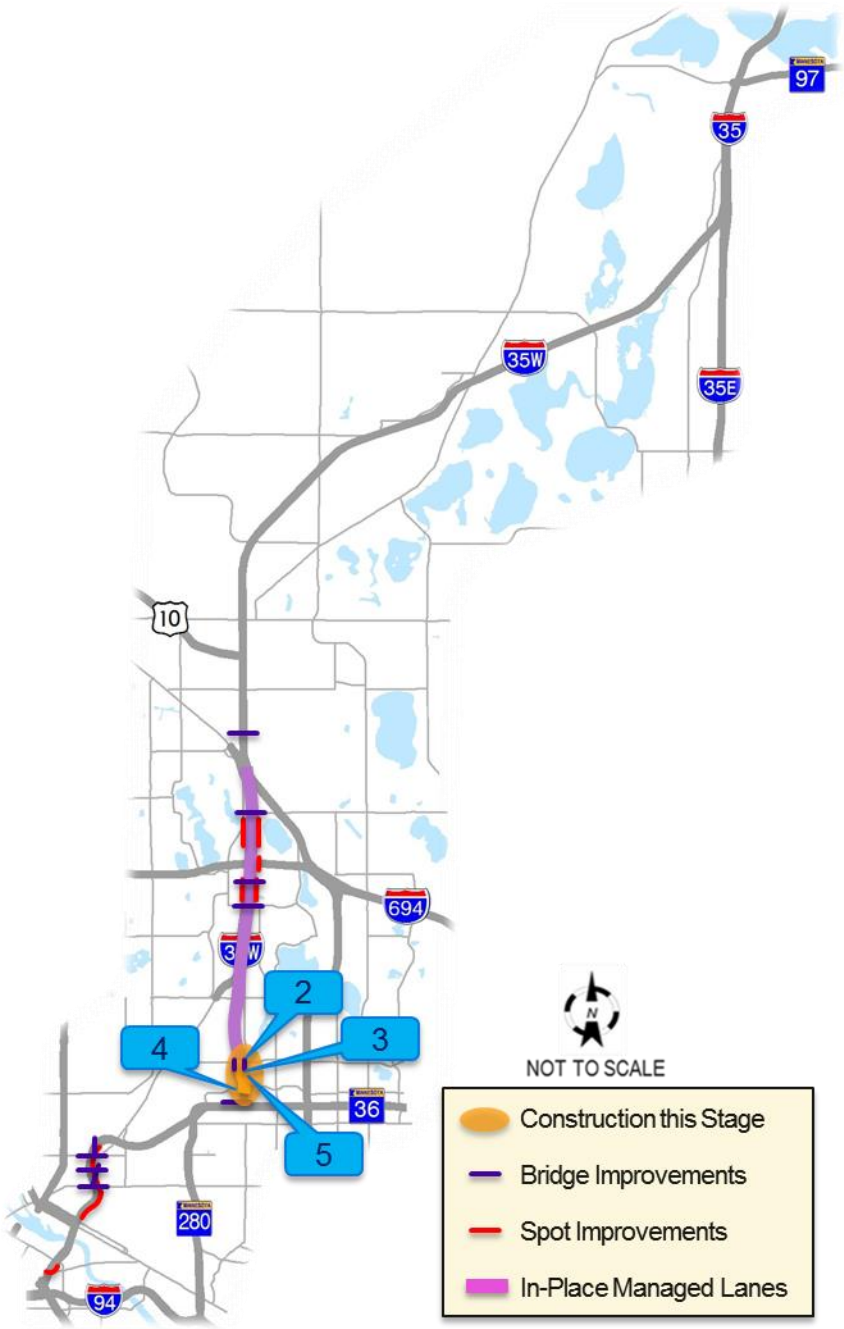
2. Reconstruct I-35W bridges over CR C - Bridge reconstruction needed for managed lanes
3. Reconstruct I-35W bridges over railroad near CR C - Bridge reconstruction needed for managed lanes

Finally Stage B includes the following projects that are not preservation needs but support the managed lane vision:

4. Extend southbound managed lane from CR C to left lane near TH 36/Cleveland Avenue exit
5. Extend northbound managed lane from south of railroad overpass to CR C

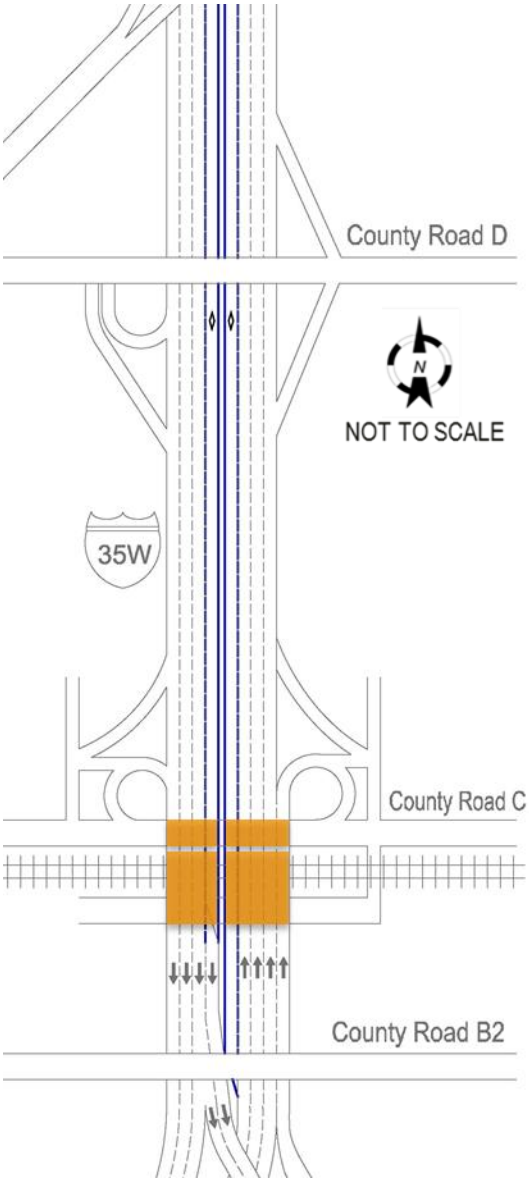
All Stage B projects are shown in Figure 18-9.

Figure 18-9 Stage B



The reconstruction of I-35W bridges over CR C and the railroad to the south will allow the managed lanes constructed in Stage A to be extended south to TH 36. This will provide improved lane continuity and enhanced operational benefits. The resulting lane configurations are shown in Figure 18-10.

Figure 18-10 Stage B Managed Lane Terminus



Stage C

Stage C includes the following projects that are preservation needs only and independent of the managed lane vision:

1. None

Stage C also includes the following projects that are preservation needs and provide synergy with the managed lane vision:

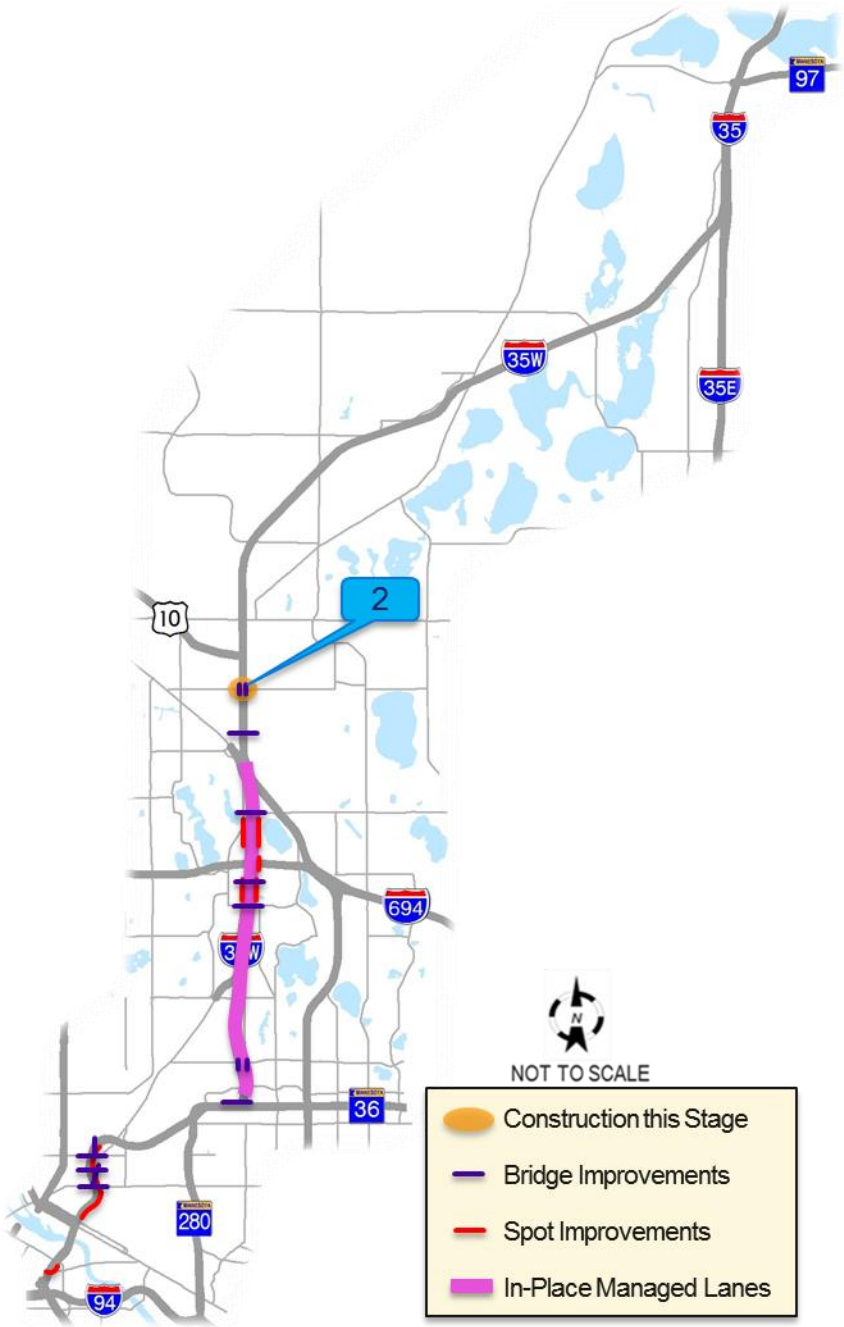
2. Reconstruct I-35W bridges over CR I – Bridge reconstruction needed for managed lanes

Finally Stage C includes the following projects that are not preservation needs but support the managed lane vision:

3. None

All Stage C projects are shown in Figure 18-11.

Figure 18-11 Stage C



The reconstruction and widening of the I-35W bridges over CR I will provide the additional width required to implement managed lanes north of the current terminus at the TH 10 south junction.

