

Capacity Analysis

Riverfront Drive Corridor Study, Mankato/North Mankato Area Planning Organization



Riverfront Drive provides access and connectivity to downtown Mankato and primary connections to the surrounding region, including US Highways 14 and 169. The corridor also serves multiple transportation modes. Several concerns exist along the corridor, including locations with elevated crashes, traffic back-ups, excessive access, lack of pedestrian facilities, and other issues that will worsen as vehicle and pedestrian traffic is projected to increase.

The corridor was divided into five segments due to varying contextual differences and length. Each segment had its own set of issues and potential solutions that were modeled using Synchro/SimTraffic. Both ends of the corridor included interchange analysis at TH 14 and TH 169, while the center portion of the corridor included a four to three lane conversion analysis through a historic portion of town. The modeling considered a variety of signal timing strategies and intersection geometrics, including unique treatments at the TH 169 interchange to mitigate heavy peak period traffic due to the high school one block away.

MAPO now has a powerful guide for project implementation along Riverfront Drive that is publicly vetted. Several near-term, long-term, and illustrative/development-driven projects were identified ranging from low to high investment that will allow for right-sized solutions in any circumstance.

The Future Traffic Analysis document is included on the following pages.



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MEMORANDUM

Date: April 10, 2017
To: Paul Vogel
From: Ross B. Tillman, P.E.
Kelsey E. Retherford, E.I.T.
Subject: Future Traffic Analysis
Riverfront Drive Corridor Study
Mankato/North Mankato Area Planning Organization
Project No.: T42.111867

Introduction

The Mankato/North Mankato Area Planning Organization in cooperation with the City of Mankato have requested a corridor study along Riverfront Drive from TH 14 to Woodland Avenue. Riverfront Drive is located along the western edge of the City of Mankato. This memorandum provides a summary of the future conditions and potential solutions.

Traffic Forecasting

Future traffic volumes for 2041 (25-yr forecast) were developed using historical data and the Mankato/North Mankato Area Planning Organization (MAPO) 2045 Long Range Transportation Plan while recognizing population growth trends in the area, which are likely to affect traffic volumes.

The historical growth rates (1997-2013) along Riverfront Drive were all calculated to be between 0.2 and 0.9 percent. An analysis was also completed using only the last 10 years of data but, the growth rates were all found to be negative. The MAPO 2045 Long Range Transportation Plan indicated future growth rates to be between 0.9 and 1.65 percent. Population growth trends have been between 0.5 percent per year and 1.5 percent per year on average depending on which time period is analyzed.

Traffic growth was compared using trend lines from various data sources and a 1% straight line growth value. These graphics are shown in **Figures 1 through 4 in Appendix A**. In general, the 1% line falls within a similar range of the 2045 Long Range Transportation Plan and the full-history trend and would appear to provide a reasonable growth rate for the corridor. This assumption is meant to be all encompassing of background growth as well as spot redevelopment in areas nearby.

The historical growth rates for side streets with data available were also calculated. Data was available from 1997 to 2013 for the side streets, leading to historical growth rates ranging from -2.9 to 3 percent. The MAPO 2045 Long Range Transportation Plan had analysis at Cherry Street, Main Street and Madison Avenue east of Riverfront Drive. The growth rates were found to be between 1 and 1.9 percent in the Transportation Plan, however using the historical data growth rates at these intersections were between -2.9 and -0.5%. The historical side street data includes periods of time when streets were converted from one-way to two-way traffic and the reconstruction of 2nd Street and Mulberry Street

occurred. These major circulation changes result in data patterns with no natural trends and essentially provide meaningless data.

Although the majority of analyzed side streets along the corridor are fully developed, they provide connectivity to other parts of the city that may experience development and growth. For this reason, a 1% per year growth rate was also applied to these approaches recognizing the potential for future growth in other areas and also the need to feed and receive a certain amount of traffic from Riverfront Drive.

Parallel routes to Riverfront Drive were also analyzed for spare capacity. TH 169 was projected to have 27,000 vehicles per day in 2045 as part of the Long Range Transportation Plan which is well under capacity for a 4-lane freeway. 2nd Street currently carries between 8,100 and 10,900 vehicles per day downtown, which if using the same growth rate as Riverfront Drive will also be under capacity in 2041.

Future Operations Analysis

A level of service (LOS) analysis of the peak hours was completed using the forecasted turning movement counts in SimTraffic. **Tables 1 through 4** show the results of the 2041 no build traffic analysis for Segments 1 through 4, respectively.

Segment 1 – Woodland Avenue to Sibley Parkway

Table 1 - 2041 Existing Geometry (No Build) Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay*- LOS		Maximum Delay-LOS**		Limiting Movement ***	Max Approach Queue		
							Direction	Average Queue (ft)	Max Queue (ft)
Riverfront Dr & Woodland Ave <i>Stop Controlled</i>	AM	2	A	7	A	NBT	NBL/T/R	25	100
	PM	3	A	7	A	SBT	SBL/T/R	50	50
Riverfront Dr & Sibley St <i>Stop Controlled</i>	AM	6	A	41	E	NBT	WBL/T	75	200
	PM	7	A	32	D	NBL	WBL/T	75	175
SB TH 169 Ramp/Owatonna St & Riverfront Dr <i>Signalized Intersection</i>	AM	49	D	75	E	SBL	SBL/T	575	950
	PM	32	C	56	E	SBT	SBL/T	275	650
NB TH 169 Ramp & Riverfront Dr <i>Stop Controlled</i>	AM	62	F	1949	F	NBL	NBR	725	1275
	PM	24	C	127	F	NBR	NBR	375	1000
Mankato West HS/Poplar St & Riverfront Dr <i>Signalized Intersection</i>	AM	79	E	351	F	WBR	WBT/R	600	800
	PM	50	D	162	F	NBT	WBT/R	575	800
Riverfront Dr & Stoltzman Rd <i>Signalized Intersection</i>	AM	89	F	320	F	NBL	NBL	800	1300
	PM	44	D	156	F	NBT	NBL/T	425	500
Riverfront Dr & Marshall St <i>Signalized Intersection</i>	AM	75	E	182	F	WBT	WBT	300	775
	PM	15	B	41	D	NBL	WBT	125	400

*Delay in seconds per vehicle

**Maximum delay and LOS on any approach and/or movement

***Limiting Movement is the highest delay movement.

AM Peak Hour

- Intersection delay has failing LOS at the intersections of Riverfront Drive with the NB TH 169 Ramp and Stoltzman Road.
- The limiting movement operates with LOS F at the following intersections:
 - TH 169 North Ramp at Riverfront Drive
 - Poplar Street-West Mankato High School at Riverfront Drive

- Stoltzman Road at Riverfront Drive
- Marshall Street at Riverfront Drive

PM Peak Hour

- Intersection delay is acceptable with LOS D or better at all of the intersections.
- The limiting movement operates with LOS F at the following intersections:
 - TH 169 North Ramp at Riverfront Drive
 - Poplar Street-West Mankato High School at Riverfront Drive
 - Stoltzman Road at Riverfront Drive

Tables B1 and B2 in Appendix B show the delay and queue lengths for each movement at all of the intersections in Segment 1.

Segment 2 –Sibley Parkway to Veterans Memorial Bridge

Table 2 - 2041 Existing Geometry (No Build) Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay*- LOS		Maximum Delay-LOS**		Limiting Movement ***	Max Approach Queue		
							Direction	Average Queue (ft)	Max Queue (ft)
Riverfront Dr & Sibley Pkwy <i>Signalized Intersection</i>	AM	38	D	84	F	WBR	WBT	175	825
	PM	5	A	41	D	EBL	WBT	50	150
Riverfront Dr & Poplar St/Warren St <i>Signalized Intersection</i>	AM	14	B	32	C	WBL	NBT/R	100	275
	PM	18	B	31	C	EBL	SBT/R	150	350
Riverfront Dr & Minnesota St/Cherry St <i>Signalized Intersection</i>	AM	11	B	32	C	WBT	SBT	75	325
	PM	19	B	56	E	SBL	WBL/T	175	350
Riverfront Dr & Main St <i>Signalized Intersection</i>	AM	8	A	26	C	WBL	NBT	50	150
	PM	13	B	31	C	EBL	NBT	100	250

*Delay in seconds per vehicle

**Maximum delay and LOS on any approach and/or movement

***Limiting Movement is the highest delay movement.

AM Peak Hour

- Intersection delay is acceptable with LOS D or better at all of the intersections.
- The limiting movement operates with LOS F at the intersection of Sibley Parkway and Riverfront Drive.

PM Peak Hour

- Intersection delay is acceptable with LOS A or B at all of the intersections.
- The limiting movement operates with LOS E at the intersections of Minnesota Street-Cherry St and Riverfront Drive

Tables B3 and B4 in Appendix B show the delay and queue lengths for each movement at all of the intersections in Segment 2.

Segment 3 –Veterans Memorial Bridge to Madison Avenue

Table 3 - 2041 Existing Geometry (No Build) Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay*- LOS		Maximum Delay-LOS**		Limiting Movement***	Max Approach Queue		
							Direction	Average Queue (ft)	Max Queue (ft)
Riverfront Dr & Plum St <i>Signalized Intersection</i>	AM	4	A	23	C	WBL	NBT	50	175
	PM	5	A	28	C	WBL	NBT	50	175
Riverfront Dr & Elm St <i>Signalized Intersection</i>	AM	4	A	11	B	WBL	NBL/T	50	125
	PM	6	A	22	C	EBL	SBL/T	75	225
Riverfront Dr & Madison Ave <i>Signalized Intersection</i>	AM	12	B	24	C	WBL	NBT/R	125	300
	PM	17	B	49	D	WBT	NBT/R	200	425

*Delay in seconds per vehicle

**Maximum delay and LOS on any approach and/or movement

***Limiting Movement is the highest delay movement.

AM Peak Hour

- Intersection delay is acceptable with LOS A or B at all of the intersections.
- The limiting movement is acceptable with LOS C or better at all of the intersections.

PM Peak Hour

- Intersection delay is acceptable with LOS A or B at all of the intersections.
- The limiting movement is acceptable with LOS D or better at all of the intersections.

Tables B5 and B6 in Appendix B show the delay and queue lengths for each movement at all of the intersections in Segment 3.

Segment 4 –Madison Avenue to TH 14

Table 4 - 2041 Existing Geometry (No Build) Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay*- LOS		Maximum Delay-LOS**		Limiting Movement***	Max Approach Queue		
							Direction	Average Queue (ft)	Max Queue (ft)
Riverfront Dr & 3rd Ave/Lafayette St <i>Stop Controlled</i>	AM	5	A	57	F	EBL	EBR	75	225
	PM	6	A	48	E	EBT	EBR	100	275
Riverfront Dr & May St <i>Stop Controlled</i>	AM	1	A	16	C	WBL	WBL/R	25	75
	PM	3	A	23	C	WBL	WBL/R	50	100
Riverfront Dr & TH 14 EB Ramp <i>Stop Controlled</i>	AM	5	A	22	C	EBL	EBR	100	250
	PM	6	A	39	E	EBL	EBL	125	325
Riverfront Dr & TH 14 WB Ramp <i>Stop Controlled</i>	AM	28	D	197	F	WBL	WBL/T	325	1025
	PM	56	F	374	F	WBL	WBL/T	650	1725

*Delay in seconds per vehicle

**Maximum delay and LOS on any approach and/or movement

***Limiting Movement is the highest delay movement.

AM Peak Hour

- Intersection delay is acceptable with LOS D or better at all of the intersections.

- The limiting movement operates with LOS F at the following intersections:
 - 3rd Avenue/Lafayette Street at Riverfront Drive
 - TH 14 Westbound Ramp at Riverfront Drive

PM Peak Hour

- Intersection delay and the limiting movement have failing LOS at the intersection of the TH 14 Westbound Ramp and Riverfront Drive.
- The intersection delay is LOS A for all other intersections.
- The limiting movement is LOS E at 3rd Avenue/Lafayette Street and the TH 14 Eastbound Ramp.
- The limiting movement is LOS C at May Street.

Tables B7 and B8 in Appendix B show the delay and queue lengths for each movement at all of the intersections in Segment 4.

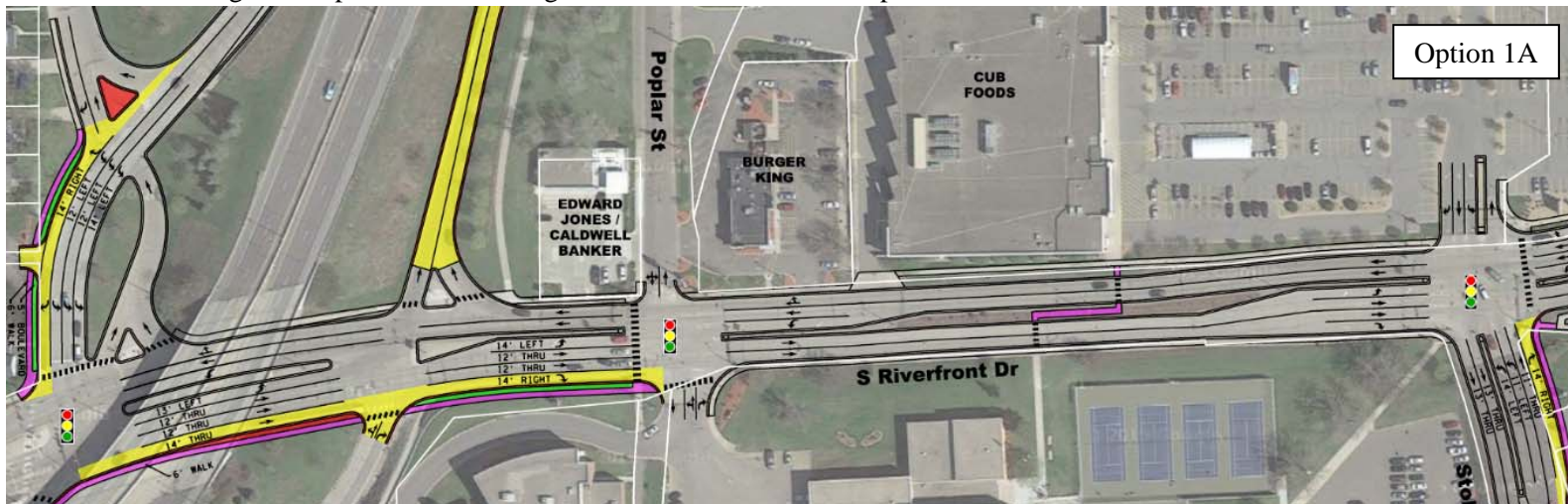
Alternative Concepts

Segment 1 – Woodland Avenue to Sibley Parkway

There were six alternatives analyzed for Segment 1. These options are detailed below with snapshots of each.

Option 1: Traditional Signalized Corridor with Capacity and Pedestrian Enhancements

Option 1A - Triple left turn from southbound TH 169, additional on ramp lane for northbound TH 169, Poplar Street remains signalized, turn lane additional and signal phasing improvement at Stoltzman Road, and signalized pedestrian crossings at Stoltzman Road and Poplar Street.



US 16

Linder Ave

Burger King

Cub Foods

Edward Jones / Caldwell Banker

S Riverfront Dr

14' THRU

12' THRU

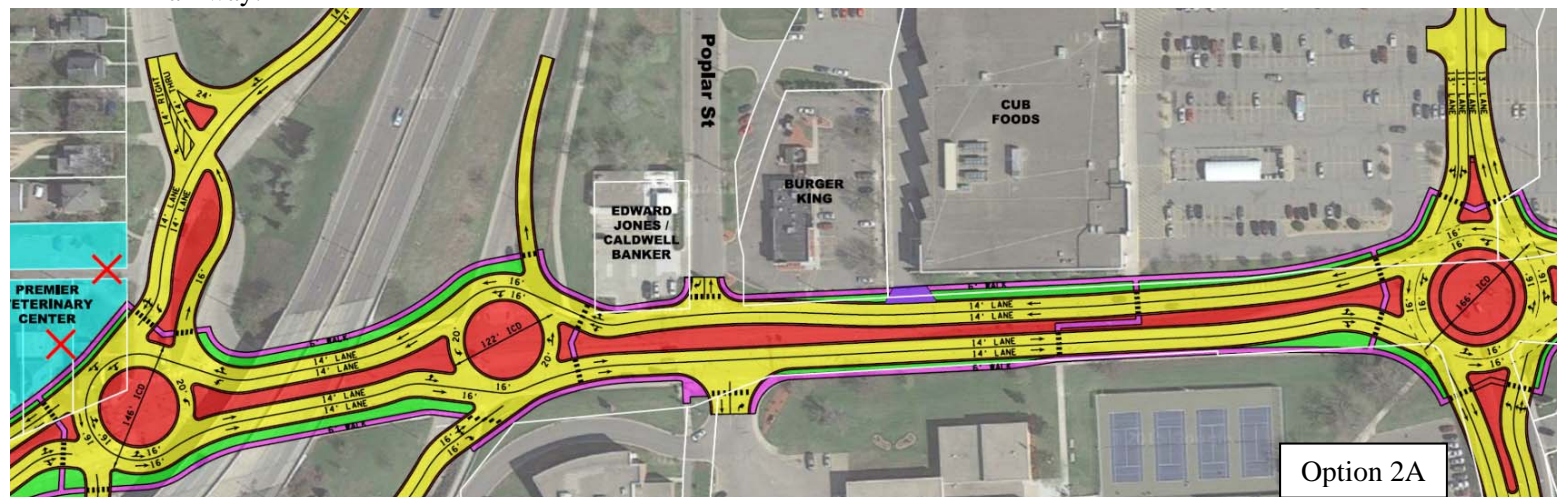
14' RIGHT

5' BOULEVARD

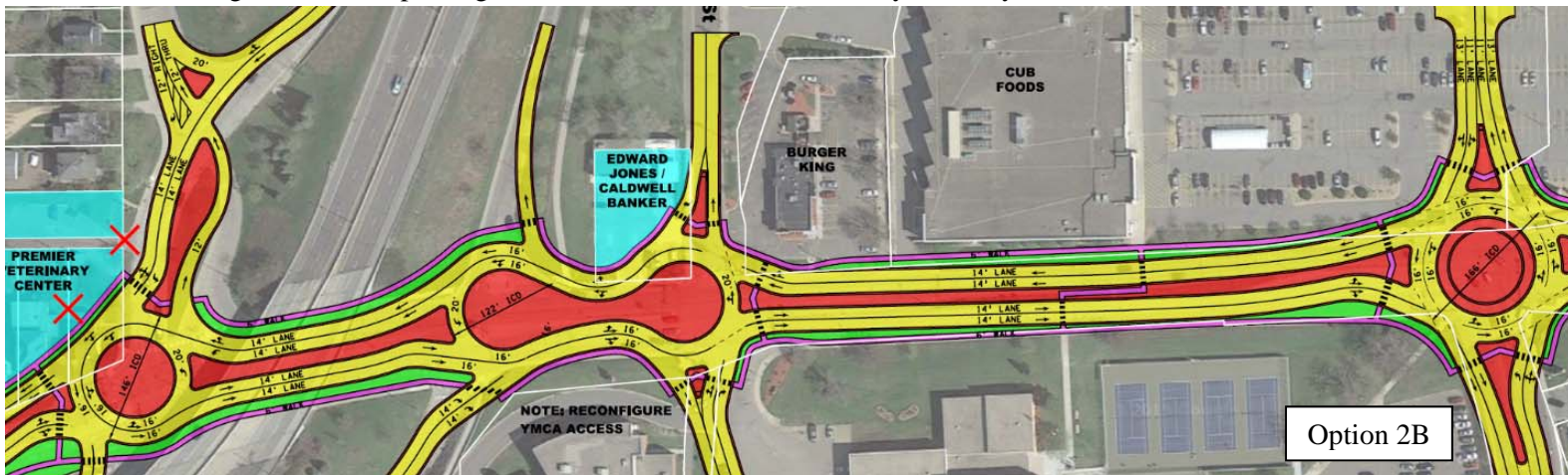
6' WALK

Option 1B

Option 2A - Roundabouts at TH 169 Ramps and Stoltzman Road, right-in/right-out at Poplar Street, and roadway expansion at Stoltzman Road through Cub Foods parking lot from Riverfront Drive to Sibley Parkway.

