Traffic Analysis Report

Red Wing TH 63 Bridge Project

Red Wing, MN

SEH No. MNT06 119112

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1.0 Project Overview

The Minnesota Department of Transportation (MnDOT) in partnership with the Wisconsin Department of Transportation (WisDOT) is studying options to rehabilitate or replace the U.S. 63 Bridge (Bridge No. 9040) over the Mississippi River and Bridge 9103 over U.S. 61 in Red Wing, Minnesota. Any identified improvements are expected to start in 2018. Though various alternatives are being considered, the location of the river crossing is not expected to change. Traffic scenarios being analyzed include a No Build, a mitigated No Build scenario and potential modifications to the approach roadway network in Red Wing.

Two previous studies have been conducted in the study area. The Downtown Red Wing Transportation Study was completed in May 2005; it examined travel patterns and traffic circulation in the downtown Red Wing area. The U.S. 63 Bridge Origin-Destination (O-D) and Traffic Circulation Study was completed in 2011; it examined travel patterns and traffic circulation in relation to the bridge traffic. Both previous studies serve as additional reference for traffic conditions in and around the U.S. 63 river bridge.

The sections of this report represent the cumulative efforts from all of the various traffic operation analysis completed as part of the project. The results of the various analyses provide information into the purpose and need for the project.

1.1 Project Evaluations

The project area has been evaluated thoroughly over the course of this project and the two predecessor projects. The existing intersection operations were evaluated during the previous O-D and traffic circulation study. Traffic forecasts were also completed as part of that study; however the forecast demands were updated as part of this project.

The existing bridge capacity was evaluated based on the latest forecasts demands as well as the downtown Red Wing intersection operations analysis. The No Build scenario was evaluated under both the current configuration and with potential mitigations to improve operations.

Concept alternatives were developed to help mitigate existing issues under the current configuration. Traffic operations for all alternatives were analyzed to provide adequate information to identify preferred solutions.

Due to the potential affect to all bridge users during the construction or rehabilitation of the U.S. 63 Bridge, a total user cost was calculated for the potential detour scenarios.

2.0 Existing Conditions

The existing conditions were documented in the U.S. 63 Bridge Origin-Destination (O-D) and Traffic Circulation Study that was completed in 2011; it examined travel patterns, traffic circulation in relation to the bridge traffic and safety concerns at the downtown intersections. For more detailed information please see the final report. Since the 2011 document, the crash history was updated for the latest 5-years of data including 2008 through 2012.

The analysis indicates the major traffic bottleneck appears to be the segment of Plum Street between Main Street and 3rd Street. The problems are worse during the PM peak hour. The concerns at the US 61/East Avenue/West Avenue intersection and US 61/Bush Street intersection are primarily due to traffic backups from the US 61/Plum Street intersection.

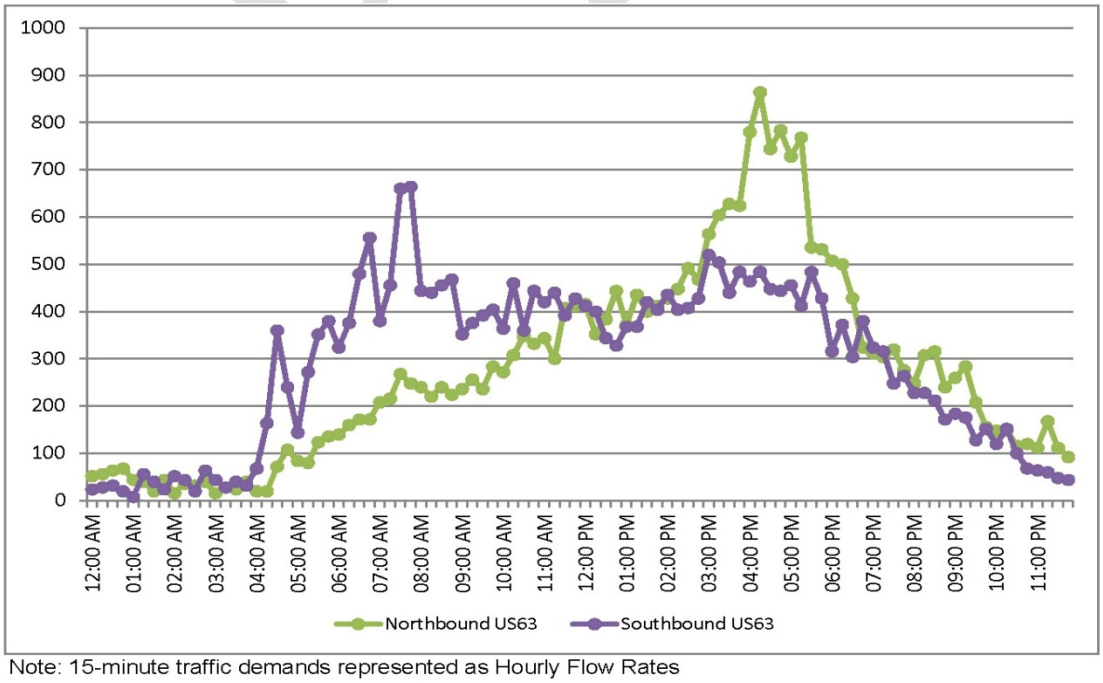
The crash rates and severity rates for the study intersections were compared to statewide system average crash rates and severity rates for similar intersections as well as the critical rates for each intersection. Four of the study intersections had both the crash and severity rates at or above the critical rates for the intersection.

2.1 Duration of Peaks

The 2010 existing 24-hour directional traffic information was analyzed to determine the existing duration of peak hours in the project area. Two locations were analyzed; U.S. 63 on the river bridge and U.S. 61, west of Fulton Street. The following graphs show the 15-minute traffic demands, represented as an hourly flow rate (Y-axis) from the 2010 traffic counts.

The U.S. 63 bridge volume has a high directional split. There is a southbound jump in traffic during the AM peak hour. During the evening peak period, higher traffic volumes last from approximately 2:00pm to 6:00pm.

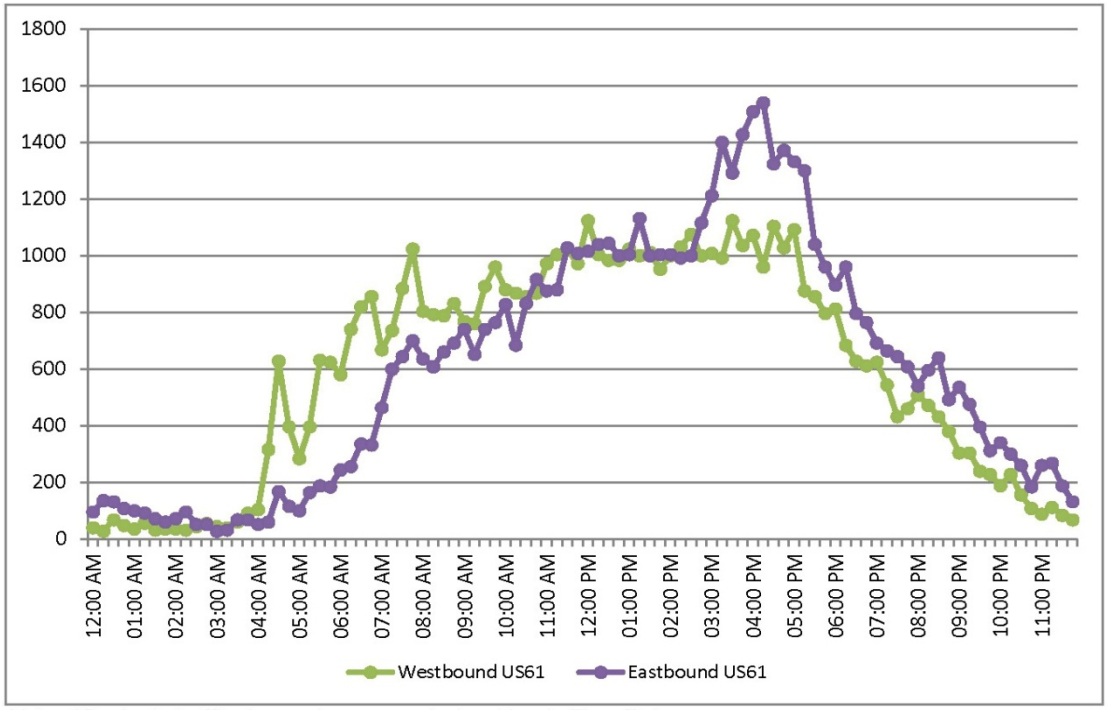
Figure 1 – US 63 2010 Peak Spreading



Note: 15-minute traffic demands represented as Hourly Flow Rates

The U.S. 61volume has a more evenly distributed traffic demand west of downtown Red Wing; with the exception of the increase in demand for eastbound U.S. 61 during the PM peak period from approximately 2:30pm to 6:00pm.

Figure 2 – US 61 2010 Peak Spreading



Note: 15-minute traffic demands represented as Hourly Flow Rates

The volume increase along eastbound U.S. 61 in the PM peak period corresponds to the same increase on the U.S. 63 river bridge. With an increase in background traffic over time, it should be expected that the peak congested periods will spread out to occupy more time of the day.

2.2 Downtown Rehabilitation and Safety Project

The Red Wing T.H. 61/Main Street Downtown Rehabilitation and Safety Improvement Project is a two phase project, which began in 2012. The project extends from Old West Main Street to Potter Street.

Phase 1, completed in 2012, involved signal improvements at the four downtown traffic signals (TH 61/East/West Avenue, TH 61/Bush Street, TH 61/Plum Street, and Plum Street/3rd Street). Pedestrian countdown timers, signal timing changes and radio interconnect between the signals ensure proper coordination and optimum operations for all users. A new southbound protected left turn phase from Plum Street to 3rd Street (U.S. 63 Bridge) was also added to the signal at Plum Street and 3rd Street.

Phase 2, expected to be completed in 2015, involves reconstruction of the existing U.S. 61 roadway. The project will include reconstruction of the existing pavement, city utilities replacements, improved sidewalk connections to meet ADA standards, curb bump-outs and median additions (raised or painted) at select locations.

2.3 Crash History

Safety conditions were reviewed in the previous study by reviewing the crash history for the study intersections (2005 through 2009). An updated safety analysis was also completed using crash history from 2008 through 2012. As the crash data between the two 5-year data sets was very similar, the following will summarize the findings from the most recent data at the most problematic intersections. Crash rates at the intersections are expressed as number of crashes per million entering vehicle (MEV) at the intersection. The critical crash rate is a statistical value that is unique to each intersection based on vehicular exposure and the average crash rate for similar intersections; an intersection with a crash or severity rate higher than the critical rates indicates a sustained crash problem at the intersection.

US 61 (Main Street) & East Avenue/West Avenue/Broad Street

This intersection had 65 crashes during the 5-year analysis period which resulted in a crash rate of 1.5, which is higher than the critical crash rate for this intersection of 1.1 and more than double the MnDOT average of 0.7 for similar intersections. The severity rate was 2.0, which is higher than the critical severity rate of 1.4 and is twice the MnDOT average of 1.0 for similar intersections.

This intersection had a high number of rear end collisions and sideswipe collision of vehicles in traveling in the same direction. Signal timing and phasing changes could be used to address some of these crashes, as well as access management changes.

US 63/TH 58 (Plum Street) & US 63 (3rd Street)

This intersection had 46 crashes during the 5-year analysis period which resulted in a crash rate of 1.7, which is almost twice the critical crash rate for this intersection of 0.9 and more than double the MnDOT average of 0.7 for similar intersections. The severity rate was 2.1, which is almost twice the critical severity rate of 1.2 and is more than double the MnDOT average of 1.0 for similar intersections.

This intersection had about 25% left turn and right angle collisions and a high percentage (37%) of "Other/Unknown" collisions. Signal timing changes could be used to address some of the crashes; the new southbound protected left turn phase could improve safety for the intersection. Improving the intersection corner radius to address semi-truck movements and removing parking near the intersection could improve vehicle movements, sight lines, and other safety concerns.

TH 63 (3rd Street) & Potter Street

This intersection had 12 crashes during the 5-year analysis period which resulted in a crash rate of 0.6, which is three times the MnDOT average of 0.2 for similar intersections and more than the critical crash rate for this intersection of 0.5. The severity rate was 0.8, which is almost three times higher than the MnDOT average of 0.3 and more than the critical severity rate of 0.6 for the intersection.

This intersection has a high number of right angle collisions. The sight distance for southbound Potter Street is of major concern as the building in the northeast corner obstructs visibility. Additional street lighting and potentially making Potter Street a limited access intersection could improve the safety of the intersection.

TH 58 (Plum Street) & 4th Street

This intersection had 11 crashes during the 5-year analysis period which resulted in a crash rate of 0.5, which is higher than critical crash rate of 0.4 for this intersection and the average crash rate of 0.4 for similar intersections. The severity rate was 0.6, which is just equal to the critical severity rate of 0.6 for this intersection and the average severity rate of 0.6 for similar intersections.

This intersection had a high number of left turn crashes; especially considering it operates under an All-Way stop traffic control. Additional street lighting and access management near the intersection could improve the safety of the intersection.

2.4 Roadway Geometrics and Design Issues

Field reviews were conducted at the seven study intersections as part of the previous project to determine any design or operational deficiencies, including sight distance and turning radii. The following issues were raised for the three main intersections of concern:

US 61 (Main Street) & US 63 (Plum Street)

- On the eastbound US 61 approach, the outside thru lane is wide enough for two lanes, and motorists use the approach as if there were a thru and a right turn lane. Marking these lanes to create an actual thru lane and right turn lane would be beneficial.
- The curb radius in the southwest and southeast corners of the intersection are too short for right-turning trucks. To compensate for the short radius in the southwest corner, the southbound accepting lane on Plum Street is very wide (wide enough for two lanes), which leads to vehicle positioning issues on Plum Street.

US 63 (Plum Street) & 3rd Street

- The curb radius in the northeast and southeast corners of the intersection are too short for right-turning trucks. To compensate for the short radius in the northeast corner, the southbound approach stop line has been marked at a location approximately 50 feet north of the intersection. However, field observations indicated not all traffic was complying with this marked stop line location.
- On the west leg of the intersection, there are no centerline or lane line markings. This leads to vehicle positioning confusion for motorists.
- On the east leg of the intersection, both the eastbound and westbound directions have very wide lanes. This leads to vehicle positioning confusion for motorists.
- For vehicles on the eastbound and northbound approaches, sight distance for vehicles attempting to make a right-turn-on-red can be limited by on-street parking on the west and south legs of the intersection.

US 63 & Potter Street

- Potter Street north of the intersection is a one-way street southbound and the southbound Potter Street approach at the intersection is over 50 feet wide. There are no lane line markings on this section of Potter Street, which leads to vehicle positioning confusion for motorists on this approach.
- Intersection sight distance for southbound Potter Street looking east along US 63 is about 250 feet. Though this distance provides sufficient stopping sight distance for westbound vehicles on US 63 (Note the posted speed limit on US 63 is 30 mph.), it does not provide the desirable intersection sight distance (approximately 400 feet) for Potter Street vehicles crossing US 63. Improving sight distance in the northeast corner of the intersection will prove difficult since the sight distance is being limited by a building in this corner.

3.0 Traffic Forecasts

The traffic forecasts and traffic data from the "Origin-Destination and Traffic Circulation Study for the U.S. 63 Bridge Area" (ODTC Study), dated February 10, 2011, were reviewed to determine if any updates or revisions were needed.

The traffic forecasts from the ODTC Study were developed based on several factors, including traffic forecasts from the 2010 Collar County Travel Demand Model, regression analysis on historical AADT data, and review of previous forecast data from MnDOT and other agencies. Though the Collar County Travel Demand Model will be updated based on 2010 census data, the update to the model will not happen until 2014. MnDOT and the City of Red Wing were contacted, and there does not appear to be any new development or information that would substantially change the forecast assumptions from the ODTC Study. An annual growth factor of 1.35% was developed during the ODTC Study for U.S. 63 on the Red Wing Bridge; however a lower, more conservative annual growth factor of 1.0% was used in this study based on input from MnDOT Central Office.

WisDOT conducted traffic counts on U.S. 63 on the Wisconsin side of the river in 2012. The resulting traffic counts came in higher than what MnDOT had previously collected and adjusted to an AADT. MnDOT factored AADT in 2011 was 11,500 vehicles per day; WisDOT AADT in 2012 was over 13,000 vehicles per day. This discrepancy in demand created a need for more research into the historical ADT volumes collected on the bridge; the ADT is the 24-hour data that is not adjusted for an AADT number.

The research indicated that traffic patterns on the U.S. 63 river bridge are not consistent with the statewide annualization factor applied as part of MnDOT's standard process to calculate AADT. For example, the recorded river crossing traffic volumes ranged between 12,500 and 14,000 over several days of the week and months of the year. As a result, a representative value of recent and historic traffic counts from both WisDOT and MnDOT was identified and the resulting 2012 AADT value is 12,000 vehicles per day.

The traffic forecasts from the ODTC Study were derived by using the compound annual growth rate method. However, the MnDOT Traffic Data and Analysis Section practice is to use a straight-line simple growth method for traffic forecasts. Therefore, revised forecasts for the Red Wing river crossing were calculated using the straight-line simple growth method. The forecasts were derived using an ADT of 12,000 for the base year of 2012 and an annual increase of 120 vehicles per year (equivalent to 11,800 for 2010), which is based on the annual growth factor of 1.0%.

The revised forecasts for U.S. 63 on the Red Wing Bridge are 2022 AADT of 13,200, and 2042 AADT of 15,600. Figure 1 in Appendix A also represents the ADT forecasts.

3.1 Turning Movement Forecasts

Based on the forecast ADT, annual growth factors for each roadway segment were used to develop the forecasts for the AM and PM peak hour volumes at the study intersections. Annual growth factors were developed for the movements at each intersection and these growth factors were applied to the 2010 peak hour volumes to determine the 2022 and 2042 AM and PM peak hour forecast volumes for the No Build condition.

For each build alternative concept, the forecast No Build turning movement volumes were routed to and from the U.S. 63 bridge based on the existing roadway network and the previous OD study findings.

Appendix A includes all turning movement forecasts. Figure 1 represents the ADT forecasts. Figure 2 shows the existing 2010 AM and PM peak hour turning movement volumes collected as part of the 2011 O-D project. Figures 3 through 6 represent the 2022 AM, 2022 PM, 2042 AM and 2042 PM peak hour volumes respectively. The turning movements forecasts represent the concept alternatives discussed further in Section 6 of this report.

3.2 Heavy Vehicle Traffic

The existing traffic mix through downtown Red Wing and on the U.S. 63 Bridge has a high percentage of heavy vehicle traffic including semi-trailers and oversized vehicles. Based on the traffic counts on the U.S. 63 Bridge, there is daily total of about 1,200 trucks, or approximately 9% of the daily vehicle total. Oversized truck traffic has ranged between 362 and 489 permitted trucks per year between 2010 and 2012. Oversized trucks are permitted trucks that are either over length (75 feet and longer), over width (8.5 feet and wider), or both.

3.2.1 Daily Heavy Vehicles

An increase in truck traffic is anticipated given growth in the frac sand industry (trips from quarries in Wisconsin to shipping terminals and potential processing plants in Red Wing). Other hauling routes are changing due to increasing fuel costs and other factors, leading to additional trucks on the bridge; however the volume is unknown at this time. Therefore a closer look at the background truck traffic built into the forecast demands was analyzed to estimate the growth in trucks and determine if any additional truck traffic should be incorporated into the traffic simulation models.

Typically, heavy truck and commercial traffic will try to avoid the more congested peak hours of traffic. This is evidenced in the collected turning movement counts. For example, at the 3rd Street and Potter Street intersection, there were 68 heavy vehicles during both the AM and PM peak hours combined, which represents only 6% of the total daily trucks.

Based on this analysis, the increase in trucks on the U.S. 63 river bridge was analyzed to estimate the total increase in daily truck volumes for years 2022 and 2042. From the existing truck percentages, the peak hour 2022 and 2042 increase in truck volumes on the river bridge would be approximately 15 and 35 respectively. While these numbers might seem low, the assumption remains that these values are only about 6% of the daily total. So the daily increase in truck traffic on the U.S. 63 river bridge for 2022 and 2042 would be approximately 265 and 620 trucks per day.

Given the potential for growth in the frac sand industry, an additional 300 trucks per day was added to both the 2022 and 2042 forecast traffic demands, based on discussions with the City of Red Wing. This volume is much lower than what could actually occur in the future if most

of the potential mining locations begin operation. This volume was chosen in order to avoid overestimating the number of trucks while still trying to estimate the potential increase in truck traffic above background growth. Based on the existing data of 6% of the truck traffic occurring in the both the AM and PM peak hours, an increase of 300 daily trucks will result in 18 additional trucks in the peak hours; 10 in the AM peak hour and 8 in the PM peak hour.

The increase in semi-truck traffic in the peak hours will result in reduced travel times and increased delays for all vehicles in the Downtown Red Wing roadway grid as the trucks make their way through the tight network of streets.

3.2.2 Oversized Permitted Heavy Vehicles

Not only does the U.S. 63 river bridge carry a high volume of daily heavy vehicle traffic, there is a high volume of both annual oversized permit trucks and single trip permit trucks that use the bridge. Trucks that are longer than 75 feet or that are wider than 8.5 feet require permits to cross the U.S. 63 river bridge.

Between 2010 and 2012 there were a total of 1279 oversized trucks that crossed the bridge. The trucks range in total length from 75 feet up to 180 feet long and truck widths can be greater than 12 feet.

From 2010 to 2012 a total of 1,221 trucks in excess of the legal width of eight feet six inches were issued permits for crossing, with 682 from 10 to 12 feet and 428 of them in excess of 12 feet.

From 2010 to 2012 a total of 653 trucks in excess of 75 feet were issued permits for crossing. The majority of these permitted trucks were included in the over width permits; only 58 permits were issued for a truck in excess of 75 feet that was not wider than 8.5 feet. There were a total of 74 over length trucks that ranged between 100 and 125 feet long and 9 trucks that ranged from 125 to 180 feet.

The annual average number of permitted trucks, based on the 3-years of data, is 426 permits per year as shown in the table below.

The continuity of US TH 63 is critical for hauling oversized loads. The existing shoulders on the Red Wing Bridge are only 3 feet wide, which requires closure of the opposing lane when certain loads go across. Depending on the time of day, this contributes to backups for the opposing traffic on US TH 63. Due to the increased length and tight geometrics in the downtown area, these longer trucks travel at a much slower rate and encroach significantly into the opposing lanes, effectively stopping opposing traffic. This increases delay times for all users in the downtown area. However, oversized vehicles were not included in any of the traffic operations analysis as they are not a daily occurrence during the peak hours.

Table 1
Oversized Truck Permits, 2010 - 2012

Permits	Description	2010	2011	2012	3-Year Total	Annual Average
Length	>75' Long & <=8.5' Wide	18	26	14	58	19
Width	>8.5' Wide & <= 75' Long	228	178	220	626	209
Width/ Length	>8.5' Wide & >75' Long	182	158	255	595	198
	TOTALS	**428**	**362**	**489**	**1279**	**426**

4.0 TH 63 Bridge Capacity

The forecast work completed for the project assumed a linear growth rate for all traffic within the project limits; therefore this analysis will assume a linear growth rate between 2022 and 2042. The U.S. 63 Bridge ADT was compared to the 2010 Highway Capacity Manual (HCM) planning level thresholds to assess the level of service for the facility.

The table below presents the planning level daily service volume thresholds from the 2010 Highway Capacity Manual for a two lane urban street facility. The daily service volumes were derived from the 2010 Highway Capacity Manual, Exhibit 16-14, assuming a posted speed of 30 mph, a K-Factor of 0.09, and a D-Factor of 0.60. The table indicates that LOS F will be attained when the traffic volumes exceed 18,300 ADT.

Table 2
HCM ADT Thresholds

Facility Type	Daily Service Volume		
	LOS C	LOS D	LOS E
2-lane	5,400	14,100	18,300
4-lane	10,300	28,800	34,800

Exhibit 16-14 from 2010 Highway Capacity Manual

Based on the above thresholds, the existing 2-lane river bridge would operate at a LOS E by the year 2030 and through 2042. A 4-lane bridge would accommodate forecast volumes through the year 2042 at a LOS D. Table 3 illustrates at what year the different LOS thresholds would be exceeded for both the 2-lane and 4-lane bridge configurations based on these thresholds.