Stage D

Stage D includes the following projects that are preservation needs only and independent of the managed lane vision:

1. None

Stage D also includes the following projects that are preservation needs and provide synergy with the managed lane vision:

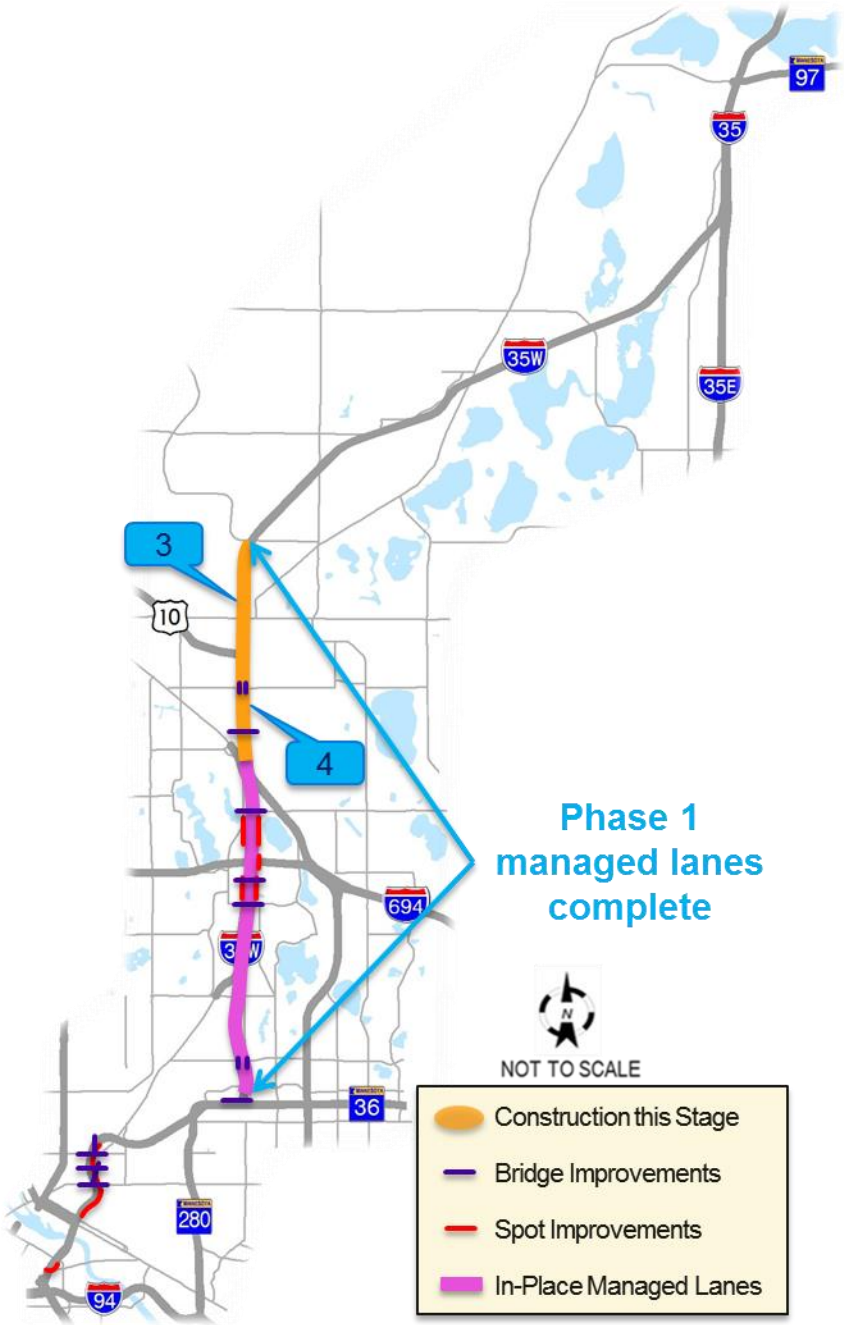
2. None

Finally Stage D includes the following projects that are not preservation needs but support the managed lane vision:

3. Construct southbound managed lane starting near the Lake Drive flyover to current start at the TH 10 south interchange.
4. Construct northbound managed lane to extend from current end at CSAH 10 to 95th Avenue.

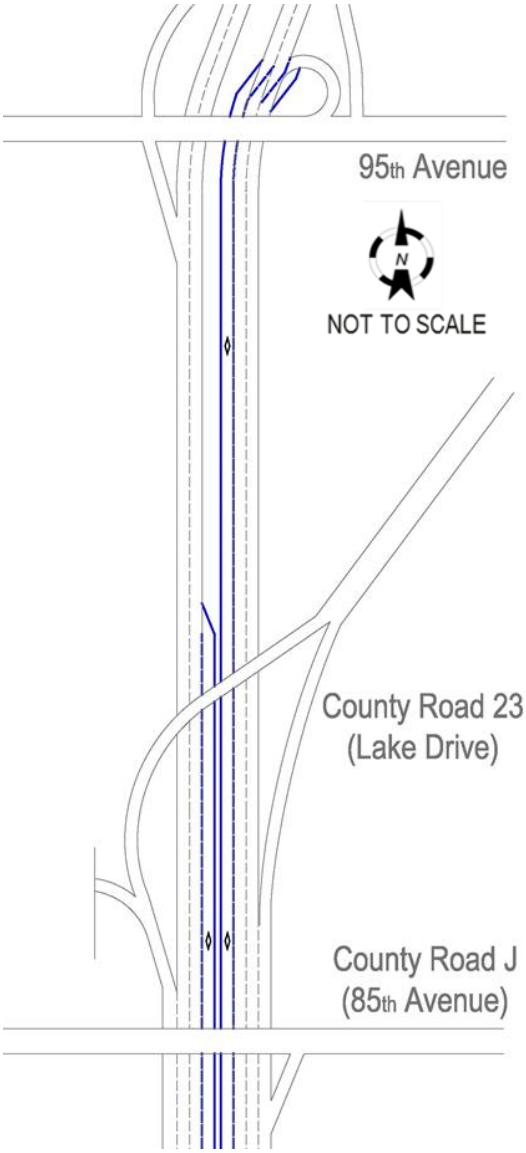
Stage D builds on the improvements constructed in the previous stage to extend managed lanes north of the previous terminus through the TH 10 interchange. This would result in the completion of Phase 1 of the managed lanes. All Stage D projects are shown in Figure 18-12.

Figure 18-12 Stage D



Similar to earlier stages of the managed lanes, the northbound managed lane designation will be expected to end approximately one mile upstream of the physical end of the lane at 95th Avenue. This will allow traffic to make any necessary lane changes in preparation for downstream destinations. The southbound managed lane would be added to the left side of the roadway just upstream of the Lake Drive Flyover, to allow managed lane users to move into the lane before Lake Drive traffic enters the mainline. These lane configurations are shown in the schematic in Figure 18-13.

Figure 18-13 Stage D Managed Lane Terminus



The completion of the northbound and southbound managed lane segments from TH 36 through the TH 10 north interchange mark the completion of Phase 1 of the managed lanes. This is a significant benchmark for operational improvements in the corridor expected to deliver on the I-35W North Managed Lanes Corridor Study goals and objectives. First, the improvements made in Stages A through D work towards completion of the managed lane while better utilizing existing and future infrastructure investments. Second, the completion of the Phase 1 managed lanes will promote transit and carpool use, particularly to the major park and ride facility along 95th Avenue. Third, the managed lanes will provide a choice for commuters during peak periods. Finally, Phase 1 of the managed lanes will reduce existing congestion by providing additional capacity through the most congested segments of the corridor.

Stage E

Stage E includes the following projects that are preservation needs only and independent of the managed lane vision:

1. None

Stage E also includes the following projects that are preservation needs and provide synergy with the managed lane vision:

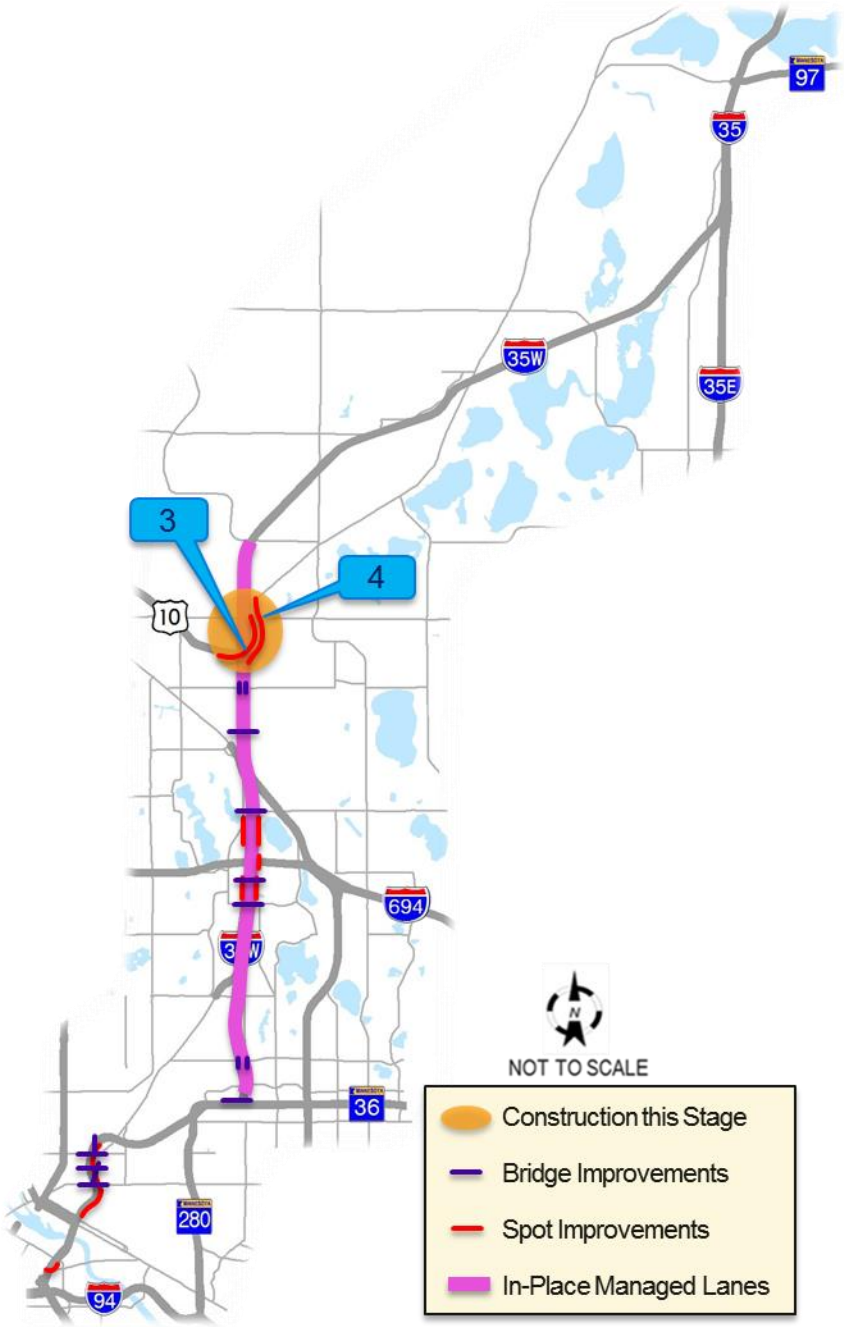
2. None

Finally Stage E includes the following projects that are not preservation needs but support the managed lane vision:

3. Construct two bridges and a new connection from eastbound TH 10 to northbound I-35W, close existing loop for this movement
4. Construct exit and CD road for northbound I-35W traffic to access CR J and Lake Drive

Stage E begins the improvements building towards Phase 2 of the managed lanes. All Stage E projects are shown in Figure 18-14.

Figure 18-14 Stage E



Stage E will result in a new flyover connection from eastbound TH 10 to northbound I-35W. This connection will continue to allow eastbound TH 10 traffic to exit northbound I-35W at 95th Avenue; however it will limit access to CR J and Lake Drive. A layout of these improvements is shown in Figure 18-15.

Figure 18-15 Stage E I-35W and TH 10 North Junction

These interchange improvements will help improve operation along northbound I-35W through this area. It will help reduce conflicts and congestion by eliminating the weave between the

TH 10 eastbound entrance and the exits to CR J and Lake Drive. It will also improve safety by closing the loop from eastbound TH 10 to northbound I-35W, which has existing safety issues.