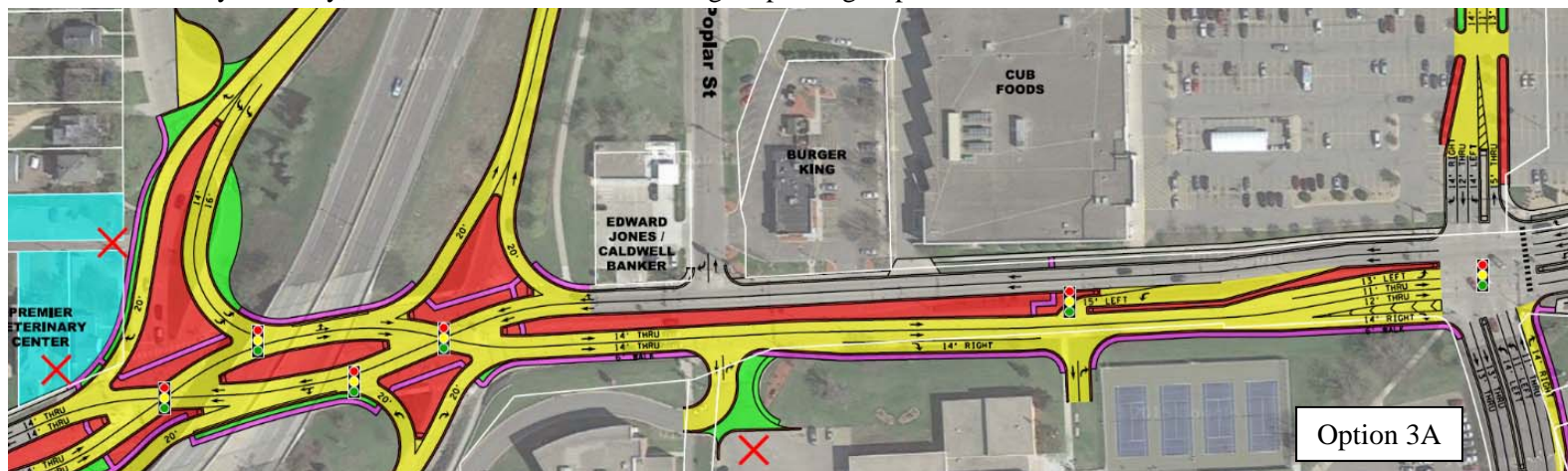


Option 2B - Roundabouts at the Southbound TH 169 Ramp and Stoltzman Road, combined tear drop roundabout at the Northbound TH 169 Ramp and Poplar Street, and roadway expansion at Stoltzman Road through Cub Foods parking lot from Riverfront Drive to Sibley Parkway.

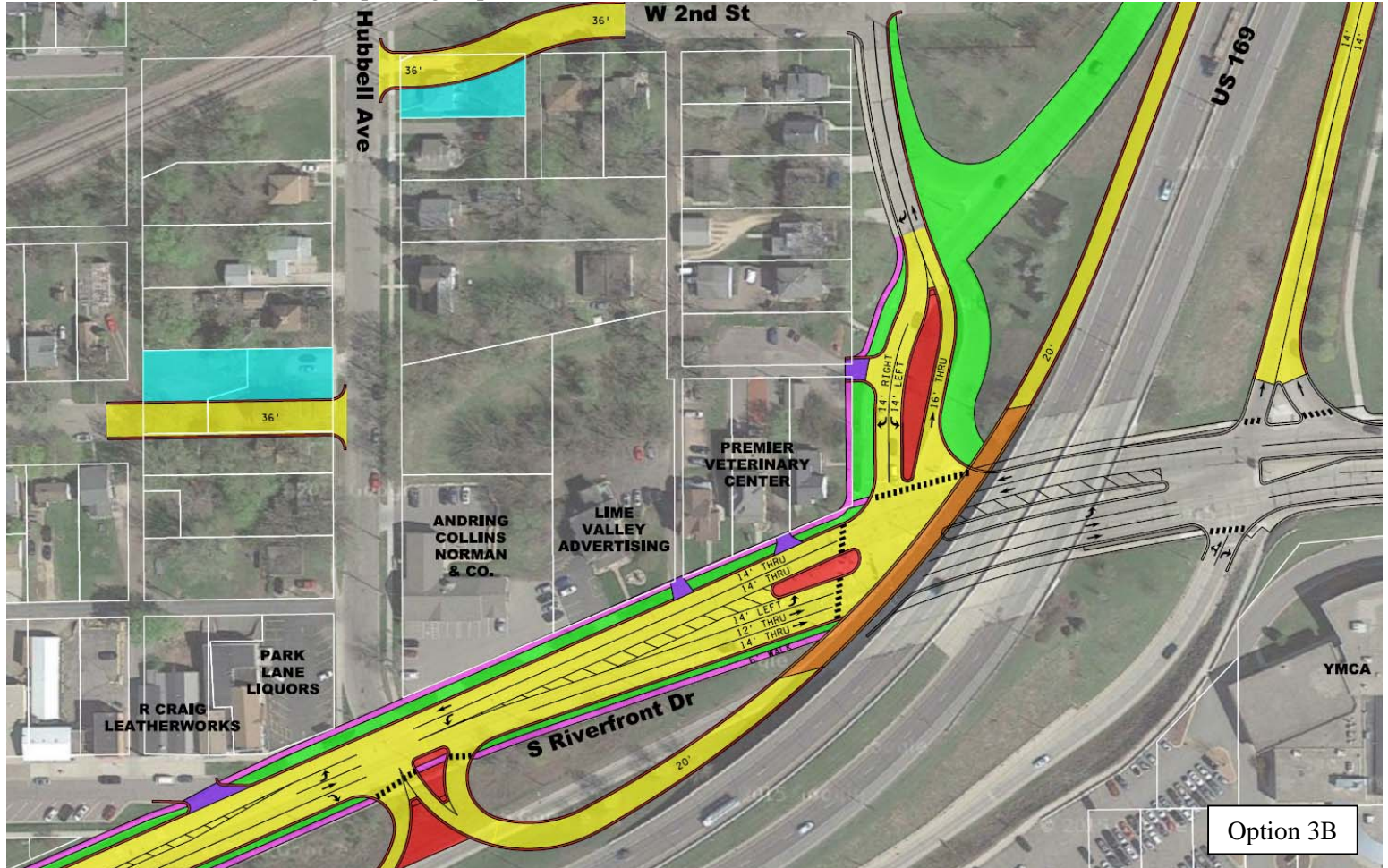


Option 3: Interchange Modifications with Signal at Stoltzman Road

Option 3A - Diverging diamond at TH 169 Ramps, right-in/right-out at Poplar Street, additional on ramp lane for northbound TH 169, Mankato West High School entrance road shifted east and partially signalized, roadway extension at Stoltzman Road through Cub Foods parking lot from Riverfront Drive to Sibley Parkway, and turn lane additional and signal phasing improvement at Stoltzman Road.



Option 3B - Loop ramp from southbound TH 169 eliminating access of Hubbell Avenue onto Riverfront Road, roadway extension of 2nd Street from Owatonna Street to Hubbell Avenue and 3rd Street between Sibley Street and Hubbell Avenue, additional on ramp lane for northbound TH 169, and turn lane additional and signal phasing improvement at Stoltzman Road.

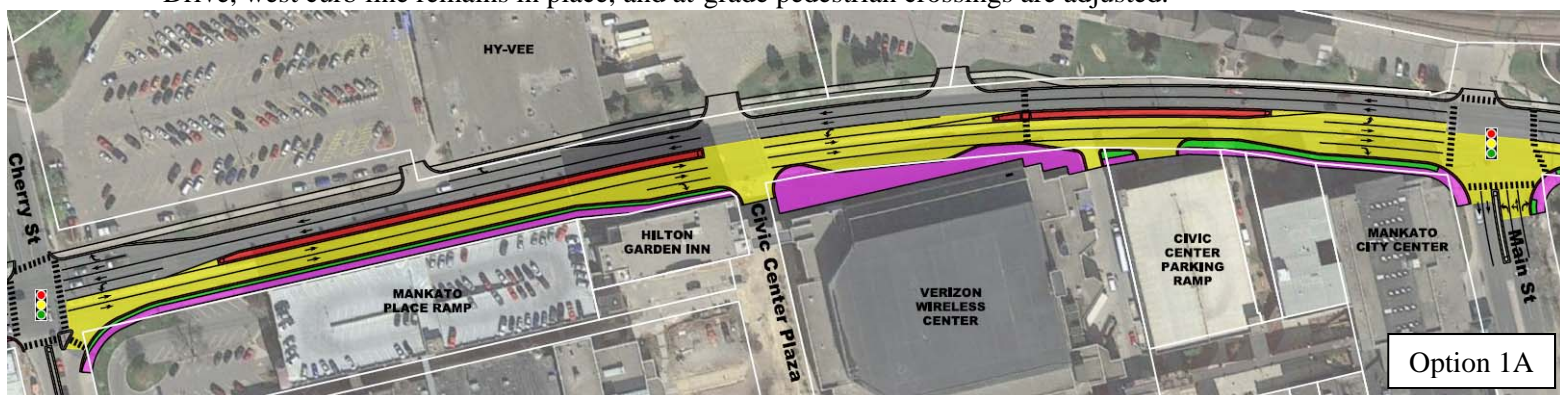


Segment 2 –Sibley Parkway to Veterans Memorial Bridge

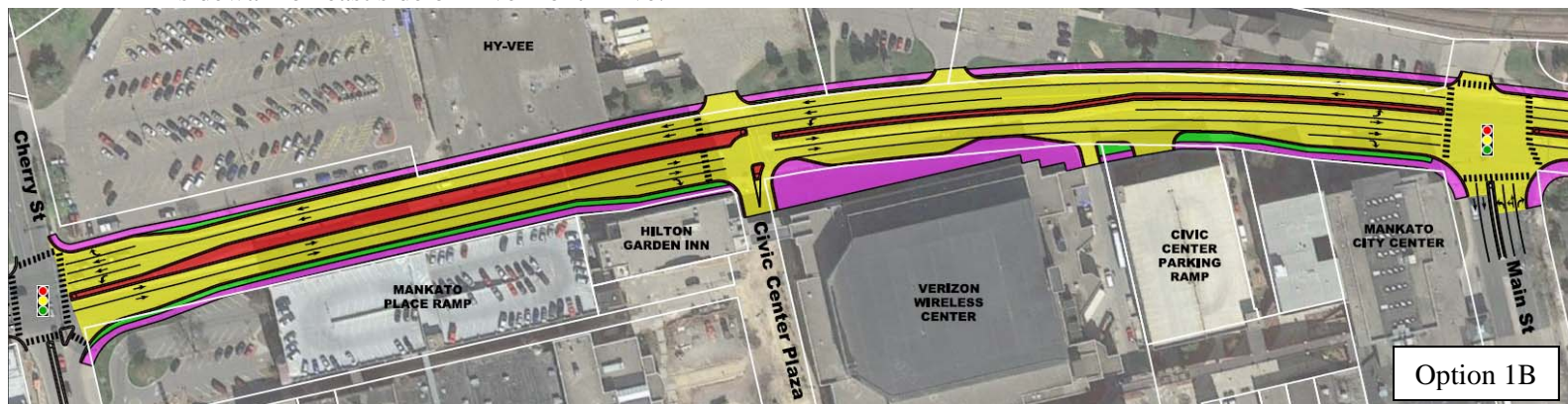
There were three alternatives analyzed for Segment 2. These options are detailed below with snapshots of each.

Option 1: Four Lane Roadway with Spot Safety and Pedestrian Enhancements

Option 1A - The median is narrowed by eight feet to allow for a sidewalk on the east side of Riverfront Drive, west curb line remains in place, and at-grade pedestrian crossings are adjusted.

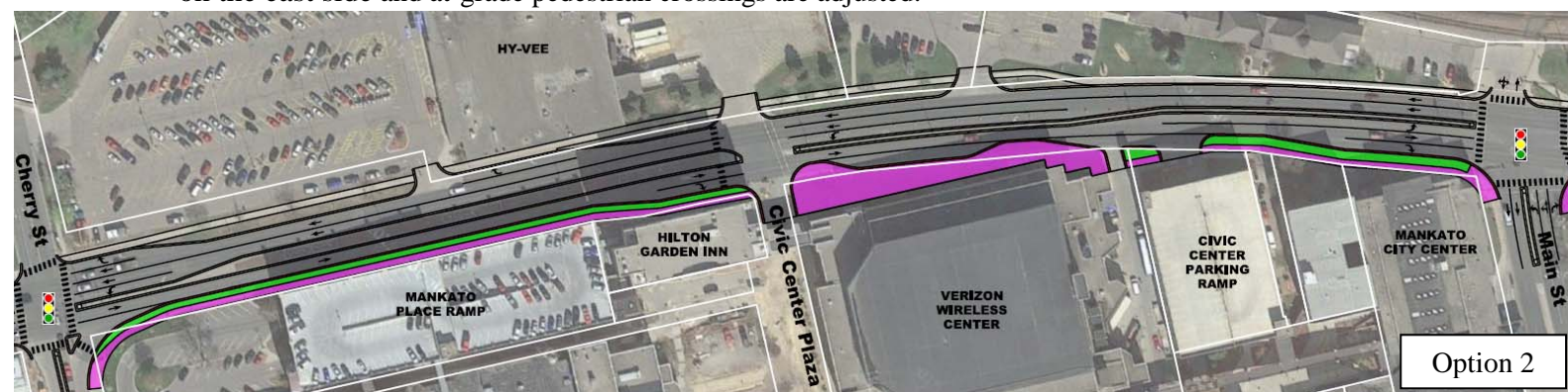


Option 1B - The west curb line between Cherry Street and Plum Street is shifted further west to provide a sidewalk on east side of Riverfront Drive.



Option 2: Three Lane Roadway with Spot Safety and Pedestrian Enhancements

Northbound through lane is removed starting 50 feet north of Cherry Street to provide a sidewalk on the east side and at-grade pedestrian crossings are adjusted.



Segment 3 – Veterans Memorial Bridge to Madison Avenue

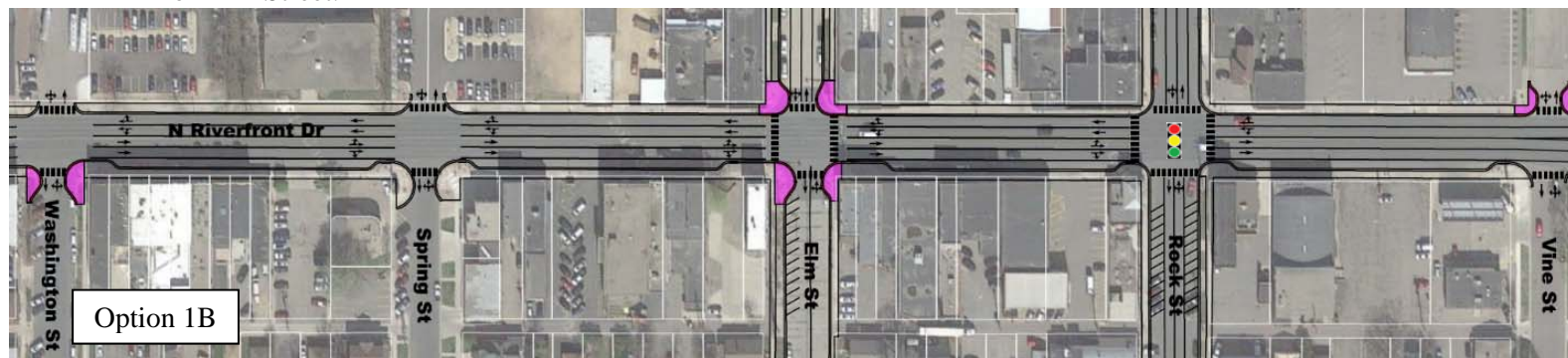
There were eight alternatives analyzed for Segment 3. These options are detailed below with snapshots of each.

Option 1: Four Lane Roadway with Spot Safety and Pedestrian Enhancements

Option 1A - Primary vehicle intersections at Plum Street & Elm Street and enhanced pedestrian corridor on Rock Street. Add bump-outs at Washington Street, Rock Street, and Vine Street.

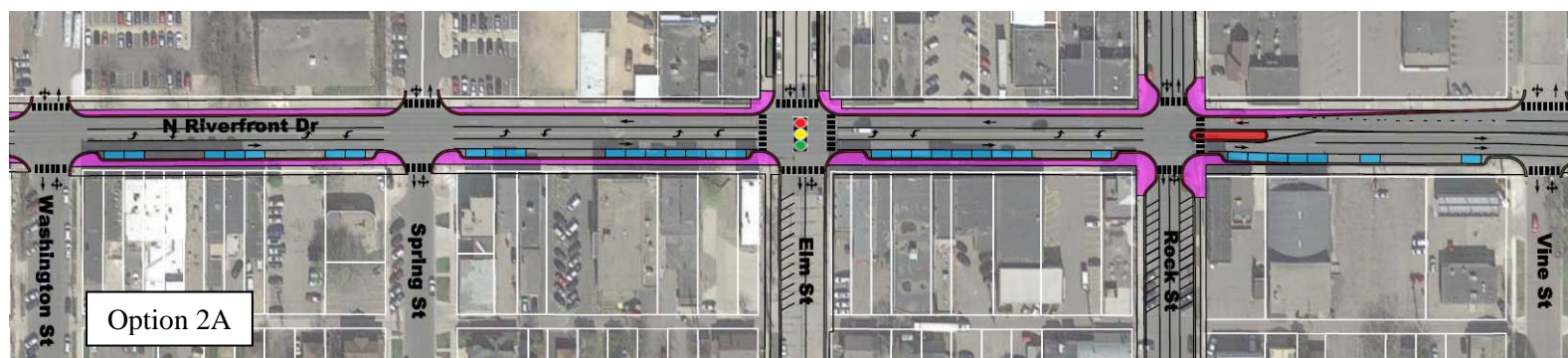


Option 1B - Primary vehicle intersections at Plum Street & Rock Street and enhanced pedestrian corridor on Elm Street.