Table 3
TH 63 Bridge ADT Assessment

	Forecast Years			
	2012	2022	2030*	2042
ADT	12,000	13,200	14,160	15,600
2-Lane LOS	D	D	E	E
4-Lane LOS	D	D	D	D

*Forecast year and ADT demands determined based on linear growth

However, even though US TH 63 is a low-speed facility on the bridge it does not function like a standard urban street facility. The primary reasons for this are because there are no direct accesses on the bridge like a standard urban street and because this section is in a transition zone between low and high speed. Due to these factors, the capacity of the bridge at LOS D is greater than the theoretical two-lane urban street capacity and greater than the 20 year forecast volume.

The controlling factor for traffic capacity of TH 63 crossing and approach roadways is not the bridge itself, but the downtown signalized intersections, specifically at the US TH 63/MN TH 58 (3rd Street/Plum Street) and US TH 63/US TH 61 (Plum Street/Main Street) intersections. Increasing the capacity at the downtown intersections would effectively increase the capacity of the bridge crossing.

5.0 No Build Conditions

Traffic operations analyses were conducted for the seven study intersections to determine the level of service (LOS), delay, and queuing information for No Build (2022 and 2042) conditions during the AM and PM peak hour.

The study intersections included in the traffic operations analysis are as follows:

- TH 58 (Plum Street) & 4th Street
- U.S. 61 (Main Street) & East Avenue/West Avenue
- U.S. 61 (Main Street) & Bush Street
- U.S. 61 (Main Street) & U.S. 63/MN 58 (Plum Street)
- U.S. 61/U.S. 63 (Main Street) & Potter Street
- U.S. 63/MN 58 (Plum Street) & U.S. 63/3rd Street
- U.S. 63 (3rd Street) & Potter Street
- U.S. 61 (Main Street) & U.S. 63 (new at-grade intersection)

LOS is a qualitative rating system used to describe the efficiency of traffic operations at an intersection. Six LOS are defined, designated by letters A through F. LOS A represents the best operating conditions (no congestion), and LOS F represents the worst operating conditions (severe congestion). For the city of Red Wing, it was assumed that LOS D or better represents acceptable operating conditions.

The traffic operations analyses were performed using the Synchro/SimTraffic (version 7) software package for stop sign controlled and signalized intersections. For signalized and unsignalized intersections, Synchro/SimTraffic uses the methods outlined in the 2000 Highway Capacity Manual (HCM).

LOS for intersections is determined by the average control delay per vehicle. The range of control delay for each LOS is different for signalized and unsignalized intersections. The expectation is that a signalized intersection is designed to carry higher traffic volumes and will experience greater delays than an unsignalized intersection; driver tolerance for delay is greater at a signal than at a stop sign. Therefore the LOS thresholds for each LOS category are lower for unsignalized intersections than for signalized intersections.

In addition to the LOS and average vehicle delay information, queuing information was examined. Queue spill-back can have a significant impact on traffic operations, especially for closely spaced intersections and for intersections with short turn lanes, which are common in the downtown Red Wing area. The SimTraffic program accounts for queue spill-back effects, and, for this reason, the SimTraffic results were used for reporting LOS and queuing information.

5.1 No Build Analysis

The No Build alternative only includes changes to the existing roadways based on programmed projects and includes the existing connection to the U.S. 63 river bridge. The AM peak hour will operate well through 2042 with all approaches and the intersection as a whole operating at a LOS C or better. The PM peak hour breaks down due to capacity constraints stemming from the Plum Street and 3rd Street intersection.

The intersection of Plum Street and 3rd Street has a very high demand of traffic in the PM peak hour making a left turn from Plum Street to U.S. 63; the majority of this traffic comes from eastbound U.S. 61. The combination of movements from the eastbound U.S. 61 to Plum Street right turn, and from the Plum Street to U.S. 63 left turn cause a large stacking effect along both roadways. The stacking queue along U.S.61 spills upstream through the East/West Avenue intersection and beyond.

The resulting operations indicate the U.S. 61 intersection with East/West Avenue will operate with over 4-minutes of delay in the PM peak, a LOS F. The majority of the remaining intersections all have queue spill back issues; however the relatively short block lengths allow for the majority of the traffic to be served at an acceptable delay.

Table 1a and 1b, in Appendix B, represents the 2022 and 2042 No Build Conditions.

5.2 No Build Failure Analysis

Based on the previous traffic work for both the 2022 year of opening and the 2042 design year, the AM peak hour intersection operations are better than the PM peak hour, with a few exceptions. However, since the majority of the poor operations occur in the PM, this analysis focuses on the PM peak hour.

Traffic volumes were developed for interim years between 2022 and 2042 in four year increments, based on linear growth. Traffic simulation models were created for the PM peak hour to determine when each concept has a failing intersection.

The previous analysis indicated that the primary issues occurring during the 2022 PM peak hour under the No Build condition would be traffic queues exceeding their available storage lengths at intersections. The No Build does include the programmed changes that have or will occur to the network in the next 5-years or less; the main improvement being a southbound left turn phase at the Plum Street and 3rd Street intersection.

Based on the incremental analysis, 2026 is the first forecast year a downtown intersection reaches LOS E, which would be at the US 61 and East/West Avenue intersection. The same intersection reaches LOS F by 2030 as traffic from downtown spills back through the intersection. Between 2030 and 2042 many of the intersection approaches will fail and the queuing between intersections will become severe. By 2042, 5 of the 7 downtown intersections would operate under failing conditions during the PM peak hour.

Although 2026 is the first year an intersection reaches a LOS E, there are operational problems that occur under existing conditions and show up as early as the 2022 analysis. The first issue is at the intersection of 3rd Street and Potter Street where the southbound approach has too few gaps to enter onto 3rd Street and the approach operates at a LOS F by 2022. This is a fairly low volume road and traffic would most likely change their route.

The second issue is the queuing and stacking that will occur between intersections. The maximum queues along US 61 heading eastbound into downtown Red Wing start to spill back between intersections as early as 2022, but really become an issue by 2026 and beyond. In 2022, the eastbound approach to Plum Street will occasionally spill into the Bush Street intersection. By 2026, that queue will extend to the East/West Avenue intersection causing major delays.

A third issue is the influence of the queuing from the northbound approach of Plum Street to 3rd Street. The queue is constantly impacting the Plum Street and 4th Street intersection where

traffic destined north on Plum Street is controlled by the queue stack. This problem becomes prevalent by 2034 where the northbound Plum Street approach to 4th Street operates at a LOS F; by 2038 the intersection will fail.

Table 3 in Appendix B presents the results of the incremental operations analysis for the No Build condition.

5.2.1 Other Factors

Although the traffic operations outputs from Synchro/SimTraffic, described above, show operational problems occur as early as 2022, the actual existing conditions observed in the field are worse than the analysis shows due to several factors. These are factors that have an impact on traffic operations that are not fully accounted for in the Synchro/SimTraffic model. These factors include:

- **Network:** The overlapping of highways and closely spaced intersections with high-volume turning movements are accounted for in the model. However the many access driveways throughout the network are not accounted for and can result in worse operations at the different intersections.
- **Geometrics:** Several corner radii are very tight for trucks, which results in encroachment and difficulties in turning. Turning speeds were adjusted in the model to reflect some of the tight radii; however there are times when trucks cannot proceed due to their turn being blocked, which is not accounted for in the model.
- **Pedestrian conflicts:** The relatively high volume of pedestrians results in pedestrian/vehicle conflicts which affects both traffic capacity and pedestrian safety. Pedestrian conflicts are accounted for in the model; however this may not represent the sporadic nature of pedestrians crossing during the entire phase.
- **On-street parking:** There is parallel parking allowed along most of the approach roadways, which increases friction for traffic and reduces capacity. Parking is accounted for in the model by a calculated change the modeled headway factors; this may not represent the full impact of parallel parking maneuvers along the roadways.

5.3 Mitigations to the Existing Network

Analysis was conducted to determine a range of improvements to the existing roadway network that could be implemented to either partially or fully address the documented traffic issues in downtown Red Wing. These mitigation concepts can be applied to either MN-1 or MN-2.

5.3.1 2005 Preferred Improvements

This concept was developed during the 2005 Downtown Red Wing Transportation Study. It includes signal timing modifications as well as capacity improvements throughout downtown. The capacity improvements include:

- Main Street at East/West Avenue: 300 foot eastbound (Main Street) right turn lane
- Main Street at Plum Street: 100 foot eastbound (Main Street) right turn lane; removes 4 on-street parking spaces
- Plum Street between 4th Street and Main Street; 4-lane wide section
    - Northbound Plum Street to 3rd Street to include additional shared through-right lane; removes 9 on-street parking spaces

    - Northbound Plum Street to Main Street to include full length left and right turn lanes; removes 8 on-street parking spaces
- 3rd Street east of Plum Street
    - Between Plum Street and Potter Street, a 5-lane wide section
    - Between Potter Street and River Bridge, a 4-lane wide section

While this alternative does improve operations over the No Build, it still has poor operations at many of the same locations. The total delay at the Main Street and East/West Avenue intersection is reduced by over a minute; however there are still approximately 3-minutes of delay per vehicle. The improvements don't add enough capacity to the major movement through downtown to the river crossing.

Different traffic patterns and a longer design year analysis can help explain why this alternative was recommended in the previous study, but would not be recommended today. There is an increase in traffic demands to and from the bridge when comparing the 2004 traffic counts to the 2011 updated traffic counts. Also, the previous study's design year went out only to the forecast year of 2025; this analysis extends the forecasts out to 2042.

Also, this alternative was recommended as a short term solution prior to any major long term improvements. Bridge alternative options were not analyzed as part of the 2005 study.

All intersection operational results are shown in the attached Table 3 in Appendix B.

5.3.2 2013 Mitigation Concept A (MN-1A and MN-2A)

This mitigation proposal was developed as an attempt to better address existing and forecast traffic conditions while avoiding significant right-of-way impacts. It includes signal timing modifications as well as capacity improvements. The capacity improvements are as follows:

- Main Street at East/West Avenue: 300 foot eastbound (Main Street) right turn lane
- Main Street at Plum Street: 100 foot eastbound (Main Street) right turn lane; removes 4 on-street parking spaces
- Plum Street between 3rd Street and Main Street; 4-lane wide section
    - Southbound Plum Street to 3rd Street to include dual left turn lanes and a shared through-right lane; removes 8 on-street parking spaces
- 3rd Street east of Plum Street
    - Between Plum Street and Potter Street, a 5-lane wide section
    - Between Potter Street and River Bridge, a 4-lane wide section

The southbound dual left turn lanes from Plum Street to 3rd Street provide adequate capacity for the approach. The movement was analyzed under a protected only phase; however current practice would allow a flashing yellow arrow to operate under a permissive phase as well. The storage lanes contain the queued vehicles so they do not impact the Main Street intersection. This reduction in queue spillback allows the Main Street at Plum Street intersection to operate more effectively.

Eastbound Main Street, through downtown Red Wing, still has major stacking in the right through lane as traffic prepares to make a right turn movement at Plum Street. The provided right turn lanes help separate turning traffic from through traffic improving operations at the key intersections.

All intersections will operate at a LOS C or better with every approach operating at a LOS D or better as shown in the attached Table 4 in Appendix B.

While these improvements would theoretically provide enough intersection capacity to keep vehicle delays to an acceptable level, they do not address the critical issues resulting from the overlapping trunk highway system within the constricted street grid in downtown Red Wing. The downtown area will still have queued vehicles that spill between intersections along Plum Street and Main Street. Geometric deficiencies, pedestrian conflicts, and on-street parking will still cause substantial delays for vehicular traffic.

In addition, these traffic related improvements come with physical impacts to the downtown including; reducing sidewalk width along Plum Street between Main Street and 3rd Street; removal of 38 on-street parking stalls along sections of Main Street, Plum Street, and 3rd Street; as well as increased pedestrian crossing times.

5.3.3 2013 Mitigation Concept B

This mitigation concept builds from Concept A and attempts to more fully address the network related traffic issues referenced above. This concept considered even more substantial modifications to the downtown street network including additional through lanes and longer turn lanes. These modifications would require removal of additional on-street parking, further impact sidewalks, and removal of the buildings in the southwest and southeast quadrants of the Main Street/Plum Street intersection.

This approach was not considered beyond the concept phase because it still fails to address the critical traffic issues resulting from the overlapping trunk highway system within the constricted street grid in downtown Red Wing. In addition, geometric deficiencies, pedestrian conflicts, and on-street parking will still cause unnecessary delays for vehicular traffic.

5.3.4 2013 Mitigation Concept C

Given Concepts A and B do not fully address the traffic stacking and turning movement issues associated with the overlapping trunk highway system in downtown Red Wing, even more substantial changes to the downtown street network were considered. The assessment concluded that the only effective solution for addressing the traffic stacking and turning movement issues would be to redirect the majority of traffic from Main Street to 3rd Street.

This would be accomplished by constructing a new road segment from Main Street to 3rd Street between Dakota Street and West Avenue. In turn, Main Street would be realigned near West Avenue to connect with the newly realigned Main Street to 3rd Street connection**.** With this modification 3rd Street through downtown would become Highway 63 and traffic destined to the river crossing and Highway 58 south, would use 3rd Street rather than Main Street. This new roadway configuration would address the previously identified network issues that result from the overlapping trunk highways along Plum Street between Main Street and 3rd Street.

Concept C addresses the primary traffic issues; however it was removed from consideration because it requires significant property and building acquisition as well as the need to expand 3rd Street through downtown from two to four lanes which involves removal of all on-street parking along 3rd Street.

6.0 Concept Alternatives

Through the Project Management Team (PMT), Technical Advisory Committee (TAC), and other agency and public input, eight concept alternatives were developed. The concepts were developed through an iterative process considering design standards, physical constraints, and traffic operations. A ninth concept was developed to address potential improvements to the existing downtown network.

The ten concept alternatives included:

- Concept 1: No-Build Traffic Conditions (Rehabilitate Bridge 9103)
- Concept 1A: Mitigation Concept A (Rehabilitate Bridge 9103 and Modify Downtown Street Network)
- Concept 2: Three Leg At Grade Intersection
- Concept 3: Three Leg At Grade Intersection (U.S. 63 Direct Connection)
- Concept 4: Four Leg At Grade Intersection
- Concept 5: Four Leg At Grade Intersection - Roundabout
- Concept 6: Button Hook Intersection
- Concept 7: Button Hook Intersection with Slip Ramp
- Concept 8: Button Hook Intersection (Roundabout or Signal) with Bridge #9103 Retained

All of the alternatives were analyzed for traffic operations with the exception of Concept 3. This concept was not analyzed due to the right of way impacts, grade problems, and other design issues.

The analysis included evaluating operations at the intersection turning movement level as well as evaluating the entire roadway grid at a network level.

6.1 Build Alternative Design Year Analysis

A Synchro model was built for each alternative. The SimTraffic micro-level simulation program was run using this model, and the average of five SimTraffic runs was used for reporting LOS and queuing results. The model also outputs a network summary of total delay, total travel time and average speed across all links included in the model. With all models created from the same network, the network summary outputs are a good comparison of how the entire network operates.

For the alternatives that included a roundabout intersection, the SimTraffic modeling outputs from the alternative most similar were used for all other intersections. The RODEL software only analyzes the roundabout as a standalone intersection; it does not take into account the surrounding intersections. The queuing information from RODEL was used to ensure the maximum queues at the roundabout would not impact the surrounding intersections.

6.2 Year of Opening Intersection Analysis - 2022

The 2022 forecast volumes generally result in acceptable operations for all approaches and intersections for all alternatives; at a LOS D or better in both AM and PM peak hours. Therefore, comparison of traffic operations in 2022 does not facilitate determination of preferred options.

The only exceptions to this are Concepts 2 and 4; where with a 2-lane river bridge the eastbound U.S. 61 dual left turns would have queuing problems that extend upstream along U.S. 61 through downtown.

The attached Tables 1 through 8 (see Appendix C) show the resulting operational output summary for all of the 2022 alternatives.

6.3 Design Year Intersection Analysis – 2042

The 2042 forecasts show operational problems for some of the alternatives. The following section presents each alternative and the resulting design year analysis.

6.3.1 Concept 1 – No-Build Traffic Conditions (Rehabilitate Bridge 9103)

This alternative was previously analyzed in Section 5 of this document. The results show severe congestion that causes queue spillbacks between many of the downtown intersections. 5 of the 7 study intersections will operate with a total intersection LOS F by the 2042 design year.

The attached Table 1 in Appendix B shows the resulting operational output summary for Concept 1, AM and PM peak hours.

6.3.2 Concept 1A – Mitigation Concept A (Rehabilitate Bridge 9103 and Modify Downtown Street Network)

This concept was one of three options addressed in the "Mitigations to the Existing Network" section earlier in this report. It was selected for further consideration because it avoids acquisition of buildings in the downtown historic district. The changes to the downtown network included with this alternative only add capacity on the approaches to each intersection; this scenario does not change traffic patterns in any way.

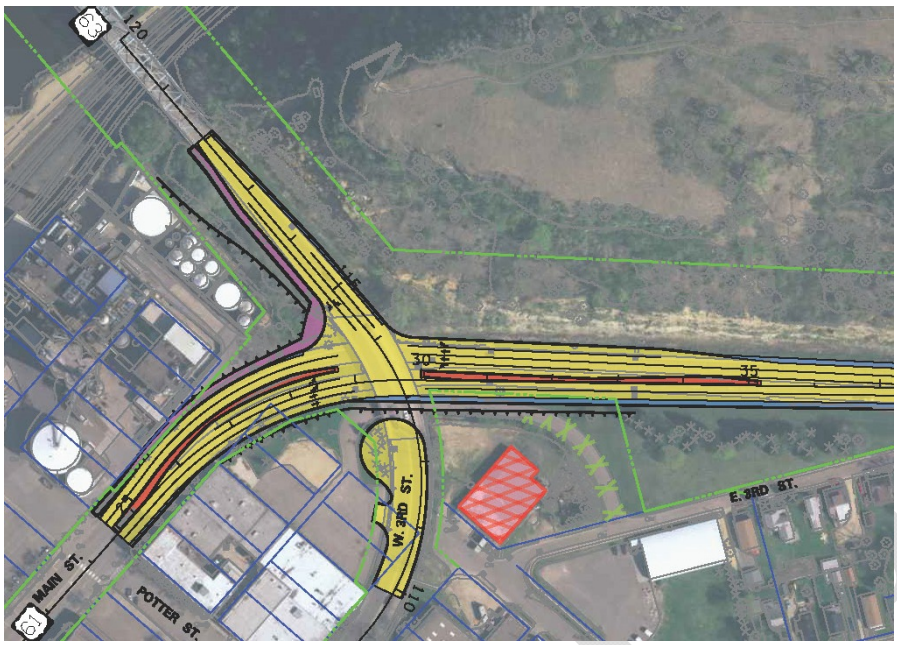
While the improvements do create acceptable LOS for each study intersection, it does not address the severe stacking along US 61 approaching the bridge. Queue spillback will still exist between intersections along both US 61 and Plum Streets as traffic approaches the bridge. The improvements do not fully address the slow turning trucks to and from the bridge; these movements will still create unnecessary delay for all users in the downtown network.

The attached Table 4 in Appendix B shows the resulting operational output summary for Concept 1A, AM and PM peak hours.

6.3.3 Concept 2 - Three Leg At Grade Signalized Intersection

This build alternative would remove the existing U.S. 63 Bridge over U.S. 61 and create an at-grade T-intersection at the junction. This alternative provides approximately 500 feet between the new intersection and Potter Street. The image below illustrates this alternative.

Figure 3 – Concept 2



The new intersection would require dual left turn lanes from U.S. 61 to U.S. 63. With a 2-lane bridge, one of the left turn lanes would make the turn through the intersection and enter into a lane drop; this reduces the lane usage and the efficiency of the dual left turn lanes. In order for this alternative to operate effectively, a 4-lane bridge would be required to allow efficient use of both turn lanes.

All other intersections would remain unchanged from the No Build conditions. The AM peak hour will operate well through 2042 (assuming a 4-lane bridge) with all approaches and intersection operating at a LOS C or better. The PM peak hour breaks down due to capacity constraints.

The intersection of U.S. 61 and Plum Street has a very high demand of traffic in the PM peak hour competing for green time at the signal. The new westbound left turn demand, from the bridge to south on Plum Street, requires a protected left turn phase which takes time away from the heavy eastbound U.S. 61 movement and the increased northbound right turns from Plum Street. The stacking queue along eastbound U.S.61 spills upstream through the East/West Avenue intersection and beyond.

The resulting operations indicate the U.S. 61 intersection with East/West Avenue will operate with over 2-minutes of delay, a LOS F. The majority of the remaining intersections all have queue spill back issues; however the relatively short block lengths allow for the majority of the traffic to be served at an acceptable delay.

The attached Tables 1A to 1D, in Appendix C, show the resulting operational output summary for Concept 2 Alternative AM and PM peak hours. Tables 1A and 1B show the results with a 2-lane river crossing and Tables 1C and 1D show the results with a 4-lane river crossing.

6.3.4 Concept 3 - Three Leg At-Grade Signalized Intersection (U.S. 63 Direct Connection)

This build alternative would remove the existing U.S. 63 Bridge over U.S. 61 and create an at-grade T-intersection at the junction; U.S. 63 would become the major movement with the east leg of U.S. 61 becoming the minor approach. This alternative provides approximately 500 feet between the new intersection and Potter Street. The image below illustrates this alternative.

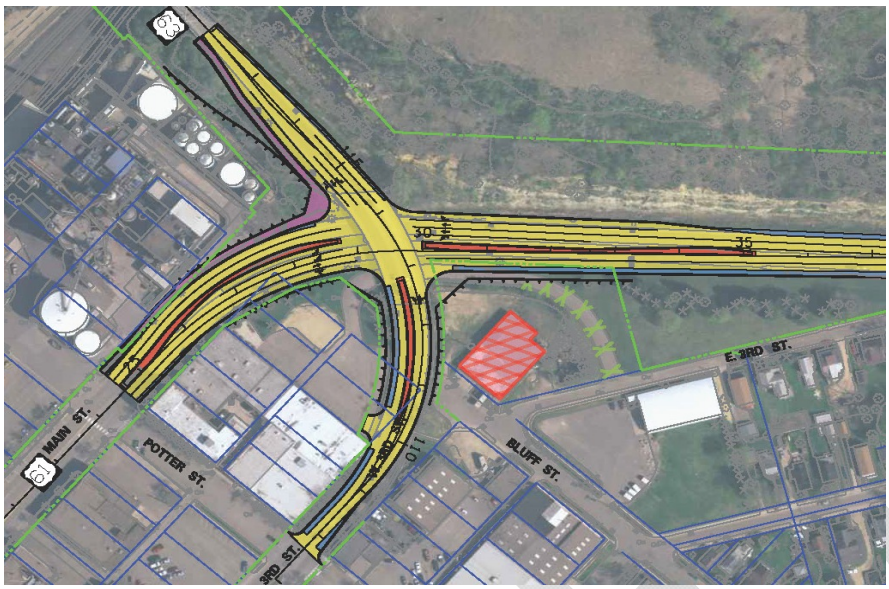
Figure 4 – Concept 3

As noted previously, this alternative was not analyzed for traffic operations given the right of way impacts at ADM. Therefore, an operations table is not included in the appendix.

6.3.5 Concept 4 - Four Leg At-Grade Signalized Intersection

This build alternative would remove the existing U.S. 63 Bridge over U.S. 61 and create an at-grade 4-leg signalized intersection. This alternative provides approximately 500 feet between the new intersection and Potter Street. The image below illustrates this design concept.

Figure 5 – Concept 4



This alternative is comparable to the Concept 2 except it retains the connection to and from 3rd Street. This concept reduces traffic from both eastbound and westbound U.S. 61 which helps operations along U.S. 61 compared to Concept 3. The access from the bridge to downtown Red Wing reduces westbound left turning traffic from U.S. 61 and the access from 3rd Street to the bridge allows traffic from Plum Street, and others, to continue to use 3rd Street.