Stage F

Stage F includes the following projects that are preservation needs only and independent of the managed lane vision:

1. Pavement rehabilitation along I-35W between Lake Drive and Sunset Avenue

Stage F also includes the following projects that are preservation needs and provide synergy with the managed lane vision:

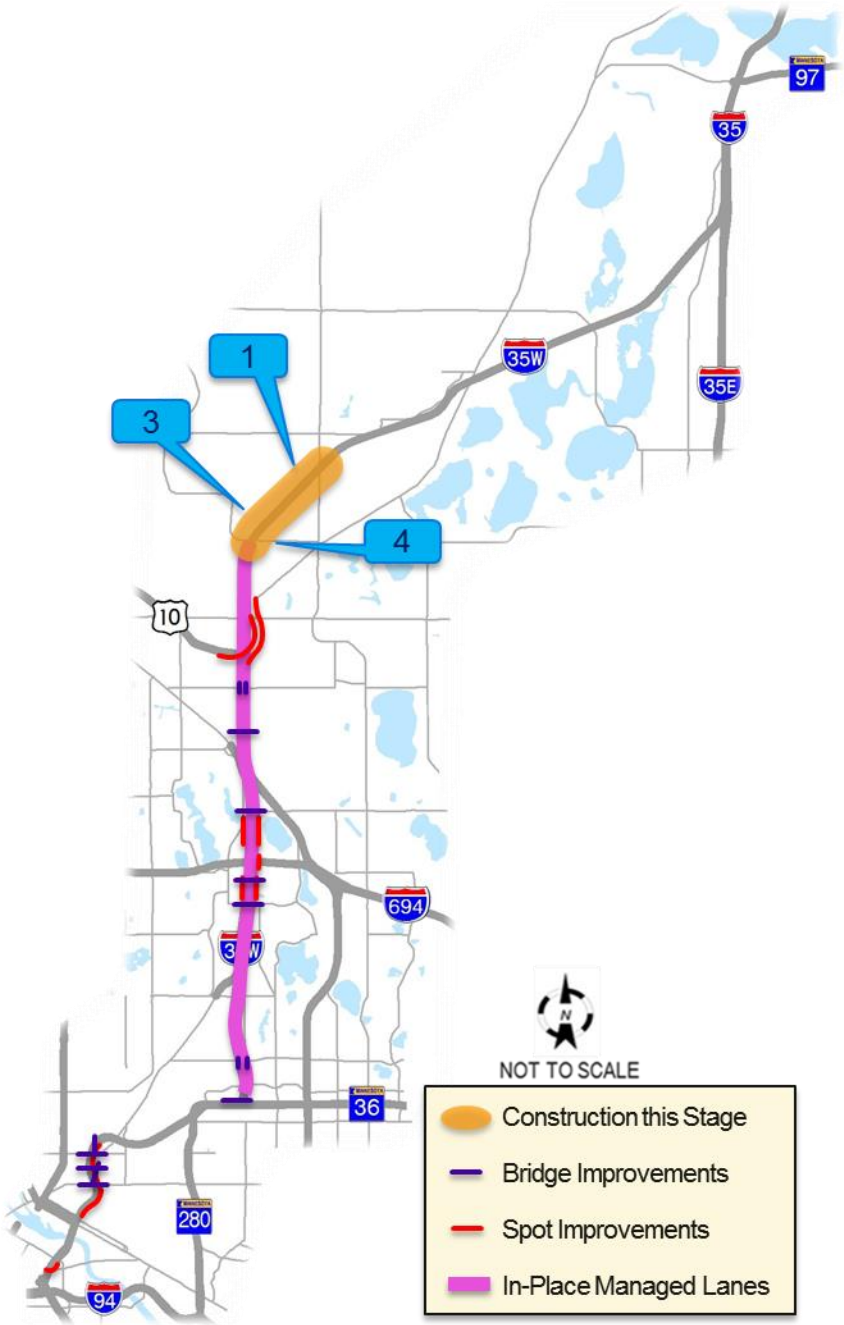
2. None

Finally Stage F includes the following projects that are not preservation needs but support the managed lane vision:

3. Construct southbound managed lane starting from Lexington Avenue to current start at Lake Drive
4. Construct northbound managed lane to extend from current end at 95th Avenue to end at Lexington Avenue

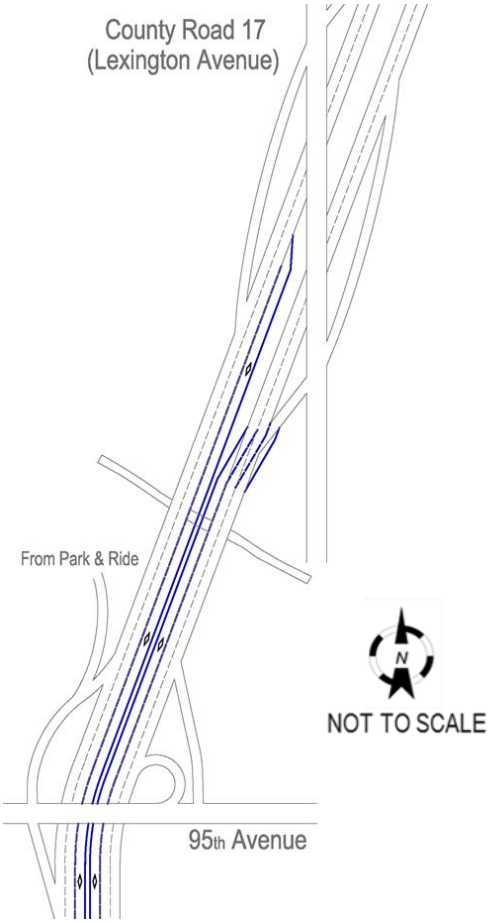
Stage F will result in continued expansion of the managed lanes. This stage would consist of the following improvements as listed below and shown in Figure 18-16.

Figure 18-16 Stage F



The improvements in this stage extend the managed lanes to their ultimate northern terminus at Lexington Avenue. Similar to other stages, the northbound managed lane designation will be expected to end approximately one mile upstream of the physical end of the lane at Lexington Avenue. This allows traffic to make any necessary lane changes in preparation for downstream destinations. The southbound managed lane will be added on the left side of the roadway between the Lexington Avenue exit and entrance ramps, to allow managed lane users to move into the lane before Lexington Avenue traffic enters the mainline. These lane configurations are shown in the schematic in Figure 18-17.

Figure 18-17 Stage F Managed Lane Terminus



As noted, these improvements extend the managed lanes to their ultimate northern terminus at Lexington Avenue. This will provide additional transit travel time benefits and a congestion-free choice for commuters. The extension of the managed lanes in this stage also utilizes future investments by coordinating construction with pavement preservation needs identified north of Lake Drive.

Stage G

Stage G includes the following projects that are preservation needs only and independent of the managed lane vision:

1. Overlay eastbound I-694 bridge over I-3W
2. Overlay CR D bridge over I-35W

Stage G also includes the following projects that are preservation needs and provide synergy with the managed lane vision:

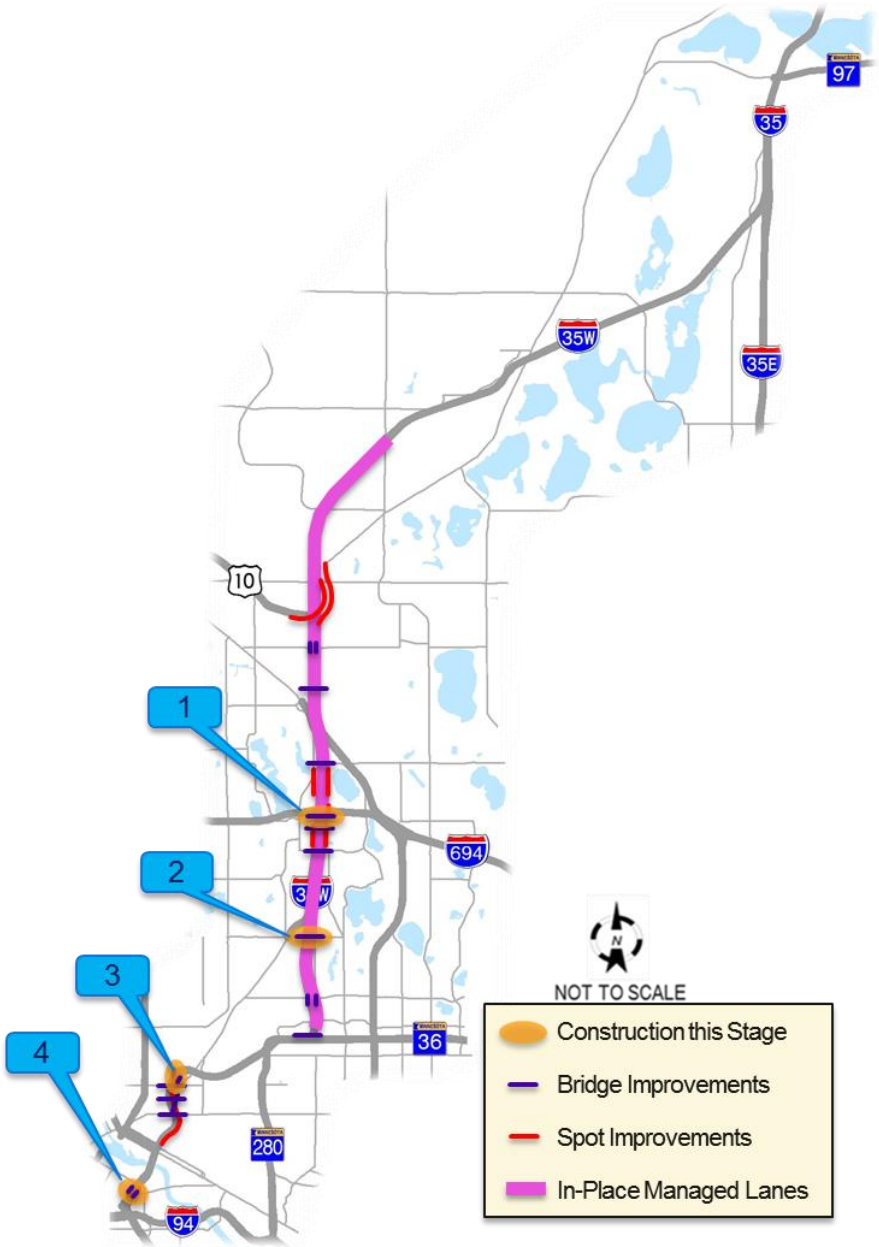
3. Reconstruct northbound I-35W bridge over northbound exit to Johnson Street – Bridge reconstruction needed for managed lane
4. Reconstruct I-35W bridges over 3rd/4th Street South

Finally Stage G includes the following projects that are not preservation needs but support the managed lane vision:

5. None

All Stage G projects are shown in Figure 18-18.

Figure 18-18 Stage G



These improvements are needed during this stage to fulfill preservation needs within the corridor, and also widening to accommodate future construction of managed lanes in the case of the I-35W northbound bridge over the Johnson Street exit. The design of the I-35W bridges over 3rd and 4th Streets in Minneapolis will depend on future plans for managed lane direct connections to downtown Minneapolis. Decision-makers should maintain awareness of future downtown direct connections as these bridge replacements are designed.