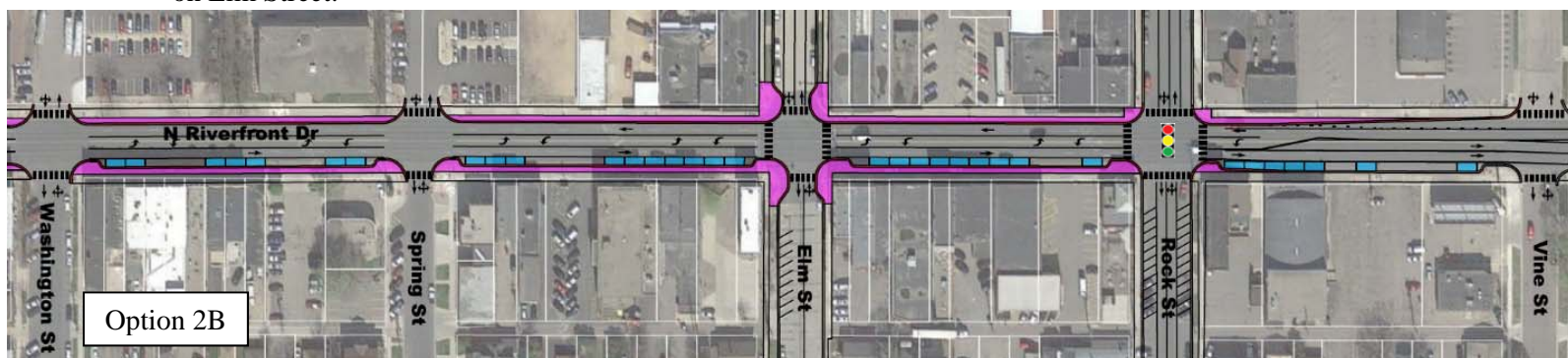


Option 2: Three Lane Roadway with Parking on South Side, Spot Safety and Pedestrian Enhancements

Option 2A - Primary vehicle intersections at Plum Street & Elm Street and enhanced pedestrian corridor on Rock Street.

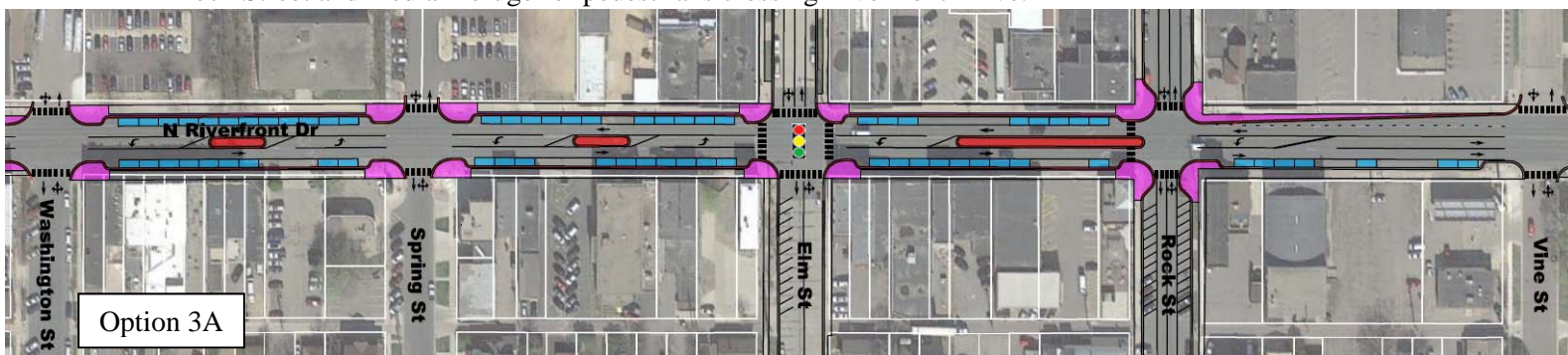


Option 2B - Primary vehicle intersections at Plum Street & Rock Street and enhanced pedestrian corridor on Elm Street.

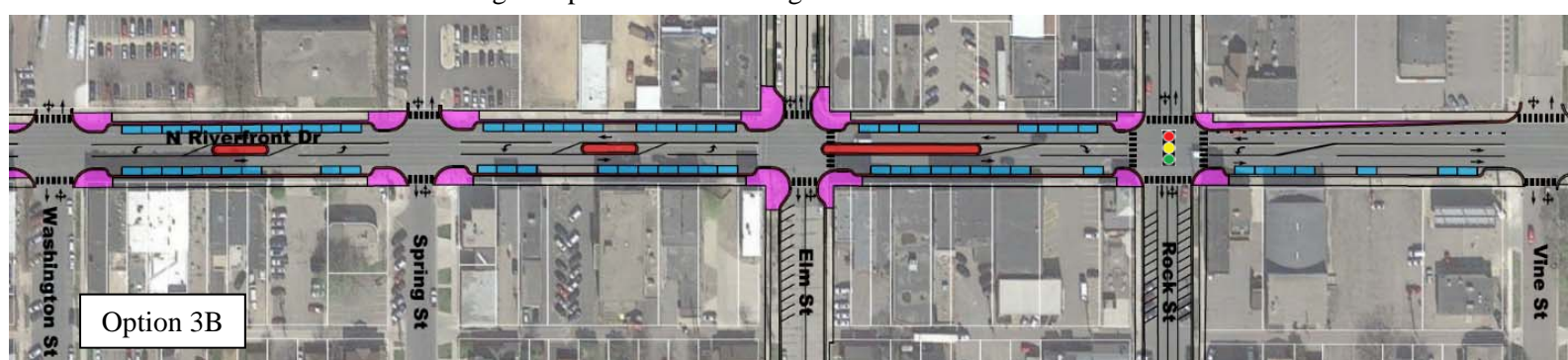


Option 3: Three Lane Roadway with Parking on Both Sides, Left Turn Lanes between Washington Street and Rock Street, Spot Safety and Pedestrian Enhancements

Option 3A - Primary vehicle intersections at Plum Street & Elm Street, enhanced pedestrian corridor on Rock Street and median refuge for pedestrians crossing Riverfront Drive.



Option 3B - Primary vehicle intersections at Plum Street & Rock Street, enhanced pedestrian corridor on Elm Street and median refuge for pedestrians crossing Riverfront Drive.

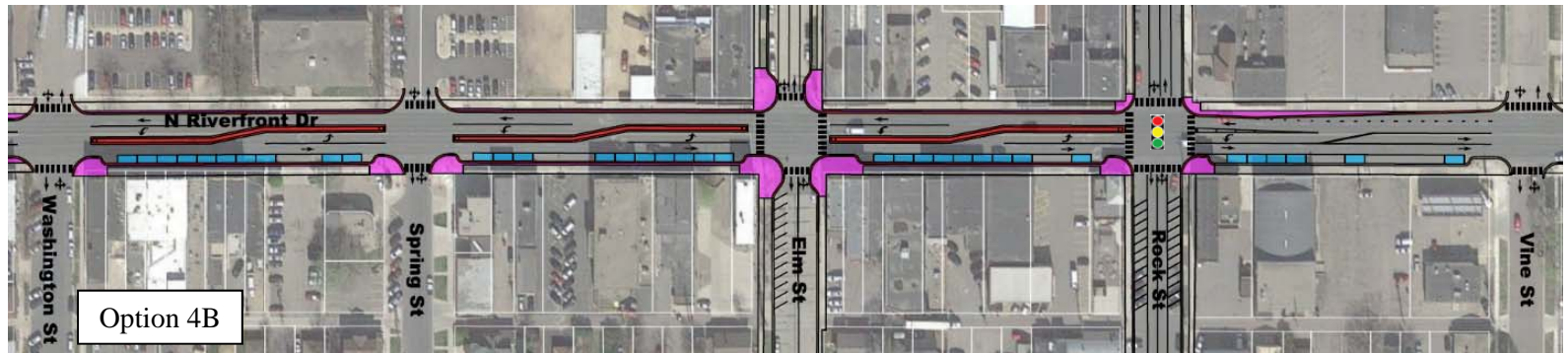


Option 4: Three Lane Roadway with Parking on South Side, Medians and Left Turn Lanes between Washington Street and Rock Street, Spot Safety and Pedestrian Enhancements

Option 4A - Primary vehicle intersections at Plum Street & Elm Street and enhanced pedestrian corridor on Rock Street.



Option 4B - Primary vehicle intersections at Plum Street & Rock Street and enhanced pedestrian corridor on Elm Street.



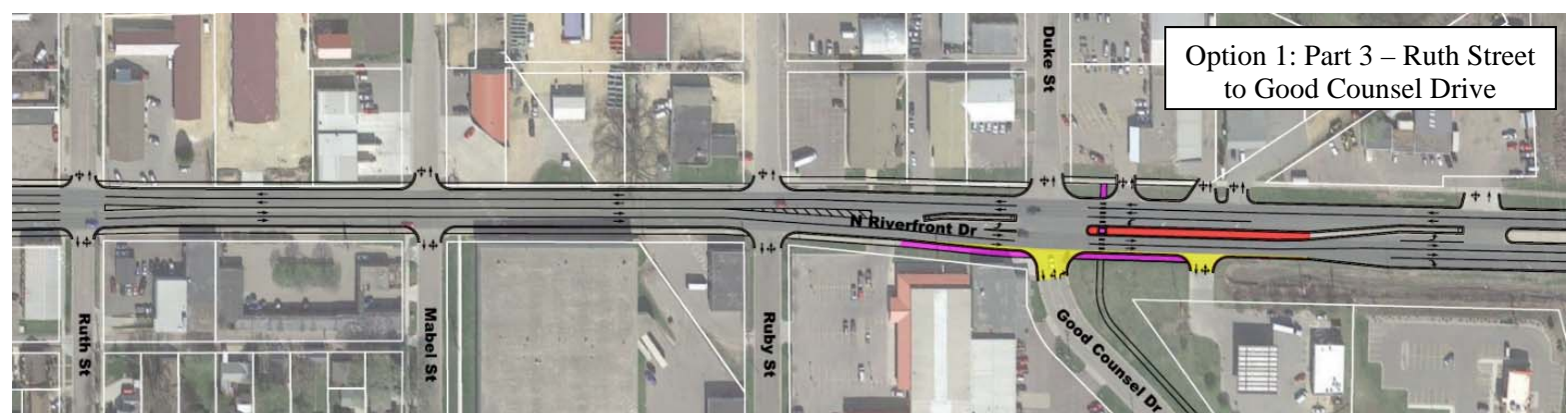
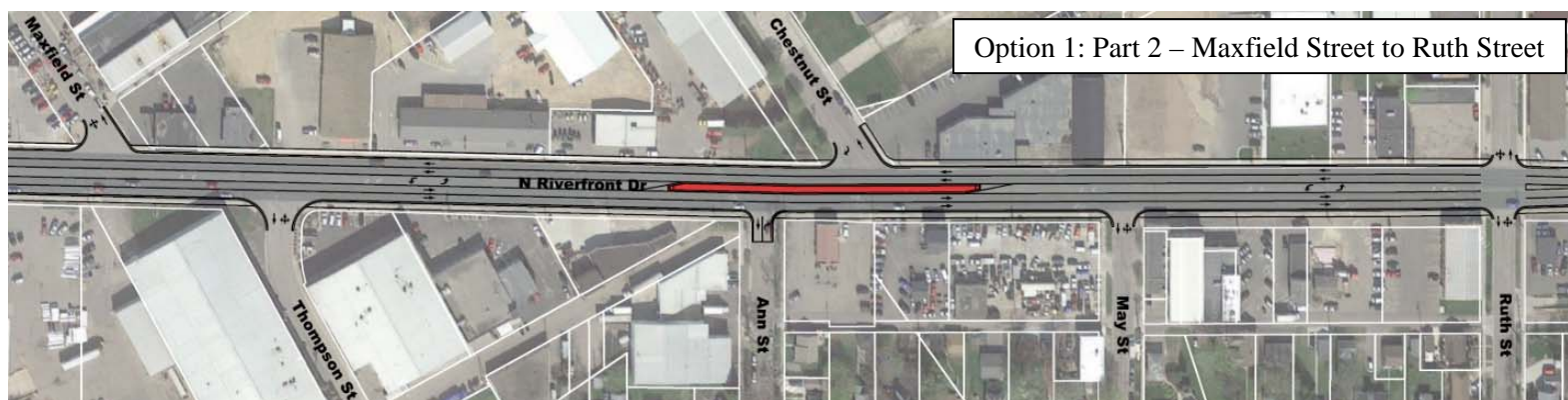
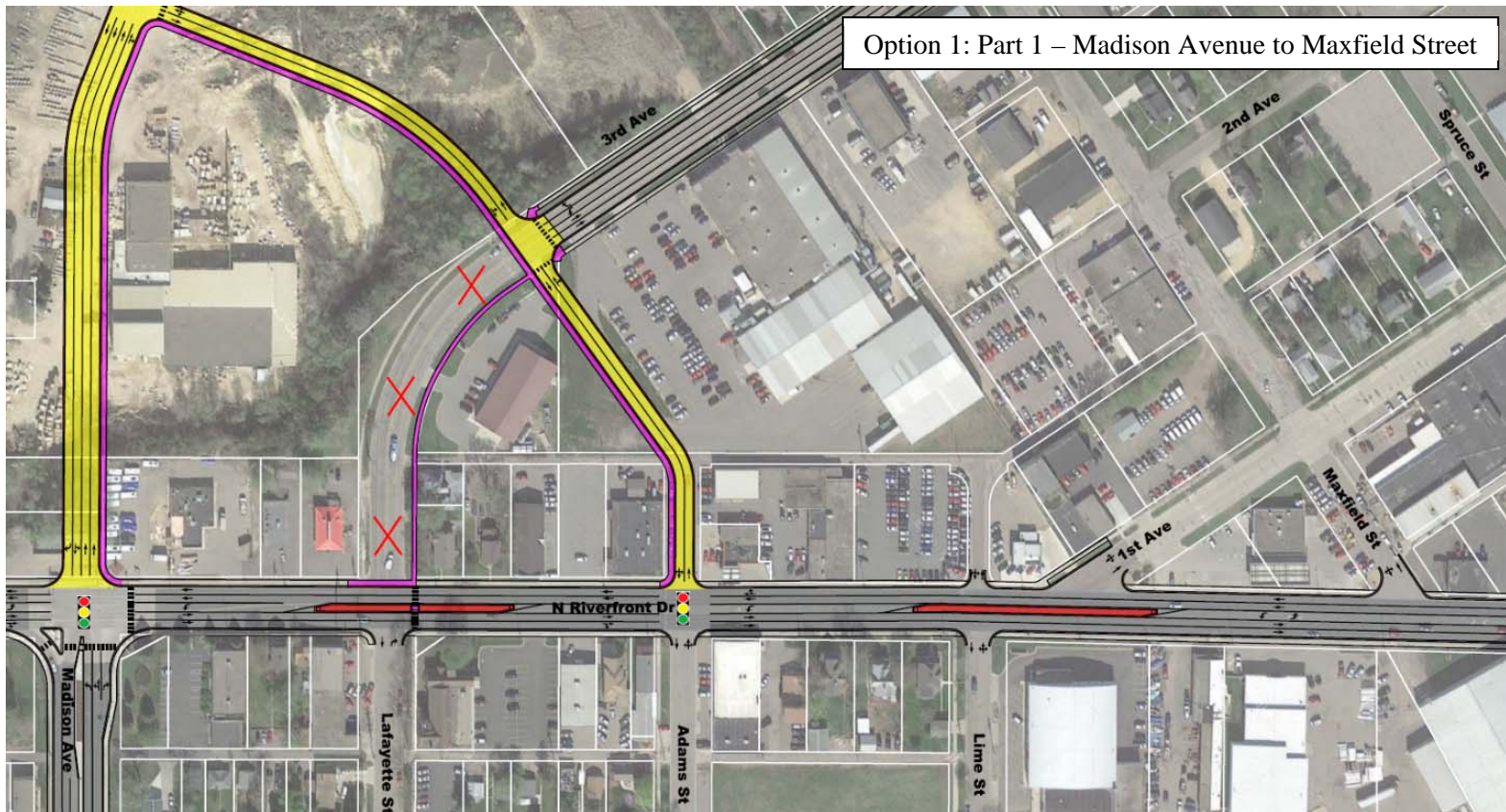
Segment 4 –Madison Avenue to Good Council Drive

For analysis purposes TH 14 was analyzed separately as its own segment and Segment 4 was analyzed from Madison Avenue to Good Council Drive. There were three alternatives analyzed for Segment 4. These options are detailed below with snapshots of each.

Option 1: Primary Vehicle Intersections at Madison Avenue, Adams Street, May Street, and Good Council Drive