Though the 3rd Street connection reduces the eastbound left turn demands, dual left turn lanes onto U.S. 63 are still needed for the eastbound movement. With a 2-lane bridge, one of the left turn lanes would make the turn through the intersection and enter into a lane drop; this reduces the lane usage and the efficiency of the dual left turn lanes. For this alternative to operate effectively, a 4-lane river bridge would be required to allow efficient use of both turn lanes.

All other intersections would remain unchanged from the No Build conditions. The AM and PM peak hour will operate well through 2042 with all approaches and intersections operating at a LOS D or better, assuming a 4-lane bridge.

The attached Tables 2A through 2D, in Appendix C, show the resulting operational output summary for Concept 4 AM and PM peak hours. Tables 2A and 2B show the results with a 2-lane river crossing and Tables 2C and 2D show the results with a 4-lane river crossing.

6.3.6 Concept 5 - Four Leg At-Grade Roundabout Intersection

This alternative would remove the existing U.S. 63 Bridge over U.S. 61 and create an at-grade 4-leg roundabout at the new junction of U.S. 61 and U.S. 63. This alternative provides approximately 600 feet between the new intersection and Potter Street. The image below illustrates this design concept.

Figure 6 – Concept 5

This alternative is comparable to Concept 4 described earlier except the intersection control is a roundabout rather than a traffic signal.

The roundabout was designed to accommodate a WB-65 truck traveling in the inside lane without encroaching into the outside lane of the roundabout. The connection between U.S. 61 and U.S. 63 is a very important truck route between Minnesota and Wisconsin and is used by many permitted trucks. From January of 2010 through mid-2012, approximately 400 permits have been issued for oversized vehicles (based on length) passing over the U.S. 63 River Bridge. A few different oversize permitted trucks were tested on the current design; traffic at the intersection would need to be stopped in order to pass a permitted truck through the intersection. However, that would also most likely be the case if it was a traffic signal.

The roundabout would operate very well in the design year with all approaches operating with a LOS A with minimal queues at each approach.

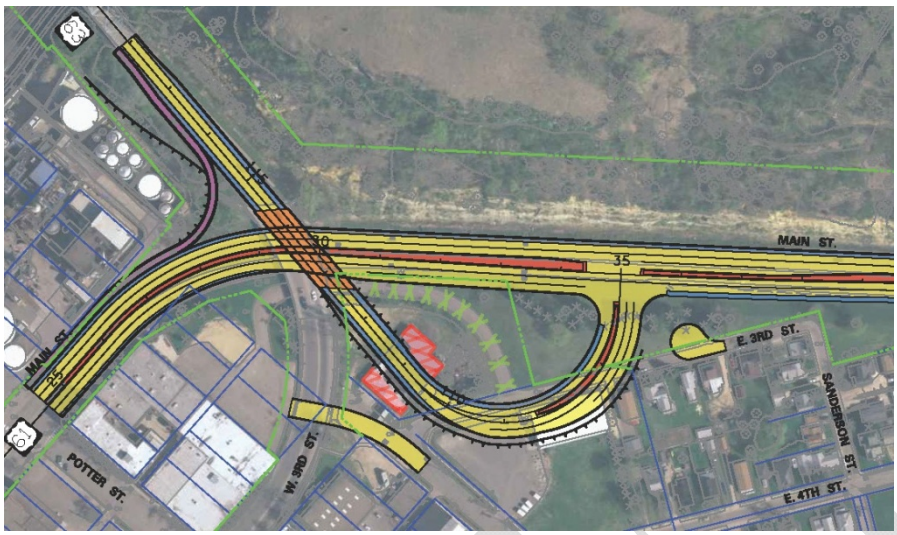
All other intersections would remain unchanged from the No Build conditions. The AM and PM peak hour will operate well through 2042 with all approaches and intersections operating at a LOS D or better, assuming a 4-lane bridge. RODEL does not analyze the departing traffic from a roundabout, therefore the effect of a lane drop before a 2-lane bridge would not be known without further detailed analysis in a different microscopic model.

The attached Tables 3A and 3B, in Appendix C, show the resulting operational output summary for Concept 5 AM and PM peak hours, assuming a 4-lane bridge.

6.3.7 Concept 6 - Buttonhook Signalized Intersection

This build alternative would replace the existing U.S. 63 Bridge over U.S. 61 and create a new at-grade signalized intersection east of downtown. This alternative provides approximately 1100 feet between the new intersection and Potter Street. The image below illustrates this concept.

Figure 7 – Concept 6



This alternative allows for better intersection spacing along U.S. 61 and for better use of both through lanes through downtown Red Wing. The right turn movement from eastbound U.S. 61 to northbound U.S. 63 would basically operate as a free movement with a no competing demand. The new left turn movement from the bridge can be served with dual left turns. This option is viable with either 2-lane or 4-lanebridges.

All other trunk highway intersections would remain unchanged from the No Build conditions. The AM peak hour will operate well through 2042 with all approaches and intersections operating at a LOS C or better. The PM peak hour will operate well through 2042 with all approaches and intersection operating at a LOS D or better, with the exception of the northbound approach of East/West Avenue which is at a LOS E due to the left turn delay.

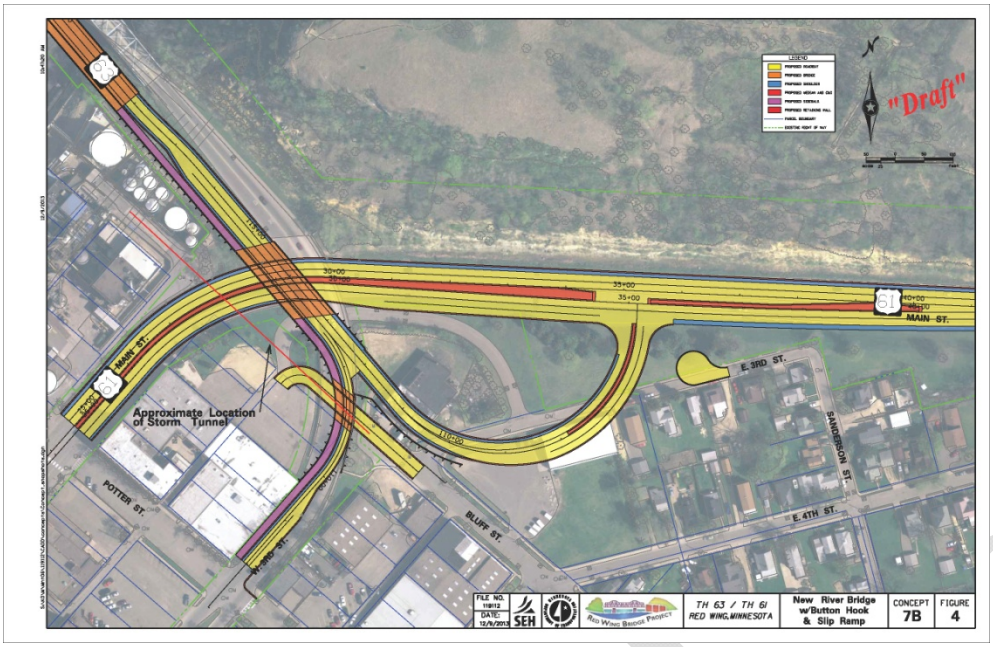
The intersection of U.S. 61 and Plum Street has a very high demand of traffic in the PM peak hour competing for green time at the signal. The westbound U.S. 61 left turn demand, from the bridge to south on Plum Street, requires a protected left turn phase which takes time away from the heavy eastbound U.S. 61 movement and the increased northbound right turns from Plum Street. While the LOS for all approaches is acceptable, there are still some storage issues at this intersection that occasionally spill upstream and impact adjacent intersections.

The attached Tables 4A and 4B, in Appendix C, show the resulting operational output summary for Concept 6 AM and PM peak hours.

6.3.8 Concept 7 - Buttonhook Signalized Intersection with Slip Ramp

This build alternative would replace the existing U.S. 63 Bridge over U.S. 61 and create a new at-grade intersection east of downtown and continue to allow the southbound U.S. 63 traffic to access downtown along a new slip ramp to 3rd Street. This alternative provides approximately 1100 feet between the new intersection and Potter Street. The image below illustrates this design concept.

Figure 8 – Concept 7



This alternative is comparable to Concept 6. The change is this alternative allows the southbound U.S. 63 bridge traffic to access downtown Red Wing without using U.S. 61. This removes traffic from U.S. 61 that would be making a westbound left turn from U.S. 61 to Plum and Bush Streets and West Avenue; without these left turning vehicles, operations along U.S. 61 are much improved. This option is viable with either a 2-lane or 4-lane bridge.

All other intersections would remain unchanged from the No Build conditions. The AM and PM peak hour will operate well through 2042 with all approaches and intersection operating at a LOS D or better.

As previously stated, allowing southbound traffic from the bridge to access downtown Red Wing and Plum Street directly, removes approximately 300 vehicles in the AM and PM peak hours that would make a left turn from U.S. 61 to the south. This not only improves operations along U.S. 61, but would likely improve both vehicle and pedestrian safety at the affected intersections.

The attached Tables 5A and 5B, in Appendix C, show the resulting operational output summary for Concept 7 AM and PM peak hours.

6.3.9 Concept 8 - Buttonhook Intersection (Roundabout) Retain Bridge 9103

This alternative would retain the existing U.S. 63 Bridge over U.S. 61 and create a new at-grade intersection east of downtown. This intersection could either be a roundabout (as shown) or a signalized intersection. This alternative provides approximately 1100 feet between the new intersection and Potter Street. The image below illustrates this concept.

Figure 9 – Concept 8

This alternative is comparable to Concept 6 described earlier except the intersection control is a roundabout and the design assumes retaining Bridge 9103.

The roundabout was designed to accommodate a WB-65 truck traveling in the inside lane without encroaching into the outside lane of the roundabout. The connection between U.S. 61 and U.S. 63 is a very important truck route between Minnesota and Wisconsin and is used by many permitted trucks. From January of 2010 to mid-2012 approximately 400 permits have been issued for oversize vehicles (based on length) passing over the U.S. 63 River Bridge. A few different oversize permitted trucks were tested on the current design; traffic at the intersection would need to be stopped in order to pass a permitted truck through the intersection. However, that would most likely be the case if it was a traffic signal.

The roundabout would operate very well in the design year with all approaches operating with a LOS A with minimal queues at each approach.

The intersection of U.S. 61 and Plum Street has a very high demand of traffic in the PM peak hour competing for green time at the signal. The westbound U.S. 61 left turn demand, from the bridge to south on Plum Street, requires a protected left turn phase which takes time away from the heavy eastbound U.S. 61 movement and the increased northbound right turns from Plum Street. While the LOS for all approaches is acceptable, there are still some storage issues from the near capacity intersection that occasionally spill upstream and impact adjacent intersections.

The attached Tables 6A and 6B, in Appendix C, show the resulting operational output summary for Concept 8-Roundabout option AM and PM peak hours. If the roundabout is replaced with a signal, the traffic operations would match those of Concept 6 – Buttonhook Signalized Intersection.

6.4 Network Operations Evaluation

In order to fully evaluate the traffic operations for the concept alternatives the entire network should be assessed. While the previous section evaluated each intersection, the total impact of the change on the entire analysis area may differ. Basically, some of the alternatives may improve and address specific issues; however they may degrade operations on other areas of the downtown roadway network.

SimTraffic has a total network summary output summary that allows comparison of the different concepts over the entire network. It compares the total hours of delay, the total travel time, and the average speeds across all segments in the traffic models. For some concepts, such as the buttonhook alternatives, many vehicles must travel a longer distance and therefore have a small increase in travel time. For other concepts that create more congestion through downtown, the total vehicle delay and travel time increases.

The following Tables 4 and 5 summarize the network summary output from the traffic operation models for both the year of opening, 2022, and the design year, 2042.

It should be noted that Concepts 5 and 8 do not have specific network summary data; both assume a roundabout intersection and as noted previously, The RODEL software was used to determine the roundabout design and operations, while the Synchro model was used for the remaining intersections. Therefore, the similar signalized concept results were used in place (Concepts 4 and 6 respectively). Again, these concepts would be expected to have slightly better operations due to the improved operations at the new intersection.

It should also be noted that Concept 1A was not included in this analysis as it was developed after the work herein.

6.4.3 Year of Opening 2022 Network Comparison

From Table 4, it is evident that the 2022 AM Peak periods all have essentially the same operations. In the PM peak hour, most of the concepts operate well. The exception is for Concepts 2 and 4 when analyzed with only a 2-lane river bridge which has a drop in speeds resulting in a LOS E and D respectively.

With a 2-lane river bridge, the eastbound dual left turns at the new US 61/63 intersection do not operate effectively because one of the accepting lanes drops quickly after the intersection. Most of the turning vehicles stack in one of the turn lanes and the queue spills out of the storage lane and impacts operations along U.S. 61.

6.4.4 Design Year 2042 Network Comparison

From Table 5, it is evident that the 2042 AM Peak periods all have essentially the same operations. The PM peak hour comparison is where the alternatives differentiate themselves.

Concept 1 and Concept 2 intersections have average speeds of 8 mph; this is a LOS F based on 30 mph speed limits (all roadway segments in the model have a speed limit of 30 mph). Concept 2 (4-Lane Bridge), and Concepts 4 and 6 with a 2-lane river bridge also has slow speeds resulting in a LOS E.

Concepts 4 (4-Lane Bridge), 5, 7, and 8 all have acceptable operations throughout the network.

Concept 4 (with 4-lane U.S. 63 Bridge), Concept 5 and Concept 7, which keep some connection to Plum Street via 3rd Street, improve operations throughout the network and perform extremely well under 2042 peak hour demands. Overall these three options are considered preferred over the remaining options.

6.5 Concept Alternative Conclusions

Nine concept alternatives were analyzed for both the 2022 year of opening and 2042 design year. Based on the operational results, the design year PM peak hour operations show the differences in each concept, which are summarized below.

Based on the analysis, Concepts 1 and 4 through 8 have potentially acceptable traffic operations, with noticeable variations in delay and queuing. Concepts 1 and 2 have major operational issues that cannot be easily mitigated without impacts. Concept 3 was not analyzed due to construction impacts. The continued use of the 3rd Street connection in Concepts 4, 5, and 7 provide the best traffic operations as it removes a sizable amount of traffic off of U.S. 61 through downtown Red Wing.

It should be noted that Concepts 4 and 5 only operate well with a 4-lane U.S. 63 Bridge (which has been removed from consideration as part of this project); with a 2-lane bridge both options will have operational problems through downtown Red Wing. Concept 7 provides for the best overall traffic conditions with a 2-lane U.S. 63 Bridge.

The nine concept alternatives and commentary are as follows:

- Concept 1: No-Build Traffic Conditions (Rehabilitate Bridge 9103)
    - Poor traffic operations through downtown Red Wing
- Concept 1A: Partially Mitigated No-Build Traffic Conditions (Rehabilitate Bridge 9103 and Modify Downtown Street Network) (*Not analyzed in Network Table*)
    - Partially addresses traffic operations through downtown Red Wing
    - Impacts to downtown Red Wing
- Concept 2: Three Leg At Grade Intersection (U.S. 61 Direct Connection)
    - Poor traffic operations through downtown Red Wing
    - Would require 4-lane U.S. 63 Bridge
- Concept 3: Three Leg At Grade Intersection (U.S. 63 Direct Connection)
    - No traffic operations analyzed due to construction impacts

Table 4
2022 SimTraffic Network Summary Output

			Concept 1 (2-Lane Bridge)	Concept 2 (2-Lane Bridge)	Concept 2 (4-Lane Bridge)	Concept 3*	Concept 4 (2-Lane Bridge)	Concept 4 (4-Lane Bridge)	Concept 5** (4-Lane Bridge)	Concept 6 (2 or 4-Lane Bridge)	Concept 7 (2 or 4-Lane Bridge)	Concept 8** (2 or 4-Lane Bridge)
AM Peak Hour	TOTAL DELAY	(HOURS)	27.0	27.0	26.4		27.1	26.8	26.8	28.2	24.6	27.2
	TRAVEL TIME	(HOURS)	79.8	77.6	76.7		74.6	75.5	75.5	79.3	71.0	77.3
	AVG SPEED	(MPH)	18	18	18		18	18	18	18	18	18
PM Peak Hour	TOTAL DELAY	(HOURS)	75.1	129.7	67.9		92.3	53.7	53.7	64.8	54.0	59.0
	TRAVEL TIME	(HOURS)	157.7	207.6	147.8		166.0	129.1	129.1	143.6	130.4	137.4
	AVG SPEED	(MPH)	14	11	15		13	16	16	15	16	16

Table 5
2042 SimTraffic Network Summary Output

			Concept 1 (2-Lane Bridge)	Concept 2 (2-Lane Bridge)	Concept 2 (4-Lane Bridge)	Concept 3*	Concept 4 (2-Lane Bridge)	Concept 4 (4-Lane Bridge)	Concept 5** (4-Lane Bridge)	Concept 6 (2 or 4-Lane Bridge)	Concept 7 (2 or 4-Lane Bridge)	Concept 8** (2 or 4-Lane Bridge)
AM Peak Hour	TOTAL DELAY	(HOURS)	38.9	34.1	34.2		36.9	33.4	33.4	36.5	30.7	34.5
	TRAVEL TIME	(HOURS)	100.8	92.2	93.0		92.8	89.7	89.7	96.4	84.7	94.2
	AVG SPEED	(MPH)	17	17	17		17	17	17	17	18	18
PM Peak Hour	TOTAL DELAY	(HOURS)	449.0	351.8	196.8		209.4	70.7	70.7	219.0	88.7	100.5
	TRAVEL TIME	(HOURS)	533.7	434.7	286.5		291.9	157.3	157.3	308.3	178.5	191.0
	AVG SPEED	(MPH)	**8**	**8**	**10**		**9**	15	15	10	14	13

* Concept 3 traffic operations were not analyzed.
** Denotes a roundabout alternative; Network summary shown for the representative signalized concept. Roundabout alternative would result in slightly improved operations as the roundabout operates better than the signalized intersections.

LOS Criteria based on 2010 Highway Capacity Manual Urban Street LOS for 30 mph roadway.
LOS A > 26 mph; LOS B between 20 to 26 mph; LOS C between 15 to 20 mph; LOS D between 12 to 15 mph; LOS E between 9 to 12 mph; LOS F less than 9 mph.

- Concept 4: Four Leg At Grade Intersection
    - Good traffic operations
    - 3rd Street connection improves downtown operations
    - Would require 4-lane U.S. 63 Bridge
- Concept 5: Four Leg At Grade Intersection – Roundabout
    - Good traffic operations
    - 3rd Street connection improves downtown operations
    - Would require 4-lane U.S. 63 Bridge
- Concept 6: Button Hook Intersection
    - Poor traffic operations
    - U.S. 61 at Plum Street Intersection still congested
    - Either 2-lane or 4-lane U.S. 63 Bridge
- Concept 7: Button Hook Intersection with Slip Ramp
    - Good traffic operations
    - 3rd Street connection improves downtown operations
    - Either 2-lane or 4-lane U.S. 63 Bridge
- Concept 8: Button Hook Intersection – Roundabout
    - Decent traffic operations
    - U.S. 61 at Plum Street Intersection still congested
    - Either 2-lane or 4-lane U.S. 63 Bridge

7.0 Detour Costs Analysis

This analysis developed costs for three separate construction scenarios for the bridge project. The three options are as follows:

- **No Closure**: For this scenario a second 2-lane bridge would be constructed parallel to the existing 2-lane bridge. When construction is completed on the new bridge, traffic would be shifted resulting in no long term closures.
- **8-Hour Closure**: This scenario includes rehabbing the existing 2-lane bridge with nightly closures between 9 PM and 5 AM. The bridge would be open to traffic the remaining 16-hours of the each day during construction.
- **Single Lane Closure**: This scenario includes rehabbing the existing 2-lane bridge with a single operating lane, 24-hours daily during construction.

Two additional scenarios were also considered, but ultimately not analyzed as part of this work. The first scenario would include a full 8-hour night closure and single lane operation during the day; this scenario would potentially reduce the construction duration by only 3-months, however the impacts to current bridge users would be too great. The second scenario would include only a single lane closure at night with the bridge fully open during the day; this scenario would potentially extend the construction an additional two years. Due to the increased impacts and extended duration these scenarios were not included in the detour cost analysis.

Traffic demand data was collected on the US 63 Bridge during the month of August, 2012 between the 7th and 30th by MnDOT staff. The traffic data was factored up to a forecast year of 2019 to represent traffic volumes during planned construction. The traffic was factored based on linear growth between 2012 and the year of opening 2022 forecasts. Weekday and weekend day volumes were separated out to achieve a more detailed analysis of the potential detour costs.

User costs for vehicles miles traveled (VMT) and vehicle hours traveled (VHT) were obtained from the MnDOT Office of Capital Programs and Performance Measures as well as occupancy rates. The occupancy rates for autos and trucks were also used to account for multiple passengers for the VHT calculations. These values are typically used for a project benefit-cost analysis.

The duration of construction was assumed to be approximately two construction seasons between April 1st and November 15th. This includes 66 weeks of construction with 330 weekdays and 128 weekend days. Between November 15th and March 31st it is assumed the bridge would be open to all traffic. The Single Lane closure would actual finish construction 1-month prior to the 8-hour closure.

There are two possible detour routes that vehicles can take to cross between Wisconsin and Minnesota. The first detour route would go through Hastings, MN and Prescott, WI via the US 10 bridge; this is assumed to be a 50 mile detour that takes approximately 1.2 hours. The second detour route would go through Wabasha, MN and Nelson, WI via TH 60/STH 25; this is assumed to be a 65 mile detour that takes approximately 1.6 hours. There is also a percentage of detoured traffic that is assumed to not make the trip during the construction season; a 20% reduction was applied to only the detoured or impacted traffic demands. There is also a reduction factor applied to the total detour route lengths as not all trips would realize

the full length of the detour; a reduction factor to 2/3's of the total distance was applied to the routes.

7.1 No Closure

For this scenario, no incurred, long term user costs would be associated with a construction detour as there is no closure.

7.2 8-hour Closure

For this scenario, the volume demand between 9PM and 5AM was assumed to be detoured to either of the possible routes. The total volume of the detour is approximately 1,700 weeknight trips and 1,875 weekend trips. There is an assumed daily cost for setting up and reopening the bridge closure.

The total user costs associated with this detour is approximately $21.4 million.

7.3 Single Lane Closure

For this scenario, a single lane of traffic would remain open 24-hours a day during the construction season. This analysis assumes four full time flaggers, two on the north side of the bridge and two on the south side of the bridge. The flaggers would manage operations to avoid, to the extent possible, northbound queues extending into downtown Red Wing causing major delays.

An operations analysis was performed to determine the impact of restricting the bridge to a single lane. The analysis was performed with four different volume scenarios to estimate the daily delay values; the scenarios include the AM peak, midday peak, PM peak and an overnight volume. The analysis assumed a single lane crossing of approximately 2,200 feet and a total crossing time of 75 seconds (20 mph). The PM peak hour is the only time frame that the traffic demands are too great for the single lane and as a result traffic would likely detour. During this time, it was assumed approximately 855 vehicles (or 15 percent of the total traffic) would detour and not use the Red Wing crossing. For all other time frames, it was assumed no traffic would detour.

As noted above, traffic would be managed to avoid, to the extent possible, queues from extending into the Plum Street and 3rd Street intersection. This means northbound queues would be limited to approximately 1,200 feet. To accomplish this, southbound (Wisconsin) traffic would receive less green time through the construction zone. As a result, the southbound queue would extend on average 2,100 feet with an estimated maximum queue of 3,800 feet. It is important to note that the queue estimates generated from the computer model represent optimized results and do not fully account for unpredictable human factors. The short-term single-lane closures which occurred in the summer of 2012 for bridge inspection illustrate this point. During these closures, southbound traffic queues extended two to three miles.

Furthermore, if the assumption of PM peak hour detouring traffic does not occur, the implications could be much greater in both downtown Red Wing and in Wisconsin. The analysis showed the downtown Red Wing street network could easily become gridlock as traffic backs up from the river bridge into the Plum Street and 3rd Street intersection. This would increase the overall delay for traffic destined to the bridge as well as vehicles in the downtown street network that are not destined for the bridge. The increased volume would also result in less green time for the Wisconsin side of the bridge, resulting in longer queues and greater delays for that traffic.

The total user costs associated with this detour is approximately $19.2 million.