Stage H

Stage H includes the following projects that are preservation needs only and independent of the managed lane vision:

1. None

Stage H also includes the following projects that are preservation needs and provide synergy with the managed lane vision:

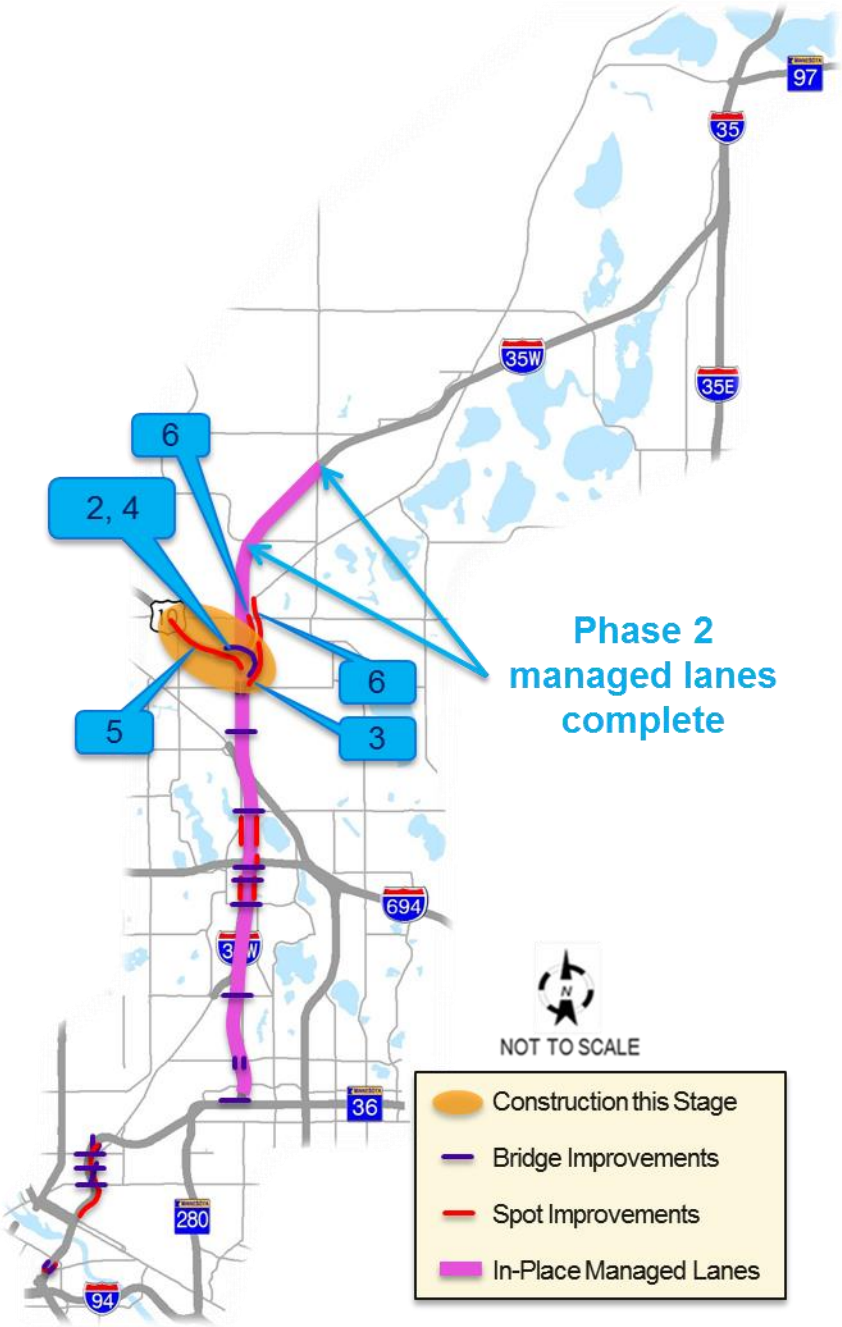
2. Reconstruct northbound I-35W to westbound TH 10 bridge over I-35W

Finally Stage H includes the following projects that are not preservation needs but support the managed lane vision:

3. Shift northbound I-35W mainline lanes east to accommodate direct connection in median
4. Construct flyover bridge and direct connection from northbound I-35W managed lane to westbound TH 10
5. Construct auxiliary lane on westbound TH 10 between direct connection and lane add near 93rd Lane
6. Construct separated entrance ramp from CR I to the CR J/Lake Drive CD road

Stage H involves completion of the interchange improvements at the TH 10 north junction. It also results in the completion of Phase 2 of the managed lanes. All Stage H projects are shown in Figure 18-19.

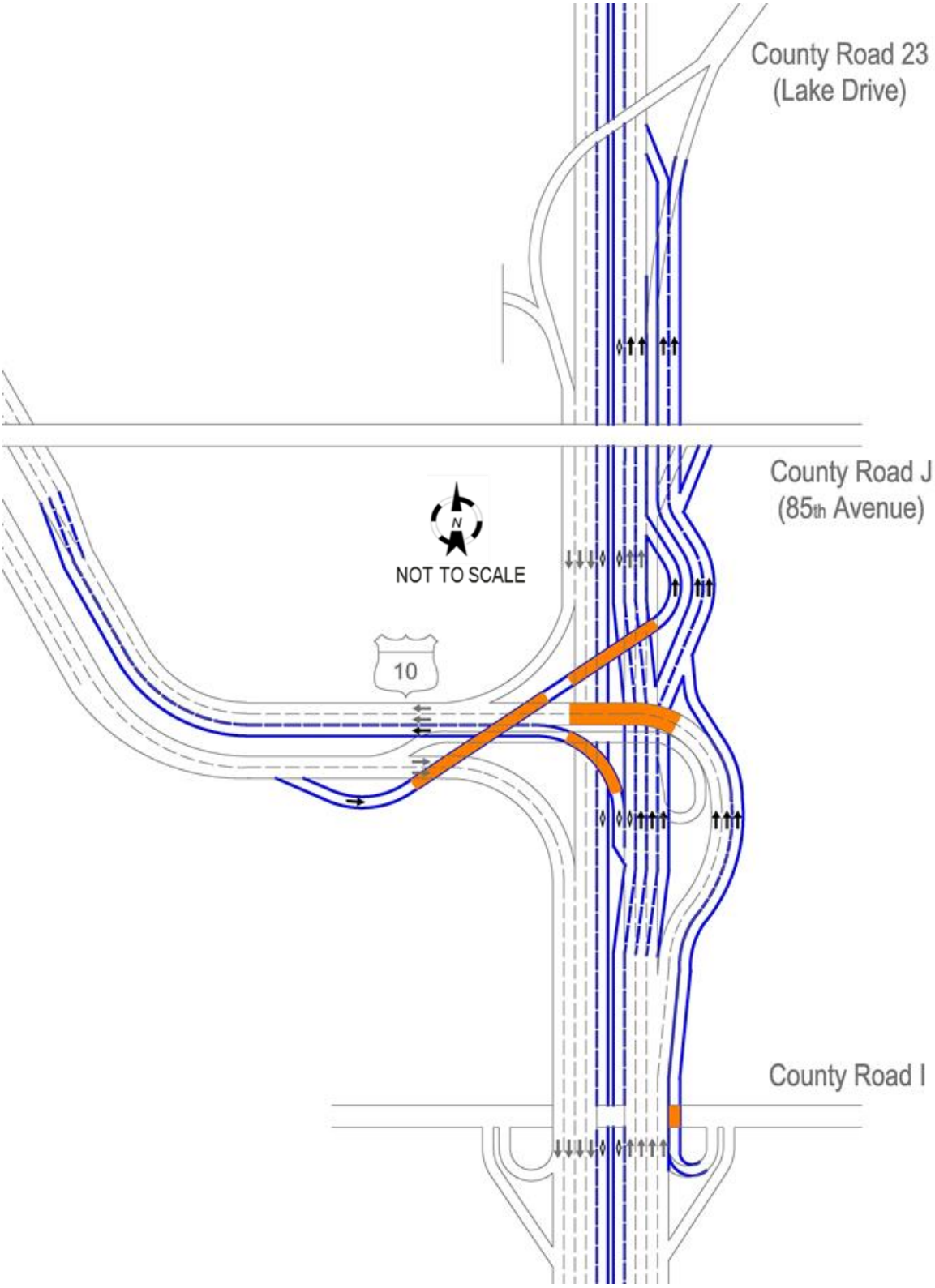
Figure 18-19 Stage H



The improvements in this stage will improve traffic operations and safety by completing the interchange improvements at the TH 10 north junction. The direct connection from the northbound managed lane will provide time savings for managed lane users and provide operations and safety benefits to all traffic on I-35W northbound by reducing lane changes. The connection from CR I to the CR J/Lake Drive CD road will improve traffic by eliminating a problematic weave between CR I and the exit to TH 10 westbound. The layout and lane configuration following this stage are shown in Figure 18-20 and Figure 18-21. The completion of the interchange improvements at TH 10 north junction marks the completion of Phase 2.

Figure 18-20 Stage H I-35W and TH 10 North Junction Layout

Figure 18-21 Stage H I-35W and TH 10 North Junction Schematic



Stage I

Stage I includes the following projects that are preservation needs only and independent of the managed lane vision:

1. Broadway Avenue over I-35W

Stage I also includes the following projects that are preservation needs and provide synergy with the managed lane vision:

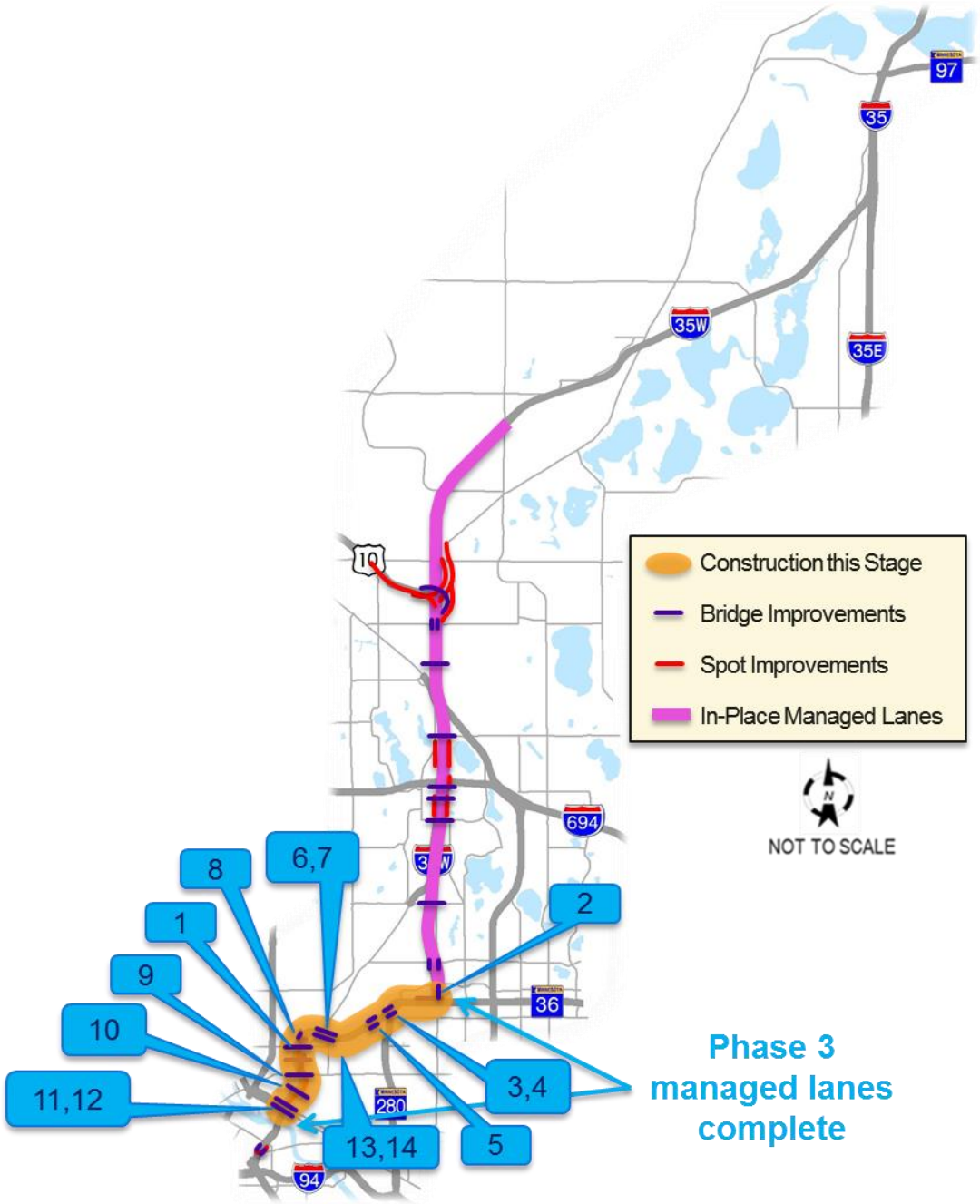
2. Exit from southbound I-35W to TH 36/Cleveland Avenue - Bridge reconstruction needed for managed lanes
3. I-35W over TH 280 - Bridge reconstruction needed for managed lanes
4. I-35W over railroad near TH 280 - Bridge reconstruction needed for managed lanes
5. I-35W over Industrial Boulevard - Bridge reconstruction needed for managed lanes
6. I-35W over Stinson Boulevard - Bridge reconstruction needed for managed lanes
7. I-35W over New Brighton Boulevard - Bridge reconstruction needed for managed lanes
8. Southbound I-35W over exit to Johnson Street - Bridge reconstruction needed for managed lanes
9. Hennepin Avenue over I-35W
10. SE 8th Street over I-35W
11. SE 4th Street over I-35W - Bridge reconstruction needed for managed lanes
12. University Avenue over I-35W - Bridge reconstruction needed for managed lanes

Finally Stage I includes the following projects that are not preservation needs but support the managed lane vision:

13. Construct southbound managed lane from current end near TH 36 to University Avenue SE
14. Redesignate northbound auxiliary lane and construct managed lane from University Avenue SE to current start near TH 36

Stage I will result in the completion of Phase 3 of the managed lane. This will complete the managed lane from University Avenue/4th Street to the current southern terminus at TH 36. Stage I coordinates with multiple bridge reconstructions through the southern portion of the corridor. All Stage I projects are shown in Figure 18-22.