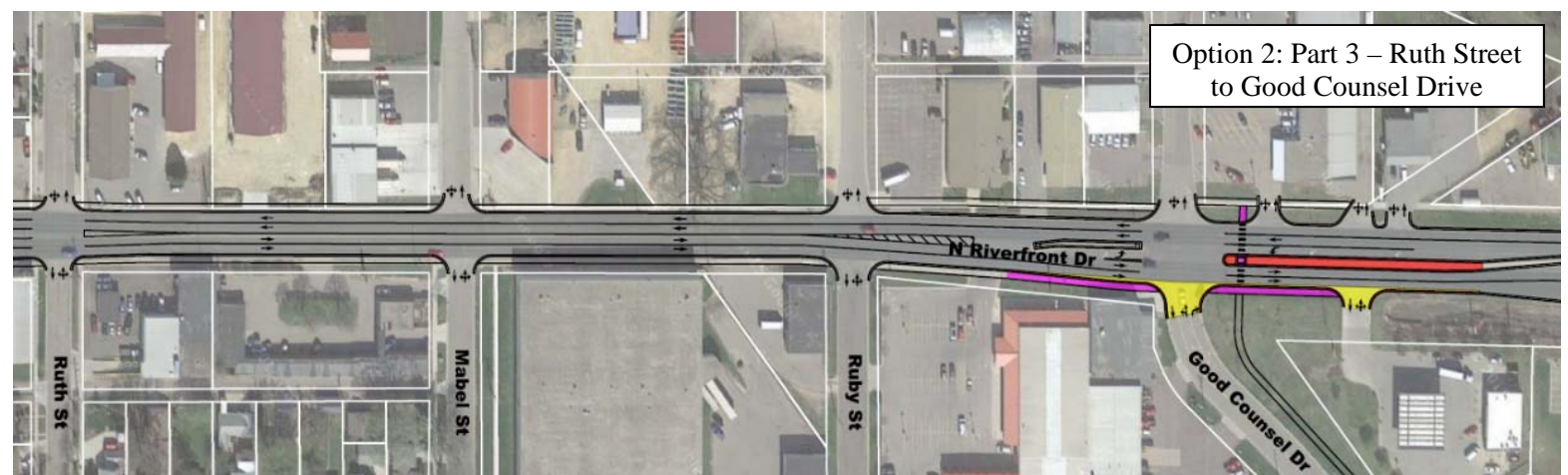
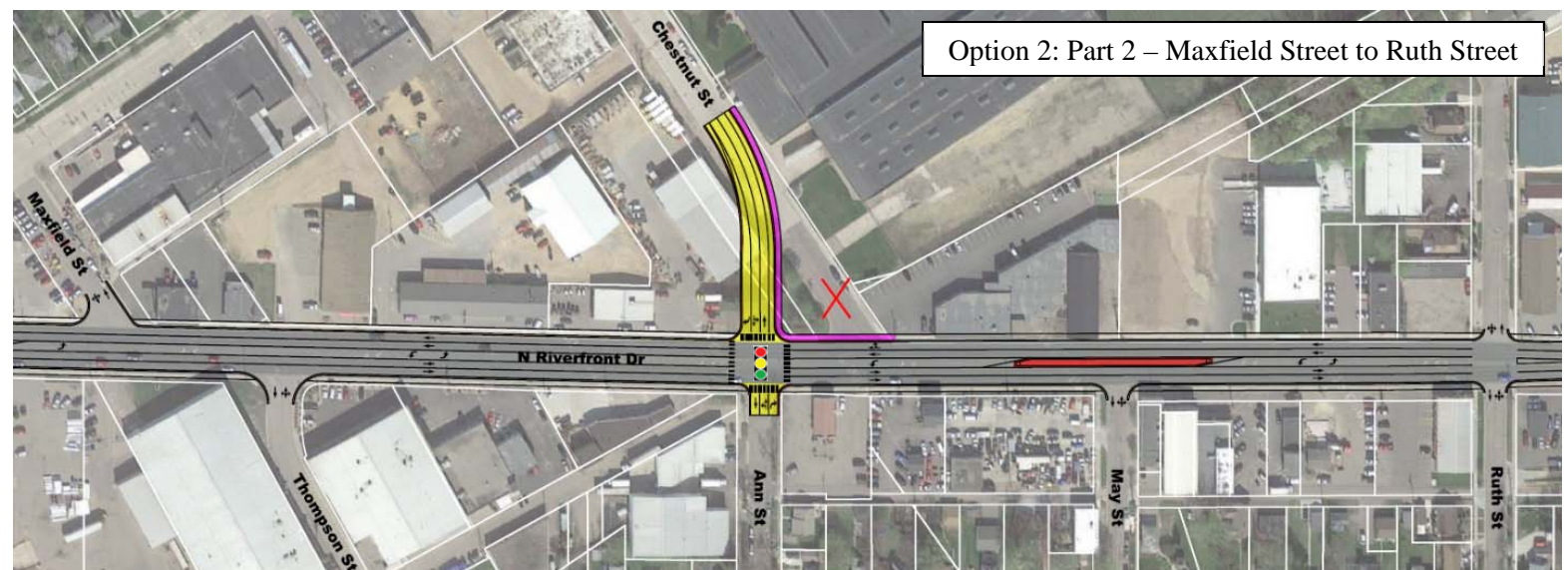
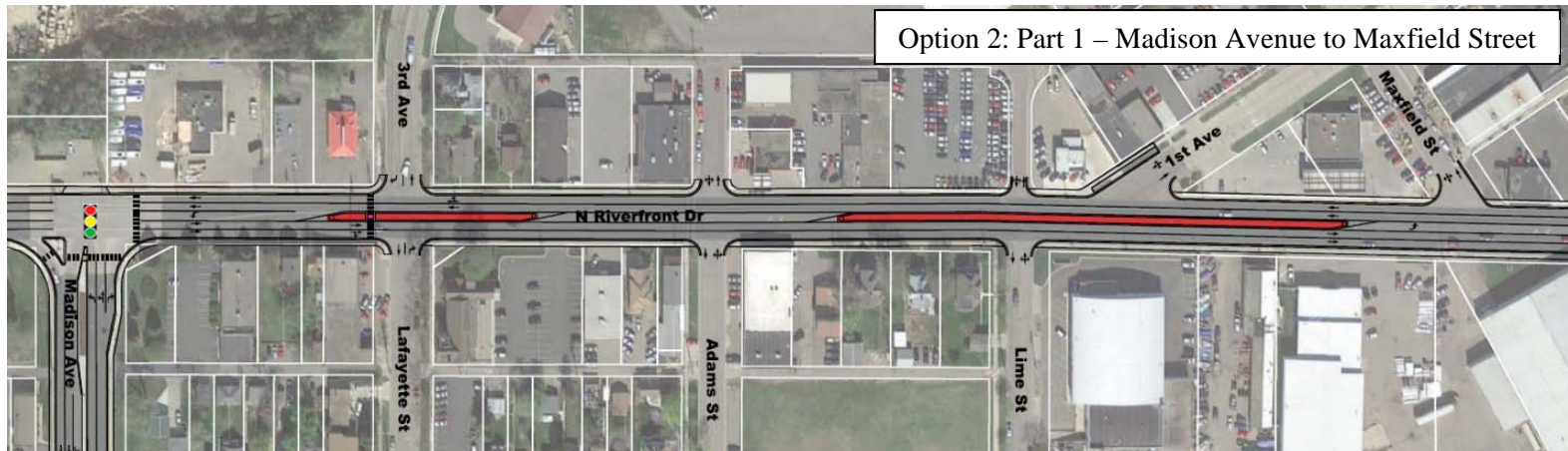
3rd Avenue is closed at Riverfront Drive, Madison Avenue is extended into current mining property and Adams Street is extended to the Madison Avenue extension. 3rd Avenue ties into Adams Street extension. Secondary intersections are converted to right-in/right-out. Pedestrian crossings at 3rd Avenue/Lafayette Street and Good Council Drive.

Option 1:



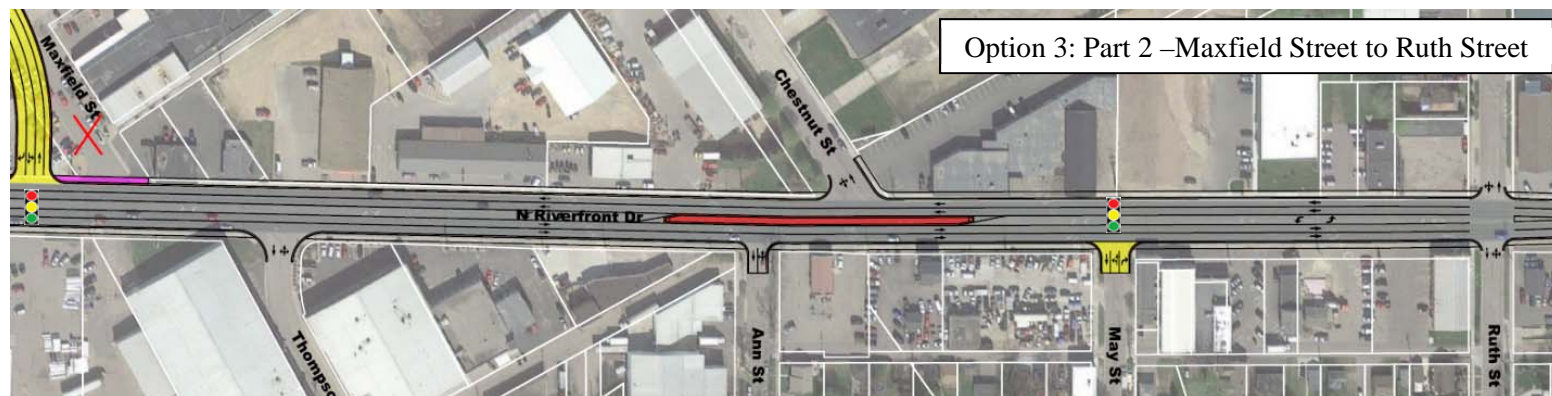
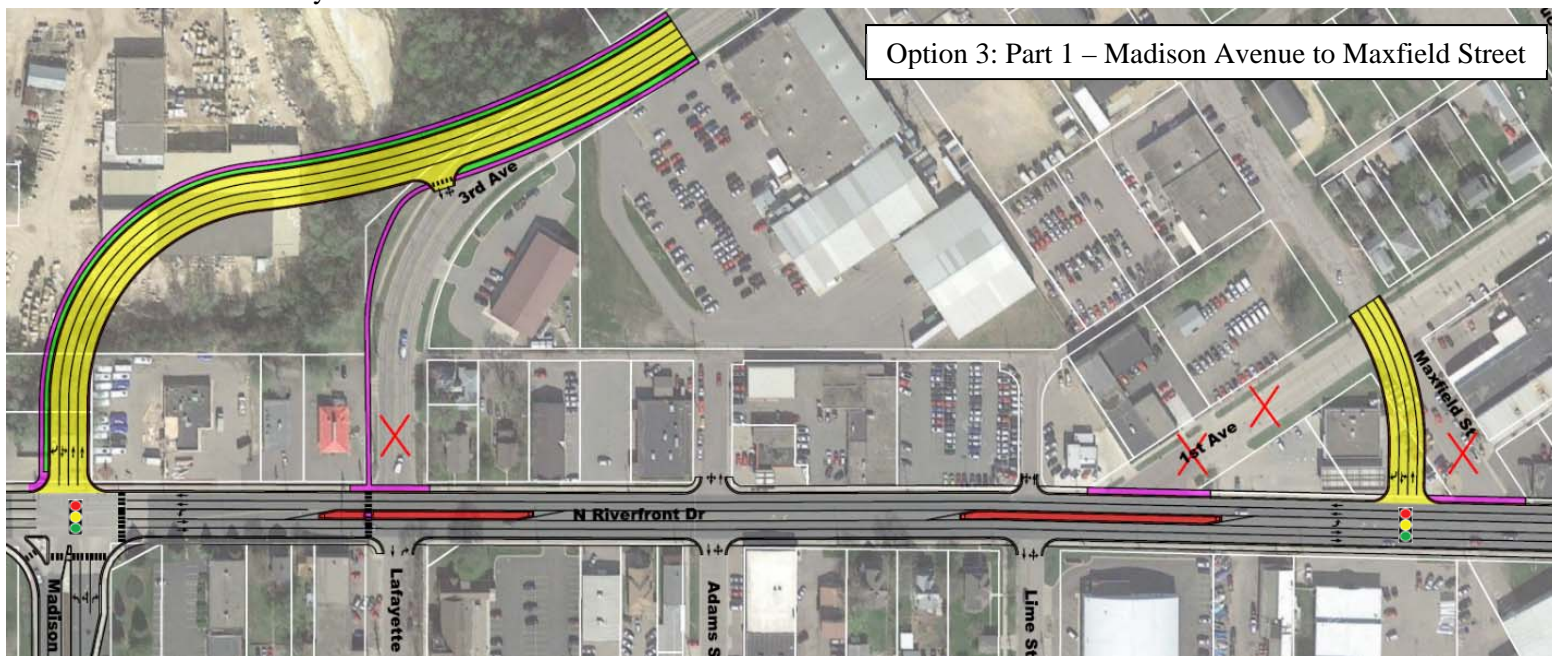
Option 2: Primary Vehicle Intersections at Madison Avenue, Chestnut Street/Ann Street, and Good Council Drive

3rd Avenue is converted to right-in/right-out. Chestnut Street is realigned and tied into Ann Street. Secondary intersections are converted to right-in/right-out. Pedestrian crossings at 3rd Avenue/Lafayette Street and Good Council Drive.



Option 3: Primary Vehicle Intersections at Madison Avenue, Maxfield Street, May Street, and Good Council Drive, realignment of 3rd Avenue to Madison Avenue Extension

3rd Avenue is realigned to tie into Madison Avenue, Maxfield Street is realigned to eliminate skewed intersection and May Street is upgraded as a primary intersection. Pedestrian crossings at 3rd Avenue/Lafayette Street and Good Council Drive.

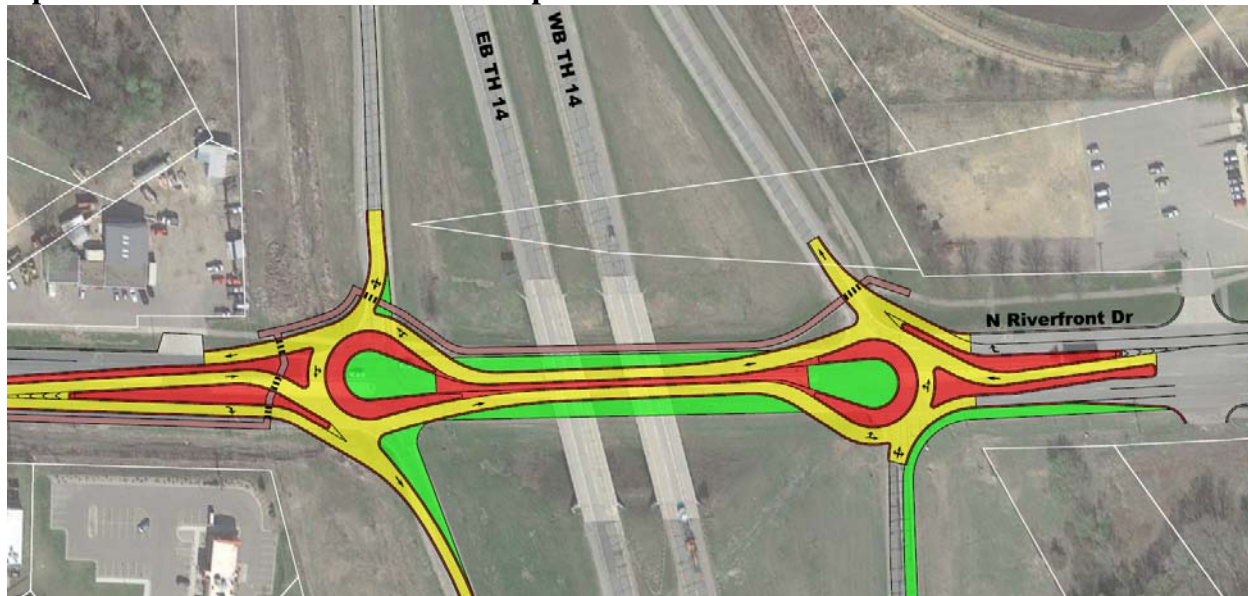


Additionally with each of the Segment 4 options there would be the option to keep the existing five lane section as shown in the snapshots, reduce the roadway to a three lane section with a center turn lane throughout the corridor or reduce the roadway to a two lane section with a median.

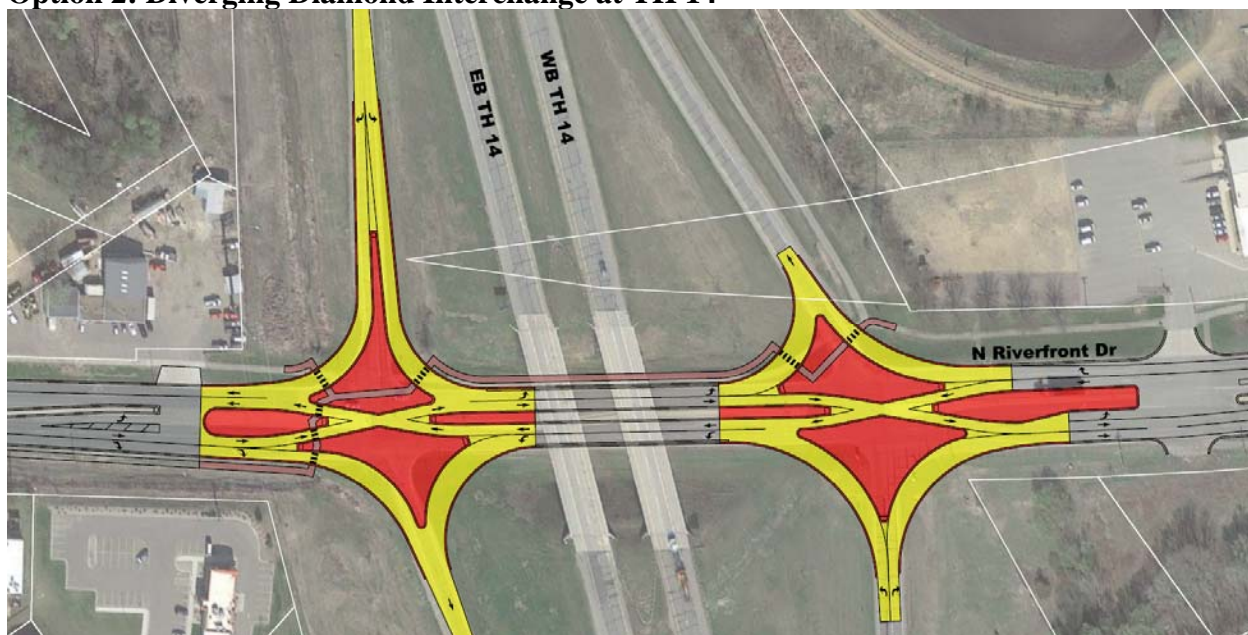
Segment 5 – TH 14 Ramps

There were two alternatives analyzed for Segment 5. These options are detailed below with snapshots of each.

Option 1: Roundabouts at TH 14 Ramps



Option 2: Diverging Diamond Interchange at TH 14



Alternative Operations Analysis

A traffic operational analysis was completed using the forecasted turning movement counts in SimTraffic for each option. **Tables 5** through **9** show the results of the 2041 no build traffic analysis compared to each option considered along each segment.

Segment 1 – Woodland Avenue to Sibley Parkway

Table 5. Segment 1 Traffic Operations Analysis

Performance Measure		No Build		Traditional Signalized Corridor				Roundabout Corridor				Interchange Modifications			
				Option 1A - Triple Lefts		Option 1B - Double Lefts		Option 2A - Three Roundabouts		Option 2B - Four Roundabout		Option 3A - Diverging Diamond		Option 3B - Loop Ramp	
Vehicle Delay on Riverfront (sec/veh)	AM	44	D	11	B	13	B	9	A	12	B	6	A	10	A
	PM	31	C	16	B	23	C	19	B	14	B	9	A	19	B
Vehicle Delay on Side Streets (sec/veh)	AM	102	F	24	C	33	C	28	C	14	B	21	C	19	B
	PM	66	E	34	C	41	D	57	E	27	C	29	C	33	C
Segment Delay (veh-hr)	AM	230		57		71		55		50		60		51	
	PM	177		90		125		127		79		96		108	
Net Change in Eastbound Travel Time (minutes)	AM	4.2 (baseline)		-1.7		-1.5		-1.8		-1.7		-1.4		-1.5	
	PM	3.2 (baseline)		-0.2		+0.3		-0.4		-0.7		-0.2		+0.4	
Net Change in Westbound Travel Time (minutes)	AM	13 (baseline)		-10.7		-10.7		-10.8		-10.6		-10.3		-10.6	
	PM	4.4 (baseline)		-1.6		-0.8		+0.9		-1.5		-0.8		-1.2	
Intersection Capacity Utilization		0.92		0.9		0.94		1.34		1.37		0.85		0.92	
Maximum Volume to Capacity Ratio		0.95		0.95		0.91		1.75		1.52		0.88		0.99	

Table 5 shows that vehicle delay and segment delay is decreased overall for each option analyzed compared to the 2041 no build analysis. Travel time is increased by less than one minute during the PM peak hour for eastbound traffic in Options 1B and 3B and westbound in Option 2A and decreased for all other options. The intersection capacity utilization and maximum volume to capacity ratio is greater than one for the roundabout corridor options, but less than one for all other options.

Tables C1 – C12 in **Appendix C** show the detailed delay and queue lengths for each option at all of the intersections in Segment 1.

Segment 2 –Sibley Parkway to Veterans Memorial Bridge

Table 6. Segment 2 Traffic Operations Analysis

Performance Measure		No Build		Option 1A - 4 Lane Narrow Median		Option 1B - 4 Lane Shifted Roadway		Option 2 - 3 Lane	
Vehicle Delay on Riverfront (sec/veh)	AM	14	B	14	B	14	B	13	B
	PM	13	B	13	B	13	B	19	B
Vehicle Delay on Side Streets (sec/veh)	AM	14	B	14	B	14	B	28	C
	PM	18	B	18	B	18	B	32	C
Maximum Queue (ft)									
Poplar St/Warren St	AM	NBT	275	NBT	275	NBT	275	NBT	650
	PM	NBT	275	NBT	275	NBT	275	NBT	625
Minnesota St/Cherry St	AM	NBT	225	NBT	225	NBT	225	NBT	375
	PM	NBT	300	NBT	300	NBT	300	NBT	375
Main St	AM	NBT	150	NBT	150	NBT	150	NBT	475
	PM	NBT	250	NBT	250	NBT	250	NBT	775
Intersection Capacity Utilization		0.79		0.79		0.79		0.89	
Maximum Volume to Capacity Ratio		0.83		0.83		0.83		0.82	

Table 6 shows that operations are acceptable and the same as the existing no build analysis for Option 1A and Option 1B as no geometric changes were made at the intersections. With Option 2 vehicle delay increases, but remains acceptable at LOS C or better during both peak hours. Northbound queuing is problematic during the PM peak hours, however most vehicles do not wait more than one cycle. Delay is acceptable with LOS C or better at Minnesota Street/Cherry Street and Main Street and LOS D at Poplar Street/Warren Street. The intersection capacity utilization and maximum volume to capacity ratio is less than one for all options.