Table 6
Detour Cost Summary

	No Closure	8-Hr Closure	Single Lane Closure
Total User Costs	$0	$21,386,000	$19,231,000

8.0 Traffic Demand Comparison

Concept 7, buttonhook with slip ramp, was compared to Concept 1, No-Build Traffic Conditions (Rehabilitate Bridge 9103), to evaluate the change in traffic demands between the two alternatives. At the time of this analysis, the concepts had undergone a naming convention change. Concept 1 is now known as MN-1. An additional alternative, MN-2, was also identified. This alternative involves replacing Bridge 9103 with a new, immediately adjacent, structure. From a traffic operations perspective both MN-1 and MN-2 retain the existing roadway and system capacity. Finally, Concept 7, the current recommended alternative is now known as MN 3.

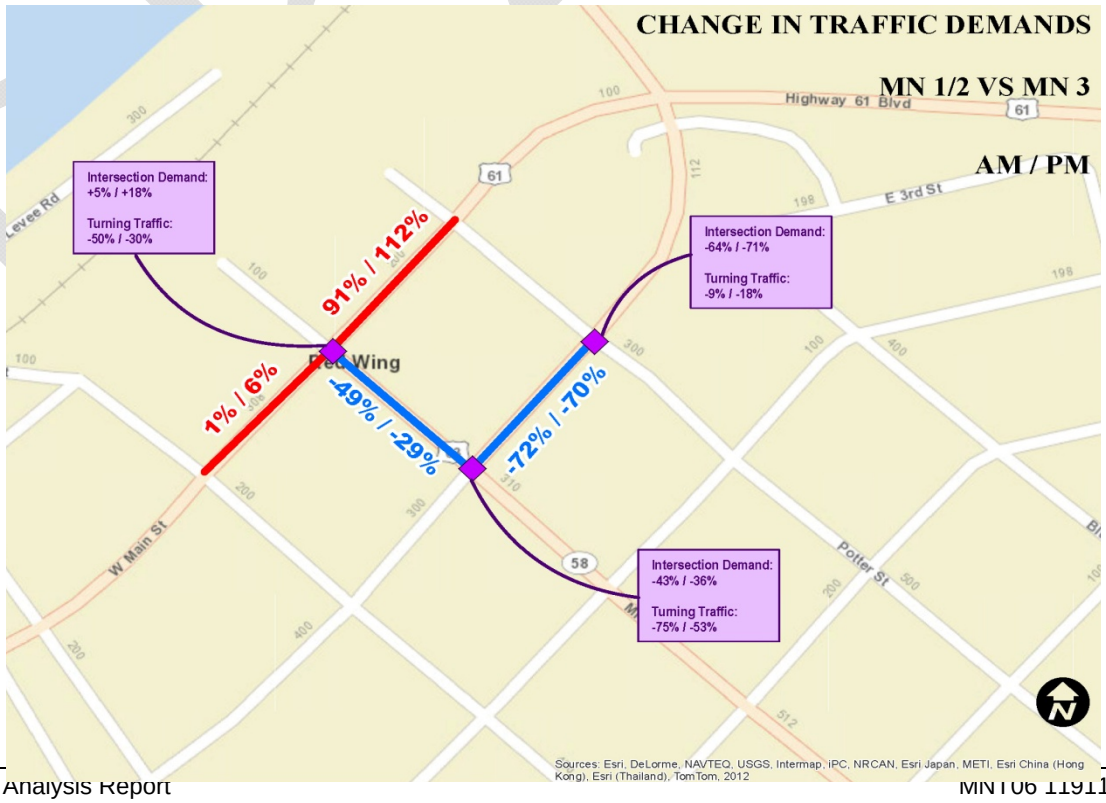
Comparing MN-3 to MN-1 and MN-2 shows a major reduction in traffic along Plum Street and 3rd Street at the Plum Street and 3rd Street intersection. Along US 61, there is only a slight increase in demands west of Plum Street. East of Plum Street there is a large increase in traffic between Plum Street and the new buttonhook intersection.

Though traffic increases in certain locations, the major benefit to the roadway network comes in the form of reduced turning traffic at each intersection. Left and right turning traffic proceed through an intersection at a much slower speed than a through vehicle; this is especially true with large trucks. The improved speeds make better use of the green time provided for each approach at the intersections, making the intersection more efficient.

At the main intersection of US 61 and Plum Street, the turning traffic is reduced by 50% in the AM peak hour and 30% in the PM peak hour; this occurs at the same time there is an increase in total intersection demand. At the intersection of Plum Street and 3rd Street there is a reduction in turning traffic of 75% in the AM peak hour and 53% in the PM peak hour.

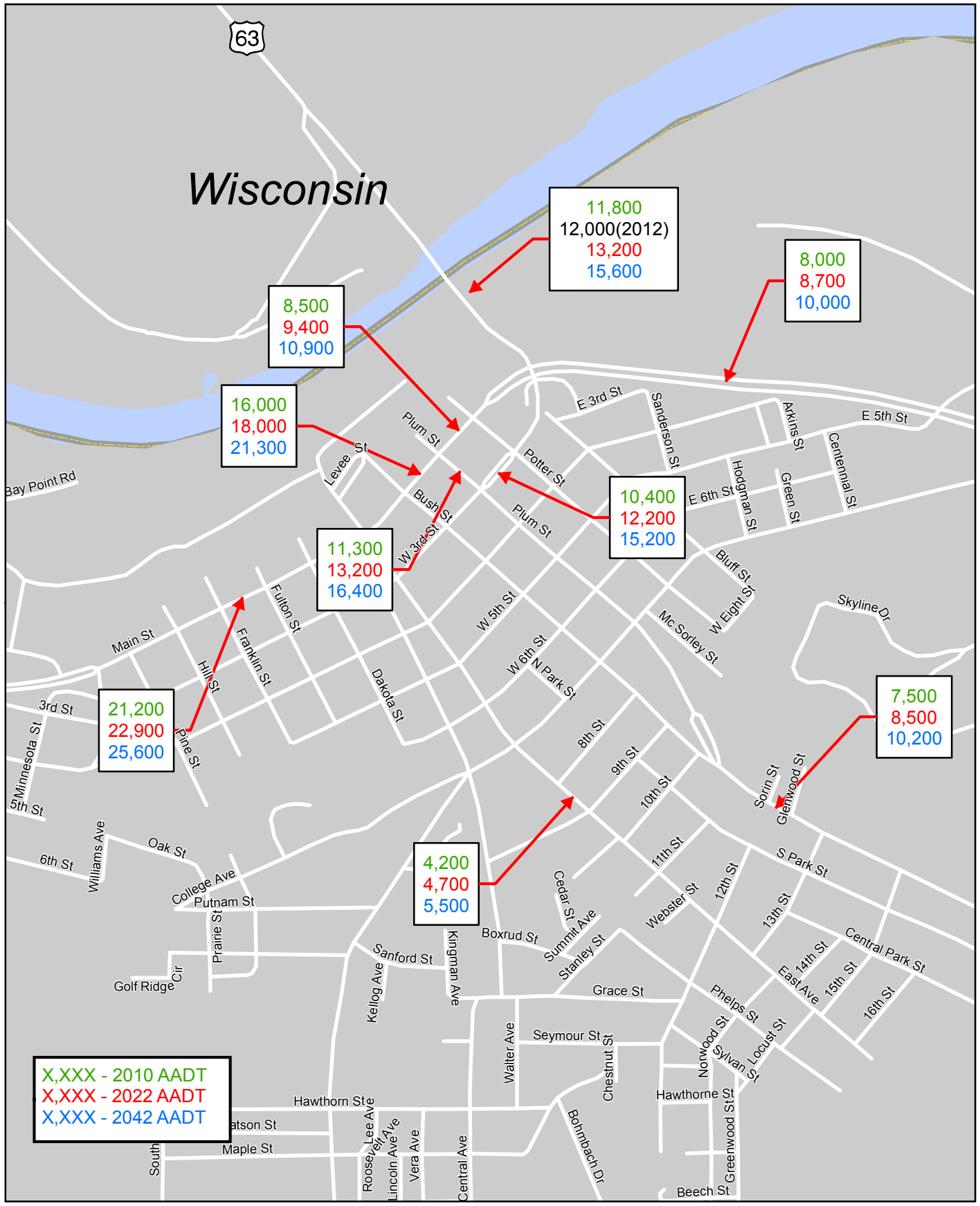
The figure below represents the change in traffic demands comparing MN-1/MN-2 with MN-3.

Figure 10 – Change in Traffic Demand



Appendix A

Traffic Forecasts



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SEH

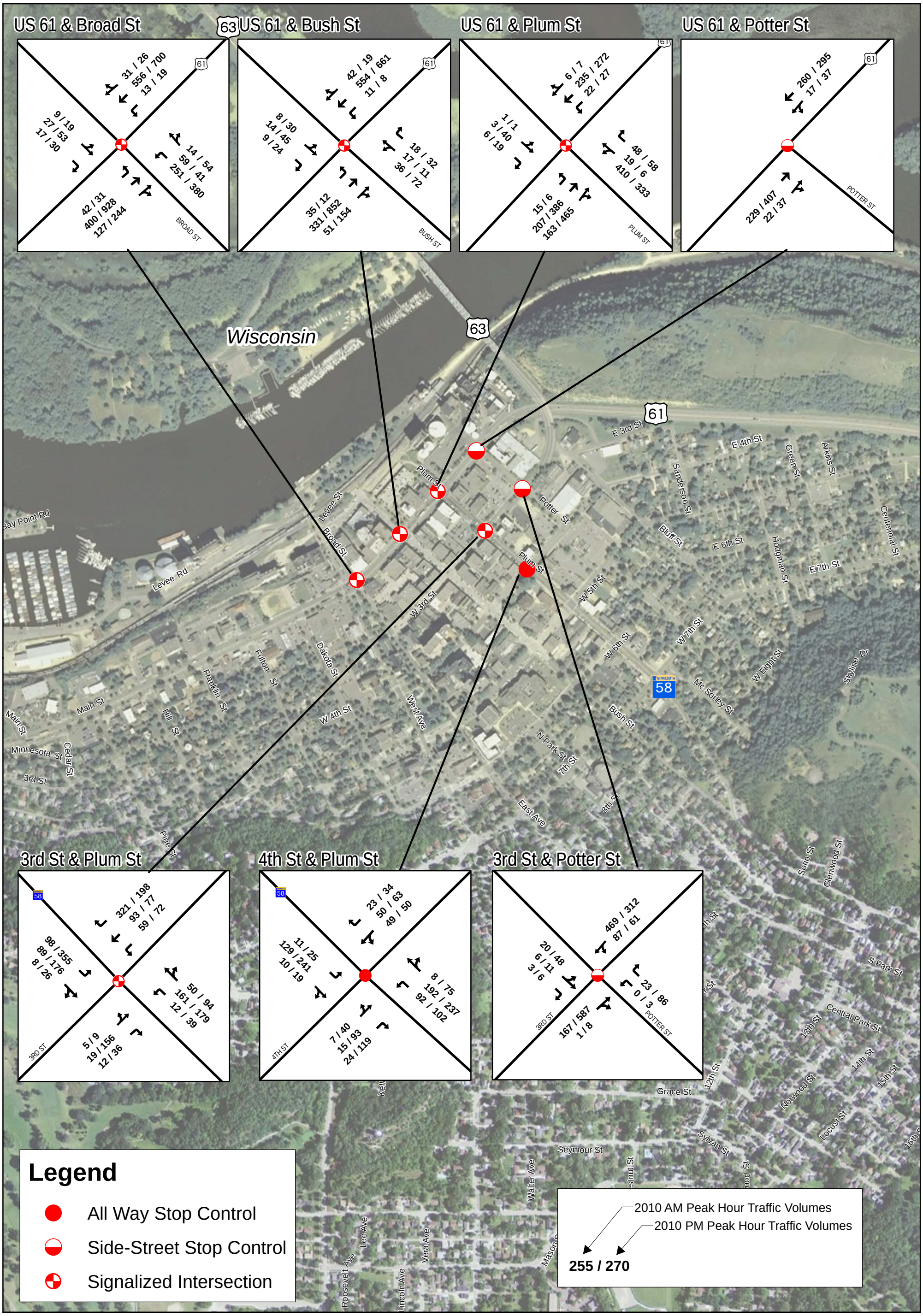
Project: MNT06 119112
Print Date: 12/5/2013

Map by: msteuernagel
Projection: UTM zone 15N
Source: MnDNR, MnDOT, MnGEO WiDNR, SEH

TH 63 Bridge / Downtown Red Wing

TRANSPORTATION STUDY
Red Wing, Minnesota

Figure 1
Annual Average Daily Traffic (AADT)



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SEH

Project: MNT06 119112
Print Date: 5/14/2012

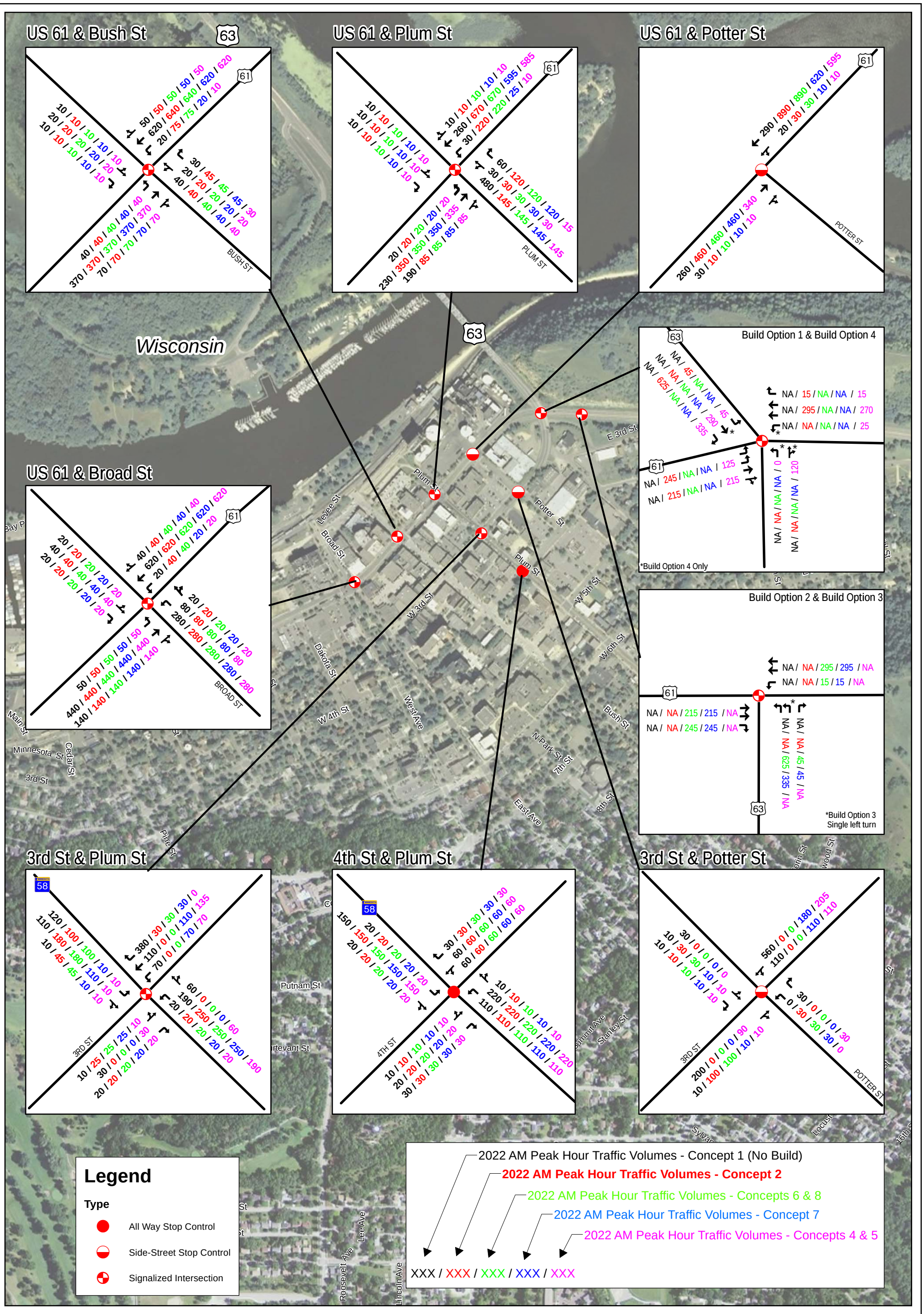
Map by: msteuernagel
Projection: UTM zone 15N
Source: MnDNR, MnDOT, MnGEO
WiDNR, SEH

TH 63 Bridge / Downtown Red Wing

TRANSPORTATION STUDY

Red Wing, Minnesota

Figure 2
Existing Counts
Peak Hour Volumes



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SEH

Project: MNT06 119112
Date: 7/30/2012

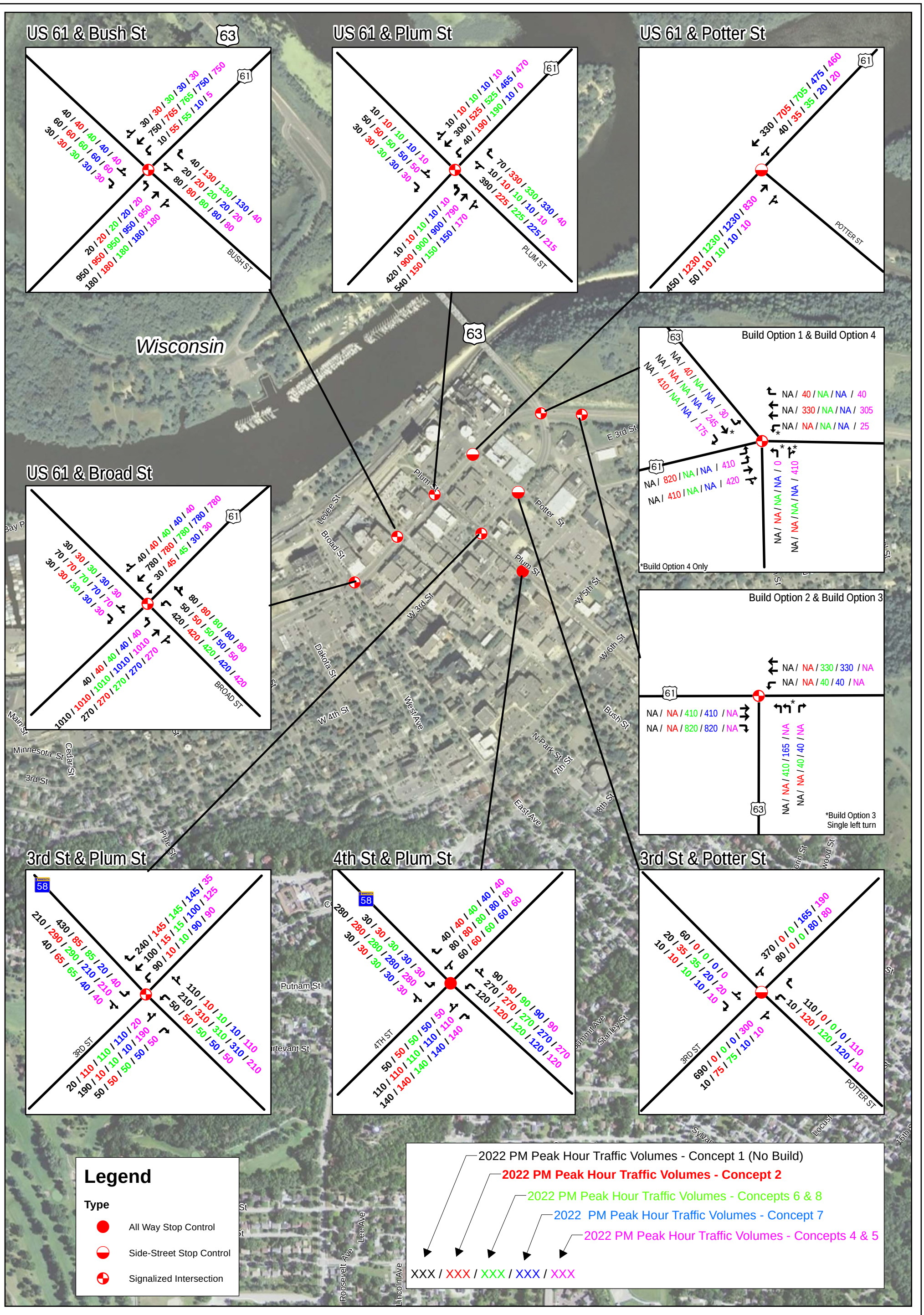
Map by: MSS
Projection: UTM zone 15N
Source: MnDNR, MnDOT, MnGEO
WiDNR, SEH

TH 63 Bridge / Downtown Red Wing

TRANSPORTATION STUDY

Red Wing, Minnesota

Figure 3
2022 AM
Peak Hour Volumes



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SEH

Project: MNT06 119112
Print Date: 7/30/2012

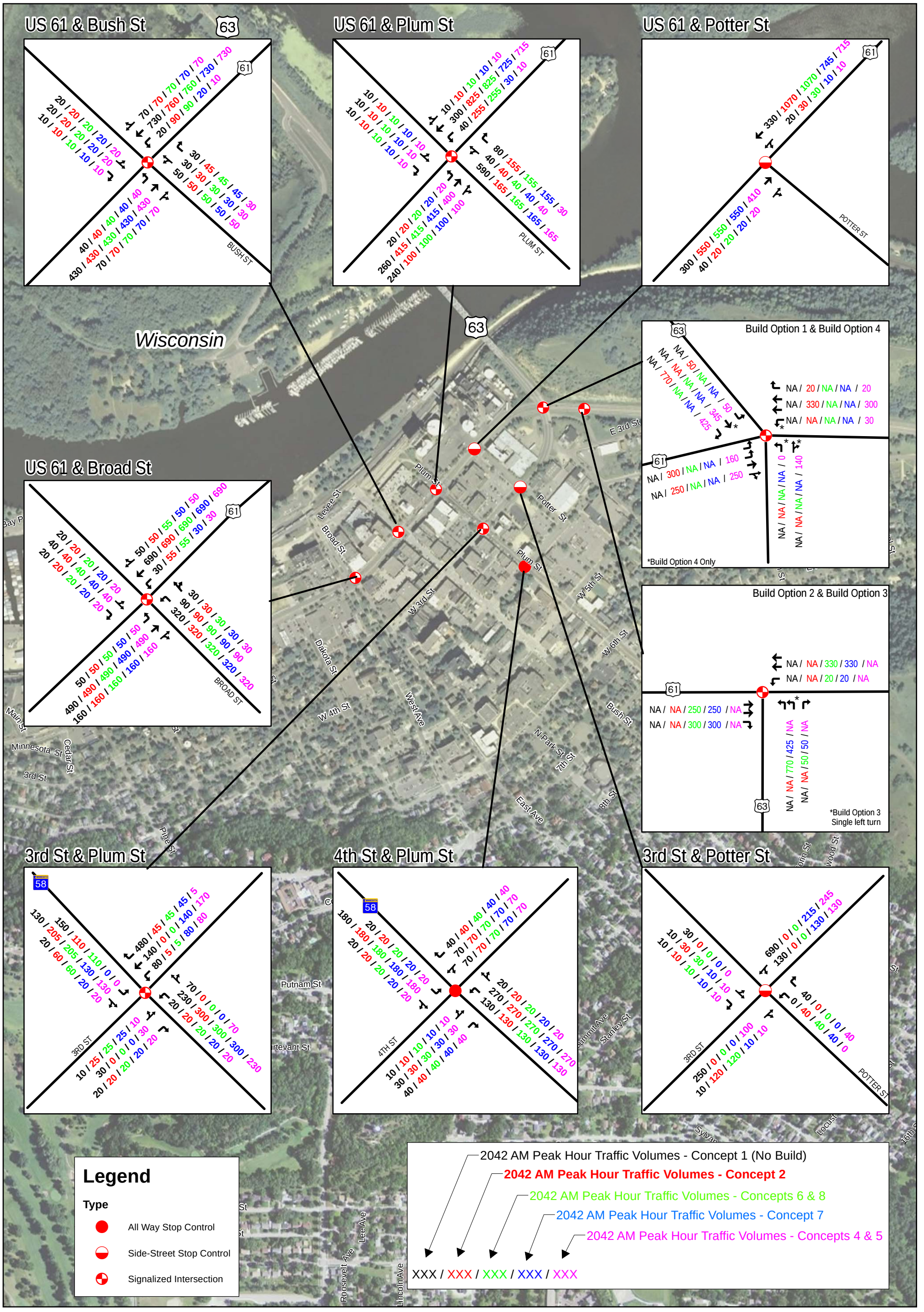
Map by: MSS
Projection: UTM zone 15N
Source: MnDNR, MnDOT, MnGEO
WiDNR, SEH