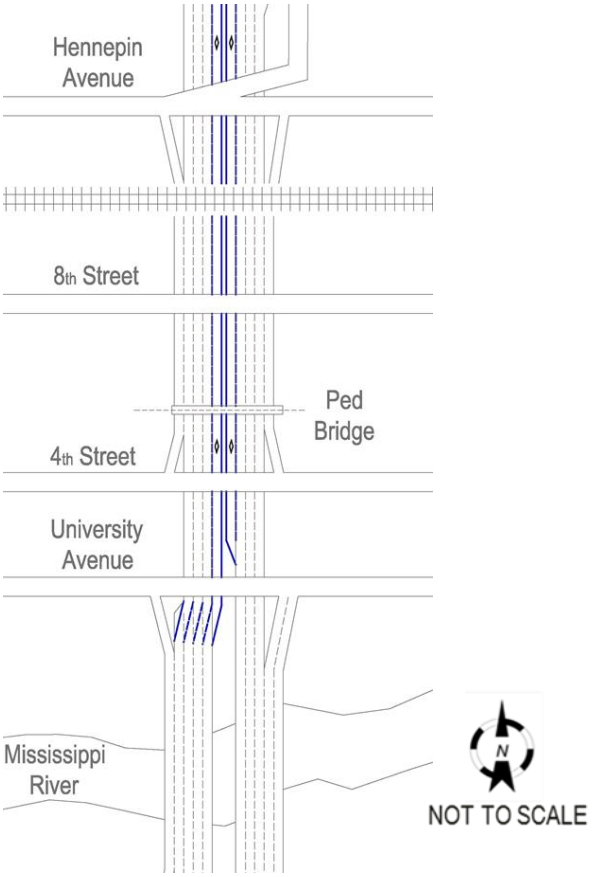
Figure 18-22 Stage I



The construction in Stage I will likely take three to four years to complete due to the extensive number of bridge reconstructions and roadway widening needed to construct the managed lanes. Following this stage, the managed lanes will have a southern terminus near University Avenue SE. The northbound managed lane will be added on the left side between the University Avenue exit ramp and the 4th Street SE entrance ramp to allow managed lane users to move into the lane before 4th Street traffic enters the mainline. The southbound managed lane designation would be expected to end approximately one mile upstream of the physical end where it would tie into the right lane add near University Avenue. This will allow traffic to make any necessary lane

changes in preparation for downstream destinations. These lane configurations are shown in the schematic in Figure 18-23.

Figure 18-23 Stage I Managed Lane Terminus



Extensive construction activities are included in Stage I to provide managed lanes between University Avenue and TH 36. This is a result of the current roadway design that has bridges which need to be widened and more significant lane realignment needed to accommodate the managed lanes. Many of these bridges, however, are identified as preservation needs; therefore utilizing future infrastructure investments to coordinate construction activities and minimize cost overlaps. The completion of the Phase 3 managed lanes will also provide transit advantages and reduce congestion.

Stage J

Stage J includes the following projects that are preservation needs only and independent of the managed lane vision:

1. None

Stage J also includes the following projects that are preservation needs and provide synergy with the managed lane vision:

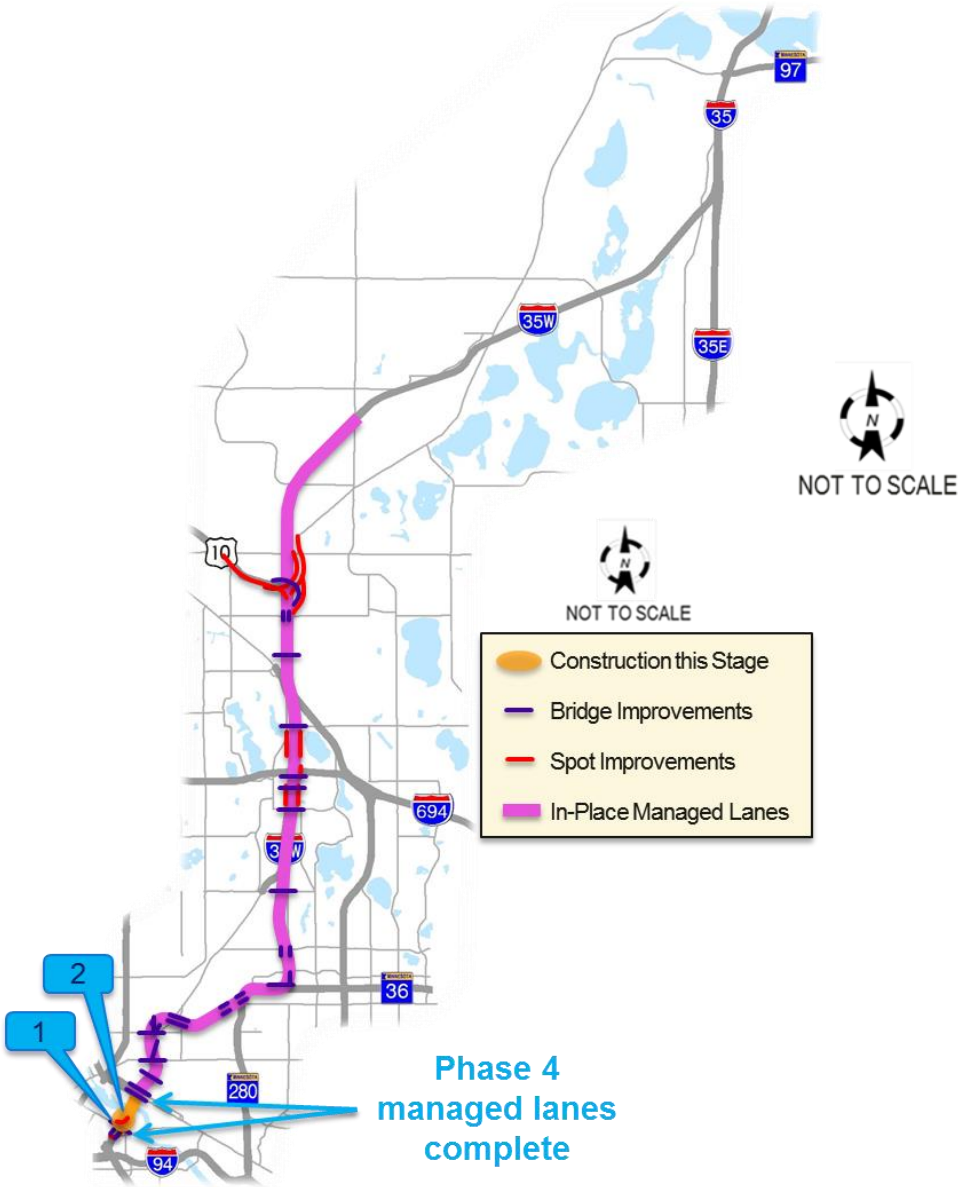
2. None

Finally Stage J includes the following projects that are not preservation needs but support the managed lane vision:

3. Construct managed lane direct connection to downtown Minneapolis (2nd Street connection, 3rd Street connection, or 3rd/4th Street connection)
4. Redesignate left general purpose lanes as managed lanes between University Avenue and direct connection to downtown Minneapolis

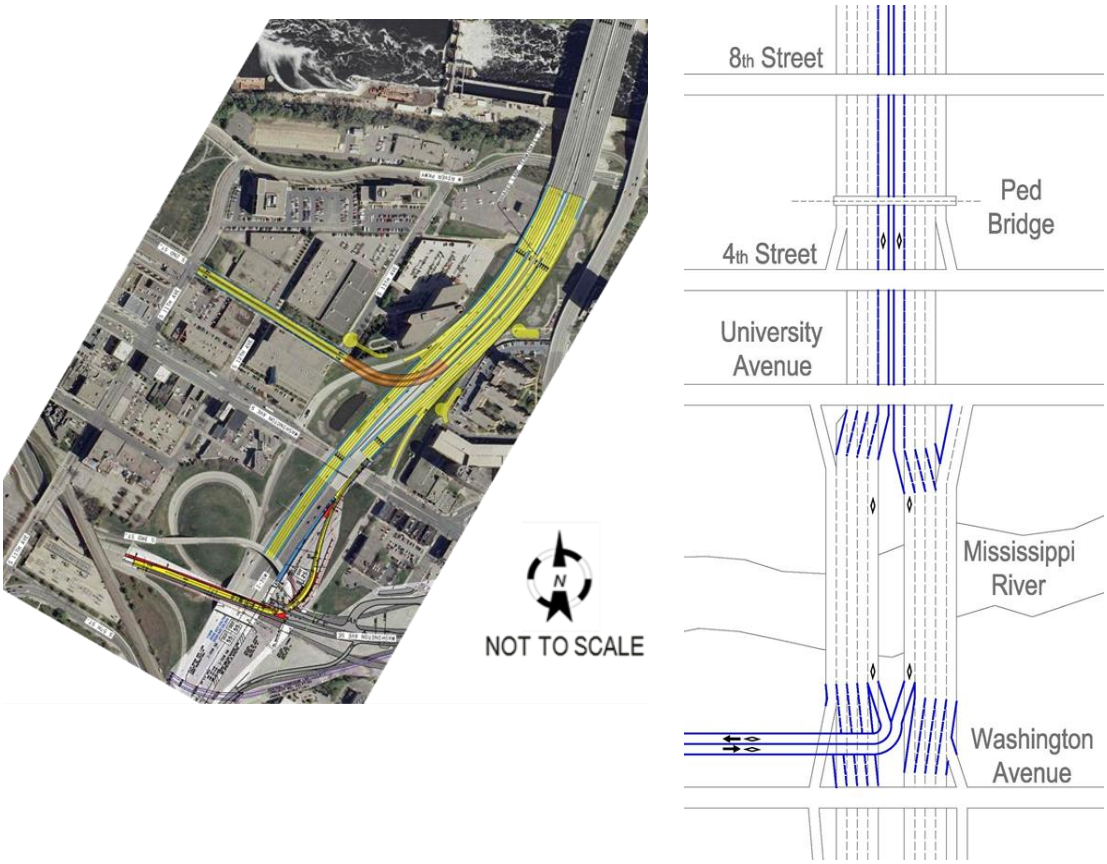
Stage J will result in the completion of Phase 4, the final phase of the managed lanes. This will be accomplished by extending the managed lanes south of University Avenue to the downtown Minneapolis direct connections. All Stage J projects are shown in Figure 18-24.