Tables C13 – C14 in **Appendix C** show the detailed delay and queue lengths at all of the intersections in Segment 2 for Option 2.

Segment 3 –Veterans Memorial Bridge to Madison Avenue

Table 7. Segment 3 Traffic Operations Analysis

Performance Measure		No Build		Four Lane				Three Lane - Parking Both Sides				Three Lane - Parking Both Sides & Left Turn Lanes				Three Lane - Parking South Side, Full Medians & Left Turn Lanes			
				Option 1A Elm Primary Intersection		Option 1B Rock Primary Intersection		Option 2A Elm Primary Intersection		Option 2B Rock Primary Intersection		Option 3A Elm Primary Intersection		Option 3B Rock Primary Intersection		Option 4A Elm Primary Intersection		Option 4B Rock Primary Intersection	
Vehicle Delay on Riverfront (sec/veh)	AM	7	A	7	A	7	A	9	A	8	A	9	A	8	A	9	A	8	A
	PM	10	A	10	A	10	A	15	B	15	B	15	B	15	B	15	B	15	B
Vehicle Delay on Side Streets (sec/veh)	AM	14	B	14	B	14	B	20	C	20	B	20	C	20	B	20	C	20	B
	PM	18	B	18	B	18	B	30	C	30	C	30	C	30	C	30	C	30	C
Intersection Capacity Utilization		0.74		0.74		0.74		0.81		0.82		0.81		0.82		0.81		0.82	
Maximum Volume to Capacity Ratio		0.78		0.78		0.78		1.05		1.05		1.05		1.05		1.05		1.05	

Table 7 shows that vehicle delay is acceptable for all options with LOS C or better. The intersection capacity utilization is less than one for all options. The maximum volume to capacity ratio is greater than one for the three lane options and less than one for the four lane option.

Tables C15 and C16 in Appendix C show the detailed delay and queue lengths at all of the intersections in the three lane options with Elm Street as a primary intersection. **Tables C17 and C18 in Appendix C** show the detailed delay and queue lengths at all of the intersections in the three lane options with Rock Street as a primary intersection.

Madison Avenue at Riverfront Drive was also analyzed as a roundabout to determine if the three lane section could begin north of Madison Avenue however the volumes were too high in this area for a single lane roundabout to function with acceptable delay.

Additionally, analysis was completed to determine if the free northbound right turn could be eliminated at Plum Street. The movement delay was found to be 4.5 seconds with the free right and 4.7 seconds without the free right so it is recommended that the free right be removed to improve pedestrian safety.

Segment 4 –Madison Avenue to Good Council Drive

Traffic operations were not analyzed for the alternatives discussed along Segment 4. Due to the lower traffic volumes it was assumed that operations would be comparable between all of the options. Instead these options were analyzed with the goals of how to provide efficient vehicle and freight mobility and access, safety for all users, infrastructure improvements compatible with the historic and natural environment and how to enhance the community identity. Details on how each option is able to meet these goals is described in the Final Study Report.

Segment 5 – TH 14 Ramps

Table 9. Segment 5 Traffic Operations Analysis

Performance Measure		No Build		Option 1 - Roundabouts		Option 2 - Diverging Diamond	
Vehicle Delay on Riverfront (sec/veh)	AM	2	A	23	C	6	A
	PM	2	A	16	C	9	A
Vehicle Delay on Ramps (sec/veh)	AM	99	F	20	C	5	A
	PM	193	F	20	C	5	A
Intersection Capacity Utilization		0.54		1.12		0.73	
Maximum Volume to Capacity Ratio		3.01		0.99		0.78	

Table 9 shows that with roundabouts at both ramps in Option 1 the vehicle delay on Riverfront Drive increases, but remains acceptable at LOS C. With the diverging diamond in Option 2 the vehicle delay on Riverfront Drive remains LOS A. The vehicle delay on the ramps is significantly less for both options compared to 2041 no build analysis. The intersection capacity utilization is greater than one for Option 1 and remains less than one for Option 2. The maximum volume to capacity ratio is greatly reduced and less than one for both options.

Appendix A: Traffic Forecasting

Figure 1. Traffic Growth at Riverfront Drive West of Stoltzman Road

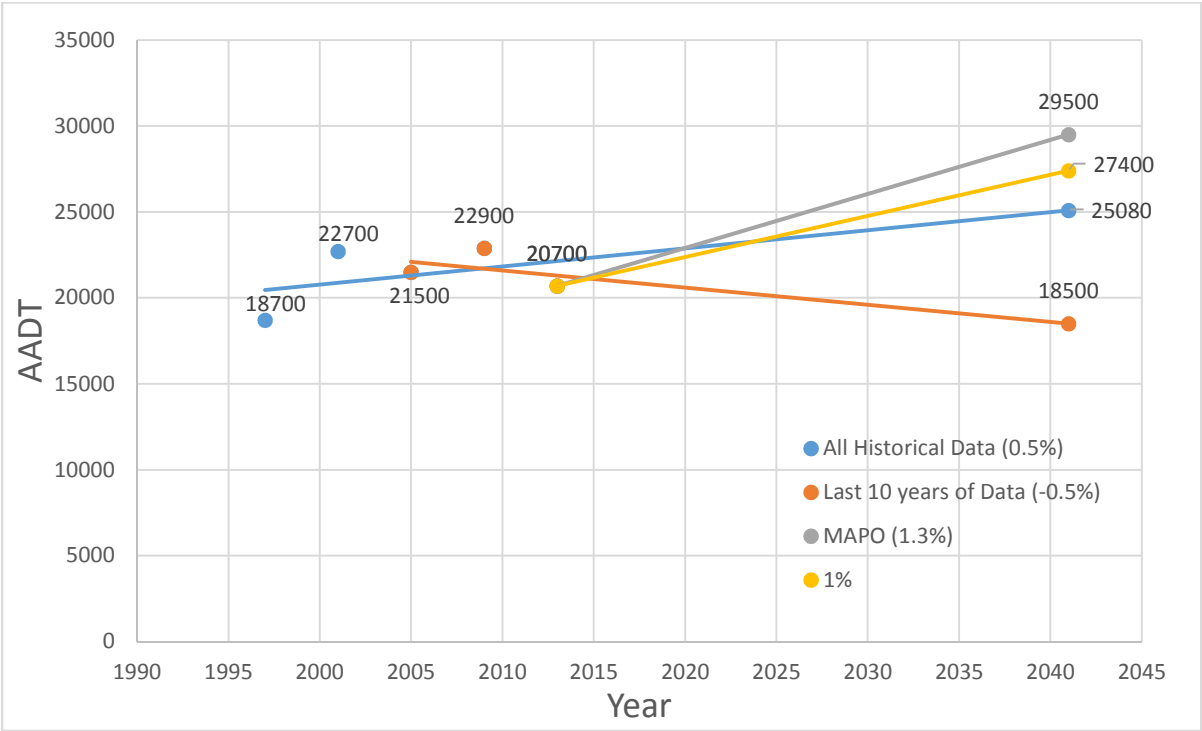


Figure 2. Traffic Growth at Riverfront Drive South of Minnesota Street-Cherry Street

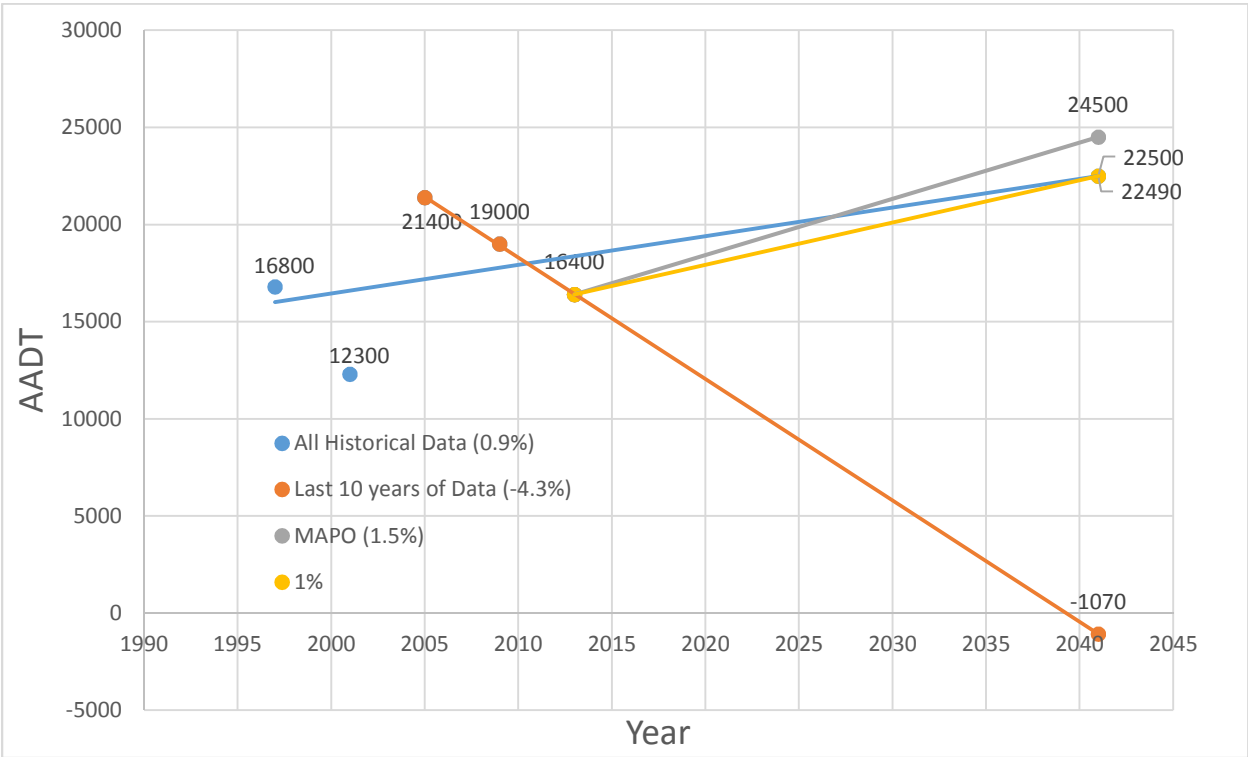


Figure 3. Traffic Growth at Riverfront Drive South of Lafayette Street-3rd Avenue

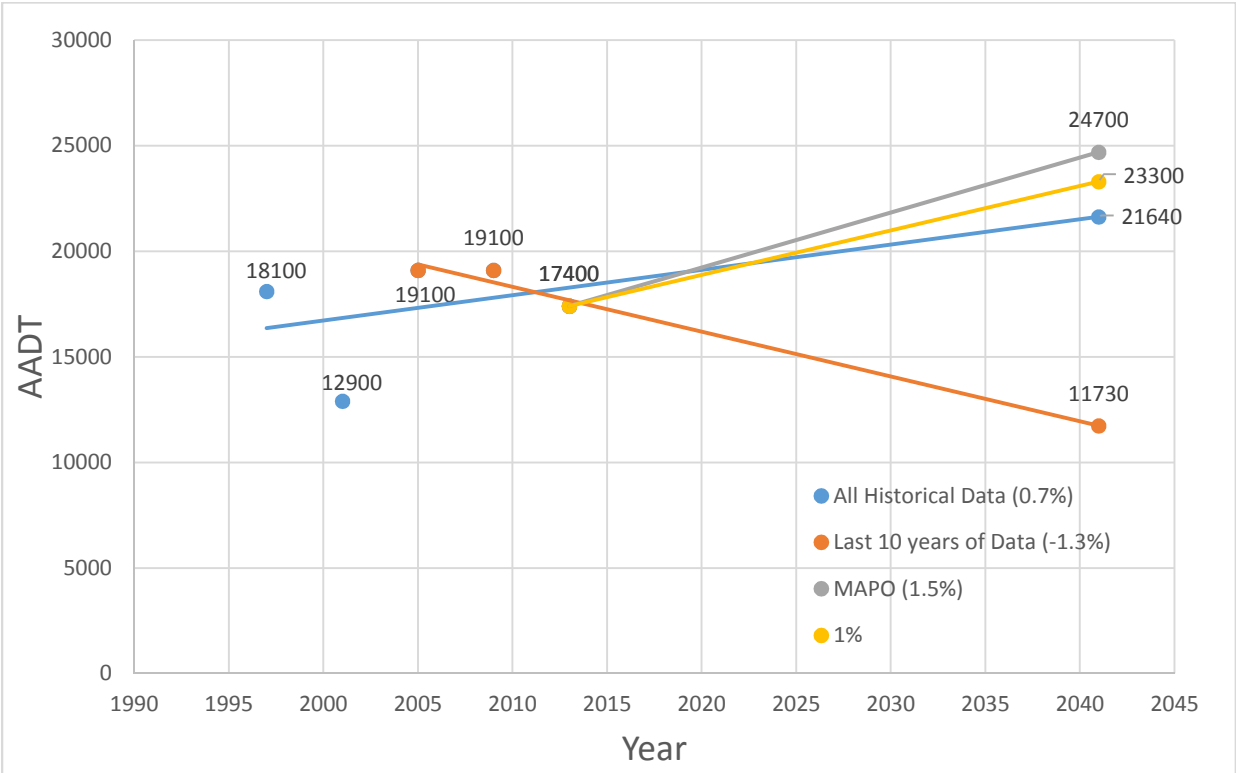
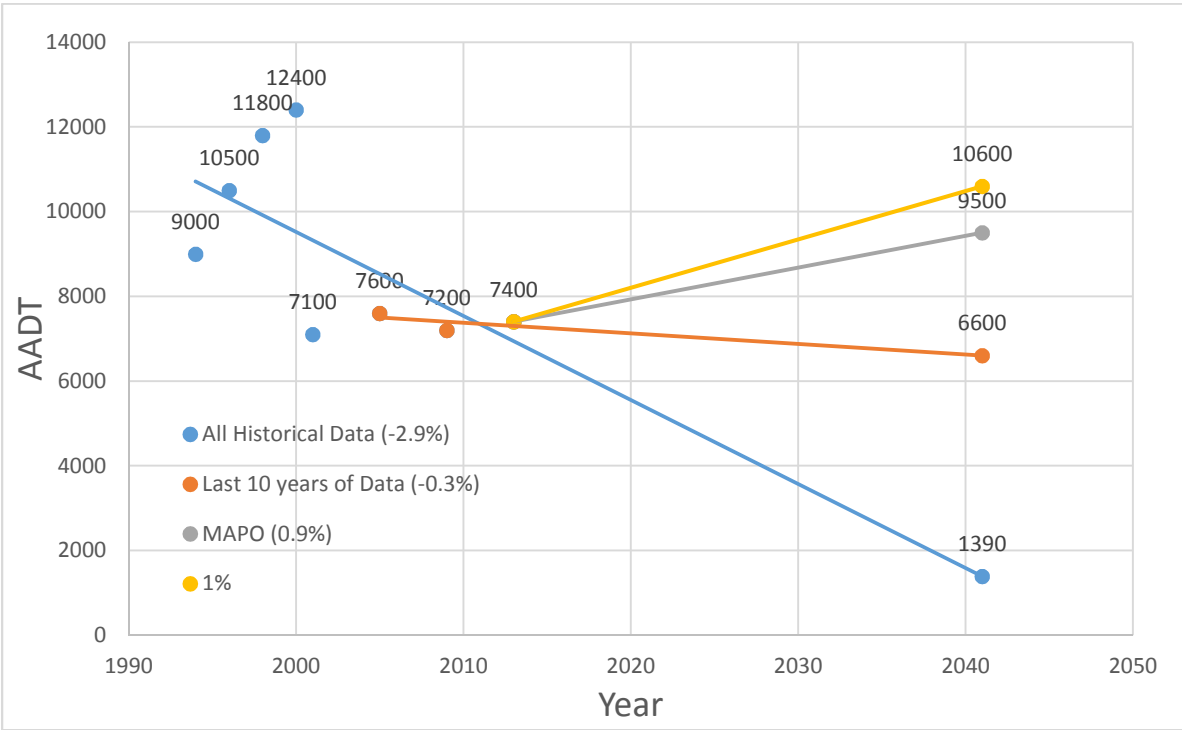


Figure 4. Traffic Growth at Riverfront Drive North of TH 14 Westbound Ramp



Appendix B: 2041 No Build Traffic Operational Analysis

Table B1: 2041 Segment 1 Existing Geometry Traffic Operations Analysis - Riverfront Drive Corridor Study

Intersection	Peak Hour	Intersection Delay*- LOS		Movement Delay (sec/veh)																							
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
Riverfront Dr & Woodland Ave Stop Controlled	AM	2	A	-		0	A	0	A	2	A	1	A	1	A	6	A	7	A	2	A	5	A	7	A	-	
	PM	3	A	2	A	0	A	0	A	3	A	1	A	1	A	6	A	7	A	2	A	5	A	7	A	3	A
Riverfront Dr & Sibley St Stop Controlled	AM	6	A	-		4	A	4	A	9	A	2	A	2	A	33	D	41	E	4	A	16	C	15	C	7	A
	PM	7	A	7	A	4	A	4	A	9	A	2	A	2	A	32	D	27	D	2	A	25	D	19	C	8	A
SB TH 169 Ramp/Owatonna St & Riverfront Dr Signalized Intersection	AM	49	D	14	B	34	C	-		22	C	17	B	2	A	-		-		-		75	E	-		41	D
	PM	32	C	8	A	43	D	33	C	26	C	16	B	3	A	-		-		-		43	D	56	E	16	B
NB TH 169 Ramp & Riverfront Dr Stop Controlled	AM	62	F	7	A	14	B	-		-		14	B	37	E	1949	F	514	F	748	F	-		-		-	
	PM	24	C	24	C	6	A	-		-		5	A	17	C	-		77	F	127	F	-		-		-	
Mankato West HS/Poplar St & Riverfront Dr Signalized Intersection	AM	79	E	11	B	19	B	22	C	59	E	156	F	351	F	261	F	253	F	153	F	78	E	86	F	111	F
	PM	50	D	22	C	18	B	19	B	62	E	69	E	103	F	134	F	162	F	65	E	73	E	60	E	60	E
Riverfront Dr & Stoltzman Rd Signalized Intersection	AM	89	F	16	B	16	B	12	B	19	B	83	F	16	B	320	F	268	F	69	E	16	B	26	C	44	D
	PM	44	D	46	D	32	C	15	B	42	D	39	D	10	B	117	F	156	F	19	B	26	C	37	D	24	C
Riverfront Dr & Marshall St Signalized Intersection	AM	75	E	-	-	7	A	4	A	128	F	182	F	-	-	176	F	-	-	1	A	-	-	-	-	-	-
	PM	15	B	-	-	7	A	4	A	23	C	18	B	-	-	41	D	-	-	1	A	-	-	-	-	-	-