TH 63 Bridge / Downtown Red Wing

TRANSPORTATION STUDY

Red Wing, Minnesota

Figure 4
2022 PM
Peak Hour Volumes



Project: MNT06 119112
Print Date: 7/30/2012

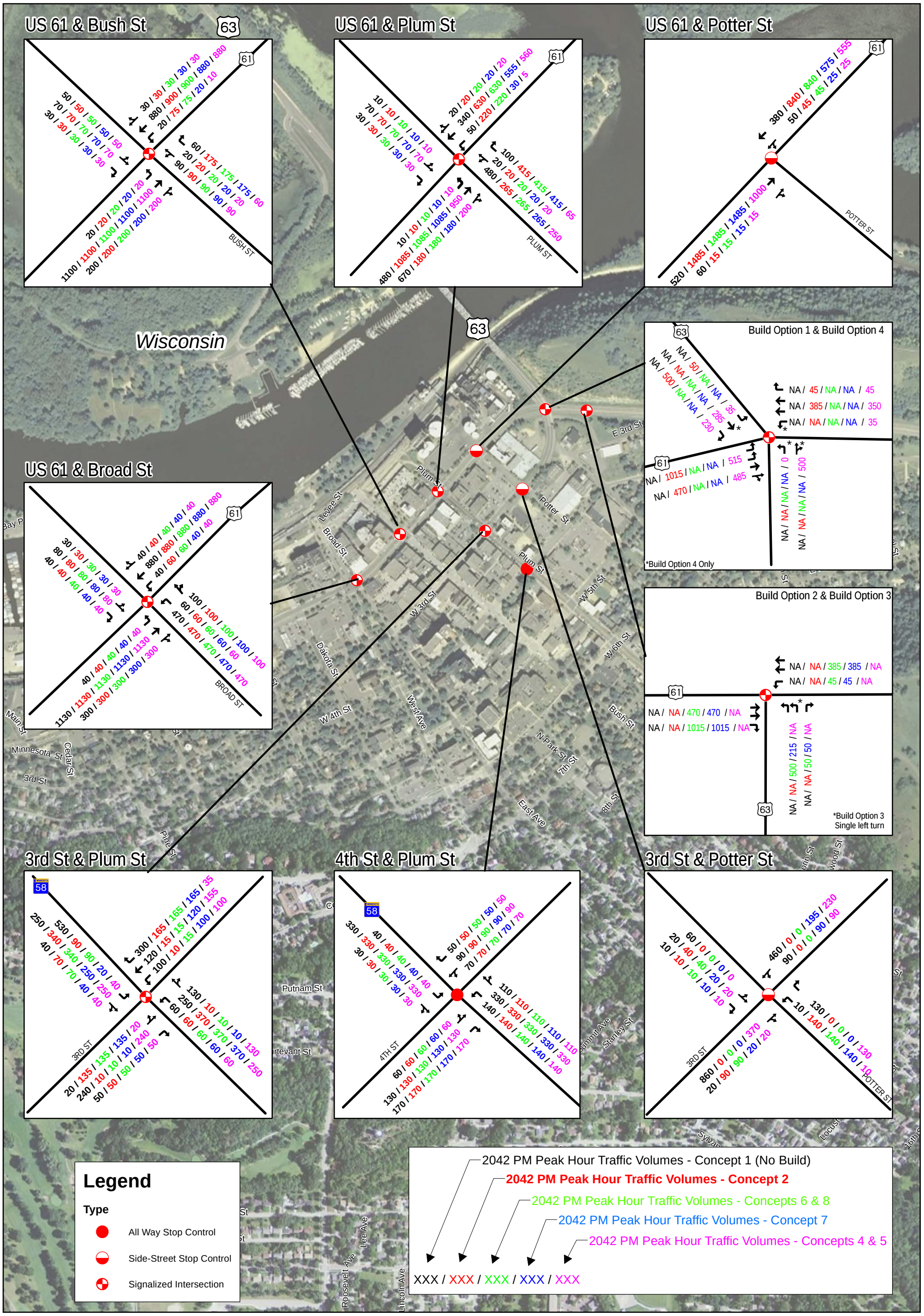
Map by: MSS
Projection: UTM zone 15N
Source: MnDNR, MnDOT, MnGEO
WiDNR, SEH

TH 63 Bridge / Downtown Red Wing

TRANSPORTATION STUDY

Red Wing, Minnesota

Figure 5
2042 AM
Peak Hour Volumes



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SEH

Project: MNT06 119112
Print Date: 7/30/2012

Map by: MSS
Source: MnDNR, MnDOT, MnGEO
WiDNR, SEH

TH 63 Bridge / Downtown Red Wing

TRANSPORTATION STUDY

Red Wing, Minnesota

Figure 6
2042 PM
Peak Hour Volumes

Appendix B

No Build Traffic Operations

Table 1A
Concept 1
No Build 2022 Conditions
Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	270	70	20	360	31.5	C	22.4	C	11.7	B	27.2	C	12.9	B	687	44	140	687	93	227	0		
		SB	20	30	20	70	28.8	C	27.0	C	15.9	B	24.3	C			480	58	169	0			25	26	77
		EB	50	450	140	640	33.0	C	12.7	B	9.2	A	13.6	B			1201	96	220	125	45	124	50	46	100
		WB	20	620	40	680	14.6	B	4.8	A	4.2	A	5.1	A			427	36	104	125	15	48	0		
	US 61 at Bush St (Signal)	NB	50	20	30	100	25.3	C	24.7	C	10.3	B	19.7	B	10.9	B	313	36	109	0			25	21	73
		SB	10	20	20	50	27.0	C	23.2	C	7.6	A	20.3	C			392	20	60	0			25	6	39
		EB	40	380	70	490	21.8	C	10.9	B	8.2	A	11.4	B			427	61	147	125	19	56	0		
		WB	20	630	50	700	14.5	B	9.1	A	7.6	A	9.1	A			291	99	226	120	11	62	0		
	US 61 at Plum St (Signal)	NB	480	30	60	570	13.7	B	8.0	A	10.1	B	12.7	B	20.2	C	283	174	317	0			0		
		SB	10	10	10	30	4.8	A	4.8	A	6.9	A	5.5	A			188	6	53	0			50	7	71
		EB	20	230	190	440	33.1	C	25.4	C	18.0	B	22.5	C			291	131	294	120	15	57	0		
		WB	30	260	10	300	59.8	E	31.6	C	20.0	C	33.5	C			323	96	187	150	33	103	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.3	A	0			0			0		
		EB	0	260	30	290	0.0	A	2.0	A	1.9	A	2.0	A			323	2	30	0			0		
		WB	20	290	0	310	3.2	A	0.5	A	0.0	A	0.7	A			1804	4	29	0			0		
	3rd St at Plum St (Signal)	NB	20	190	60	270	20.0	C	22.2	C	14.4	B	20.3	C	14.6	B	264	103	217	100	10	108	0		
		SB	120	110	10	240	11.1	B	5.8	A	2.0	A	8.3	A			283	32	100	283	61	148	0		
		EB	10	30	20	60	26.0	C	20.8	C	7.8	A	18.0	B			287	30	116	0			50	12	44
		WB	70	110	380	560	27.4	C	22.3	C	9.4	A	14.2	B			310	96	270	150	47	180	50	85	100
	3rd St at Potter St (2-Way Stop)	NB	0	0	30	30	0.0	A	0.0	A	8.0	A	8.0	A	4.1	A	0			300			25	20	50
		SB	30	10	10	50	16.6	C	9.3	A	6.2	A	13.3	B			319	26	64	0			319	6	31
		EB	0	200	10	210	0.0	A	1.2	A	0.9	A	1.2	A			0			0			0		
		WB	110	550	0	660	4.9	A	3.9	A	0.0	A	4.1	A			1532	20	122	0			0		
	4th St at Plum St (All-Way Stop)	NB	110	220	10	340	10.6	B	8.1	A	4.9	A	8.8	A	8.1	A	348	46	90	150	28	67	0		
		SB	20	150	20	190	6.2	A	8.7	A	5.6	A	8.1	A			264	45	114	125	14	40	0		
		EB	10	20	30	60	5.4	A	6.7	A	7.5	A	6.8	A			342	21	49	0			25	19	46
		WB	60	60	30	150	5.9	A	7.2	A	8.7	A	7.0	A			325	41	86	0			25	22	65
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	400	50	70	520	31.8	C	20.3	C	17.5	B	27.4	C	34.2	C	687	49	139	687	163	335	0		
		SB	30	60	30	120	26.0	C	21.2	C	13.5	B	20.5	C			480	51	138	0			25	23	70
		EB	30	1020	260	1,310	72.2	E	52.0	D	47.6	D	51.6	D			1201	415	833	125	36	149	50	86	100
		WB	30	790	40	860	55.2	E	12.2	B	11.3	B	13.7	B			427	103	175	125	31	82	0		
	US 61 at Bush St (Signal)	NB	90	20	40	150	26.8	C	25.0	C	17.0	B	23.6	C	20.0	C	313	55	124	0			25	28	75
		SB	40	60	30	130	24.4	C	22.9	C	13.1	B	20.8	C			392	54	115	0			25	25	74
		EB	20	960	180	1,160	22.3	C	26.4	C	37.0	D	28.0	C			427	217	461	125	12	46	0		
		WB	10	750	30	790	54.5	D	7.8	A	6.5	A	8.4	A			291	88	173	120	12	71	0		
	US 61 at Plum St (Signal)	NB	390	10	70	470	33.9	C	18.3	B	25.3	C	31.6	C	23.1	C	283	259	430	0			0		
		SB	10	50	30	90	16.2	B	14.7	B	8.8	A	12.9	B			188	34	109	0			50	20	78
		EB	10	420	540	970	17.7	B	14.7	B	25.5	C	20.3	C			291	213	368	120	8	61	0		
		WB	40	300	10	350	57.4	E	18.3	B	9.2	A	21.6	C			323	85	160	150	36	111	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.4	A	0			0			0		
		EB	0	450	50	500	0.0	A	1.5	A	1.8	A	1.5	A			323	2	41	0			0		
		WB	40	330	0	370	5.3	A	0.8	A	0.0	A	1.3	A			1808	16	75	0			0		
	3rd St at Plum St (Signal)	NB	50	210	110	370	31.4	C	33.4	C	25.8	C	30.8	C	35.5	D	264	151	268	100	38	149	0		
		SB	430	210	40	680	55.6	E	11.1	B	16.4	B	40.0	D			283	76	327	283	229	311	0		
		EB	20	190	50	260	59.0	E	53.0	D	26.2	C	48.4	D			287	152	296	0			50	41	100
		WB	90	100	240	430	51.2	D	30.4	C	13.4	B	25.0	C			310	97	276	150	70	166	50	80	100
	3rd St at Potter St (2-Way Stop)	NB	10	0	110	120	38.0	E	0.0	A	26.1	D	27.0	D	9.3	A	0			300	19	116	25	48	75
		SB	60	20	10	90	70.5	F	53.8	F	4.4	A	61.0	F			319	75	168	0			319	7	31
		EB	0	690	20	710	0.0	A	1.9	A	1.2	A	1.9	A			310		8	0			0		
		WB	80	370	0	450	11.3	B	5.2	A	0.0	A	6.2	A			1541	72	236	0			0		
	4th St at Plum St (All-Way Stop)	NB	120	270	90	480	17.1	C	21.7	C	15.3	C	19.4	C	15.5	C	348	104	267	150	44	122	0		
		SB	30	280	30	340	8.4	A	16.1	C	12.0	B	15.1	C			264	79	197	125	20	93	0		
		EB	50	110	140	300	13.0	B	13.0	B	12.6	B	12.8	B			342	57	162	0			25	47	76
		WB	60	80	40	180	9.0	A	10.0	B	11.4	B	10.0	B			325	49	87	0			25	26	70

Table 1B
Concept 1
No Build 2042 Conditions
Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	290	80	30	400	35.8	D	24.9	C	14.0	B	30.9	C	13.3	B	687	49	113	687	129	259	0		
		SB	20	40	20	80	30.0	C	25.6	C	15.6	B	23.3	C			480	44	170	0			25	25	74
		EB	40	510	140	690	33.2	C	13.0	B	9.8	A	13.6	B			1201	99	239	125	41	129	50	52	100
		WB	30	730	50	810	10.4	B	5.0	A	4.1	A	5.2	A			427	43	106	125	17	65	0		
	US 61 at Bush St (Signal)	NB	50	30	30	110	25.9	C	20.2	C	10.3	B	19.6	B	10.8	B	313	47	144	0			25	24	75
		SB	20	20	20	60	26.7	C	25.5	C	10.1	B	23.2	C			392	27	68	0			25	7	56
		EB	50	450	80	580	18.7	B	11.0	B	8.0	A	11.1	B			427	72	206	125	18	51	0		
		WB	20	740	60	820	14.6	B	8.8	A	7.6	A	8.8	A			291	108	193	120	12	131	0		
	US 61 at Plum St (Signal)	NB	590	40	80	710	18.7	B	12.4	B	16.5	B	17.7	B	24.1	C	283	271	396	0			0		
		SB	10	10	10	30	9.7	A	7.7	A	8.2	A	8.6	A			188	8	54	0			50	8	57
		EB	20	260	240	520	41.2	D	27.8	C	22.9	C	26.1	C			291	164	310	120	18	91	0		
		WB	40	300	10	350	85.5	F	30.7	C	18.1	B	36.1	D			323	102	177	150	56	141	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.4	A	0			0			0		
		EB	0	300	40	340	0.0	A	2.0	A	2.2	A	2.0	A			323	2	32	0			0		
		WB	20	330	0	350	3.8	A	0.6	A	0.0	A	0.8	A			1804	6	62	0			0		
	3rd St at Plum St (Signal)	NB	20	230	70	320	26.0	C	26.8	C	18.2	B	24.9	C	19.4	B	264	138	260	100	14	104	0		
		SB	150	130	20	300	13.4	B	8.9	A	4.5	A	10.8	B			283	51	147	283	82	163	0		
		EB	10	30	20	60	67.9	E	31.1	C	8.4	A	28.7	C			287	32	110	0			50	13	62
		WB	80	140	480	700	29.1	C	27.4	C	15.6	B	19.5	B			310	181	328	150	57	199	50	93	100
	3rd St at Potter St (2-Way Stop)	NB	0	0	40	40	0.0	A	0.0	A	9.1	A	9.1	A	6.1	A	0			300			25	21	50
		SB	30	10	10	50	29.4	D	10.8	B	11.4	B	20.5	C			319	26	61	0			319	7	39
		EB	0	250	10	260	0.0	A	1.4	A	0.8	A	1.4	A			0			0			0		
		WB	130	680	0	810	7.0	A	6.4	A	0.0	A	6.5	A			1532	51	264	0			0		
	4th St at Plum St (All-Way Stop)	NB	130	270	20	420	11.9	B	10.7	B	5.6	A	10.8	B	9.6	A	348	66	193	150	32	86	0		
		SB	20	180	20	220	6.8	A	10.0	B	6.4	A	9.4	A			264	54	124	125	10	30	0		
		EB	10	30	40	80	5.3	A	7.3	A	8.2	A	7.5	A			342	22	45	0			25	22	59
		WB	70	70	40	180	6.9	A	8.3	A	9.0	A	7.9	A			325	43	90	0			25	29	76
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	430	60	100	590	209.4	F	167.9	F	177.3	F	196.9	F	474.2	F	687	188	566	687	460	708	0		
		SB	30	70	30	130	108.9	F	83.1	F	61.9	E	81.8	F			480	117	355	0			25	37	75
		EB	30	1170	270	1,470	1103.6	F	1097.2	F	1146.1	F	1107.0	F			1201	1169	1252	125	47	174	50	89	100
		WB	40	930	40	1,010	51.6	D	12.0	B	10.1	B	13.4	B			427	106	197	125	31	86	0		
	US 61 at Bush St (Signal)	NB	100	20	50	170	64.2	E	83.0	F	71.7	E	68.8	E	92.3	F	313	91	232	0			25	46	76
		SB	40	70	40	150	65.4	E	49.3	D	31.5	C	51.3	D			392	84	218	0			25	19	75
		EB	20	1140	210	1,370	59.4	E	185.6	F	214.0	F	187.7	F			427	454	533	125	14	119	0		
		WB	20	890	30	940	33.1	C	7.0	A	4.5	A	7.5	A			291	85	174	120	16	64	0		
	US 61 at Plum St (Signal)	NB	480	20	100	600	64.7	E	101.7	F	63.1	E	66.1	E	49.1	D	283	370	431	0			0		
		SB	10	70	30	110	47.2	D	46.8	D	48.6	D	47.2	D			188	60	157	0			50	15	76
		EB	10	480	670	1,160	30.3	C	36.0	D	59.6	E	49.2	D			291	302	377	120	11	114	0		
		WB	50	340	20	410	72.4	E	20.8	C	12.3	B	25.5	C			323	86	172	150	43	120	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	56.4	F	0			0			0		
		EB	0	520	60	580	0.0	A	22.1	C	22.8	C	22.2	C			323	33	109	0			0		
		WB	50	380	0	430	178.4	F	81.4	F	0.0	A	92.2	F			1808	149	427	0			0		
	3rd St at Plum St (Signal)	NB	60	250	130	440	48.1	D	68.0	E	64.3	E	64.3	E	106.8	F	264	244	281	100	56	149	0		
		SB	530	250	40	820	99.7	F	29.1	C	23.1	C	74.1	E			283	103	322	283	277	317	0		
		EB	20	240	50	310	322.9	F	297.2	F	272.8	F	295.0	F			287	272	323	0			50	48	100
		WB	100	120	300	520	170.8	F	65.6	E	41.6	D	72.9	E			310	215	328	150	135	199	50	90	100
	3rd St at Potter St (2-Way Stop)	NB	10	0	130	140	261.6	F	0.0	A	62.4	F	75.6	F	43.1	E	0			300	51	232	25	49	75
		SB	60	20	10	90	173.3	F	105.5	F	18.0	C	143.2	F			319	110	213	0			319	18	103
		EB	0	860	20	880	0.0	A	2.4	A	1.6	A	2.4	A			310	8	152	0			0		
		WB	90	450	0	540	76.2	F	76.3	F	0.0	A	76.3	F			1541	305	1014	0			0		
	4th St at Plum St (All-Way Stop)	NB	140	330	110	580	288.5	F	320.8	F	325.1	F	314.0	F	141.9	F	348	321	402	150	149	200	0		
		SB	40	330	30	400	12.2	B	27.4	D	21.2	C	25.6	D			264	108	274	125	27	148	0		
		EB	60	130	170	360	60.2	F	51.5	F	54.0	F	54.2	F			342	105	285	0			25	56	76
		WB	70	90	50	210	24.2	C	31.1	D	54.8	F	33.7	D			325	70	196	0			25	32	75

Table 2
Concept 1 Operational Analysis
No Build Conditions
Failure Year Analysis

	Intersection	Approach	2022						2026						2030					
			LOS By		LOS By		QUEUE		LOS By		LOS By		QUEUE		LOS By		LOS By		QUEUE	
			Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Max Queue	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Max Queue	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Max Queue
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	27.4	C	34.2	C	350	139	30.4	C	63.6	E	350	242	44.4	D	116.1	F	350	339
		SB	20.5	C			300	138	22.1	C			300	161	34.8	C			300	247
		EB	51.6	D			1000	833	111.2	F			1000	847	225.2	F			1000	1118
		WB	13.7	B			400	175	12.6	B			400	156	13.6	B			400	179
	US 61 at Bush St (Signal)	NB	23.6	C	20.0	C	315	124	25.0	C	22.9	C	315	121	28.2	C	42.1	D	315	158
		SB	20.8	C			315	115	21.0	C			315	115	22.9	C			315	135
		EB	28.0	C			400	461	32.9	C			400	454	72.4	E			400	531
		WB	8.4	A			315	173	8.3	A			315	158	8.1	A			315	174
	US 61 at Plum St (Signal)	NB	31.6	C	23.1	C	315	430	32.6	C	24.5	C	315	418	44.6	D	31.3	C	315	440
		SB	12.9	B			315	109	13.5	B			315	106	15.0	B			315	124
		EB	20.3	C			315	368	21.7	C			315	365	28.7	C			315	370
		WB	21.6	C			315	160	23.6	C			315	159	24.0	C			315	156
	US 61 at Potter St	NB	0.0	A	1.4	A			0.0	A	1.4	A			0.0	A	1.5	A		
	(2-Way Stop)	EB	1.5	A			315	41	1.5	A			315	34	1.6	A			315	116
		WB	1.3	A			2000	75	1.2	A			2000	72	1.4	A			2000	68
	3rd St at Plum St (Signal)	NB	30.8	C	35.5	D	315	268	33.4	C	35.0	D	315	280	39.6	D	45.2	D	315	280
		SB	40.0	D			315	327	40.0	D			315	318	51.4	D			315	326
		EB	48.4	D			315	296	40.8	D			315	284	55.7	E			315	302
		WB	25.0	C			315	276	25.1	C			315	265	34.8	C			315	312
	3rd St at Potter St	NB	27.0	D	9.3	A	315	116	27.7	D	8.7	A	315	138	32.2	D	13.1	B	315	154
	(2-Way Stop)	SB	61.0	F			315	168	50.6	F			315	176	72.9	F			315	213
		EB	1.9	A			315	8	2.0	A			315	84	2.2	A			315	102
		WB	6.2	A			2000	236	5.2	A			2000	203	12.8	B			2000	445
	4th St at Plum St	NB	19.4	C	15.5	C	315	267	20.9	C	16.7	C	315	317	23.3	C	19.0	C	315	349
	(All-Way Stop)	SB	15.1	C			315	197	17.1	C			315	213	20.2	C			315	219
		EB	12.8	B			315	162	13.1	B			315	149	15.4	C			315	198
		WB	10.0	B			315	87	10.8	B			315	109	12.1	B			315	121

	Intersection	Approach	2034						2038						2042					
			LOS By		LOS By		QUEUE		LOS By		LOS By		QUEUE		LOS By		LOS By		QUEUE	
			Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Max Queue	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Max Queue	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Max Queue
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	87.5	F	213.2	F	350	422	86.7	F	263.3	F	350	394	196.9	F	474.2	F	350	566
		SB	27.7	C			300	167	31.8	C			300	192	81.8	F			300	355
		EB	430.8	F			1000	1247	560.7	F			1000	1252	1107.0	F			1000	1252
		WB	13.4	B			400	174	14.4	B			400	213	13.4	B			400	197
	US 61 at Bush St (Signal)	NB	28.9	C	44.1	D	315	178	29.8	C	49.6	D	315	197	68.8	E	92.3	F	315	232
		SB	23.8	C			315	144	25.1	C			315	178	51.3	D			315	218
		EB	77.6	E			400	530	91.0	F			400	530	187.7	F			400	533
		WB	8.0	A			315	175	7.7	A			315	189	7.5	A			315	174
	US 61 at Plum St (Signal)	NB	42.0	D	32.9	C	315	431	44.3	D	35.0	D	315	435	66.1	E	49.1	D	315	431
		SB	14.5	B			315	115	18.3	B			315	140	47.2	D			315	157
		EB	32.3	C			315	377	34.1	C			315	388	49.2	D			315	377
		WB	25.4	C			315	158	27.9	C			315	174	25.5	C			315	172
	US 61 at Potter St	NB	0.0	A	1.8	A			0.0	A	1.6	A			0.0	A	56.4	F		
	(2-Way Stop)	EB	2.0	A			315	18	1.9	A			315	108	22.2	C			315	109
		WB	1.5	A			2000	82	1.3	A			2000	68	92.2	F			2000	427
	3rd St at Plum St (Signal)	NB	48.8	D	51.9	D	315	281	51.8	D	73.1	E	315	280	64.3	E	106.8	F	315	281
		SB	48.6	D			315	322	49.8	D			315	319	74.1	E			315	322
		EB	90.0	F			315	306	197.3	F			315	309	295.0	F			315	323
		WB	37.3	D			315	324	50.4	D			315	328	72.9	E			315	328
	3rd St at Potter St	NB	42.5	E	15.8	C	315	178	93.1	F	27.3	D	315	238	75.6	F	43.1	E	315	232
	(2-Way Stop)	SB	111.2	F			315	300	132.1	F			315	279	143.2	F			315	213
		EB	2.3	A			315	154	2.4	A			315	16	2.4	A			315	152
		WB	10.6	B			2000	384	26.1	D			2000	618	76.3	F			2000	1014
	4th St at Plum St	NB	68.3	F	35.8	E	315	348	128.6	F	58.7	F	315	378	314.0	F	141.9	F	315	402
	(All-Way Stop)	SB	20.1	C			315	225	23.2	C			315	283	25.6	D			315	274
		EB	15.1	C			315	179	17.7	C			315	197	54.2	F			315	285
		WB	12.5	B			315	118	12.4	B			315	125	33.7	D			315	196