Figure 18-24 Stage J



As noted in the improvement list, the managed lanes that would be provided between the downtown direct connections and the Phase 3 terminus of the managed lanes near University Avenue would be the existing left general purpose lanes redesignated as managed lanes. The ultimate I-35W North Managed Lanes Vision described three different downtown direct connection options: 2nd Street, 3rd Street, and 3rd/4th Street. A layout and lane schematic are shown in Figure 18-25 for the 2nd Street option to illustrate how a direct connection could be reconfigured at the south end of the corridor. This stage marks the completion of Phase 4.

Figure 18-25 Stage J 2nd Street Option



The construction of the managed lane Phases 1 through 4 marks the completion of the managed lanes vision through the corridor. This is expected to provide travel time advantages to encourage carpooling and transit use. It will provide a congestion free choice for commuters during peak periods, and reduces congestion and improves safety in the corridor.

Stage K

Stage K includes the following projects that are preservation needs only and independent of the managed lane vision:

1. Redeck Sunset Avenue Bridge over I-35W
2. Redeck CSAH 14 Bridge over I-35W
3. Reconstruct northbound I-35W Bridge over southbound I-35E

Stage K also includes the following projects that are preservation needs and provide synergy with the managed lane vision:

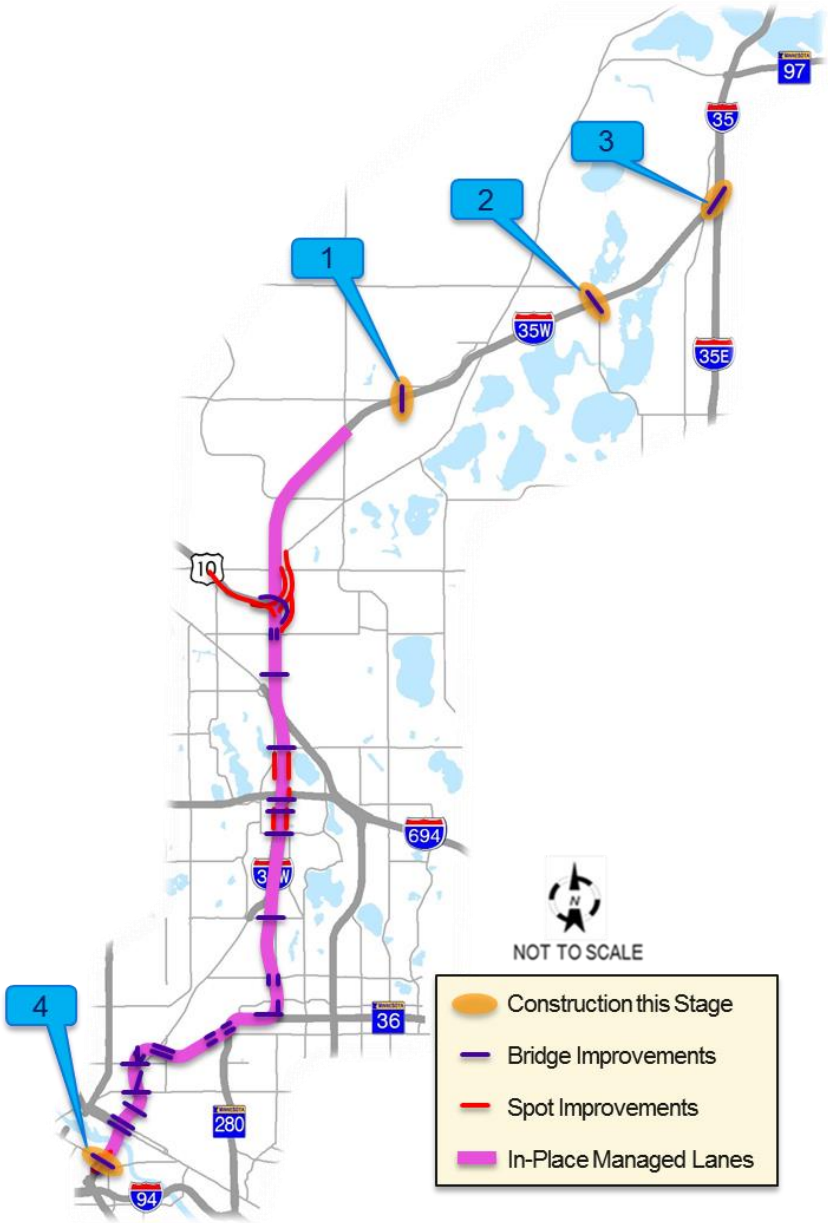
4. Reconstruct Washington Avenue Bridge over I-35W

Finally Stage K includes the following projects that are not preservation needs but support the managed lane vision:

5. None

Stage K is included in the implementation plan to account for additional bridge preservation needs that MnDOT has identified in the corridor. All Stage K projects are shown in Figure 18-26.

Figure 18-26 Stage K



The bridge preservation activities at Sunset Drive, CSAH 14, and the northbound I-35W Bridge do not directly impact the I-35W North Managed Lanes Vision. They will however result in some construction impacts to corridor users and could be coordinated to minimize traffic disruptions. The Washington Avenue Bridge replacement is also identified as a bridge preservation need, but the design of the bridge may depend on the downtown direct connection option selected. Specifically, the 3rd Street and 3rd/4th Street options will require the Washington Avenue Bridge be lengthened. In this case, reconstruction will have to be moved up to Stage J or earlier in preparation for those improvements. If the 2nd Street direct connection were selected, it may be desirable to complete the managed lane direct connection first, so the new access can provide traffic relief while the bridge is under construction.

To further enhance benefits, temporary facilities may want to be explored. Specifically after the completion of Phase 1 or Phase 1 and Phase 2, a temporary southbound I-35W managed lane may want to be implemented. This temporary managed lane could be very similar to alternative 1B – Southbound Dynamic Managed Shoulder/Lane. This would provide better advantages for vehicles destined for downtown including transit.

Other Potential Concepts

Other potential concepts are included in the implementation plan to acknowledge these concepts being beneficial to a managed lane along the corridor. Other potential concepts will consist of the following improvements as listed below and shown in Figure 18-27, Figure 18-28 and Figure 18-29:

1. North ramps at Hennepin Avenue
    a. Connect southbound parallel acceleration lane from Johnson Street entrance to Hennepin exit as auxiliary lane
2. Construct eastbound TH 36 left lane extension from current lane drop to Snelling Avenue northbound exit loop
    a. Widen eastbound TH 36 bridge over Fairview Avenue
    b. Lane would be converted when TH 36 eastbound MnPASS is constructed

Figure 18-27 Other Potential Concepts

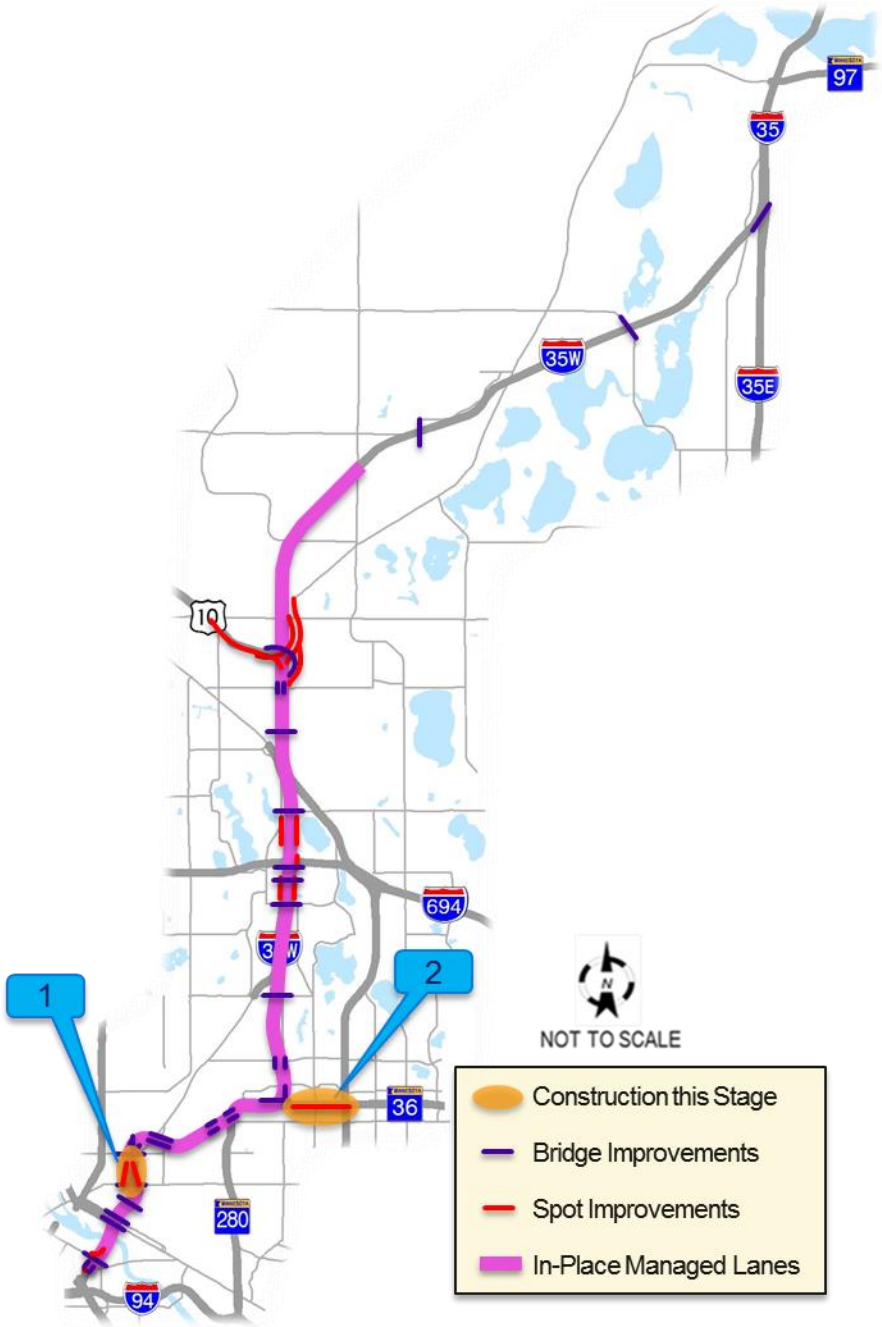
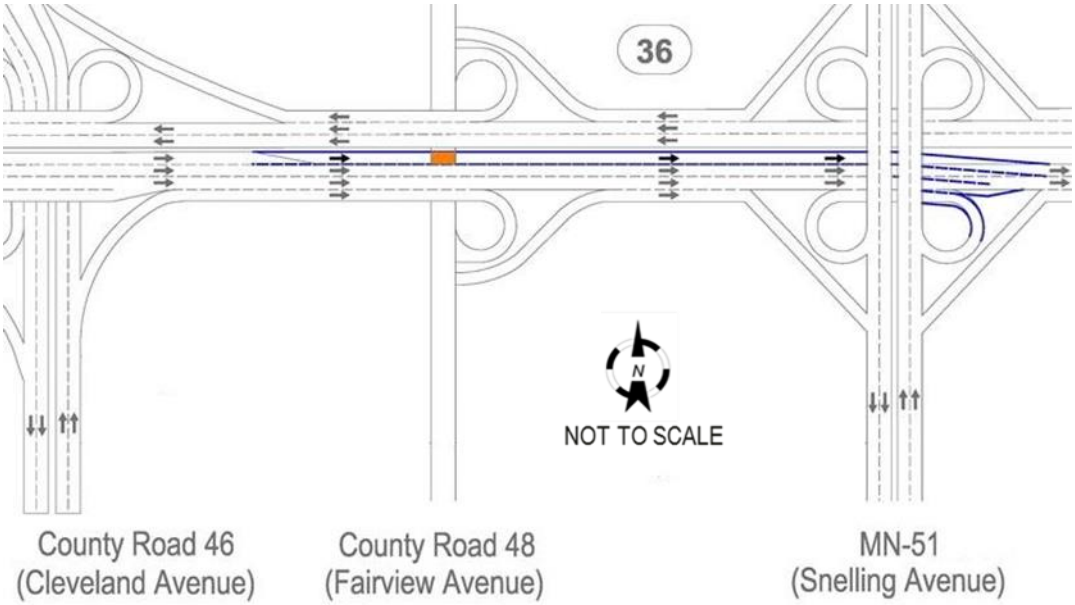


Figure 18-28 North Ramps at Hennepin Avenue

Figure 18-29 TH 36 Left Lane Extension



These improvements have not been included in the implementation plan stages because they can be constructed independently of managed lanes. This means that either project could be constructed before the managed lanes without precluding future improvements, or could be constructed after managed lanes are in place to provide additional congestion relief. Both projects were included in the I-35W North Managed Lanes Vision since they were found to provide worthwhile operational and safety benefits to corridor users. It will be the discretion of the decision-makers to determine the appropriate time for implementation of these concepts.