*Delay in seconds per vehicle

**Maximum delay and LOS on any approach and/or movement

***Limiting Movement is the highest delay movement.

Table B2: 2041 Segment 1 Existing Geometry Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Riverfront Dr & Woodland Ave <i>Stop Controlled</i>	AM	0	25	0	25	0	25	25	50	25	50	-	-	25	100	25	100	25	100	25	50	25	50	25	50
	PM	0	25	0	25	0	25	25	50	25	50	-	-	25	25	25	25	25	50	50	50	50	50	50	50
Riverfront Dr & Sibley St <i>Stop Controlled</i>	AM	25	75	25	75	25	75	75	200	75	200	25	75	50	125	50	125	-	-	25	50	25	50	25	50
	PM	25	50	25	50	25	50	75	175	75	175	25	25	25	75	25	75	-	-	25	75	25	75	25	75
SB TH 169 Ramp/Owatonna St & Riverfront Dr <i>Signalized Intersection</i>	AM	25	25	200	350	200	350	75	150	25	125	25	125	-	-	-	-	-	-	575	950	-	-	175	300
	PM	0	25	150	300	150	300	200	275	75	150	75	150	-	-	-	-	-	-	275	650	-	-	125	300
NB TH 169 Ramp & Riverfront Dr <i>Stop Controlled</i>	AM	75	250	200	300	-	-	-	-	200	250	175	200	25	150	25	150	725	1275	-	-	-	-	-	-
	PM	100	250	100	275	-	-	-	-	250	275	200	225	25	100	25	100	375	1000	-	-	-	-	-	-
Mankato West HS/Poplar St & Riverfront Dr <i>Signalized Intersection</i>	AM	50	150	200	225	200	225	75	200	600	800	600	800	350	525	350	525	100	150	150	375	150	375	150	375
	PM	75	225	225	250	225	250	125	250	575	800	575	800	225	500	225	500	100	150	200	450	200	450	200	450
Riverfront Dr & Stoltzman Rd <i>Signalized Intersection</i>	AM	25	75	100	200	100	200	50	150	175	275	25	175	800	1300	-	-	725	1300	25	75	-	-	25	100
	PM	125	225	150	300	125	225	150	250	200	300	100	200	425	500	-	-	325	475	75	125	-	-	100	125
Riverfront Dr & Marshall St <i>Signalized Intersection</i>	AM	-	-	75	175	50	125	50	175	300	775	-	-	150	525	-	-	-	-	-	-	-	-	-	-
	PM	-	-	75	250	50	150	50	175	125	400	-	-	125	250	-	-	0	25	-	-	-	-	-	-

Table B3: 2041 Segment 2 Existing Geometry Traffic Operations Analysis - Riverfront Drive Corridor Study

Intersection	Peak Hour	Intersection Delay*- LOS		Movement Delay (sec/veh)																							
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
Riverfront Dr & Sibley Pkwy Signalized Intersection	AM	38	D	39	D	3	A	-	-	74	E	84	F	-	-	-	-	33	C	-	-	48	D				
	PM	5	A	41	D	4	A	-	-	5	A	4	A	-	-	-	-	26	C	-	-	7	A				
Riverfront Dr & Poplar St/Warren St Signalized Intersection	AM	14	B	30	C	26	C	21	C	32	C	24	C	10	B	10	B	10	B	9	A	19	B	12	B	11	B
	PM	18	B	31	C	30	C	22	C	29	C	25	C	11	B	28	C	15	B	13	B	24	C	15	B	12	B
Riverfront Dr & Minnesota St/Cherry St Signalized Intersection	AM	11	B	28	C	30	C	13	B	30	C	32	C	2	A	10	B	6	A	4	A	22	C	10	B	6	A
	PM	19	B	25	C	20	C	11	B	30	C	29	C	3	A	27	C	13	B	10	B	56	E	18	B	9	A
Riverfront Dr & Main St Signalized Intersection	AM	8	A	26	C	-	-	-	-	26	C	-	-	7	A	6	A	8	A	5	A	15	B	5	A	5	A
	PM	13	B	31	C	-	-	8	A	26	C	18	B	9	A	17	B	13	B	9	A	23	C	9	A	-	-

*Delay in seconds per vehicle

**Maximum delay and LOS on any approach and/or movement

***Limiting Movement is the highest delay movement.

Table B4: 2041 Segment 2 Existing Geometry Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Riverfront Dr & Sibley Pkwy <i>Signalized Intersection</i>	AM	25	50	25	125	-	-	-	-	175	825	25	150	-	-	-	-	-	-	25	75	-	-	25	50
	PM	25	75	50	125	-	-	-	-	50	150	25	50	-	-	-	-	-	-	50	100	-	-	25	50
Riverfront Dr & Poplar St/Warren St <i>Signalized Intersection</i>	AM	75	200	75	200	75	200	50	125	50	150	50	150	25	100	100	275	100	275	50	150	75	275	75	275
	PM	125	250	125	250	125	250	75	175	75	150	75	150	50	150	125	275	125	275	75	225	150	350	150	350
Riverfront Dr & Minnesota St/Cherry St <i>Signalized Intersection</i>	AM	50	100	25	100	25	100	100	225	100	225	25	75	25	50	75	200	75	200	50	100	75	325	25	75
	PM	75	125	50	150	50	150	175	350	175	350	50	125	50	150	125	300	125	300	75	225	150	325	50	175
Riverfront Dr & Main St <i>Signalized Intersection</i>	AM	25	25	25	25	25	25	75	150	75	150	50	125	25	50	50	150	25	50	25	100	50	125	50	125
	PM	25	75	25	75	25	75	100	175	100	175	50	100	25	50	100	250	50	175	50	125	75	200	75	200

Table B5: 2041 Segment 3 Existing Geometry Traffic Operations Analysis - Riverfront Drive Corridor Study

Intersection	Peak Hour	Intersection Delay*- LOS		Movement Delay (sec/veh)																							
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
Riverfront Dr & Plum St Signalized Intersection	AM	4	A	-		-		-		23	C	-		7	A	15	B	5	A	3	A	8	A	3	A	3	A
	PM	5	A	10	B	-		-		28	C	-		9	A	-		5	A	5	A	13	B	3	A	-	
Riverfront Dr & Elm St Signalized Intersection	AM	4	A	10	B	6	A	4	A	11	B	-		6	A	10	B	4	A	2	A	6	A	3	A	3	A
	PM	6	A	22	C	21	C	9	A	18	B	-		7	A	14	B	6	A	5	A	16	B	6	A	4	A
Riverfront Dr & Madison Ave Signalized Intersection	AM	12	B	-		-		-		24	C	-		10	B	-		14	B	8	A	22	C	6	A	-	
	PM	17	B	-		-		-		26	C	49	D	12	B	-		25	C	14	B	22	C	8	A	9	A

*Delay in seconds per vehicle

**Maximum delay and LOS on any approach and/or movement

***Limiting Movement is the highest delay movement.

Table B6: 2041 Segment 3 Existing Geometry Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Riverfront Dr & Plum St <i>Signalized Intersection</i>	AM	-	-	-	-	-	-	25	50	25	50	50	75	25	25	50	175	25	25	25	75	25	75	25	75
	PM	25	25	25	25	25	25	25	75	25	75	50	75	-	-	50	175	25	50	50	125	25	100	25	100
Riverfront Dr & Elm St <i>Signalized Intersection</i>	AM	25	50	25	50	25	50	25	50	25	50	-	-	50	125	50	125	50	125	25	125	25	125	-	-
	PM	50	125	50	125	50	125	25	50	25	50	-	-	75	175	75	175	75	175	75	225	75	225	-	-
Riverfront Dr & Madison Ave <i>Signalized Intersection</i>	AM	-	-	-	-	-	-	75	125	25	150	75	150	-	-	125	300	125	300	75	200	75	225	75	225
	PM	-	-	-	-	-	-	125	200	100	200	100	175	-	-	200	425	200	425	100	200	75	175	75	175

Table B7: 2041 Segment 4 Existing Geometry Traffic Operations Analysis - Riverfront Drive Corridor Study

Intersection	Peak Hour	Intersection Delay*- LOS		Movement Delay (sec/veh)																						
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR
Riverfront Dr & 3rd Ave/Lafayette St Stop Controlled	AM	5	A	57	F	25	D	15	C	-	45	E	12	B	10	B	2	A	2	A	8	A	3	A	2	A
	PM	6	A	48	E	48	E	17	C	-	-	-	6	A	9	A	3	A	3	A	8	A	3	A	1	A
Riverfront Dr & May St Stop Controlled	AM	1	A	-	-	-	-	-	16	C	-	-	6	A	-	-	2	A	2	A	3	A	0	A	-	-
	PM	3	A	-	-	-	-	-	23	C	-	-	11	B	-	-	3	A	3	A	6	A	0	A	-	-
Riverfront Dr & TH 14 EB Ramp Stop Controlled	AM	5	A	22	C	-	-	13	B	-	-	-	-	-	-	1	A	2	A	5	A	1	A	-	-	
	PM	6	A	39	E	-	-	7	A	-	-	-	-	-	-	2	A	3	A	12	B	1	A	-	-	
Riverfront Dr & TH 14 WB Ramp Stop Controlled	AM	28	D	-	-	-	-	197	F	-	-	80	F	11	B	1	A	-	-	-	-	1	A	1	A	
	PM	56	F	-	-	-	-	374	F	-	-	242	F	6	A	1	A	-	-	-	-	1	A	1	A	

*Delay in seconds per vehicle

**Maximum delay and LOS on any approach and/or movement

***Limiting Movement is the highest delay movement.

Table B8: 2041 Segment 4 Existing Geometry Peak Hour Queues By Movement

[illegible]

Appendix C: 2041 Alternative Traffic Operational Analysis

Table C1: 2041 Segment 1 - Option 1A Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay* - LOS		Movement Delay (sec/veh)																							
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
Riverfront Dr & Woodland Ave Stop Controlled	AM	2	A	-		0	A	0	A	2	A	1	A	1	A	6	A	8	A	2	A	6	A	6	A	-	
	PM	3	A	3	A	1	A	0	A	3	A	1	A	1	A	6	A	8	A	2	A	6	A	7	A	2	A
Riverfront Dr & Sibley St Stop Controlled	AM	9	A	-		5	A	4	A	11	B	2	A	1	A	68	F	66	F	7	A	24	C	17	C	11	B
	PM	8	A	5	A	4	A	4	A	11	B	2	A	2	A	38	E	29	D	2	A	32	D	26	D	13	B
Riverfront Dr & SB TH 169 Ramps/Owatonna St Signalized Intersection	AM	27	C	13	B	31	C	-		24	C	12	B	2	A	-		-		-		33	C	-		13	B
	PM	32	C	34	C	46	D	41	D	29	C	15	B	3	A	-		-		-		42	D	43	D	12	B
Riverfront Dr & NB TH 169 Ramps Stop Controlled	AM	6	A	9	A	3	A	-		-		2	A	3	A	84	F	23	C	36	E	-		-		-	
	PM	12	B	24	C	4	A	-		-		4	A	4	A	-		48	E	64	F	-		-		-	
Mankato West HS/Poplar St & Riverfront Dr Signalized Intersection	AM	22	C	18	B	14	B	6	A	54	D	16	B	16	B	62	E	59	E	41	D	32	C	28	C	21	C
	PM	25	C	29	C	14	B	3	A	58	E	23	C	21	C	62	E	63	E	28	C	54	D	46	D	42	D
Riverfront Dr & Stoltzman Rd Signalized Intersection	AM	16	B	16	B	17	B	17	B	16	B	12	B	3	A	22	C	19	B	9	A	18	B	27	C	8	A
	PM	28	C	42	D	29	C	16	B	36	D	27	C	7	A	36	D	38	D	11	B	34	C	49	D	20	C
Riverfront Dr & Marshall St Signalized Intersection	AM	5	A	-		5	A	3	A	14	B	4	A	-		13	B	-		1	A	-		-		-	
	PM	11	B	-		6	A	3	A	22	C	9	A	-		41	D	-		1	A	-		-		-	

*Delay in seconds per vehicle

Table C2: 2041 Segment 1 - Option 1A Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths (ft)																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Riverfront Dr & Woodland Ave Stop Controlled	AM	0	25	0	25	0	25	25	50	25	50	-	-	25	50	25	50	25	50	25	50	25	50	25	50
	PM	0	25	0	25	0	25	25	50	25	50	-	-	25	25	25	25	25	25	50	75	50	75	50	75
Riverfront Dr & Sibley St Stop Controlled	AM	25	50	25	50	25	50	75	200	75	200	75	200	75	200	75	200	25	50	25	50	25	50	25	50
	PM	25	50	25	50	25	50	100	300	100	300	100	300	25	75	25	75	-	-	25	100	25	100	25	100
Riverfront Dr & SB TH 169 Ramps/Owatonna St Signalized Intersection	AM	25	75	200	375	200	375	100	200	25	100	25	100	-	-	-	-	-	-	150	500	150	500	75	275
	PM	25	25	175	275	175	275	200	300	75	150	75	150	-	-	-	-	-	-	175	550	175	550	100	275
Riverfront Dr & NB TH 169 Ramps Stop Controlled	AM	75	225	50	175	-	-	-	-	25	150	25	125	25	25	25	25	100	275	-	-	-	-	-	-
	PM	100	225	25	200	-	-	-	-	50	250	25	200	25	25	25	25	225	700	-	-	-	-	-	-
Mankato West HS/Poplar St & Riverfront Dr Signalized Intersection	AM	50	150	175	250	100	200	125	275	175	400	175	400	225	625	225	625	100	150	75	175	75	175	75	175
	PM	75	175	175	250	50	100	125	250	275	500	275	500	150	475	150	475	75	150	175	350	175	350	175	350
Riverfront Dr & Stoltzman Rd Signalized Intersection	AM	50	125	125	450	150	225	50	125	75	175	25	100	125	250	50	225	75	175	-	-	-	-	25	75
	PM	125	225	125	300	125	225	150	250	175	275	75	200	175	275	100	375	75	150	-	-	-	-	75	125
Riverfront Dr & Marshall St Signalized Intersection	AM	-	-	50	125	50	100	25	75	50	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	PM	-	-	75	200	50	150	50	150	100	275	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C3: 2041 Segment 1 - Option 1B Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay* - LOS		Movement Delay (sec/veh)																									
				EBU		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
Riverfront Dr & Woodland Ave Stop Controlled	AM	2	A	-	-	0	A	0	A	3	A	1	A	1	A	6	A	8	A	2	A	5	A	7	A	-	-		
	PM	3	A	-	2	A	0	A	0	A	3	A	1	A	1	A	7	A	8	A	2	A	6	A	7	A	4	A	
Riverfront Dr & Sibley St Stop Controlled	AM	7	A	-	-	4	A	4	A	9	A	2	A	1	A	43	E	46	E	5	A	19	C	17	C	11	B		
	PM	7	A	-	8	A	4	A	4	A	10	B	2	A	1	A	29	D	24	C	2	A	25	D	23	C	11	B	
Riverfront Dr & SB TH 169 Ramps/Owatonna St Signalized Intersection	AM	42	D	-	16	B	33	C	22	C	26	C	7	A	2	A	-	-	-	-	-	64	E	-	-	34	C		
	PM	34	C	-	19	B	44	D	16	B	31	C	13	B	4	A	-	-	-	-	-	46	D	-	-	16	B		
Riverfront Dr & NB TH 169 Ramps Signalized Intersection	AM	11	B	-	9	A	13	B	-	-	-	7	A	3	A	23	C	66	E	28	C	-	-	-	-	-	-		
	PM	14	B	-	16	B	11	B	-	-	-	14	B	4	A	44	D	42	D	35	D	-	-	-	-	-	-		
Mankato West HS/Poplar St & Riverfront Dr Signalized Intersection	AM	16	B	-	-	16	B	9	A	23	C	6	A	5	A	-	-	-	-	39	D	-	-	-	-	55	E		
	PM	22	C	-	-	14	B	5	A	38	D	15	B	18	B	-	-	-	-	65	E	-	-	-	-	51	D		
Riverfront Dr & Stoltzman Rd Signalized Intersection	AM	21	C	28	C	30	C	17	B	14	B	20	C	25	C	5	A	33	C	22	C	9	A	41	D	42	D	14	B
	PM	42	D	97	F	80	F	33	C	14	B	38	D	55	E	18	B	70	E	38	D	9	A	54	D	50	D	24	C
Riverfront Dr & Marshall St Signalized Intersection	AM	6	A	-	-	3	A	2	A	11	B	4	A	-	-	37	D	-	-	1	A	-	-	-	-	-	-		
	PM	21	C	-	-	14	B	6	A	37	D	48	D	-	-	85	F	-	-	1	A	-	-	-	-	-	-		

*Delay in seconds per vehicle

Table C4: 2041 Segment 1 - Option 1B Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths (ft)																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Riverfront Dr & Woodland Ave <i>Stop Controlled</i>	AM	-	-	-	-	-	-	25	50	25	50	25	50	25	75	25	75	25	75	25	50	25	50	25	50
	PM	25	25	25	25	25	25	25	75	25	75	25	75	25	75	25	50	25	50	25	50	25	50	25	75
Riverfront Dr & Sibley St <i>Stop Controlled</i>	AM	25	75	25	75	25	75	75	175	75	175	75	175	50	200	50	200	25	50	25	50	25	50	25	50
	PM	25	50	25	50	25	50	75	250	75	250	75	250	25	75	25	75	-	-	25	100	25	100	25	100
Riverfront Dr & SB TH 169 Ramps/Owatonna St <i>Signalized Intersection</i>	AM	25	25	175	325	175	325	75	150	25	75	25	75	-	-	-	-	-	550	950	550	950	175	300	
	PM	0	25	150	250	150	250	225	275	50	150	50	150	-	-	-	-	-	300	775	300	775	125	300	
Riverfront Dr & NB TH 169 Ramps <i>Signalized Intersection</i>	AM	100	225	175	300	-	-	-	-	50	175	25	175	25	50	25	50	100	225	-	-	-	-	-	-
	PM	100	200	150	275	-	-	-	-	125	275	50	225	25	50	25	50	150	400	-	-	-	-	-	-
Mankato West HS/Poplar St & Riverfront Dr <i>Signalized Intersection</i>	AM	-	-	175	250	125	200	100	225	75	175	75	175	-	-	-	-	250	525	-	-	-	-	75	175
	PM	-	-	175	275	75	225	100	225	250	550	250	550	-	-	-	-	225	500	-	-	-	-	175	300
Riverfront Dr & Stoltzman Rd <i>Signalized Intersection</i>	AM	150	250	125	500	125	225	75	150	125	250	25	100	175	275	50	425	75	175	25	75	25	75	25	75
	PM	225	250	275	825	125	225	175	250	225	325	175	200	225	275	225	700	75	225	100	125	150	350	100	125
Riverfront Dr & Marshall St <i>Signalized Intersection</i>	AM	-	-	50	100	25	75	25	75	25	125	-	-	75	150	-	-	-	-	-	-	-	-	-	-
	PM	-	-	125	200	75	200	75	200	275	700	-	-	175	375	-	-	0	25	-	-	-	-	-	-