NOTES: The first Street named at each intersection is the Eastbound and Westbound street approaches; Northbound and Southbound are the minor street approaches

Maximum queue information from SimTraffic analysis. If Maximum queue exceeds the link length, the queue will occasionally spill into the upstream intersection.

xxx Above 85% of the available storage

xxx Max queue spills out of link

Table 3
2005 Alternative 1 Mitigations
No Build 2042 Conditions
Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	290	80	30	400	33.4	C	24.4	C	11.8	B	28.6	C	12.8	B	687	53	144	687	123	292	0		
		SB	20	40	20	80	29.7	C	28.8	C	11.0	B	24.6	C			480	44	130	0			25	**19**	**74**
		EB	40	510	140	690	35.1	D	12.6	B	7.9	A	13.2	B			1201	104	208	125	43	**124**	300	31	75
		WB	30	730	50	810	11.1	B	4.9	A	3.9	A	5.1	A			427	43	103	125	18	64	0		
	US 61 at Bush St (Signal)	NB	50	30	30	110	27.3	C	25.2	C	10.1	B	21.8	C	10.9	B	313	49	135	0			25	**21**	**75**
		SB	20	20	20	60	26.6	C	27.4	C	11.9	B	24.7	C			392	27	91	0			25	5	**48**
		EB	50	450	80	580	20.1	C	9.9	A	6.9	A	10.3	B			427	65	158	125	19	51	0		
		WB	20	740	60	820	14.0	B	9.3	A	8.2	A	9.3	A			291	113	205	120	13	79	0		
	US 61 at Plum St (Signal)	NB	590	40	80	710	14.9	B	7.7	A	2.9	A	12.8	B	17.6	B	273	198	**332**	0			0	**23**	**177**
		SB	10	10	10	30	7.0	A	6.9	A	9.3	A	7.8	A			188	7	52	0			50	10	**58**
		EB	20	260	240	520	32.4	C	20.3	C	5.4	A	13.7	B			291	66	141	120	13	57	100	62	**136**
		WB	40	300	10	350	53.9	D	32.4	C	26.0	C	34.4	C			310	94	158	150	37	99	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.2	A	0			0			0		
		EB	0	300	40	340	0.0	A	1.7	A	1.9	A	1.7	A			310		4	0			0		
		WB	20	330	0	350	3.8	A	0.6	A	0.0	A	0.8	A			1803	5	35	0			0		
	3rd St at Plum St (Signal)	NB	20	230	70	320	26.0	C	21.7	C	6.6	A	18.6	B	14.6	B	265	86	194	100	11	72	0		
		SB	150	130	20	300	14.5	B	12.4	B	7.2	A	13.1	B			273	57	163	273	75	179	0		
		EB	10	30	20	60	28.9	C	22.2	C	7.2	A	18.1	B			287	24	73	0			50	11	**38**
		WB	80	140	480	700	23.2	C	21.0	C	9.0	A	13.1	B			299	69	141	150	44	109	0	**106**	**267**
	3rd St at Potter St (2-Way Stop)	NB	0	0	40	40	0.0	A	0.0	A	8.2	A	8.2	A	6.0	A	0			300			25	**24**	**40**
		SB	30	10	10	50	16.6	C	9.1	A	6.3	A	12.5	B			307	29	70	0			307	8	36
		EB	0	250	10	260	0.0	A	0.8	A	0.7	A	0.8	A			299		2	0			0		
		WB	130	680	0	810	8.6	A	6.8	A	0.0	A	7.1	A			0	**24**	**104**	0			0		
	4th St at Plum St (All-Way Stop)	NB	130	270	20	420	11.2	B	9.2	A	6.0	A	9.6	A	8.7	A	348	53	108	150	30	62	0		
		SB	20	180	20	220	6.6	A	9.3	A	6.6	A	8.8	A			265	48	105	125	13	42	0		
		EB	10	30	40	80	5.7	A	7.1	A	8.2	A	7.4	A			342	25	49	0			25	**24**	**60**
		WB	70	70	40	180	6.4	A	7.5	A	8.2	A	7.2	A			312	36	76	0			25	**25**	**63**
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	430	60	100	590	56.9	E	31.6	C	34.6	C	48.3	D	181.2	F	687	86	230	687	277	**586**	0		
		SB	30	70	30	130	32.2	C	24.7	C	18.0	B	24.2	C			480	56	164	0			25	**29**	**75**
		EB	30	1170	270	1,470	315.2	F	381.0	F	382.2	F	379.3	F			1201	**1046**	**1226**	125	43	**174**	300	**276**	**356**
		WB	40	930	40	1,010	48.1	D	12.1	B	10.7	B	13.5	B			427	113	208	125	36	**98**	0		
	US 61 at Bush St (Signal)	NB	100	20	50	170	26.8	C	25.6	C	24.0	C	25.7	C	34.4	C	313	72	157	0			25	**39**	**76**
		SB	40	70	40	150	24.8	C	23.4	C	13.4	B	21.7	C			392	63	168	0			25	**23**	**74**
		EB	20	1140	210	1,370	26.0	C	55.9	E	72.2	E	58.0	E			427	**382**	**526**	125	8	29	0		
		WB	20	890	30	940	43.6	D	8.4	A	6.4	A	9.0	A			291	110	186	120	21	**106**	0		
	US 61 at Plum St (Signal)	NB	480	20	100	600	22.9	C	24.2	C	2.8	A	19.5	B	22.2	C	273	**205**	**379**	0			0	**22**	**208**
		SB	10	70	30	110	14.4	B	13.0	B	8.8	A	11.9	B			188	39	102	0			50	18	**72**
		EB	10	480	670	1,160	25.6	C	16.9	B	27.9	C	23.1	C			291	**238**	**353**	120	10	**95**	100	**143**	**150**
		WB	50	340	20	410	73.8	E	21.0	C	17.7	B	26.6	C			310	88	192	150	50	**154**	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.6	A	0			0			0		
		EB	0	520	60	580	0.0	A	1.8	A	2.1	A	1.8	A			0			0			0		
		WB	50	380	0	430	4.9	A	0.8	A	0.0	A	1.3	A			1799	17	73	0			0		
	3rd St at Plum St (Signal)	NB	60	250	130	440	29.9	C	26.6	C	9.2	A	22.0	C	38.2	D	265	104	**202**	100	40	**127**	0		
		SB	530	250	40	820	83.5	F	31.3	C	49.1	D	66.0	E			273	132	**314**	273	**274**	**311**	0		
		EB	20	240	50	310	34.7	C	32.5	C	15.2	B	29.7	C			287	135	**301**	0			50	35	**100**
		WB	100	120	300	520	41.5	D	24.4	C	6.3	A	17.2	B			299	65	138	150	70	**157**	0	**71**	**153**
	3rd St at Potter St (2-Way Stop)	NB	10	0	130	140	26.8	D	0.0	A	14.8	B	15.7	C	5.3	A	0			300	12	76	25	**46**	**74**
		SB	60	20	10	90	23.7	C	16.6	C	4.7	A	20.2	C			307	46	102	0			307	7	31
		EB	0	860	20	880	0.0	A	1.2	A	1.0	A	1.2	A			299	1	12	0			0		
		WB	90	450	0	540	11.5	B	4.9	A	0.0	A	6.0	A			0	**38**	**124**	0			0		
	4th St at Plum St (All-Way Stop)	NB	140	330	110	580	15.3	C	18.9	C	15.4	C	17.4	C	15.3	C	348	109	**269**	150	46	**173**	0		
		SB	40	330	30	400	9.6	A	18.5	C	15.7	C	17.3	C			265	90	**232**	125	23	**123**	0		
		EB	60	130	170	360	12.9	B	13.5	B	12.7	B	13.0	B			342	60	144	0			25	**53**	**76**
		WB	70	90	50	210	9.7	A	10.6	B	9.1	A	10.0	B			312	43	95	0			25	**26**	**64**

Table 4

Mitigated 2013

No Build 2042 Conditions - Mitigated

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	290	80	30	400	36.9	D	25.2	C	15.5	B	31.5	C	13.6	B	687	53	142	687	124	258	0		
		SB	20	40	20	80	25.2	C	24.7	C	14.0	B	21.7	C			480	47	142	0			25	26	75
		EB	40	510	140	690	39.4	D	13.4	B	7.8	A	13.9	B			1201	100	218	125	48	136	300	30	75
		WB	30	730	50	810	12.9	B	5.1	A	4.6	A	5.4	A			427	43	129	125	20	78	0		
	US 61 at Bush St (Signal)	NB	50	30	30	110	26.7	C	23.5	C	10.6	B	21.3	C	11.2	B	313	49	130	0			25	24	76
		SB	20	20	20	60	23.4	C	20.2	C	9.0	A	18.9	B			392	22	61	0			25	7	47
		EB	50	450	80	580	21.9	C	10.3	B	8.1	A	10.9	B			427	67	172	125	21	71	0		
		WB	20	740	60	820	14.1	B	9.7	A	9.7	A	9.8	A			281	121	220	120	15	110	0		
	US 61 at Plum St (Signal)	NB	590	40	80	710	16.8	B	10.6	B	9.7	A	15.3	B	19.4	B	274	230	410	0			100	34	150
		SB	10	10	10	30	8.2	A	4.4	A	8.2	A	7.2	A			188	6	50	0			50	12	76
		EB	20	260	240	520	27.0	C	22.8	C	5.8	A	15.1	B			281	78	200	120	15	56	120	60	161
		WB	40	300	10	350	82.4	F	31.1	C	18.0	B	36.1	D			309	92	194	150	47	152	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.6	A	0			0			0		
		EB	0	300	40	340	0.0	A	2.3	A	2.1	A	2.3	A			309	2	36	0			0		
		WB	20	330	0	350	4.4	A	0.6	A	0.0	A	0.8	A			1804	6	48	0			0		
	3rd St at Plum St (Signal)	NB	20	230	70	320	23.3	C	25.0	C	17.6	B	23.3	C	17.5	B	265	139	271	100	12	95	0		
		SB	150	130	20	300	13.8	B	9.7	A	3.6	A	11.2	B			274	44	123	274	53	118	0		
		EB	10	30	20	60	63.6	E	19.6	B	7.8	A	24.3	C			280	19	69	50	11	43	50	9	49
		WB	80	140	480	700	23.7	C	22.0	C	14.2	B	17.0	B			305	68	195	150	45	128	0	138	296
	3rd St at Potter St (2-Way Stop)	NB	0	0	40	40	0.0	A	0.0	A	7.6	A	7.6	A	5.8	A	0			300			25	20	40
		SB	30	10	10	50	22.1	C	9.6	A	5.9	A	15.2	C			305	23	77	0			305	7	32
		EB	0	250	10	260	0.0	A	1.1	A	0.8	A	1.1	A			0			0			0		
		WB	130	680	0	810	7.4	A	6.2	A	0.0	A	6.4	A			1532	50	293	0			0		
	4th St at Plum St (All-Way Stop)	NB	130	270	20	420	11.4	B	10.4	B	5.8	A	10.5	B	9.5	A	348	61	144	150	32	87	0		
		SB	20	180	20	220	7.1	A	10.1	B	6.5	A	9.4	A			265	57	135	125	15	38	0		
		EB	10	30	40	80	5.8	A	7.1	A	7.9	A	7.3	A			342	24	53	0			25	22	68
		WB	70	70	40	180	7.5	A	8.3	A	9.2	A	8.2	A			324	44	93	0			25	29	72
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	430	60	100	590	44.4	D	22.6	C	19.8	B	35.6	D	27.1	C	687	70	170	687	221	471	0		
		SB	30	70	30	130	27.7	C	23.4	C	16.7	B	22.7	C			480	57	143	0			25	28	75
		EB	30	1170	270	1,470	48.1	D	35.2	D	18.9	B	32.0	C			1201	293	623	125	35	144	300	117	350
		WB	40	930	40	1,010	57.8	E	15.5	B	15.3	B	17.1	B			427	145	222	125	40	128	0		
	US 61 at Bush St (Signal)	NB	100	20	50	170	32.1	C	26.1	C	25.0	C	28.9	C	16.9	B	313	74	201	0			25	40	75
		SB	40	70	40	150	31.7	C	25.4	C	14.0	B	24.7	C			392	70	142	0			25	27	74
		EB	20	1140	210	1,370	20.4	C	20.1	C	26.1	C	21.0	C			427	208	456	125	11	41	0		
		WB	20	890	30	940	45.6	D	7.0	A	6.6	A	7.7	A			281	78	186	120	16	60	0		
	US 61 at Plum St (Signal)	NB	480	20	100	600	31.2	C	37.9	D	14.1	B	28.4	C	20.9	C	274	233	428	0			100	60	150
		SB	10	70	30	110	14.1	B	12.7	B	9.6	A	11.8	B			188	37	108	0			50	19	70
		EB	10	480	670	1,160	22.7	C	13.9	B	9.3	A	11.4	B			281	102	197	120	8	72	120	81	169
		WB	50	340	20	410	177.1	F	22.9	C	17.8	B	40.5	D			309	91	237	150	80	180	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	2.0	A	0			0			0		
		EB	0	520	60	580	0.0	A	2.3	A	2.5	A	2.3	A			309	2	44	0			0		
		WB	50	380	0	430	5.3	A	1.0	A	0.0	A	1.5	A			1808	18	77	0			0		
	3rd St at Plum St (Signal)	NB	60	250	130	440	37.0	D	35.1	D	26.7	C	33.0	C	25.1	C	265	199	274	100	51	150	0		
		SB	530	250	40	820	28.6	C	8.7	A	5.8	A	20.8	C			274	76	259	274	146	245	0		
		EB	20	240	50	310	54.7	D	28.0	C	18.8	B	27.9	C			280	129	275	50	19	87	50	42	100
		WB	100	120	300	520	55.2	E	26.6	C	11.2	B	23.7	C			305	64	175	150	82	174	0	94	209
	3rd St at Potter St (2-Way Stop)	NB	10	0	130	140	27.3	D	0.0	A	15.0	C	15.9	C	6.3	A	0			300	10	61	25	46	76
		SB	60	20	10	90	40.5	E	27.2	D	4.5	A	33.4	D			305	52	153	0			305	8	28
		EB	0	860	20	880	0.0	A	1.6	A	1.2	A	1.6	A			305	1	25	0			0		
		WB	90	450	0	540	10.0	B	5.6	A	0.0	A	6.3	A			1540	65	252	0			0		
	4th St at Plum St (All-Way Stop)	NB	140	330	110	580	39.5	E	59.4	F	48.5	E	52.6	F	34.0	D	348	206	365	150	95	200	0		
		SB	40	330	30	400	15.8	C	36.9	E	34.2	D	34.5	D			265	163	362	125	42	174	0		
		EB	60	130	170	360	14.9	B	16.4	C	15.1	C	15.5	C			342	70	158	0			25	58	76
		WB	70	90	50	210	13.1	B	12.7	B	12.6	B	12.8	B			324	59	121	0			25	34	71

NOTES: Main/Plum Intersection: Add 120' Eastbound Right Turn Lane and Shared Through-Right (Left, Through, Through-Right, Right), Northbound 100' Right Turn Lane
Plum/3rd Intersection: Add Southbound Left Turn Lane (Left, Left, Through-Right), Westbound Full Right Turn Lane, Eastbound 50' Left Turn Lane
Main/East/West Intersection: Extend Eastbound Right Turn Lane to 300'

Appendix C

Concept Alternative Traffic Operations

Table 1a

Concept 2

Build 2022 Three Leg At Grade Intersection **US 63 River Bridge 2-Lane**

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	280	80	20	380	26.8	C	18.7	B	7.7	A	22.9	C	12.2	B	339	40	114	339	87	212	0		
		SB	20	40	20	80	21.4	C	22.3	C	12.0	B	19.4	B			480	43	131	0			25	18	73
		EB	50	440	140	630	37.8	D	12.8	B	7.9	A	13.5	B			1201	81	173	125	42	127	50	40	99
		WB	40	620	40	700	12.5	B	5.7	A	3.9	A	6.1	A			427	45	95	125	26	71	0		
	US 61 at Bush St (Signal)	NB	40	20	45	105	21.0	C	21.3	C	9.1	A	15.9	B	8.7	A	313	34	101	0			25	25	73
		SB	10	20	10	40	24.0	C	17.9	B	9.1	A	17.7	B			392	19	64	0			25	5	39
		EB	40	370	70	480	20.5	C	9.3	A	4.6	A	9.6	A			427	40	112	125	21	64	0		
		WB	75	640	50	765	12.1	B	6.4	A	5.2	A	6.8	A			291	48	111	120	25	69	0		
	US 61 at Plum St (Signal)	NB	145	30	125	300	21.9	C	10.6	B	5.2	A	13.3	B	14.0	B	300	87	178	0			300	44	111
		SB	10	10	10	30	23.0	C	15.0	B	10.3	B	15.1	B			187	14	63	0			50	8	53
		EB	20	350	85	455	26.7	C	17.2	B	9.4	A	16.2	B			291	67	175	120	12	35	0		
		WB	215	670	10	895	17.3	B	11.8	B	10.0	B	13.1	B			312	103	189	150	75	172	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.1	A	0			0			0		
		EB	0	465	10	475	0.0	A	1.3	A	1.4	A	1.3	A			0			0			0		
		WB	30	885	0	915	4.6	A	0.9	A	0.0	A	1.0	A			0			75	10	44	0		
	3rd St at Plum St (Signal)	NB	20	250	0	270	13.6	B	11.9	B	0.0	A	12.0	B	8.5	A	289	64	152	100	9	37	0		
		SB	100	175	45	320	8.7	A	5.0	A	1.7	A	5.6	A			320	24	82	75	30	74	0		
		EB	25	0	20	45	23.3	C	0.0	A	7.1	A	15.6	B			287	16	65	0			50	11	48
		WB	5	0	35	40	0.0	A	0.6	A	3.1	A	2.5	A			300	14	31	0			300		
	3rd St at Potter St (2-Way Stop)	NB	30	0	0	30	4.0	A	0.0	A	0.0	A	4.0	A	2.3	A	300			300	20	36	0		
		SB	0	30	10	40	0.0	A	5.9	A	3.2	A	5.3	A			314	17	35	0			314	7	31
		EB	0	0	100	100	0.0	A	0.0	A	0.7	A	0.7	A			311		5	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St (All-Way Stop)	NB	110	220	10	340	10.7	B	8.4	A	5.1	A	9.1	A	8.1	A	348	45	95	150	28	53	0		
		SB	20	150	20	190	6.1	A	8.1	A	4.6	A	7.5	A			289	38	87	125	15	34	0		
		EB	10	20	30	60	5.4	A	6.4	A	8.0	A	7.1	A			342	20	40	0			25	20	49
		WB	60	60	30	150	6.1	A	7.2	A	8.3	A	7.0	A			325	39	73	0			25	20	36
	US 61 at US 63 New Intersection (Signal)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	13.2	B	0			0			0		
		SB	40	0	620	660	45.8	D	0.0	A	10.9	B	12.9	B			1000			1000	34	96	1000	142	265
		EB	245	220	0	465	31.3	C	0.5	A	0.0	A	16.8	B			448	5	32	280	152	261	0		
		WB	0	295	15	310	0.0	A	8.8	A	5.3	A	8.6	A			1261	48	119	0			300	7	54
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	420	50	80	550	38.4	D	22.5	C	20.4	C	32.6	C	67.7	E	339	58	160	339	181	346	0		
		SB	30	70	30	130	24.1	C	19.6	B	14.7	B	19.4	B			480	53	157	0			25	23	75
		EB	40	1010	270	1,320	123.0	F	127.0	F	103.1	F	121.6	F			1201	636	1098	125	46	174	50	75	100
		WB	45	780	40	865	44.9	D	10.6	B	9.1	A	12.3	B			427	99	183	125	40	121	0		
	US 61 at Bush St (Signal)	NB	80	20	130	230	35.2	D	32.0	C	34.0	C	34.2	C	36.3	D	313	87	254	0			25	60	76
		SB	40	60	30	130	44.0	D	32.7	C	21.9	C	33.8	C			392	73	200	0			25	26	74
		EB	20	950	180	1,150	69.2	E	62.7	E	39.1	D	59.1	E			427	380	488	125	30	173	0		
		WB	55	765	30	850	32.5	C	6.4	A	4.7	A	8.1	A			291	74	130	120	36	96	0		
	US 61 at Plum St (Signal)	NB	225	10	330	565	36.0	D	12.1	B	29.0	C	30.6	C	31.7	C	300	152	248	0			300	160	336
		SB	10	50	30	90	33.7	C	24.9	C	9.9	A	20.7	C			187	38	111	0			50	22	94
		EB	10	900	150	1,060	51.9	D	45.1	D	25.1	C	42.6	D			291	303	357	120	15	167	0		
		WB	190	525	10	725	46.5	D	6.9	A	3.0	A	17.6	B			312	50	138	150	107	181	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	8.0	A	0			0			0		
		EB	0	1230	10	1,240	0.0	A	11.8	B	1.8	A	11.7	B			312	232	349	0			0		
		WB	35	705	0	740	14.5	B	1.2	A	0.0	A	1.8	A			0			75	19	52	0		
	3rd St at Plum St (Signal)	NB	50	310	10	370	25.8	C	20.8	C	12.6	B	21.2	C	20.1	C	289	121	250	100	28	92	0		
		SB	85	290	65	440	21.2	C	17.1	B	12.4	B	17.1	B			320	117	257	75	43	114	0		
		EB	110	10	50	170	37.8	D	40.7	D	18.8	B	32.5	C			287	81	238	0			50	32	100
		WB	10	15	145	170	21.9	C	30.6	C	11.1	B	13.2	B			300	57	153	150	7	63	300		
	3rd St at Potter St (2-Way Stop)	NB	120	0	0	120	4.4	A	0.0	A	0.0	A	4.4	A	3.0	A	300			300	35	60	0		
		SB	0	35	10	45	0.0	A	7.3	A	3.4	A	6.5	A			314	22	62	0			314	8	31
		EB	0	0	85	85	0.0	A	0.0	A	0.9	A	0.9	A			311		7	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St (All-Way Stop)	NB	120	270	90	480	13.3	B	12.2	B	8.6	A	11.8	B	12.0	B	348	69	158	150	35	75	0		
		SB	30	280	30	340	8.7	A	15.8	C	11.6	B	14.9	B			289	86	180	125	18	93	0		
		EB	50	110	140	300	9.4	A	10.8	B	11.2	B	10.7	B			342	51	123	0			25	43	76
		WB	60	80	40	180	8.5	A	9.8	A	9.4	A	9.3	A			325	47	106	0			25	27	62
	US 61 at US 63 New Intersection (Signal)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	26.9	C	0			0			0		
		SB	40	0	410	450	44.3	D	0.0	A	4.5	A	7.8	A			1000			1000	28	90	1000	74	158
		EB	820	410	0	1,230	52.9	D	1.0	A	0.0	A	35.2	D			448	385	469	280	310	330	0		
		WB	0	330	40	370	0.0	A	25.3	C	6.1	A	23.0	C			1261	87	170	0			300	22	73