18.3 Implementation Plan Cost Summary

Managed Lane Investments

Roadway construction costs were estimated for completion of improvements to the I-35W north corridor. First, costs of the elements required to provide managed lanes through the corridor were estimated, which includes the following improvements:

- Managed lanes between downtown Minneapolis and Lexington Avenue
- Interchange improvements at the I-35W and TH 10 north junction
- Interchange improvements along I-35W at I-694
- Managed lane direct connections to downtown Minneapolis

Note that other potential concepts in the implementation plan, specifically the TH 36 lane extension and Hennepin Avenue north ramps, were not included since these items are not necessary for completion of the managed lanes.

The total cost to construct these managed lane improvements is estimated to be $430 million in 2011 dollars. This cost includes construction not only the managed lanes themselves and the interchange improvements at TH 10, I-694, and downtown Minneapolis, but also replacement and widening of several bridges that are unable to accommodate the managed lane design in their current configuration. In other words, this would be the cost to construct the managed lane improvements immediately, with no coordination with other preservation activities.

Preservation Investments

A number of bridge and pavement preservation needs have been identified for the I-35W north corridor, as discussed previously in the document. These construction activities are anticipated to occur over the next 20 years regardless of the advancement of managed lanes in this corridor. The total cost of these investments is estimated to be $250 million in 2011 dollars. These costs assume that only the level of expenditure stated in the identified need is implemented. For example, bridges with identified needs for redecking or overlay, costs were estimated only for these actions. Similarly, costs estimated for pavement rehabilitation and bridge replacements assumed replacement in kind, and did not include any lengthening or widening for current designs.

State Transportation Improvement Program

The State Transportation Improvement Program is the current four-year program of funded projects for the period 2013 to 2016. The I-35W north corridor includes a number of STIP projects as described in the implementation plan. The total cost for these programmed improvements is approximately $35 million. These investments are fully expected to move forward to construction, and are not influenced by other factors of the managed lane vision.

Implementation Plan Cost Synergy

The Secondary Screening Analysis chapter described how cost synergy would be achieved by coordinating managed lane construction with programmed improvements and identified preservation needs. As a result, the proportion of the total construction costs attributable to the managed lanes and associated improvements are much lower than the total required to construct these improvements on their own.

The cost summary is presented in Table 18-1. The total corridor expenditures in 2011 dollars were $35 million for STIP, $250 million for preservation needs, $430 million for managed lanes, for a total corridor investment of $715 million. Following the schedule outlined in the implementation plan, it is expected that approximately $165 million of corridor investments will overlap between the managed lane and preservation needs categories. This results in a total corridor investment of $550 million.

Table 18-1 Implementation Plan Cost Summary

Category	Cost
Managed Lane Investments	$430M
Preservation Investments	$250M
2013-2016 Program	$35M
Corridor Investments – Subtotal	$715M
Cost Synergy	-$165M
Corridor Investments – Total	$550M

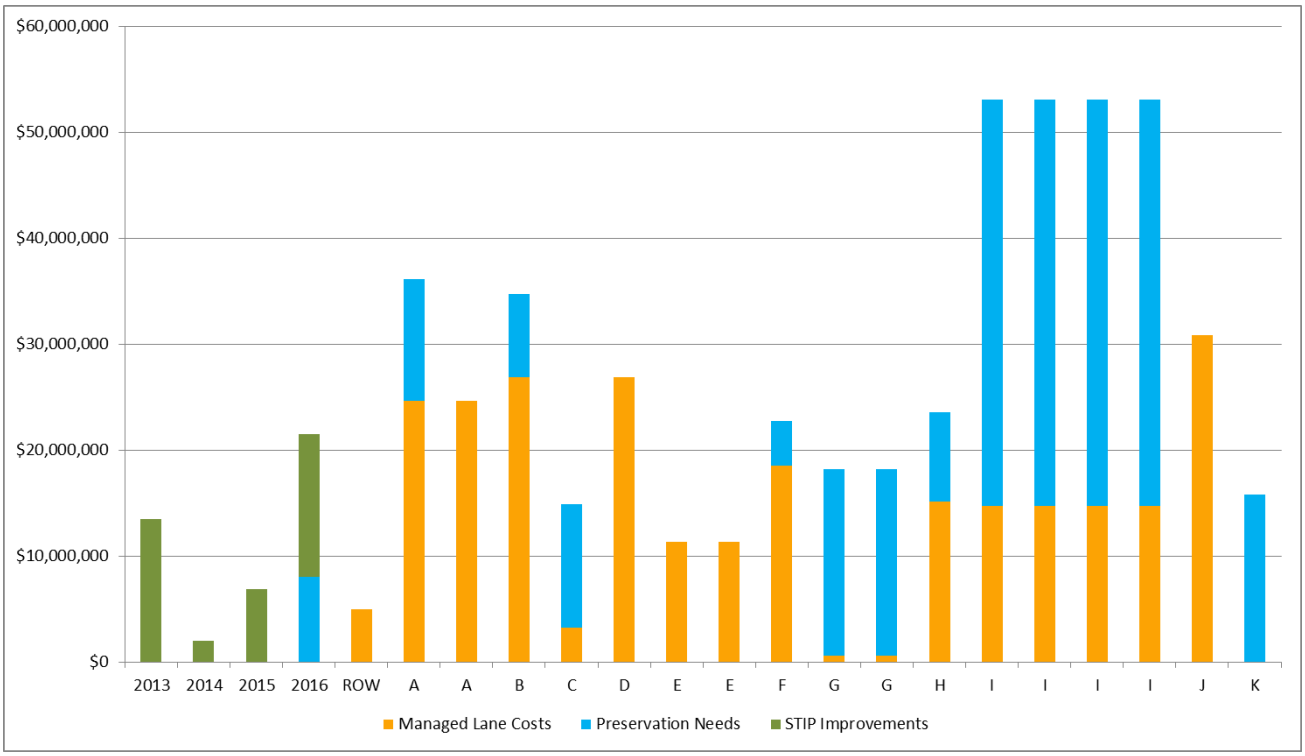
Implementation Plan Annual Expenditures

Annual expenditures were calculated and summarized for each stage of the implementation plan. Based on the scope of improvements to be constructed in each stage, some stages were projected to take multiple years to complete. In these cases, construction costs for multi-year stages were distributed evenly by year. STIP costs are programmed dollars dedicated to projects in the 2013 to 2016 timeframe. The other two categories would be expected to occur after that time.

Figure 18-30 illustrates anticipated annual expenditures to complete the implementation plan. The green bars in years 2013 through 2016 are the programmed investments included in the current STIP. The blue bars represent the preservation needs MnDOT has identified for pavement and bridges through the I-35W north corridor. These investments are assumed to be needed regardless of future managed lanes. The values of the preservation needs assume "replacement in kind," if design changes are needed, such as lengthening or widening, these additional amounts are allocated to the managed lanes costs. The orange bars show the estimated costs to construct the managed lanes portion of the implementation plan. This includes all capacity expansion for managed lanes and localized improvements.

As noted previously, some stages of the implementation would be expected to require multiple construction seasons to complete. In these cases, the construction costs are distributed evenly across each year. For example, Stage G is shown as requiring two years and Stage I is shown as requiring four years. While this graph shows each stage occurring sequentially, it is important to note the actual deployment of these improvements may not occur in the order presented, as some stages may overlap or be separated by a period of years.

Figure 18-30 Implementation Plan Annual Expenditures



Interim Managed Lane Connection

Upon completion of the first phase of construction, the southbound managed lane will terminate near TH 36. The traffic operations analysis completed for this study indicated an increase in congestion during the a.m. peak period south of TH 36.

The segment between TH 36 and downtown Minneapolis is identified as the third phase of the project which may not be constructed for a significant amount of time after the first phase is operational. In order to address the study's goals, an interim managed lane connection should be considered during the next phase of this project. This connection is identified as Alternative 1B in Chapter 14.

The interim managed lane connection would consist of a managed lane with minimal pavement widening on southbound I-35W between TH 36 and downtown Minneapolis. This option introduces placing dynamic lane controls above each southbound lane at a set designated interval. The outside lane may be designated as a general purpose through lane or as a shoulder lane and the inside lane may be designated as a managed lane or a general purpose lane.

Figure 18-31 represents Alternative 1B with the inside lane operated as a dynamic managed lane and the outside lane operating as a dynamic general purpose lane. Figure 18-32 represents Alternative 1B with the inside lane operated as a dynamic general purpose lane and the outside lane operated as a dynamic shoulder.

Figure 18-31 Alternative 1B - Southbound Dynamic Managed Shoulder/Lane

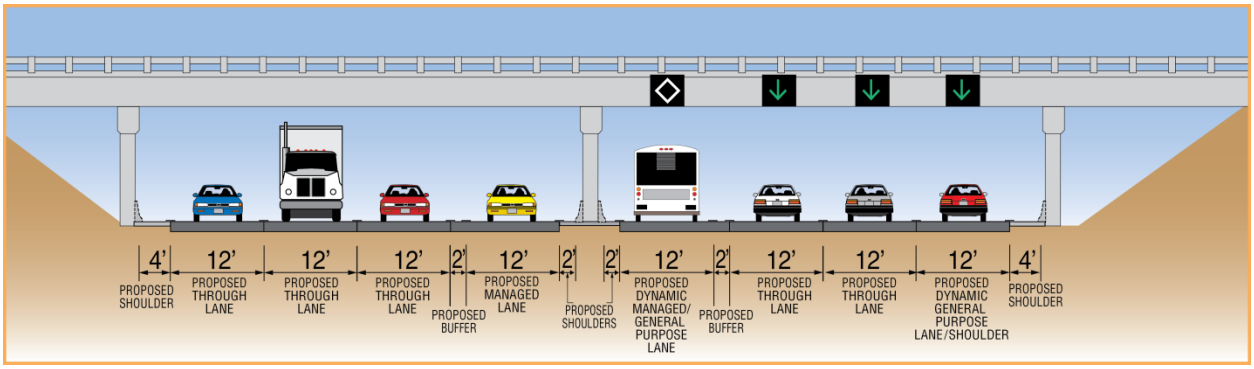
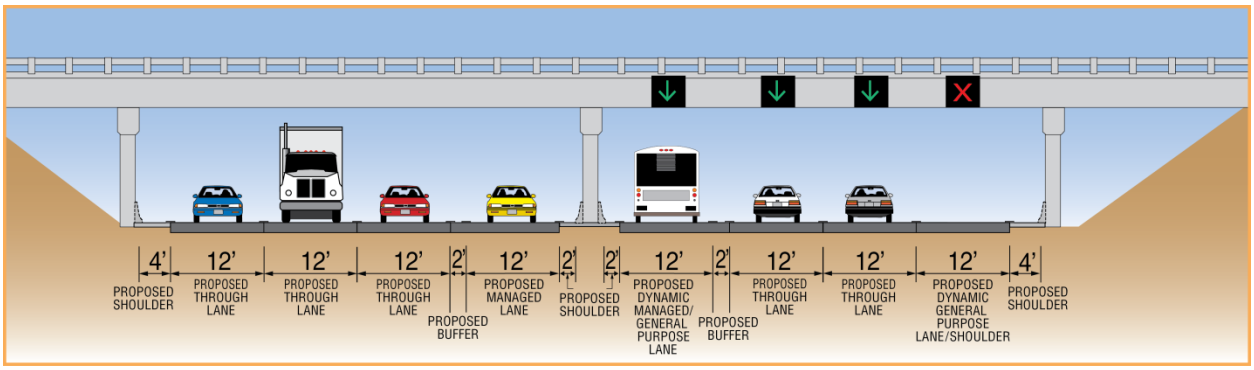


Figure 18-32 Alternative 1B - Southbound Dynamic Managed Shoulder/Lane



19.0 Public Outreach

Various forms of public outreach were utilized throughout the I-35W North Managed Lanes Corridor Study, including public open houses, presentations, websites, electronic newsletters, and news releases.