Table C5: 2041 Segment 1 - Option 2A Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay* - LOS		Movement Delay (sec/veh)																							
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
Riverfront Dr & Woodland Ave Stop Controlled	AM	2	A	-		1	A	0	A	2	A	1	A	1	A	6	A	8	A	2	A	5	A	7	A	-	
	PM	2	A	3	A	0	A	0	A	3	A	1	A	0	A	6	A	8	A	2	A	6	A	8	A	3	A
Riverfront Dr & Sibley St Stop Controlled	AM	7	A	-		4	A	4	A	8	A	1	A	1	A	39	E	47	E	6	A	20	C	14	B	4	A
	PM	6	A	5	A	4	A	4	A	6	A	1	A	1	A	32	D	26	D	2	A	30	D	33	D	12	B
Mankato West HS/Poplar St & Riverfront Dr Signalized Intersection	AM	34	D	-		3	A	2	A	-		5	A	2	A	-		-	124	F	-		-	-	78	F	
	PM	37	E	-		4	A	3	A	-		13	B	9	A	-		-	115	F	-		-	-	321	F	
Riverfront Dr & Marshall St Signalized Intersection	AM	5	A	-		4	A	2	A	13	B	4	A	-		13	B	-		1	A	-		-	-	-	
	PM	57	E	-		8	A	4	A	22	C	9	A	-		51	D	-		1	A	-		-	-	-	
				EBL/T		EBT/R				WBL		WBT/R								SBL		SBT/R					
Riverfront Dr & SB TH 169 Ramps/Owatonna St Signalized Intersection	AM	14	B	23	C	22	C	-		4	A	4	A	-		-	-	-	-	13	B	10	B	-			
	PM	20	C	18	C	17	C	-		5	A	5	A	-		-	-	-	-	40	E	22	C	-			
				EBL/T		EBT				WBL/L/T		WBR				NBL/T/R		NBR									
Riverfront Dr & NB TH 169 Ramps Signalized Intersection	AM	12	B	9	A	10	B	-		8	A	16	C	-		20	C	18	C	-		-	-	-			
	PM	12	B	7	A	8	A	-		15	C	14	B	-		16	C	15	C	-		-	-	-			
				EBU/L/T		EBT/R				WBL/T		WBT/R				NBL		NBL/T/R				SBL/T		SBT/R			
Riverfront Dr & Stoltzman Rd Signalized Intersection	AM	15	C	13	B	15	C	-		11	B	11	B	-		25	D	17	C	-		9	A	8	A	-	
	PM	50	E	43	E	55	F	-		60	F	64	F	-		56	F	29	D	-		36	E	31	D	-	

*Delay in seconds per vehicle

Table C6: 2041 Segment 1 - Option 2A Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths (ft)																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Riverfront Dr & Woodland Ave <i>Stop Controlled</i>	AM	25	25	25	25	25	25	25	50	25	50	25	50	25	50	25	50	25	50	25	50	25	50	25	50
	PM	25	25	25	25	25	25	25	50	25	50	25	50	25	50	25	50	25	50	50	75	50	75	50	75
Riverfront Dr & Sibley St <i>Stop Controlled</i>	AM	25	50	25	50	25	50	75	175	75	175	25	50	50	350	50	350	25	150	25	50	25	50	25	50
	PM	25	50	25	50	25	50	50	150	50	150	0	25	25	50	25	50	25	50	25	100	25	100	25	100
Mankato West HS/Poplar St & Riverfront Dr <i>Signalized Intersection</i>	AM	-		25	175	25	175	-		25	175	25	125	-		-		350	525	-		-		125	300
	PM	-		50	150	50	200	-		75	350	100	400	-		-		200	500	-		-		550	650
Riverfront Dr & Marshall St <i>Signalized Intersection</i>	AM	-		75	150	25	75	25	75	25	125	-		50	100	-		0	0	-		-		-	
	PM	-		75	150	50	75	100	200	350	775	-		125	250	-		0	0	-		-		-	
		EBL/T		EBT/R				WBL		WBT/R										SBL		SBT/T/R			
Riverfront Dr & SB TH 169 Ramps/Owatonna St <i>Signalized Intersection</i>	AM	-	125	-	125	-		-	0	-	0	-		-		-		-		-	100	-	75	-	
	PM	-	75	-	75	-		-	25	-	25	-		-		-		-		-	275	-	150	-	
		EBL/T		EBT				WBL/L/T		WBR				NBL/T/R		NBR									
Riverfront Dr & NB TH 169 Ramps <i>Signalized Intersection</i>	AM	-	100	-	125	-		-	50	-	150	-		-	25	-	25	-		-		-		-	
	PM	-	50	-	75	-		-	150	-	200	-		-	50	-	50	-		-		-		-	
		EBU/L/T		EBT/R				WBL/T		WBT/R				NBL		NBL/T/R				SBL/T		SBT/R			
Riverfront Dr & Stoltzman Rd <i>Signalized Intersection</i>	AM	-	125	-	175	-		-	50	-	50	-		-	150	-	100	-		-	0	-	0	-	
	PM	-	350	-	425	-		-	325	-	375	-		-	250	-	150	-		-	125	-	125	-	

Table C7: 2041 Segment 1 - Option 2A Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay* - LOS		Movement Delay (sec/veh)																							
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
Riverfront Dr & Woodland Ave <i>Stop Controlled</i>	AM	2	A	-		1	A	0	A	2	A	1	A	1	A	6	A	8	A	2	A	5	A	7	A	-	
	PM	2	A	3	A	0	A	0	A	3	A	1	A	0	A	6	A	8	A	2	A	6	A	8	A	3	A
Riverfront Dr & Sibley St <i>Stop Controlled</i>	AM	7	A	-		4	A	4	A	8	A	1	A	1	A	39	E	47	E	6	A	20	C	14	B	4	A
	PM	6	A	5	A	4	A	4	A	6	A	1	A	1	A	32	D	26	D	2	A	30	D	33	D	12	B
Riverfront Dr & Marshall St <i>Signalized Intersection</i>	AM	5	A	-		4	A	2	A	13	B	4	A	-		13	B	-		1	A	-		-		-	
	PM	57	E	-		8	A	4	A	22	C	9	A	-		51	D	-		1	A	-		-		-	
				EBL/T		EBT/R				WBL		WBT/R								SBL		SBL/T/R					
Riverfront Dr & SB TH 169 Ramps/Owatonna St <i>Roundabout</i>	AM	14	B	23	C	22	C	-		4	A	4	A	-		-		-		-		13	B	10	B	-	
	PM	20	C	18	C	17	C	-		5	A	5	A	-		-		-		-		40	E	22	C	-	
				EBL/T		EBT/R				WBL/T				WBR		NBL/T				NBR							
Riverfront Dr & NB TH 169 Ramps <i>Roundabout</i>	AM	13	B	12	B	15	C	-		6	A	-		15	C	26	D	-		22	C	-		-		-	
	PM	12	B	8	A	9	A	-		12	B	-		13	B	20	C	-		18	C	-		-		-	
				EBL/T		EBT/R				WBL/T		WBT/R				NBL		NBL/T/R								SBR	
Mankato West HS/Poplar St & Riverfront Dr <i>Roundabout</i>	AM	16	C	11	B	14	B	-		16	C	19	C	-		31	D	20	C	-		-		-		16	C
	PM	18	C	9	A	11	B	-		17	C	23	C	-		23	C	13	B	-		-		-		55	F
				EBL/T		EBT/R				WBL/T		WBT/R				NBL		NBL/T/R				SBL/T		SBT/R			
Riverfront Dr & Stoltzman Rd <i>Roundabout</i>	AM	11	B	9	A	9	A	-		9	A	9	A	-		16	C	12	B	-		8	A	7	A	-	
	PM	27	D	19	C	21	C	-		34	D	37	E	-		29	D	19	C	-		30	D	26	D	-	

*Delay in seconds per vehicle

**Maximum delay and LOS on any approach and/or movement

***Limiting Movement is the highest delay movement.

Table C8: 2041 Segment 1 - Option 2A Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths (ft)																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Riverfront Dr & Woodland Ave Stop Controlled	AM	25	25	25	25	25	25	25	50	25	50	25	50	25	50	25	50	25	50	25	50	25	50	25	50
	PM	25	25	25	25	25	25	25	50	25	50	25	50	25	50	25	50	25	50	50	75	50	75	50	75
Riverfront Dr & Sibley St Stop Controlled	AM	25	50	25	50	25	50	75	175	75	175	25	50	50	350	50	350	25	150	25	50	25	50	25	50
	PM	25	50	25	50	25	50	50	150	50	150	0	25	25	50	25	50	25	50	25	100	25	100	25	100
Riverfront Dr & Marshall St Signalized Intersection	AM	-		75	150	25	75	25	75	25	125	-		50	100	-		0	0	-		-		-	
	PM	-		75	150	50	75	100	200	350	775	-		125	250	-		0	0	-		-		-	
		EBL/T		EBT/R				WBL		WBT/R								SBL		SBL/T/R					
Riverfront Dr & SB TH 169 Ramps/Owatonna St Signalized Intersection	AM	-	125	-	125	-		-	0	-	0	-		-		-		-		-	100	-	75	-	
	PM	-	75	-	75	-		-	25	-	25	-		-		-		-		-	275	-	150	-	
		EBL/T		EBT				WBU/L/T		WBR				NBL/T/R		NBR									
Riverfront Dr & NB TH 169 Ramps Signalized Intersection	AM	-	125	-	175	-		-	50	-	225	-		-	50	-	50	-		-		-		-	
	PM	-	75	-	75	-		-	150	-	175	-		-	50	-	50	-		-		-		-	
		EBL/T		EBT/R				WBL/T		WBT/R				NBL		NBL/T/R						SBR			
Mankato West HS/Poplar St & Riverfront Dr Roundabout	AM	-	150	-	200	-		-	100	-	150	-		-	100	-	75	-		-		-		-	50
	PM	-	100	-	125	-		-	150	-	225	-		-	50	-	25	-		-		-		-	175
		EBU/L/T		EBT/R				WBL/T		WBT/R				NBL		NBL/T/R				SBL/T		SBT/R			
Riverfront Dr & Stoltzman Rd Signalized Intersection	AM	-	75	-	75	-		-	25	-	50	-		-	100	-	75	-		-	0	-	0	-	
	PM	-	150	-	200	-		-	225	-	275	-		-	175	-	100	-		-	100	-	100	-	

Table C9: 2041 Segment 1 - Option 3A Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay*- LOS		Movement Delay (sec/veh)																									
				EBU		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
SB TH 169 Intersection (Crossover) <i>Signalized Intersection</i>	AM	15	B	-	-	16	B	2	A	-	10	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	PM	13	B	-	-	17	B	3	A	-	8	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
SB TH 169 Intersection SBL off Ramp <i>Signalized Intersection</i>	AM	14	B	-	-	3	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	C	-	-	-	-		
	PM	13	B	-	-	3	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	B	-	-	-	-		
NB TH 169 Intersection (Crossover) <i>Signalized Intersection</i>	AM	7	A	-	-	7	A	-	-	10	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	PM	9	A	-	-	9	A	-	-	9	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
SB TH 169 Intersection WBL onto Ramp	AM	1	A	-	-	-	-	-	2	A	1	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	PM	2	A	-	-	-	-	-	2	A	1	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
SB TH 169 SBR off Ramp	AM	2	A	-	-	-	-	-	-	2	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	A		
	PM	2	A	-	-	-	-	-	-	2	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	A		
SB TH 169 Intersection (Off Ramp)	AM	9	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	A	-	-	6	A		
	PM	3	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	A	-	-	2	A		
SB TH 169 Intersection (On Ramp)	AM	0	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	A	1	A			
	PM	0	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	A	7	A				
NB TH 169 Intersection WBR onto Ramp	AM	1	A	-	-	-	-	-	-	2	A	1	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	PM	2	A	-	-	-	-	-	-	4	A	1	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
NB TH 169 Intersection NBR off Ramp	AM	3	A	-	-	2	A	-	-	-	-	-	-	-	-	9	A	-	-	-	-	-	-	-	-	-	-		
	PM	4	A	-	-	2	A	-	-	-	-	-	-	-	-	11	B	-	-	-	-	-	-	-	-	-	-		
NB TH 169 Intersection (On Ramp)	AM	1	A	-	-	-	-	-	-	-	2	A	-	-	1	A	-	1	A	-	-	-	-	-	-	-	-		
	PM	1	A	-	-	-	-	-	-	-	1	A	-	-	0	A	-	-	-	-	-	-	-	-	-	-	-		
NB TH 169 Intersection EBL onto Ramp	AM	8	A	-	1	A	11	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	PM	12	B	-	1	A	14	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
NB TH 169 Intersection NBL off Ramp <i>Signalized Intersection</i>	AM	2	A	-	-	-	-	-	-	2	A	-	-	32	C	-	-	-	-	-	-	-	-	-	-	-	-		
	PM	2	A	-	-	-	-	-	-	2	A	-	-	19	B	-	-	-	-	-	-	-	-	-	-	-	-		
NB TH 169 NBR off Ramp	AM	1	A	-	-	-	-	-	-	-	-	-	-	-	1	A	1	A	-	-	-	-	-	-	-	-	-		
	PM	1	A	-	-	-	-	-	-	-	-	-	-	-	1	A	1	A	-	-	-	-	-	-	-	-	-		
Riverfront Dr & Poplar St <i>Stop Controlled</i>	AM	2	A	-	-	1	A	-	-	1	A	0	A	-	-	-	-	-	-	-	-	-	-	-	15	C			
	PM	14	B	-	-	0	A	-	-	2	A	1	A	-	-	-	-	-	-	-	-	-	-	-	185	F			
Mankato West HS & Riverfront Dr <i>Signalized Intersection</i>	AM	9	A	-	-	10	A	6	A	16	C	1	A	-	-	-	-	27	D	-	-	-	-	-	-	-	-		
	PM	9	A	-	-	7	A	3	A	18	C	2	A	-	-	-	-	53	F	-	-	-	-	-	-	-	-		
Riverfront Dr & Stoltzman Rd <i>Signalized Intersection</i>	AM	19	B	22	C	22	C	15	B	8	A	19	B	20	C	5	A	37	D	28	C	11	B	49	D	48	D	15	B
	PM	38	D	45	D	53	D	31	C	11	B	47	D	54	D	18	B	51	D	30	C	10	B	55	E	50	D	25	C
Riverfront Dr & Marshall St <i>Signalized Intersection</i>	AM	7	A	-	-	5	A	3	A	15	B	3	A	-	-	47	D	-	-	1	A	-	-	-	-	-	-		
	PM	26	C	-	-	8	A	4	A	26	C	18	B	-	-	174	F	-	-	3	A	-	-	-	-	-	-		
Riverfront Dr & Sibley St <i>Stop Controlled</i>	AM	29	D	-	0	A	2	A	1	A	7	A	0	A	0	A	77	F	79	F	64	F	17	C	10	A	5	A	
	PM	9	A	-	3	A	1	A	1	A	6	A	1	A	0	A	35	E	48	E	21	C	28	D	20	C	9	A	

*Delay in seconds per vehicle

Table C10: 2041 Segment 1 - Option 3A Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths (ft)																									
		EBU		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
SB TH 169 Intersection (Crossover) <i>Signalized Intersection</i>	AM	-		-		125	250	0	25	-		25	75	-		-		-		-		-		-		-	
	PM	-		-		100	200	0	25	-		50	100	-		-		-		-		-		-		-	
SB TH 169 Intersection SBL off Ramp <i>Signalized Intersection</i>	AM	-		-		25	75	-		-		-		-		-		-		-		200	250	-		-	
	PM	-		-		25	75	-		-		-		-		-		-		-		175	250	-		-	
NB TH 169 Intersection (Crossover) <i>Signalized Intersection</i>	AM	-		-		75	100	-		-		75	100	-		-		-		-		-		-		-	
	PM	-		-		75	100	-		-		100	125	-		-		-		-		-		-		-	
SB TH 169 Intersection WBL onto Ramp	AM	-		-		-		-		0	0	0	25	-		-		-		-		-		-		-	
	PM	-		-		-		-		0	50	0	50	-		-		-		-		-		-		-	
SB TH 169 SBR off Ramp	AM	-		-		-		-		-		0	0	-		-		-		-		-		-		25	75
	PM	-		-		-		-		-		0	25	-		-		-		-		-		-		50	100
SB TH 169 Intersection (Off Ramp)	AM	-		-		-		-		-		-		-		-		-		-		50	500	-		25	200
	PM	-		-		-		-		-		-		-		-		-		-		25	150	-		0	50
SB TH 169 Intersection (On Ramp)	AM	-		-		-		-		-		-		-		-		-		-		-		0	0	0	25
	PM	-		-		-		-		-		-		-		-		-		-		-		0	0	0	25
NB TH 169 Intersection WBR onto Ramp	AM	-		-		-		-		-		25	125	0	0	-		-		-		-		-		-	
	PM	-		-		-		-		-		75	150	0	0	-		-		-		-		-		-	
NB TH 169 Intersection NBR off Ramp	AM	-		-		25	75	-		-		-		-		-		-		75	150	-		-		-	
	PM	-		-		25	50	-		-		-		-		-		-		125	250	-		-		-	
NB TH 169 Intersection (On Ramp)	AM	-		-		-		-		-		-	0	25	-		25	50	-		-		-		-		-
	PM	-		-		-		-		-		-	0	0	-		0	0	-		-		-		-		-
NB TH 169 Intersection EBL onto Ramp	AM	-		0	0	200	250	-		-		-		-		-		-		-		-		-		-	
	PM	-		0	0	200	250	-		-		-		-		-		-		-		-		-		-	
NB TH 169 Intersection NBL off Ramp <i>Signalized Intersection</i>	AM	-		-		-		-		-		0	0	-		0	25	-		-		-		-		-	
	PM	-		-		-		-		-		0	25	-		25	50	-		-		-		-		-	
NB TH 169 NBR off Ramp	AM	-		-		-		-		-		-		-		-	0	0	0	0	-		-		-		-
	PM	-		-		-		-		-		-		-		-	0	0	25	75	-		-		-		-
Riverfront Dr & Poplar St <i>Stop Controlled</i>	AM	-		-		25	125	-		-		0	25	0	25	-		-		-		-		-		50	125
	PM	-		-		25	100	-		-		0	50	0	50	-		-		-		-		-		325	550
Mankato West HS & Riverfront Dr <i>Signalized Intersection</i>	AM	-		-		150	275	100	250	75	225	25	100	-		-		175	500	-		-		-		-	
	PM	-		-		125	325	50	250	75	150	0	50	-		-		175	625	-		-		-		-	
Riverfront Dr & Stoltzman Rd <i>Signalized Intersection</i>	AM	125	250	125	250	100	375	100	225	50	100	100	225	25	125	200	275	75	450	100	225	25	75	25	100	25	75
	PM	200	250	200	250	225	425	125	225	175	250	200	300	150	200	200	275	175	550	75	250	100	175	150	325	102	175
Riverfront Dr & Marshall St <i>Signalized Intersection</i>	AM	-		-		75	200	25	125	25	75	50	125	-		75	175	-		0	25	-		-		-	
	PM	-		-		100	225	50	200	50	175	175	350	-		250	550	-		25	225	-		-		-	
Riverfront Dr & Sibley St <i>Stop Controlled</i>	AM	-		25	50	25	50	25	50	50	175	0	0	0	0	300	525	300	525	300	525	25	50	25	50	25	50
	PM	-		0	50	0	50	0	50	75	200	0	0	0	0	100	325	100	325	100	325	25	75	25	75	25	75