Table 1b

Concept 2

Build 2042 Three Leg At Grade Intersection **US 63 River Bridge 2-Lane**

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	320	90	30	440	35.9	D	23.8	C	10.7	B	30.0	C	12.9	B	339	51	124	339	132	286	0		
		SB	20	40	20	80	30.9	C	26.0	C	14.8	B	24.2	C			480	46	130	0			25	20	75
		EB	50	490	160	700	39.1	D	11.9	B	8.5	A	13.1	B			1201	84	184	125	44	129	50	40	100
		WB	55	690	50	795	13.3	B	4.5	A	4.1	A	5.1	A			427	41	96	125	30	85	0		
	US 61 at Bush St (Signal)	NB	50	30	45	125	25.5	C	22.7	C	9.0	A	18.3	B	8.9	A	313	43	137	0			25	27	76
		SB	20	20	10	50	24.0	C	21.5	C	11.1	B	21.3	C			392	25	69	0			25	6	47
		EB	40	430	70	540	22.4	C	9.0	A	5.0	A	9.4	A			427	45	131	125	20	63	0		
		WB	90	755	70	915	12.4	B	6.3	A	5.8	A	6.8	A			291	57	124	120	27	76	0		
	US 61 at Plum St (Signal)	NB	175	40	155	370	27.0	C	15.0	B	6.4	A	16.5	B	15.0	B	300	118	239	0			300	49	118
		SB	10	10	10	30	22.2	C	21.6	C	11.4	B	18.1	B			187	13	58	0			50	7	63
		EB	20	415	100	535	22.8	C	17.3	B	9.6	A	16.0	B			291	85	168	120	15	68	0		
		WB	260	810	10	1,080	19.5	B	12.1	B	8.8	A	13.8	B			312	131	234	150	89	176	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.2	A	0			0			0		
		EB	0	550	20	570	0.0	A	1.3	A	1.2	A	1.3	A			0			0			0		
		WB	30	1060	0	1,090	5.0	A	1.0	A	0.0	A	1.1	A			0			75	11	40	0		
	3rd St at Plum St (Signal)	NB	20	300	0	320	13.7	B	11.7	B	0.0	A	11.8	B	8.7	A	289	80	196	100	9	54	0		
		SB	110	210	60	380	8.7	A	3.9	A	1.8	A	5.0	A			320	22	112	75	36	96	0		
		EB	25	0	20	45	28.8	C	0.0	A	7.9	A	19.5	B			287	20	65	0			50	12	44
		WB	0	5	55	60	27.7	C	0.0	A	4.5	A	7.0	A			300	22	44	150	5	35	300		
	3rd St at Potter St (2-Way Stop)	NB	40	0	0	40	4.0	A	0.0	A	0.0	A	4.0	A	2.4	A	300			300	25	50	0		
		SB	0	30	10	40	0.0	A	5.0	A	3.2	A	4.7	A			314	22	35	0			314	7	31
		EB	0	0	120	120	0.0	A	0.0	A	0.8	A	0.8	A			311		9	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St (All-Way Stop)	NB	130	270	20	420	11.1	B	9.4	A	6.1	A	9.8	A	8.7	A	348	52	108	150	29	65	0		
		SB	20	180	20	220	5.5	A	8.4	A	5.4	A	7.9	A			289	46	109	125	12	34	0		
		EB	10	30	40	80	5.6	A	7.2	A	8.3	A	7.6	A			342	24	50	0			25	26	67
		WB	70	70	40	180	6.5	A	7.9	A	8.9	A	7.6	A			325	42	76	0			25	24	59
	US 61 at US 63 New Intersection (Signal)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	14.4	B	0			0			0		
		SB	50	0	760	810	45.8	D	0.0	A	14.4	B	15.9	B			1000			1000	37	115	1000	193	273
		EB	300	250	0	550	24.8	C	0.6	A	0.0	A	13.6	B			448	4	38	280	178	267	0		
		WB	0	330	20	350	0.0	A	12.5	B	5.9	A	12.1	B			1261	63	146	0			300	12	64
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	470	60	100	630	75.8	E	43.8	D	38.2	D	63.5	E	297.2	F	339	77	162	339	280	354	0		
		SB	30	80	40	150	28.2	C	24.6	C	19.1	B	23.7	C			480	60	146	0			25	31	75
		EB	40	1130	300	1,470	681.1	F	724.9	F	679.2	F	714.1	F			1201	1116	1229	125	60	174	50	68	100
		WB	60	880	40	980	33.7	C	8.8	A	8.8	A	10.0	B			427	96	234	125	37	135	0		
	US 61 at Bush St (Signal)	NB	90	20	175	285	246.7	F	249.6	F	266.7	F	259.3	F	74.5	E	313	265	329	0			25	72	75
		SB	50	70	30	150	177.0	F	130.4	F	118.1	F	140.9	F			392	181	375	0			25	34	75
		EB	20	1100	200	1,320	87.6	F	87.4	F	57.3	E	82.8	F			427	438	496	125	31	174	0		
		WB	75	900	30	1,005	37.7	D	6.8	A	5.7	A	9.2	A			291	95	258	120	48	130	0		
	US 61 at Plum St (Signal)	NB	270	20	415	705	59.3	E	37.3	D	41.4	D	47.9	D	37.5	D	300	213	250	0			300	269	341
		SB	10	70	30	110	35.0	D	29.8	C	11.7	B	24.8	C			187	54	128	0			50	22	77
		EB	10	1085	180	1,275	53.6	D	51.7	D	28.2	C	48.5	D			291	307	356	120	5	78	0		
		WB	215	625	20	860	50.9	D	7.0	A	5.3	A	17.9	B			312	68	207	150	123	198	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	7.9	A	0			0			0		
		EB	0	1475	25	1,500	0.0	A	12.0	B	1.6	A	11.9	B			312	269	340	0			0		
		WB	45	830	0	875	19.1	C	1.4	A	0.0	A	2.4	A			448	2	45	75	29	71	0		
	3rd St at Plum St (Signal)	NB	60	370	10	440	39.3	D	29.3	C	25.9	C	30.5	C	29.5	C	289	177	287	100	48	149	0		
		SB	90	335	70	495	29.4	C	21.6	C	14.6	B	21.7	C			320	164	315	75	50	125	0		
		EB	135	10	50	195	68.3	E	65.9	E	35.2	D	60.1	E			287	123	295	0			50	38	100
		WB	15	15	170	200	19.4	B	23.3	C	16.4	B	17.1	B			300	71	163	150	8	78	300		
	3rd St at Potter St (2-Way Stop)	NB	140	0	0	140	4.6	A	0.0	A	0.0	A	4.6	A	3.6	A	300			300	36	65	0		
		SB	0	40	10	50	0.0	A	5.7	A	3.6	A	5.4	A			314	23	45	0			314	8	31
		EB	0	0	90	90	0.0	A	0.8	A	1.0	A	1.0	A			311		2	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St (All-Way Stop)	NB	140	330	110	580	20.8	C	30.8	D	27.7	D	27.8	D	21.2	C	348	148	318	150	64	173	0		
		SB	40	330	30	400	11.8	B	24.8	C	22.1	C	23.3	C			289	125	268	125	31	132	0		
		EB	60	130	170	360	15.7	C	15.7	C	13.3	B	14.6	B			342	69	200	0			25	51	75
		WB	70	90	50	210	10.2	B	11.5	B	12.3	B	11.2	B			325	52	118	0			25	32	73
	US 61 at US 63 New Intersection (Signal)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	27.6	C	0			0			0		
		SB	50	0	490	540	49.1	D	0.0	A	6.2	A	10.0	B			1000			1000	37	88	1000	101	250
		EB	1005	470	0	1,475	50.8	D	1.4	A	0.0	A	34.9	C			448	424	466	280	321	330	0		
		WB	0	385	45	430	0.0	A	32.0	C	6.5	A	29.2	C			1261	115	240	0			300	26	73

Table 1c

Concept 2

Build 2022 Three Leg At Grade Intersection **US 63 River Bridge 4-Lane**

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	280	80	20	380	27.3	C	20.2	C	9.5	A	23.6	C	12.5	B	339	42	123	339	89	226	0		
		SB	20	40	20	80	22.8	C	20.5	C	13.2	B	18.9	B			480	41	135	0			25	24	76
		EB	50	440	140	630	40.5	D	13.4	B	8.7	A	14.6	B			1201	86	175	125	47	128	50	44	100
		WB	40	620	40	700	11.2	B	5.7	A	5.3	A	6.0	A			427	46	90	125	21	74	0		
	US 61 at Bush St (Signal)	NB	40	20	45	105	24.4	C	21.4	C	9.0	A	16.9	B	9.0	A	313	39	122	0			25	26	75
		SB	10	20	10	40	26.0	C	18.0	B	11.2	B	17.9	B			392	18	65	0			25	7	39
		EB	40	370	70	480	18.8	B	9.3	A	4.8	A	9.5	A			427	43	131	125	19	54	0		
		WB	75	640	50	765	12.0	B	6.8	A	5.7	A	7.2	A			291	55	126	120	23	59	0		
	US 61 at Plum St (Signal)	NB	145	30	125	300	22.0	C	11.7	B	5.0	A	13.8	B	14.5	B	300	95	202	0			300	40	86
		SB	10	10	10	30	21.6	C	21.7	C	8.4	A	16.9	B			187	17	71	0			50	9	68
		EB	20	350	85	455	25.3	C	17.8	B	9.5	A	16.6	B			291	74	175	120	13	68	0		
		WB	215	670	10	895	19.2	B	12.0	B	10.0	B	13.7	B			312	104	191	150	81	180	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.0	A	0			0			0		
		EB	0	465	10	475	0.0	A	1.3	A	1.0	A	1.3	A			0			0			0		
		WB	30	885	0	915	5.2	A	0.8	A	0.0	A	0.9	A			471		10	75	12	44	0		
	3rd St at Plum St (Signal)	NB	20	250	0	270	13.6	B	12.1	B	0.0	A	12.2	B	8.9	A	289	71	183	100	9	38	0		
		SB	100	175	45	320	8.7	A	4.7	A	2.1	A	5.6	A			320	27	132	75	34	87	0		
		EB	25	0	20	45	26.4	C	0.0	A	7.4	A	17.8	B			287	18	70	0			50	11	55
		WB	5	0	35	40	0.0	A	0.5	A	4.1	A	3.3	A			300	16	36	0			300		
	3rd St at Potter St (2-Way Stop)	NB	30	0	0	30	3.9	A	0.0	A	0.0	A	3.9	A	2.2	A	300			300	19	31	0		
		SB	0	30	10	40	0.0	A	5.5	A	3.2	A	5.1	A			314	20	35	0			314	6	31
		EB	0	0	100	100	0.0	A	0.0	A	0.7	A	0.7	A			311		4	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St (All-Way Stop)	NB	110	220	10	340	10.5	B	8.1	A	4.8	A	8.7	A	7.8	A	348	44	96	150	29	66	0		
		SB	20	150	20	190	5.8	A	7.7	A	4.4	A	7.2	A			289	39	84	125	12	30	0		
		EB	10	20	30	60	5.1	A	6.7	A	7.8	A	6.9	A			342	20	36	0			25	23	51
		WB	60	60	30	150	5.7	A	7.3	A	8.1	A	6.9	A			325	38	72	0			25	22	40
	US 61 at US 63 New Intersection (Signal)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	11.7	B	0			0			0		
		SB	40	0	620	660	46.0	D	0.0	A	11.7	B	14.0	B			1000			1000	43	109	1000	137	370
		EB	245	220	0	465	19.0	B	0.8	A	0.0	A	10.6	B			471	7	52	280	80	157	0		
		WB	0	295	15	310	0.0	A	8.4	A	5.9	A	8.3	A			1246	47	117	0			300	8	66
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	420	50	80	550	34.8	C	19.5	B	13.4	B	28.3	C	20.9	C	339	50	175	339	165	338	0		
		SB	30	70	30	130	20.0	C	20.8	C	13.1	B	18.9	B			480	51	120	0			25	22	69
		EB	40	1010	270	1,320	41.1	D	26.1	C	19.2	B	25.1	C			1201	231	428	125	39	138	50	78	100
		WB	45	780	40	865	38.0	D	10.2	B	8.7	A	11.7	B			427	95	165	125	39	96	0		
	US 61 at Bush St (Signal)	NB	80	20	130	230	31.5	C	26.3	C	19.1	B	23.9	C	17.6	B	313	69	192	0			25	56	75
		SB	40	60	30	130	29.6	C	24.3	C	13.5	B	23.2	C			392	56	130	0			25	26	75
		EB	20	950	180	1,150	31.8	C	24.0	C	14.9	B	22.7	C			427	165	373	125	19	119	0		
		WB	55	765	30	850	32.5	C	6.7	A	4.2	A	8.4	A			291	78	139	120	35	98	0		
	US 61 at Plum St (Signal)	NB	225	10	330	565	31.6	C	8.9	A	13.6	B	20.3	C	22.5	C	300	135	240	0			300	124	301
		SB	10	50	30	90	30.5	C	22.9	C	10.1	B	19.4	B			187	38	112	0			50	19	62
		EB	10	900	150	1,060	35.5	D	27.3	C	18.0	B	26.1	C			291	234	332	120	10	112	0		
		WB	190	525	10	725	49.2	D	8.2	A	3.4	A	19.2	B			312	69	281	150	114	199	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	2.0	A	0			0			0		
		EB	0	1230	10	1,240	0.0	A	2.1	A	1.5	A	2.1	A			312	3	73	0			0		
		WB	35	705	0	740	16.3	C	1.1	A	0.0	A	1.8	A			0			75	20	74	0		
	3rd St at Plum St (Signal)	NB	50	310	10	370	27.6	C	19.6	B	12.5	B	20.4	C	17.6	B	289	123	250	100	30	136	0		
		SB	85	290	65	440	22.6	C	16.8	B	11.1	B	17.1	B			320	123	254	75	48	125	0		
		EB	110	10	50	170	24.8	C	25.1	C	10.2	B	20.5	C			287	71	147	0			50	33	99
		WB	10	15	145	170	21.2	C	19.5	B	7.7	A	9.7	A			300	49	123	150	7	39	300		
	3rd St at Potter St (2-Way Stop)	NB	120	0	0	120	4.3	A	0.0	A	0.0	A	4.3	A	3.0	A	300			300	35	61	0		
		SB	0	35	10	45	0.0	A	7.2	A	3.5	A	6.3	A			314	23	55	0			314	10	36
		EB	0	0	85	85	0.0	A	0.0	A	0.9	A	0.9	A			311		7	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St (All-Way Stop)	NB	120	270	90	480	13.4	B	14.0	B	9.9	A	13.0	B	12.9	B	348	81	192	150	34	70	0		
		SB	30	280	30	340	9.2	A	17.1	C	12.8	B	16.1	C			289	95	216	125	22	143	0		
		EB	50	110	140	300	9.7	A	11.2	B	11.1	B	10.9	B			342	51	114	0			25	44	75
		WB	60	80	40	180	8.6	A	9.6	A	9.5	A	9.2	A			325	46	92	0			25	26	57
	US 61 at US 63 New Intersection (Signal)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	16.3	B	0			0			0		
		SB	40	0	410	450	43.3	D	0.0	A	6.1	A	9.5	A			1000			1000	38	100	1000	79	195
		EB	820	410	0	1,230	27.5	C	0.9	A	0.0	A	18.4	B			471	14	215	280	182	328	0		
		WB	0	330	40	370	0.0	A	18.8	B	12.5	B	18.1	B			1246	77	165	0			300	20	78

Table 1d

Concept 2

Build 2042 Three Leg At Grade Intersection **US 63 River Bridge 4-Lane**

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	320	90	30	440	34.9	C	25.0	C	11.6	B	29.7	C	13.2	B	339	59	153	339	126	272	0		
		SB	20	40	20	80	32.9	C	26.3	C	13.4	B	24.8	C			480	49	135	0			25	20	72
		EB	50	490	160	700	46.9	D	12.6	B	9.0	A	14.1	B			1201	89	192	125	46	129	50	49	100
		WB	55	690	50	795	12.7	B	4.6	A	4.3	A	5.1	A			427	44	92	125	30	88	0		
	US 61 at Bush St (Signal)	NB	50	30	45	125	25.7	C	22.0	C	9.7	A	18.8	B	9.1	A	313	47	121	0			25	28	75
		SB	20	20	10	50	26.0	C	25.2	C	9.1	A	22.9	C			392	26	77	0			25	5	39
		EB	40	430	70	540	27.5	C	8.8	A	4.9	A	9.7	A			427	44	112	125	23	67	0		
		WB	90	755	70	915	13.3	B	6.5	A	5.0	A	6.9	A			291	56	133	120	27	72	0		
	US 61 at Plum St (Signal)	NB	175	40	155	370	26.8	C	16.7	B	6.4	A	17.0	B	15.1	B	300	120	238	0			300	52	150
		SB	10	10	10	30	23.2	C	18.8	B	11.1	B	18.0	B			187	15	76	0			50	7	58
		EB	20	415	100	535	22.0	C	16.8	B	10.8	B	15.9	B			291	83	195	120	10	58	0		
		WB	260	810	10	1,080	19.9	B	12.2	B	11.4	B	13.9	B			312	132	202	150	90	180	0		
	US 61 at Potter St	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.3	A	0			0			0		
	(2-Way Stop)	EB	0	550	20	570	0.0	A	1.4	A	1.1	A	1.4	A			312		4	0			0		
		WB	30	1060	0	1,090	6.6	A	1.0	A	0.0	A	1.2	A			0			75	14	43	0		
	3rd St at Plum St (Signal)	NB	20	300	0	320	16.1	B	11.0	B	0.0	A	11.4	B	8.3	A	289	76	183	100	12	46	0		
		SB	110	210	60	380	8.4	A	3.6	A	1.7	A	4.7	A			320	18	88	75	35	87	0		
		EB	25	0	20	45	28.6	C	0.0	A	7.0	A	18.6	B			287	18	74	0			50	9	31
		WB	0	5	55	60	38.1	D	0.0	A	4.4	A	7.0	A			300	21	48	150	4	31	300		
	3rd St at Potter St	NB	40	0	0	40	4.0	A	0.0	A	0.0	A	4.0	A	2.4	A	300			300	23	46	0		
	(2-Way Stop)	SB	0	30	10	40	0.0	A	4.9	A	3.0	A	4.6	A			314	22	46	0			314	9	31
		EB	0	0	120	120	0.0	A	0.0	A	0.8	A	0.8	A			311		6	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St	NB	130	270	20	420	11.1	B	9.1	A	5.9	A	9.5	A	8.4	A	348	52	90	150	29	51	0		
	(All-Way Stop)	SB	20	180	20	220	5.9	A	8.0	A	4.6	A	7.6	A			289	41	86	125	12	26	0		
		EB	10	30	40	80	5.5	A	6.9	A	8.1	A	7.3	A			342	23	55	0			25	23	64
		WB	70	70	40	180	6.4	A	7.5	A	8.5	A	7.3	A			325	40	63	0			25	24	36
	US 61 at US 63 New Intersection (Signal)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	15.9	B	0			0			0		
		SB	50	0	760	810	49.7	D	0.0	A	19.6	B	21.5	C			1000			1000	69	375	1000	224	598
		EB	300	250	0	550	17.4	B	0.7	A	0.0	A	9.7	A			471	8	46	280	95	182	0		
		WB	0	330	20	350	0.0	A	12.8	B	7.0	A	12.4	B			1246	65	135	0			300	12	59
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	470	60	100	630	79.6	E	45.4	D	41.9	D	66.8	E	123.2	F	339	82	256	339	279	365	0		
		SB	30	80	40	150	29.4	C	29.1	C	19.3	B	26.6	C			480	66	160	0			25	31	75
		EB	40	1130	300	1,470	254.6	F	240.5	F	217.2	F	236.2	F			1201	961	1229	125	46	174	50	76	100
		WB	60	880	40	980	61.4	E	8.8	A	6.5	A	11.7	B			427	101	195	125	56	126	0		
	US 61 at Bush St (Signal)	NB	90	20	175	285	45.6	D	42.0	D	42.0	D	43.2	D	33.9	C	313	144	279	0			25	69	75
		SB	50	70	30	150	42.6	D	36.1	D	17.0	B	34.2	C			392	81	187	0			25	25	75
		EB	20	1100	200	1,320	74.8	E	55.9	E	38.7	D	53.5	D			427	415	489	125	39	174	0		
		WB	75	900	30	1,005	32.1	C	5.5	A	4.5	A	7.5	A			291	78	158	120	44	123	0		
	US 61 at Plum St (Signal)	NB	270	20	415	705	66.8	E	46.8	D	27.2	C	43.0	D	32.6	C	300	209	250	0			300	255	353
		SB	10	70	30	110	32.6	C	30.7	C	14.2	B	26.8	C			187	61	146	0			50	21	100
		EB	10	1085	180	1,275	45.5	D	38.1	D	24.7	C	36.3	D			291	305	344	120	11	140	0		
		WB	215	625	20	860	56.5	E	7.8	A	5.9	A	19.8	B			312	85	270	150	127	199	0		
	US 61 at Potter St	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	2.7	A	0			0			0		
	(2-Way Stop)	EB	0	1475	25	1,500	0.0	A	3.0	A	1.3	A	3.0	A			312	38	323	0			0		
		WB	45	830	0	875	21.8	C	1.3	A	0.0	A	2.3	A			471	3	43	75	28	65	0		
	3rd St at Plum St (Signal)	NB	60	370	10	440	36.8	D	32.5	C	26.0	C	32.9	C	33.9	C	289	186	302	100	47	149	0		
		SB	90	335	70	495	28.7	C	22.3	C	18.9	B	22.9	C			320	185	331	75	52	125	0		
		EB	135	10	50	195	84.4	F	88.8	F	44.1	D	73.9	E			287	129	240	0			50	44	100
		WB	15	15	170	200	25.0	C	33.6	C	22.3	C	23.3	C			300	82	215	150	7	73	300		
	3rd St at Potter St	NB	140	0	0	140	4.5	A	0.0	A	0.0	A	4.5	A	3.4	A	300			300	38	56	0		
	(2-Way Stop)	SB	0	40	10	50	0.0	A	5.4	A	3.8	A	5.2	A			314	24	40	0			314	8	31
		EB	0	0	90	90	0.0	A	0.8	A	1.0	A	1.0	A			311		2	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St	NB	140	330	110	580	26.7	D	36.5	E	33.2	D	33.4	D	24.8	C	348	142	338	150	68	200	0		
	(All-Way Stop)	SB	40	330	30	400	12.0	B	29.8	D	26.3	D	28.0	D			289	154	295	125	34	174	0		
		EB	60	130	170	360	15.4	C	14.9	B	14.9	B	15.0	C			342	69	185	0			25	55	76
		WB	70	90	50	210	10.9	B	11.0	B	11.5	B	11.1	B			325	52	115	0			25	30	75
	US 61 at US 63 New Intersection (Signal)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	17.9	B	0			0			0		
		SB	50	0	490	540	52.7	D	0.0	A	8.1	A	12.0	B			1000			1000	49	128	1000	108	240
		EB	1005	470	0	1,475	25.8	C	1.0	A	0.0	A	18.0	B			471	70	488	280	201	329	0		
		WB	0	385	45	430	0.0	A	26.3	C	18.6	B	25.5	C			1246	103	188	0			300	26	91