Elected Officials Briefing

An Elected Officials Briefing was held in April 2012 to provide information to elected officials in the corridor about the project prior to public open houses. Twenty-five people (plus project staff) attended the elected officials briefing. All city and county elected officials and regional appointed officials in the I-35W north corridor were invited by letter to the briefing. TAC members were also notified of the meeting and asked to encourage their respective elected/appointed officials to attend the meeting.

Display boards were provided at the meeting illustrating the project corridor, goals and objectives of the study; existing congestion along the corridor; projected traffic volumes and transit ridership; proposed managed lane alternatives; proposed spot improvement alternatives; and the proposed screening approach. Project team members were available to answer one-on-one questions. A presentation was also made summarizing the same material as well as providing an explanation of managed lanes alternatives and BRT.

Comments and questions received during the Elected Officials Briefing included:

- What is the schedule for bridge replacements – especially Old Hwy 8, 96 and CR E?
- Several questions about specific bridges, their condition, and their planned replacement.
- Old Hwy 8 and 96 is a popular bypass for congestion at the I-694 interchange
- Will improvements be coordinated with I-35W south?
- Several comments about the benefits of BRT and questions about what BRT alternatives would be considered for I-35W north.
- Question about whether the “build” forecast was for no-build or for a full build alternative (it is a no-build forecast)
- What role will local governments have in deciding what improvements will be selected and built?
- Will additional lanes be considered as well as managed lanes and/or spot improvements?
- Support for retaining both north and south access to I-35W at CR I.

Public Open Houses

Two series of public open houses were held during the I-35W North Managed Lanes Corridor Study. The first series was held in April 2012 and the second series was held in February 2013.

Public Open House Series #1

Two meetings were held as part of the Public Open House Series #1 for the I-35W North Managed Lanes Corridor Study. The purpose of these meetings was to introduce the study to the public, describe existing conditions in the study area, and present alternatives being considered and the proposed screening methodology. The meetings included:

- Public Open House – May 2, 5:00 p.m.-7:00 p.m., Blaine City Hall
- Public Open House – May 10, 11:30 a.m. – 1:00 p.m., Hennepin County Central Library Minneapolis

Fifteen people (plus project staff) attended the two public open houses – three in Blaine and twelve in Minneapolis. Some of the individuals in Minneapolis attended because they thought the open house was related to the 4th Street Exit Ramp/Auxiliary Lane Project. The public open houses were advertised through:

- Distribution of flyers to TAC members to publicize locally and post on agency websites
- Publication on the project website
- News releases to regional and local news media
- Distribution of posters to libraries, park and ride sites, and community centers
- Request to the Minneapolis Transportation Management Organization to distribute flyers to members

Display boards were provided illustrating the project corridor, goals and objectives of the study; existing congestion along the corridor; projected traffic volumes and transit ridership; proposed managed lane alternatives; proposed spot improvement alternatives; and the proposed screening approach. Project team members were available to answer one-on-one questions. A presentation was also made summarizing the same material as well as providing an explanation of managed lanes alternatives and BRT

Comments received during the public open houses included the following:

- Several questions/concerns were raised about noise walls that are proposed north of 4th Street (this is related to a separate project, not to the I-35W North Managed Lanes Corridor Study).
- Opinions were expressed, both pro and con, regarding MnPASS lanes (priced managed lanes).
- One person expressed a preference for a center managed lane and noted that a reduced inside shoulder would be acceptable.
- One person expressed a preference for the proposed flyover ramps at I-694 but was also concerned about the grade becoming slippery in the snow.
- One person noted that all alternatives for improvements at the TH 36 interchange would be acceptable.

- There was general support for attempts to address congestion in the corridor.
- There was general support for attempts to improve transit in the corridor.
- Two people expressed a strong preference for rail over transit with one noting a number of reasons to use the Northern Lights Express (NLX) rail corridor.
- One person inquired about which agency would be responsible for mitigation of impacts.

Public Open House Series #2

Two meetings were held as part of the Public Open House Series #2 for the I-35W North Managed Lanes Corridor Study. The purpose of these meetings was to present the study's recommendations and next steps, and gain public feedback. The meetings included:

- Public Open House – February 19, 2013, 5:00 p.m.-7:00 p.m., Blaine City Hall
- Public Open House – February 21, 2013 11:00 a.m. – 1:00 p.m., Hennepin County Central Library Minneapolis

Thirty-three people (plus project staff) attended the two public open houses – twenty in Blaine and thirteen in Minneapolis. The public open houses were advertised through:

- Distribution of flyers to TAC members to publicize locally and post on agency websites
- Publication on the project website
- News releases to regional and local news media
- Distribution of posters to libraries, park and ride sites, and community centers
- Request to the Minneapolis Transportation Management Organization to distribute flyers to members

Display boards were provided illustrating the goals and objectives of the study, what are managed lanes, existing congestion along the corridor, traffic forecasts, corridor alternatives, screening criteria, corridor vision, implementation plan, cost summary and implementation benefits. Distributed fact sheets also reflected this information. Project team members were available to answer one-on-one questions. A presentation was also made summarizing the same material as well as providing an explanation of recommendations and next steps.

Comments received during the public open houses included the following:

- The advance planning is to be commended. More of these projects should be anticipated rather than addressed under pressure—such as the 169 bottleneck.
- Toll lanes have already appeared now in MN—in one of the wealthiest parts of the Twin Cities—I-394. Next, tolls are being talked about for the Stillwater Bridge—again, serving a high real estate value area. There are plenty of people that can pay for the privilege of a dedicated lane for their community. This is far less true in the northern reaches of I-35.
- Designating the added capacity as a 'pay for the privilege' benefit at the expense of those who may not be able to pay is not very acceptable regardless of the precedent already set.

My suggestion is just to add extra lanes for everyone to use. The reason Interstate 35 is called a freeway is because it is not a toll way.

- One attendee did not like the idea of "managed lanes" and asked why general purpose lanes were not considered.
    - Staff responded that the Metropolitan Council long-range plan states that all capacity expansion must be managed. Staff also responded that managed lanes are controlled to provide free-flow conditions for transit users, HOVs and MnPASS vehicles. General purpose lanes are likely to fill up and become congested.
- One attendee asked about funding sources.
    - Staff talked about preservation and mobility funds, and also stated that these funds come from gas taxes and motor registration fees and not from income taxes or property taxes.
- One attendee mentioned that St. Louis has more general purpose lanes than the Twin Cities and was not happy with the amount of general purpose lanes in the Twin Cities.
    - Staff mentioned that limited funding sources have dictated policy and that policy does not support general purpose lanes.
- One attendee mentioned that community livability is a concern, and was not in favor of major freeway expansion since it will impact the local communities along the corridor.
    - Staff expressed agreement with attendee's statements.
- Several attendees stated that only people that actually use (and choose to pay for use of) a managed lane benefit from it.
    - Staff disagreed, stating that I-394 data has indicated that vehicles in the general purpose lanes experienced less travel time after the HOV lanes were modified to MnPASS lanes.
- Other general comments made included:
    - Some discussion at the end of the presentation about the proposed sales tax on clothing and how such taxes could factor into a transportation project.
    - Potentially having BRT along the corridor would be a benefit.
- The concern that I have is adding the north ramp access at Hennepin Avenue and the speed of adding the ramp. The community and neighborhoods were very clear of their opposition to this ramp when it was considered during the 35W Bridge collapse. Any addition of furthering this option [at] the legislature is not supported by the community, this year or any year. We are not supportive of adding more cars and traffic to our city streets. We are supportive of changing people's behavior toward other transit options. Thank you for the presentation.
- One attendee asked if staff were aware of community opposition to a managed lane after the 35W Bridge collapse.
    - Staff answered that yes, this information was known.

- An attendee wanted to see the MnDOT I-35W vision aligned with the city of Minneapolis' vision of more pedestrian-friendly roadways and facilities, and believed that this would mean not including a new ramp from Hennepin Avenue to I-35W north.
    - Staff stated that design details and specifics are something that would be looked at further beyond the current study.
- An attendee asked if something was currently moving through the legislature to move the managed lane vision forward.
    - Staff responded no, there is nothing directly/solely about funding for this project moving through the legislature although there is legislative discussion of general transportation funding.
- Several attendees stated that they would like to see more transit, particularly BRT, and offered the following comments on this topic:
    - Those conducting the study need to 'paint a vision' about how things will be different due to a project in order to attract money—don't think that this study does that. There's no BRT shown, [MnDOT] should study BRT and station locations to make the project attractive; identifying station locations could help sell the project.
    - Don't rely on shoulders for transit (for example, a stalled car on the shoulder could lead to huge transit delays)
    - The Northeast Minneapolis Chamber of Commerce has expressed a desire for more transit.
- One attendee asked how CCLRT and other planned transit projects are factored in to the study.
    - Staff stated that such planned projects were assumed and included/factored in when gathering data (for things such as traffic forecasting).
- A few attendees expressed confusion as to why the potential future projects shown included breaking up a managed lane project into various sections (constructed at different times) along the corridor.
    - Staff stated that in order to utilize resources efficiently, a potential managed lane project would likely be paired with other programmed projects (such as bridge replacement), allowing the projects to become more feasible for funding purposes, etc.

Presentations

Presentations were made to cities, counties and other local organizations when requested. Presentations made to date include:

- Anoka County elected officials meeting
- North Metro I-35W Corridor Coalition (several presentations)
- I-35 W/E Coalition

Website

A project website (www.dot.state.mn.us/metro/projects/i35wstudy) was maintained on MnDOT's website and updated approximately four times during the study.

Project Updates

Project updates were prepared quarterly and distributed to the TAC and an email distribution list. The TAC members used these project updates to keep their elected officials, constituents and members up to date on the progress of the I-35W North Managed Lanes Corridor Study.

News Releases

News releases were sent to the media to announce public open houses.

20.0 Appendix Items

The following is a list of potential appendix items: Appendix reference's need to be added to each chapter as appropriate.

A – Congestion Maps
B – Forecast Memo Information
C – BRT Appendix items
D – Typical Sections and Physical Impact Evaluation Criteria
E – CORSIM Operations Results
F – Civil Cost Estimates
G – Benefit Cost Memo
H – Pocket – Design File CD

21.0 References

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