Table C11: 2041 Segment 1 - Option 3B Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay* - LOS		Movement Delay (sec/veh)																							
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
Riverfront Dr & Woodland Ave Stop Controlled	AM	2	A	-		1	A	0	A	3	A	1	A	1	A	6	A	8	A	2	A	6	A	7	A	-	
	PM	3	A	2	A	0	A	0	A	3	A	1	A	1	A	6	A	7	A	2	A	6	A	7	A	2	A
Riverfront Dr & Sibley St Stop Controlled	AM	8	A	-		6	A	5	A	11	B	1	A	0	A	35	E	43	E	7	A	21	C	16	C	10	B
	PM	7	A	5	A	4	A	4	A	9	A	2	A	1	A	26	D	24	C	2	A	23	C	27	D	9	A
Riverfront Dr & TH 169 SB Ramp Signalized Intersection	AM	19	B	-		20	C	8	A	25	C	3	A	-		50	D	-		13	B	-		-		-	
	PM	32	C	-		49	D	8	A	57	E	24	C	-		36	D	-		7	A	-		-		-	
Riverfront Dr & Owatonna St Stop Controlled	AM	4	A	6	A	5	A	-		-		1	A	3	A	-		-		-		18	C	-		4	A
	PM	10	B	31	D	7	A	-		-		7	A	3	A	-		-		-		159	F	-		10	B
Riverfront Dr & NB TH 169 Ramps Signalized Intersection	AM	3	A	9	A	0	A	-		-		4	A	4	A	33	C	18	B	5	A	-		-		-	
	PM	19	B	22	C	16	B	-		-		12	B	4	A	66	E	21	C	72	E	-		-		-	
Riverfront Dr & Mankato West HS/Poplar St Signalized Intersection	AM	21	C	17	B	19	B	16	B	61	E	14	B	13	B	35	D	34	C	16	B	35	D	33	C	19	B
	PM	31	C	36	D	17	B	17	B	59	E	29	C	31	C	92	F	91	F	42	D	59	E	61	E	48	D
Riverfront Dr & Stoltzman Rd Signalized Intersection	AM	18	B	17	B	17	B	10	B	16	B	12	B	3	A	33	C	29	C	10	B	31	C	42	D	9	A
	PM	29	C	41	D	32	C	15	B	35	D	31	C	10	B	37	D	36	D	11	B	31	C	50	D	23	C
Riverfront Dr & Marshall St Signalized Intersection	AM	6	A	-		4	A	2	A	9	A	3	A	-		35	D	-		1	A	-		-		-	
	PM	12	B	-		8	A	4	A	18	B	10	B	-		45	D	-		1	A	-		-		-	

*Delay in seconds per vehicle

Table C12: 2041 Segment 1 - Option 3B Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths (ft)																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Riverfront Dr & Woodland Ave <i>Stop Controlled</i>	AM	0	25	0	25	0	25	-	-	-	-	-	-	25	75	25	75	25	75	25	50	25	50	25	50
	PM	0	25	0	25	0	25	-	-	-	-	-	-	25	50	25	50	25	50	50	50	50	50	50	50
Riverfront Dr & Sibley St <i>Stop Controlled</i>	AM	25	125	25	125	25	125	75	275	25	25	25	25	75	325	75	325	25	125	25	75	25	75	25	75
	PM	25	50	25	50	25	50	100	300	25	25	25	25	25	75	25	75	-	-	25	75	25	75	25	75
Riverfront Dr & TH 169 SB Ramp <i>Signalized Intersection</i>	AM	-	-	225	475	100	550	100	175	-	-	-	-	-	-	-	-	75	550	-	-	-	-	-	-
	PM	-	-	300	425	75	375	325	500	-	-	-	-	-	-	-	-	50	300	-	-	-	-	-	-
Riverfront Dr & Owatonna St <i>Stop Controlled</i>	AM	0	25	25	250	-	-	-	-	25	75	25	75	-	-	-	-	-	-	50	100	-	-	25	50
	PM	25	25	25	375	-	-	-	-	25	75	25	75	-	-	-	-	-	-	50	175	-	-	25	100
Riverfront Dr & NB TH 169 Ramps <i>Signalized Intersection</i>	AM	100	225	-	-	-	-	-	-	50	225	25	200	25	25	25	25	50	75	-	-	-	-	-	-
	PM	100	225	175	375	-	-	-	-	125	250	50	200	25	100	25	100	250	900	-	-	-	-	-	-
Riverfront Dr & Mankato West HS/Poplar St <i>Signalized Intersection</i>	AM	50	125	175	225	175	225	125	250	175	450	175	450	150	400	150	400	100	150	75	200	75	200	75	200
	PM	75	200	225	250	225	250	125	250	350	600	350	600	175	500	175	500	100	150	175	375	175	375	175	375
Riverfront Dr & Stoltzman Rd <i>Signalized Intersection</i>	AM	25	75	100	200	100	200	50	125	75	175	25	50	175	275	75	425	75	200	25	75	25	125	25	75
	PM	125	250	125	325	125	225	150	250	200	275	125	200	200	275	100	350	75	175	75	125	150	325	100	125
Riverfront Dr & Marshall St <i>Signalized Intersection</i>	AM	-	-	75	200	25	75	25	75	25	125	-	-	75	150	-	-	0	25	-	-	-	-	-	-
	PM	-	-	100	250	50	175	50	150	125	300	-	-	125	250	-	-	0	25	-	-	-	-	-	-

Table C13: 2041 Segment 2 - Option 2 Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay* - LOS		Movement Delay (sec/veh)																								
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR		
Riverfront Dr & Sibley Pkwy Signalized Intersection	AM	2	A	24	C	1	A	-	-	2	A	3	A	-	-	-	-	25	C	-	-	5	A					
	PM	5	A	39	D	3	A	-	-	5	A	5	A	-	-	-	-	24	C	-	-	7	A					
Riverfront Dr & Poplar St/Warren St Signalized Intersection	AM	26	C	41	D	44	D	18	B	33	C	41	D	14	B	34	C	37	D	19	B	26	C	8	A	7	A	
	PM	30	C	54	D	46	D	29	C	34	C	44	D	22	C	46	D	49	D	19	B	31	C	17	B	15	B	
Riverfront Dr & Minnesota St/Cherry St Signalized Intersection	AM	15	B	41	D	36	D	14	B	40	D	45	D	2	A	15	B	14	B	3	A	46	D	5	A	2	A	
	PM	21	C	31	C	22	C	15	B	37	D	35	D	2	A	33	C	28	C	4	A	38	D	15	B	7	A	
Riverfront Dr & Main St Signalized Intersection	AM	14	B	36	D	-		-		29		C	-		16	B	11	B	16	B	8	A	28	C	6	A	2	A
	PM	23	C	61	E	-		9	A	46	D	57	E	34	C	23	C	30	C	15	B	36	D	9	A	-		

*Delay in seconds per vehicle

Table C14: 2041 Segment 2 - Option 2 Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths (ft)																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Riverfront Dr & Sibley Pkwy <i>Signalized Intersection</i>	AM	25	50	25	125	-	-	-	-	25	100	25	50	-	-	-	-	-	-	25	75	-	-	25	50
	PM	25	75	50	125	-	-	-	-	50	150	25	50	-	-	-	-	-	-	50	100	-	-	25	50
Riverfront Dr & Poplar St/Warren St <i>Signalized Intersection</i>	AM	50	125	50	125	50	125	50	125	50	200	50	200	50	225	275	650	225	625	50	125	75	200	75	200
	PM	75	200	100	200	100	200	100	175	100	225	100	225	75	250	300	625	250	600	100	225	200	350	200	350
Riverfront Dr & Minnesota St/Cherry St <i>Signalized Intersection</i>	AM	50	125	50	100	50	100	125	275	125	275	25	25	25	150	225	375	50	300	50	100	75	175	25	75
	PM	75	150	50	125	50	125	200	350	200	350	25	50	75	200	300	375	75	325	75	100	175	200	25	100
Riverfront Dr & Main St <i>Signalized Intersection</i>	AM	25	25	25	25	25	25	75	175	-	-	75	150	25	50	200	475	50	350	50	125	50	100	50	100
	PM	25	75	25	75	25	75	150	225	-	-	75	175	25	225	375	775	125	400	50	150	75	225	75	225

Table C15: 2041 Segment 3 - Options 2A, 3A and 4A Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay* - LOS		Movement Delay (sec/veh)																							
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
Riverfront Dr & Plum St Signalized Intersection	AM	10	B	-		-		-		30	C	-		17	B	11	B	12	B	6	A	17	B	5	A	3	A
	PM	13	B	41	D	-		-		38	D	-		23	C	-		16	B	10	B	27	C	8	A	-	
Riverfront Dr & Elm St Signalized Intersection	AM	6	A	24	C	34	C	9	A	25	C	-		11	B	14	B	7	A	7	A	22	C	3	A	3	A
	PM	10	B	47	D	53	D	27	C	49	D	39	D	26	C	38	D	10	B	9	A	29	C	7	A	6	A
Riverfront Dr & Madison Ave Signalized Intersection	AM	14	B	39	D	47	D	6	A	40	D	37	D	9	A	15	B	11	B	5	A	13	B	12	B	4	A
	PM	24	C	60	E	57	E	8	A	44	D	38	D	10	B	22	C	24	C	12	B	23	C	24	C	5	A

*Delay in seconds per vehicle

Table C16: 2041 Segment 3 - Options 2A, 3A and 4A Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths (ft)																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Riverfront Dr & Plum St <i>Signalized Intersection</i>	AM	-	-	-	-	-	-	25	50	25	50	50	125	25	25	150	500	25	250	50	100	50	175	50	175
	PM	25	50	25	50	25	50	25	75	25	75	50	100	-	-	200	575	50	300	75	150	75	200	75	200
Riverfront Dr & Elm St <i>Signalized Intersection</i>	AM	25	75	25	75	25	75	25	50	25	50	25	50	25	50	75	225	75	225	25	50	50	175	50	175
	PM	50	125	50	125	50	125	50	75	50	75	50	75	25	50	100	325	100	325	25	75	125	325	125	325
Riverfront Dr & Madison Ave <i>Signalized Intersection</i>	AM	50	125	50	125	50	125	100	175	-	-	75	175	75	175	100	275	100	275	50	175	50	225	50	225
	PM	75	175	75	175	75	125	200	325	-	-	100	175	75	275	200	375	200	375	75	150	125	300	125	300

Table C17: 2041 Segment 3 - Options 2B, 3B and 4B Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay* - LOS		Movement Delay (sec/veh)																							
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
Riverfront Dr & Plum St <i>Signalized Intersection</i>	AM	9	A	-	-	-	-	-	-	35	D	-	-	17	B	6	A	11	B	6	A	18	B	5	A	4	A
	PM	14	B	38	D	-	-	-	-	41	D	-	-	22	C	-	-	16	B	10	B	28	C	8	A	-	-
Riverfront Dr & Rock St <i>Signalized Intersection</i>	AM	6	A	20	C	20	C	11	B	27	C	-	-	13	B	16	B	8	A	9	A	20	C	2	A	2	A
	PM	9	A	51	D	45	D	33	C	53	D	41	D	22	C	37	D	12	B	10	B	31	C	4	A	2	A
Riverfront Dr & Madison Ave <i>Signalized Intersection</i>	AM	14	B	44	D	48	D	6	A	41	D	36	D	8	A	14	B	10	B	5	A	14	B	12	B	4	A
	PM	24	C	73	E	59	E	8	A	43	D	37	D	11	B	24	C	24	C	14	B	25	C	24	C	9	A

*Delay in seconds per vehicle

Table C18: 2041 Segment 3 - Options 2B, 3B and 4B Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths (ft)																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
Riverfront Dr & Plum St <i>Signalized Intersection</i>	AM	-	-	-	-	-	-	25	50	25	50	50	125	0	25	125	425	25	125	50	100	50	150	50	150
	PM	25	50	25	50	25	50	25	75	25	75	50	100	-	-	225	600	25	300	75	175	75	225	75	225
Riverfront Dr & Rock St <i>Signalized Intersection</i>	AM	25	75	25	75	25	75	25	75	25	75	25	75	25	50	75	200	75	200	25	50	75	200	75	200
	PM	50	125	50	125	50	125	50	100	50	100	50	100	25	50	100	300	100	300	25	100	125	250	125	250
Riverfront Dr & Madison Ave <i>Signalized Intersection</i>	AM	50	150	50	150	50	125	100	200	75	175	75	175	75	175	100	225	100	225	50	125	100	225	50	200
	PM	75	150	75	150	75	150	175	350	150	325	75	175	100	300	225	425	225	425	75	150	175	325	125	275

Table C19: 2041 Segment 5 - Option 1 Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay* - LOS		Movement Delay (sec/veh)										
				EBL/T/R		NBT		NBR		SBL/T				
Riverfront Dr & TH 14 EB Ramp <i>Roundabout</i>	AM	14	B	28	D	-	9	A	7	A	11	B	-	
	PM	14	B	17	C	-	20	C	9	A	8	A	-	
				WBL/T/R		NBL/T				SBT		SBR		
Riverfront Dr & TH 14 WB Ramp <i>Roundabout</i>	AM	13	B	-	13	B	9	A			20	C	9	A
	PM	17	C	-	14	B	21	C			10	B	7	A

*Delay in seconds per vehicle

Table C20: 2041 Segment 5 - Option 1 Peak Hour Queues By Movement

Intersection	Peak Hour	Maximum Queue Lengths (ft)					
		EBL/T/R		NBT	NBR	SBL/T	
Riverfront Dr & TH 14 EB Ramp <i>Roundabout</i>	AM	200	-	75	25	100	-
	PM	125	-	200	50	50	-
		WBL/T/R		NBL/T		SBT	SBR
Riverfront Dr & TH 14 WB Ramp <i>Roundabout</i>	AM	-	50	75	-	150	25
	PM	-	50	250	-	50	25

Table C21: 2041 Segment 5 - Option 2 Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay* - LOS		Movement Delay (sec/veh)																							
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
EB TH 14 Intersection (Crossover) <i>Signalized Intersection</i>	AM	13	B	-		-		-		-		-		-		-		15	B	6	A	-		16	B	-	
	PM	17	B	-		-		-		-		-		-		-		16	B	7	A	-		28	C	-	
EB TH 14 Intersection SBL off Ramp <i>Signalized Intersection</i>	AM	6	A	19	B	-		-		-		-		-		-		2	A	-		-		-		-	
	PM	6	A	18	B	-		-		-		-		-		-		2	A	-		-		-		-	
WB TH 14 Intersection (Crossover) <i>Signalized Intersection</i>	AM	11	B	-		-		-		-		-		-		-		10	A	-		-		12	B	-	
	PM	11	B	-		-		-		-		-		-		-		8	A	-		-		17	B	-	
EB TH 14 Intersection WBL onto Ramp	AM	3	A	-		-		-		-		-		-		-		-		-		3	A	3	A	-	
	PM	7	A	-		-		-		-		-		-		-		-		-		4	A	7	A	-	
EB TH 14 SBR off Ramp	AM	4	A	-		-		7	A	-		-		-		-		-		-		-		3	A	-	
	PM	3	A	-		-		6	A	-		-		-		-		-		-		-		1	A	-	
EB TH 14 Intersection (Off Ramp)	AM	0	A	0	A	-		0	A	-		-		-		-		-		-		-		-		-	
	PM	1	A	0	A	-		1	A	-		-		-		-		-		-		-		-		-	
EB TH 14 Intersection (On Ramp)	AM	3	A	-		0	A	4	A	-		-		-		-		-		-		-		-		-	
	PM	4	A	-		0	A	4	A	-		-		-		-		-		-		-		-		-	
WB TH 14 Intersection WBR onto Ramp	AM	2	A	-		-		-		-		-		-		-		-		-		-		2	A	1	A
	PM	1	A	-		-		-		-		-		-		-		-		-		-		1	A	0	A
WB TH 14 Intersection NBR off Ramp	AM	3	A	-		-		-		-		-		1	A	-		10	B	-		-		-		-	
	PM	2	A	-		-		-		-		-		1	A	-		14	B	-		-		-		-	
WB TH 14 Intersection (On Ramp)	AM	2	A	-		-		-		-		1	A	3	A	-		-		-		-		-		-	
	PM	2	A	-		-		-		-		0	A	5	A	-		-		-		-		-		-	
WB TH 14 Intersection EBL onto Ramp	AM	2	A	-		-		-		-				-		1	A	2	A	-		-		-		-	
	PM	3	A	-		-		-		-				-		1	A	5	A	-		-		-		-	
WB TH 14 Intersection NBL off Ramp <i>Signalized Intersection</i>	AM	8	A	-		-		-		23	C	-		-		-		-		-		-		2	A	-	
	PM	11	B	-		-		-		19	B	-		-		-		-		-		-		4	A	-	
WB TH 14 NBR off Ramp	AM	1	A	-		-		-		0	A	-		0	A	-		-		-		-		-		-	
	PM	1	A	-		-		-		1	A	-		0	A	-		-		-		-		-		-	

*Delay in seconds per vehicle

Table C22: 2041 Segment 5 - Option 2 Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths (ft)																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
EB TH 14 Intersection (Crossover) <i>Signalized Intersection</i>	AM	-		-		-		-		-		-		-		150	275	100	175	-		200	250	-	
	PM	-		-		-		-		-		-		-		225	300	150	175	-		175	250	-	
EB TH 14 Intersection SBL off Ramp <i>Signalized Intersection</i>	AM	75	150	-		-		-		-		-		-		0	0	-		-		-		-	
	PM	100	175	-		-		-		-		-		-		25	75	-		-		-		-	
WB TH 14 Intersection (Crossover) <i>Signalized Intersection</i>	AM	-		-		-		-		-		-		-		100	150	-		-		150	200	-	
	PM	-		-		-		-		-		-		-		100	150	-		-		125	175	-	
EB TH 14 Intersection WBL onto Ramp	AM	-		-		-		-		-		-		-		-		-		25	175	50	200	-	
	PM	-		-		-		-		-		-		-		-		-		25	125	50	150	-	
EB TH 14 SBR off Ramp	AM	-		-		100	200	-		-		-		-		-		-		-		25	100	-	
	PM	-		-		75	175	-		-		-		-		-		-		-		25	75	-	
EB TH 14 Intersection (Off Ramp)	AM	0	0	-		0	0	-		-		-		-		-		-		-		-		-	
	PM	0	0	-		0	0	-		-		-		-		-		-		-		-		-	
EB TH 14 Intersection (On Ramp)	AM	-		0	0	25	75	-		-		-		-		-		-		-		-		-	
	PM	-		0	0	25	75	-		-		-		-		-		-		-		-		-	
WB TH 14 Intersection WBR onto Ramp	AM	-		-		-		-		-		-		-		-		-		-		25	150	0	0
	PM	-		-		-		-		-		-		-		-		-		-		25	75	0	0
WB TH 14 Intersection NBR off Ramp	AM	-		-		-		-		-		0	0	-		50	125	-		-		-		-	
	PM	-		-		-		-		-		0	0	-		25	75	-		-		-		-	
WB TH 14 Intersection (On Ramp)	AM	-		-		-		-		0	0	50	100	-		-		-		-		-		-	
	PM	-		-		-		-		0	0	50	75	-		-		-		-		-		-	
WB TH 14 Intersection EBL onto Ramp	AM	-		-		-		-		-		-		0	0	25	100	-		-		-		-	
	PM	-		-		-		-		-		-		0	0	75	200	-		-		-		-	
WB TH 14 Intersection NBL off Ramp <i>Signalized Intersection</i>	AM	-		-		-		100	175	-		-		-		-		-		-		25	50	-	
	PM	-		-		-		100	175	-		-		-		-		-		-		25	25	-	
WB TH 14 NBR off Ramp	AM	-		-		-		0	0	-		0	0	-		-		-		-		-		-	
	PM	-		-		-		0	0	-		0	0	-		-		-		-		-		-	