Table 2a

Concept 4

Build 2022 Four Leg At Grade Intersection **US 63 River Bridge only 2 Lane**

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	280	80	20	380	26.2	C	19.0	B	7.9	A	22.6	C	14.6	B	339	42	121	339	90	227	0		
		SB	20	40	20	80	28.5	C	18.9	B	13.3	B	19.7	B			480	40	115	0			25	21	72
		EB	50	440	140	630	26.1	C	13.5	B	8.6	A	13.4	B			1201	82	176	125	38	122	50	49	99
		WB	20	620	40	680	21.1	C	11.6	B	10.9	B	11.9	B			427	89	154	125	13	44	0		
	US 61 at Bush St (Signal)	NB	40	20	30	90	23.7	C	22.3	C	8.7	A	17.6	B	6.7	A	313	34	91	0			25	21	72
		SB	10	20	10	40	18.8	B	19.0	B	7.9	A	16.3	B			392	16	60	0			25	6	39
		EB	40	370	70	480	15.6	B	3.7	A	3.0	A	4.6	A			427	17	67	125	23	56	0		
		WB	10	620	50	680	13.2	B	6.4	A	3.6	A	6.3	A			291	46	102	120	7	44	0		
	US 61 at Plum St (Signal)	NB	145	30	20	195	11.4	B	7.6	A	3.5	A	9.9	A	10.2	B	300	69	166	0			300	8	31
		SB	10	10	10	30	17.7	B	16.6	B	10.5	B	15.0	B			187	14	76	0			50	9	59
		EB	20	335	85	440	23.5	C	9.2	A	4.0	A	8.9	A			291	40	111	120	14	47	0		
		WB	10	585	10	605	14.3	B	11.0	B	9.3	A	11.0	B			312	76	148	150	5	30	0		
	US 61 at Potter St	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.1	A	0			0			0		
	(2-Way Stop)	EB	0	325	10	335	0.0	A	0.9	A	1.2	A	0.9	A			0			0			0		
		WB	10	595	0	605	5.3	A	1.1	A	0.0	A	1.2	A			0			75	5	31	0		
	3rd St at Plum St (Signal)	NB	20	190	60	270	14.7	B	12.3	B	7.6	A	11.4	B	9.2	A	289	66	206	100	8	39	0		
		SB	10	110	10	130	8.5	A	4.0	A	1.5	A	4.1	A			320	22	72	75	5	40	0		
		EB	10	30	20	60	26.5	C	17.2	B	7.4	A	15.5	B			287	23	66	0			50	12	39
		WB	70	110	5	185	11.6	B	6.0	A	0.0	A	7.9	A			300	19	78	150	21	66	300		
	3rd St at Potter St	NB	0	0	30	30	0.0	A	0.0	A	7.3	A	7.3	A	4.3	A	300			300			25	18	36
	(2-Way Stop)	SB	0	10	10	20	0.0	A	5.4	A	3.3	A	4.4	A			314	7	31	0			314	8	31
		EB	0	90	10	100	0.0	A	0.7	A	0.7	A	0.7	A			0			0			0		
		WB	110	200	0	310	5.1	A	4.9	A	0.0	A	5.0	A			509	8	47	0			0		
	4th St at Plum St	NB	110	220	10	340	10.3	B	8.2	A	4.8	A	8.8	A	7.7	A	348	44	106	150	28	50	0		
	(All-Way Stop)	SB	20	150	20	190	5.6	A	7.3	A	4.2	A	6.8	A			289	37	77	125	13	30	0		
		EB	10	20	30	60	5.1	A	6.5	A	8.0	A	7.1	A			342	19	48	0			25	22	60
		WB	60	60	30	150	5.8	A	7.0	A	8.4	A	6.8	A			325	39	71	0			25	19	41
	US 61 at US 63 New Intersection (Signal)	NB	0	140	0	140	0.0	A	25.1	C	0.0	A	25.1	C	19.7	B	509	57	146	0			0		
		SB	40	285	335	660	35.8	D	31.2	C	6.5	A	19.6	B			1000	164	270	1000	31	153	1000	101	178
		EB	105	220	0	325	34.7	C	11.0	B	0.0	A	19.8	B			431	9	49	280	60	168	0		
		WB	25	270	15	310	46.8	D	15.6	B	5.2	A	17.9	B			1225	39	84	300	15	75	300	2	34
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	420	50	80	550	28.3	C	17.7	B	10.5	B	23.1	C	23.6	C	339	45	120	339	141	323	0		
		SB	30	70	30	130	23.8	C	17.3	B	13.2	B	17.8	B			480	47	108	0			25	23	74
		EB	40	1010	270	1,320	50.0	D	32.5	C	25.4	C	31.5	C			1201	281	718	125	34	133	50	76	100
		WB	30	780	40	850	33.3	C	12.3	B	12.4	B	13.1	B			427	105	175	125	27	79	0		
	US 61 at Bush St (Signal)	NB	80	20	40	140	25.2	C	20.9	C	23.2	C	24.1	C	15.4	B	313	62	157	0			25	27	74
		SB	40	60	30	130	41.0	D	28.4	C	22.0	C	30.7	C			392	68	208	0			25	21	74
		EB	20	950	180	1,150	21.5	C	18.1	B	13.7	B	17.5	B			427	122	366	125	14	94	0		
		WB	5	750	30	785	26.3	C	8.5	A	6.5	A	8.5	A			291	83	152	120	6	61	0		
	US 61 at Plum St (Signal)	NB	215	10	40	265	22.4	C	15.4	B	198.8	F	44.7	D	26.5	C	300	111	239	0			300	69	242
		SB	10	50	30	90	120.5	F	82.5	F	46.6	D	73.9	E			187	57	153	0			50	24	85
		EB	10	790	170	970	36.1	D	30.3	C	15.2	B	27.8	C			291	182	298	120	17	169	0		
		WB	0	470	10	480	0.0	A	6.0	A	2.9	A	5.9	A			312	47	106	0			0		
	US 61 at Potter St	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	20.3	C	0			0			0		
	(2-Way Stop)	EB	0	830	10	840	0.0	A	32.1	D	1.8	A	31.7	D			312	216	320	0			0		
		WB	20	460	0	480	11.0	B	1.5	A	0.0	A	1.9	A			0			75	12	48	0		
	3rd St at Plum St (Signal)	NB	50	210	110	370	22.9	C	22.6	C	15.5	B	20.5	C	23.7	C	289	105	246	100	21	73	0		
		SB	40	210	40	290	11.3	B	6.8	A	4.2	A	7.1	A			320	54	126	75	21	62	0		
		EB	20	190	50	260	55.4	E	35.2	D	16.4	B	33.0	C			287	114	236	0			50	38	99
		WB	90	100	35	225	42.2	D	36.8	D	25.0	C	37.1	D			300	102	219	150	73	170	300		
	3rd St at Potter St	NB	10	0	110	120	9.6	A	0.0	A	9.2	A	9.2	A	4.2	A	300			300	8	31	25	35	65
	(2-Way Stop)	SB	0	20	10	30	0.0	A	8.8	A	4.1	A	7.0	A			314	14	35	0			314	10	31
		EB	0	300	20	320	0.0	A	1.6	A	1.0	A	1.6	A			311	1	16	0			0		
		WB	80	190	0	270	5.7	A	4.7	A	0.0	A	5.0	A			502	18	94	0			0		
	4th St at Plum St	NB	120	270	90	480	24.6	C	32.1	D	24.3	C	28.8	D	19.5	C	348	86	234	150	37	99	0		
	(All-Way Stop)	SB	30	280	30	340	7.5	A	13.3	B	10.2	B	12.5	B			289	69	174	125	17	68	0		
		EB	50	110	140	300	21.9	C	16.5	C	18.5	C	18.3	C			342	64	184	0			25	42	75
		WB	60	80	40	180	8.5	A	9.4	A	15.5	C	10.4	B			325	47	104	0			25	24	74
	US 61 at US 63 New Intersection (Signal)	NB	0	410	0	410	0.0	A	26.9	C	0.0	A	26.9	C	45.9	D	502	179	396	0			0		
		SB	30	245	175	450	39.1	D	25.5	C	4.8	A	18.2	B			1000	120	230	1000	21	120	1000	62	147
		EB	410	420	0	830	163.3	F	10.8	B	0.0	A	82.6	F			439	407	457	280	316	330	0		
		WB	25	305	40	370	52.8	D	23.1	C	7.2	A	23.3	C			1227	61	125	300	15	48	300	6	46

Table 2b

Concept 4

Build 2042 Four Leg At Grade Intersection

Red Wing, MN

US 63 River Bridge only 2 Lane

EB Dual Lefts are not effective with Lane Drop creating severe gridlock in the PM PEAK HOUR.

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	320	90	30	440	29.6	C	21.6	C	9.7	A	25.2	C	14.5	B	339	47	119	339	106	242	0		
		SB	20	40	20	80	25.4	C	21.4	C	12.9	B	19.9	B			480	42	140	0			25	22	75
		EB	50	490	160	700	32.9	C	12.9	B	9.0	A	13.5	B			1201	86	186	125	44	125	50	50	100
		WB	30	690	50	770	18.2	B	10.4	B	10.7	B	10.7	B			427	95	165	125	18	50	0		
	US 61 at Bush St (Signal)	NB	50	30	30	110	21.9	C	21.7	C	9.1	A	18.1	B	7.4	A	313	45	115	0			25	22	75
		SB	20	20	10	50	23.1	C	20.8	C	11.3	B	19.8	B			392	25	78	0			25	6	41
		EB	40	430	70	540	20.7	C	5.4	A	3.0	A	6.2	A			427	25	78	125	23	76	0		
		WB	10	730	70	810	13.6	B	6.3	A	4.2	A	6.2	A			291	55	112	120	8	52	0		
	US 61 at Plum St (Signal)	NB	175	40	30	245	12.0	B	8.7	A	3.3	A	10.2	B	11.0	B	300	82	162	0			300	11	36
		SB	10	10	10	30	13.8	B	9.9	A	10.9	B	11.5	B			187	10	64	0			50	9	80
		EB	20	400	100	520	24.2	C	10.0	B	5.5	A	9.7	A			291	51	123	120	14	60	0		
		WB	10	705	10	725	17.4	B	12.1	B	9.5	A	12.1	B			312	99	218	150	5	25	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.2	A	0			0			0		
		EB	0	390	20	410	0.0	A	1.0	A	1.1	A	1.0	A			0			0			0		
		WB	10	705	0	715	5.1	A	1.2	A	0.0	A	1.3	A			0			75	6	36	0		
	3rd St at Plum St (Signal)	NB	20	230	70	320	14.5	B	13.1	B	8.8	A	12.3	B	10.6	B	289	86	165	100	9	43	0		
		SB	0	130	20	150	0.0	A	4.0	A	2.3	A	3.8	A			320	26	95	0			0		
		EB	10	30	20	60	22.9	C	23.3	C	7.2	A	17.7	B			287	27	87	0			50	11	31
		WB	80	140	15	235	14.6	B	8.5	A	6.4	A	10.3	B			300	28	82	150	24	84	300		
	3rd St at Potter St (2-Way Stop)	NB	0	0	40	40	0.0	A	0.0	A	7.3	A	7.3	A	4.5	A	300			300			25	24	35
		SB	0	10	10	20	0.0	A	3.1	A	3.3	A	3.2	A			314	8	31	0			314	8	31
		EB	0	100	10	110	0.0	A	0.9	A	0.6	A	0.9	A			0			0			0		
		WB	130	245	0	375	5.6	A	5.1	A	0.0	A	5.3	A			501	15	72	0			0		
	4th St at Plum St (All-Way Stop)	NB	130	270	20	420	10.9	B	9.3	A	6.3	A	9.6	A	8.4	A	348	54	117	150	29	51	0		
		SB	20	180	20	220	6.1	A	7.5	A	4.7	A	7.1	A			289	37	94	125	14	34	0		
		EB	10	30	40	80	6.1	A	6.9	A	8.2	A	7.4	A			342	24	60	0			25	23	63
		WB	70	70	40	180	6.5	A	7.9	A	8.4	A	7.5	A			325	44	84	0			25	25	52
	US 61 at US 63 New Intersection (Signal)	NB	0	160	0	160	0.0	A	25.5	C	0.0	A	25.5	C	21.6	C	501	70	177	0			0		
		SB	50	345	415	810	41.1	D	33.2	C	12.2	B	22.7	C			1000	204	235	1000	49	146	1000	129	147
		EB	140	250	0	390	30.3	C	11.4	B	0.0	A	18.3	B			439	19	70	280	70	170	0		
		WB	30	300	20	350	47.4	D	19.5	B	5.5	A	21.2	C			1215	46	116	300	18	72	300	3	28
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	470	60	100	630	54.1	D	29.6	C	22.8	C	44.5	D	82.4	F	339	64	192	339	244	371	0		
		SB	30	80	40	150	27.7	C	24.7	C	16.4	B	23.2	C			480	64	170	0			25	29	75
		EB	40	1130	300	1,470	162.8	F	151.9	F	140.1	F	149.7	F			1201	714	1232	125	44	174	50	78	100
		WB	40	880	40	960	43.7	D	12.1	B	12.8	B	13.3	B			427	115	201	125	31	95	0		
	US 61 at Bush St (Signal)	NB	90	20	60	170	35.7	D	32.9	C	43.5	D	38.2	D	31.2	C	313	74	208	0			25	41	75
		SB	50	70	30	150	124.8	F	105.2	F	60.4	E	101.3	F			392	131	354	0			25	23	75
		EB	20	1100	200	1,320	44.3	D	40.7	D	30.9	C	39.3	D			427	281	473	125	26	173	0		
		WB	10	880	30	920	31.0	C	6.7	A	5.4	A	7.0	A			291	77	145	120	10	64	0		
	US 61 at Plum St (Signal)	NB	255	20	65	340	38.6	D	44.0	D	319.0	F	93.3	F	50.2	D	300	125	249	0			300	161	336
		SB	10	70	30	110	353.3	F	267.2	F	231.8	F	264.8	F			187	91	176	0			50	18	99
		EB	10	950	200	1,160	43.2	D	44.5	D	24.6	C	41.0	D			291	267	351	120	14	144	0		
		WB	5	555	20	580	34.4	C	7.8	A	3.9	A	7.9	A			312	58	153	150	4	25	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	23.3	C	0			0			0		
		EB	0	990	25	1,015	0.0	A	37.2	E	2.2	A	36.7	E			312	285	360	0			0		
		WB	25	550	0	575	13.8	B	1.6	A	0.0	A	2.1	A			0			75	15	49	0		
	3rd St at Plum St (Signal)	NB	60	250	130	440	29.1	C	43.8	D	34.3	C	38.8	D	44.9	D	289	160	303	100	31	132	0		
		SB	40	250	40	330	14.3	B	8.8	A	6.3	A	9.2	A			320	61	230	75	22	62	0		
		EB	20	240	50	310	128.7	F	92.0	F	75.7	E	91.4	F			287	144	279	0			50	35	99
		WB	100	120	40	260	51.1	D	50.5	D	53.6	D	51.1	D			300	138	302	150	83	199	300		
	3rd St at Potter St (2-Way Stop)	NB	10	0	130	140	35.0	E	0.0	A	11.3	B	12.6	B	8.2	A	300			300	11	56	25	40	70
		SB	0	20	10	30	0.0	A	7.5	A	8.7	A	7.8	A			314	13	40	0			314	10	31
		EB	0	370	20	390	0.0	A	2.2	A	1.7	A	2.2	A			311	6	59	0			0		
		WB	90	225	0	315	15.6	C	12.3	B	0.0	A	13.2	B			499	53	332	0			0		
	4th St at Plum St (All-Way Stop)	NB	140	330	110	580	71.5	F	99.4	F	104.0	F	93.3	F	48.1	E	348	172	375	150	61	200	0		
		SB	40	330	30	400	10.2	B	21.7	C	20.0	C	20.3	C			289	103	284	125	34	174	0		
		EB	60	130	170	360	35.6	E	35.4	E	33.0	D	34.3	D			342	105	340	0			25	53	75
		WB	70	90	50	210	12.9	B	12.6	B	28.0	D	16.5	C			325	57	183	0			25	36	75
	US 61 at US 63 New Intersection (Signal)	NB	0	500	0	500	0.0	A	39.4	D	0.0	A	39.4	D	60.8	E	499	279	497	0			0		
		SB	35	280	225	540	57.3	E	27.8	C	6.5	A	20.9	C			1000	149	239	1000	34	129	1000	77	147
		EB	505	485	0	990	215.5	F	12.1	B	0.0	A	113.7	F			439	437	461	280	327	330	0		
		WB	35	350	45	430	50.6	D	26.6	C	8.6	A	26.7	C			1206	60	162	300	15	63	300	3	32

Table 2c

Concept 4

Build 2022 Four Leg At Grade Intersection **US 63 River Bridge 4-Lane**

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	280	80	20	380	26.3	C	20.0	C	8.2	A	22.9	C	14.6	B	339	46	130	339	84	226	0		
		SB	20	40	20	80	25.9	C	21.0	C	11.2	B	19.9	B			480	41	120	0			25	17	74
		EB	50	440	140	630	29.1	C	13.0	B	8.4	A	13.3	B			1201	76	180	125	41	117	50	42	99
		WB	20	620	40	680	19.5	B	12.0	B	10.0	B	12.1	B			427	98	167	125	13	48	0		
	US 61 at Bush St (Signal)	NB	40	20	30	90	20.4	C	20.1	C	8.6	A	16.3	B	6.7	A	313	32	93	0			25	19	74
		SB	10	20	10	40	20.0	C	17.9	B	9.8	A	16.2	B			392	13	48	0			25	6	31
		EB	40	370	70	480	18.7	B	4.3	A	3.0	A	5.2	A			427	21	70	125	22	58	0		
		WB	10	620	50	680	11.5	B	6.3	A	4.1	A	6.2	A			291	50	100	120	7	55	0		
	US 61 at Plum St (Signal)	NB	145	30	20	195	12.4	B	7.4	A	3.0	A	10.4	B	10.6	B	300	69	156	0			300	8	31
		SB	10	10	10	30	14.0	B	19.7	B	9.7	A	14.5	B			187	15	70	0			50	8	75
		EB	20	335	85	440	24.8	C	8.8	A	4.1	A	8.6	A			291	41	107	120	13	47	0		
		WB	10	585	10	605	18.5	B	11.7	B	10.2	B	11.8	B			312	84	151	150	5	29	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.0	A	0			0			0		
		EB	0	325	10	335	0.0	A	0.9	A	1.0	A	0.9	A			0			0			0		
		WB	10	595	0	605	3.5	A	1.0	A	0.0	A	1.0	A			0			75	4	31	0		
	3rd St at Plum St (Signal)	NB	20	190	60	270	14.7	B	11.6	B	6.5	A	10.6	B	9.2	A	289	63	149	100	9	54	0		
		SB	10	110	10	130	7.2	A	4.1	A	2.2	A	4.1	A			320	23	62	75	5	30	0		
		EB	10	30	20	60	28.2	C	23.3	C	7.2	A	18.0	B			287	25	72	0			50	12	31
		WB	70	110	5	185	10.6	B	6.9	A	0.0	A	8.2	A			300	22	96	150	20	94	300		
	3rd St at Potter St (2-Way Stop)	NB	0	0	30	30	0.0	A	0.0	A	7.0	A	7.0	A	4.4	A	300			300			25	21	31
		SB	0	10	10	20	0.0	A	5.9	A	3.4	A	4.8	A			314	10	31	0			314	9	31
		EB	0	90	10	100	0.0	A	0.9	A	0.5	A	0.9	A			0			0			0		
		WB	110	200	0	310	5.4	A	5.1	A	0.0	A	5.2	A			509	9	65	0			0		
	4th St at Plum St (All-Way Stop)	NB	110	220	10	340	10.3	B	8.3	A	4.7	A	8.8	A	7.8	A	348	44	87	150	27	45	0		
		SB	20	150	20	190	5.5	A	7.2	A	4.8	A	6.9	A			289	36	72	125	11	30	0		
		EB	10	20	30	60	5.6	A	6.7	A	7.9	A	7.2	A			342	20	40	0			25	23	70
		WB	60	60	30	150	6.0	A	7.0	A	8.2	A	6.8	A			325	40	70	0			25	20	32
	US 61 at US 63 New Intersection (Signal)	NB	0	140	0	140	0.0	A	27.5	C	0.0	A	27.5	C	18.6	B	509	63	150	0			0		
		SB	40	285	335	660	41.7	D	31.5	C	5.8	A	18.8	B			1000	150	316	1000	42	152	1000	68	173
		EB	105	220	0	325	28.6	C	9.9	A	0.0	A	16.9	B			458	27	84	280	41	98	0		
		WB	25	270	15	310	49.4	D	14.0	B	5.3	A	16.5	B			1226	47	117	300	18	60	300	5	49
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	420	50	80	550	32.1	C	19.1	B	11.0	B	26.0	C	20.3	C	339	40	118	339	154	329	0		
		SB	30	70	30	130	20.7	C	16.6	B	13.6	B	16.8	B			480	43	112	0			25	20	73
		EB	40	1010	270	1,320	40.1	D	24.3	C	18.4	B	23.6	C			1201	230	381	125	35	132	50	77	100
		WB	30	780	40	850	37.6	D	12.4	B	9.2	A	13.2	B			427	105	175	125	29	74	0		
	US 61 at Bush St (Signal)	NB	80	20	40	140	26.1	C	23.6	C	12.8	B	22.1	C	9.7	A	313	61	142	0			25	26	75
		SB	40	60	30	130	24.2	C	22.6	C	12.7	B	20.8	C			392	55	142	0			25	20	72
		EB	20	950	180	1,150	13.8	B	7.5	A	7.3	A	7.6	A			427	53	130	125	11	40	0		
		WB	5	750	30	785	27.3	C	8.7	A	5.5	A	8.7	A			291	81	153	120	5	38	0		
	US 61 at Plum St (Signal)	NB	215	10	40	265	16.9	B	13.7	B	3.5	A	14.9	B	11.3	B	300	98	221	0			300	12	90
		SB	10	50	30	90	19.5	B	17.1	B	9.0	A	14.5	B			187	32	92	0			50	16	69
		EB	10	790	170	970	26.2	C	12.7	B	10.4	B	12.4	B			291	103	182	120	7	63	0		
		WB	0	470	10	480	0.0	A	6.3	A	2.3	A	6.2	A			312	50	130	0			0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.4	A	0			0			0		
		EB	0	830	10	840	0.0	A	1.2	A	1.3	A	1.2	A			0			0			0		
		WB	20	460	0	480	7.5	A	1.5	A	0.0	A	1.8	A			0			75	6	36	0		
	3rd St at Plum St (Signal)	NB	50	210	110	370	19.8	B	15.7	B	10.9	B	14.7	B	18.3	B	289	96	220	100	25	116	0		
		SB	40	210	40	290	11.4	B	6.9	A	4.4	A	7.2	A			320	59	146	75	20	81	0		
		EB	20	190	50	260	29.6	C	22.7	C	10.8	B	20.9	C			287	105	202	0			50	34	100
		WB	90	100	35	225	41.4	D	33.6	C	19.3	B	34.5	C			300	98	199	150	71	179	300		
	3rd St at Potter St (2-Way Stop)	NB	10	0	110	120	10.0	B	0.0	A	9.6	A	9.6	A	4.1	A	300			300	9	35	25	36	69
		SB	0	20	10	30	0.0	A	7.4	A	4.3	A	6.1	A			314	13	40	0			314	11	31
		EB	0	300	20	320	0.0	A	1.5	A	1.3	A	1.5	A			311		5	0			0		
		WB	80	190	0	270	5.8	A	4.7	A	0.0	A	5.0	A			502	23	118	0			0		
	4th St at Plum St (All-Way Stop)	NB	120	270	90	480	12.9	B	13.9	B	10.1	B	12.9	B	11.8	B	348	79	174	150	31	65	0		
		SB	30	280	30	340	7.7	A	12.9	B	9.8	A	12.2	B			289	69	138	125	18	81	0		
		EB	50	110	140	300	9.4	A	11.7	B	11.4	B	11.2	B			342	53	122	0			25	43	74
		WB	60	80	40	180	8.0	A	9.4	A	9.6	A	8.9	A			325	45	72	0			25	24	53
	US 61 at US 63 New Intersection (Signal)	NB	0	410	0	410	0.0	A	25.0	C	0.0	A	25.0	C	20.6	C	502	184	419	0			0		
		SB	30	245	175	450	64.3	E	26.9	C	3.6	A	20.5	C			1000	122	276	1000	32	127	1000	42	101
		EB	410	420	0	830	23.0	C	11.8	B	0.0	A	17.5	B			458	73	157	280	98	204	0		
		WB	25	305	40	370	51.7	D	21.9	C	8.3	A	22.4	C			1227	67	135	300	18	66	300	12	54

Table 2d

Concept 4

Build 2042 Four Leg At Grade Intersection **US 63 River Bridge is 4-Lanes**

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	320	90	30	440	30.2	C	20.0	C	8.5	A	25.0	C	14.4	B	339	47	116	339	112	247	0		
		SB	20	40	20	80	27.1	C	21.4	C	13.7	B	20.4	C			480	43	132	0			25	**24**	**76**
		EB	50	490	160	700	30.8	C	13.0	B	8.9	A	13.5	B			1201	85	188	125	42	**124**	50	**52**	**100**
		WB	30	690	50	770	18.2	B	10.2	B	8.9	A	10.4	B			427	93	143	125	19	49	0		
	US 61 at Bush St (Signal)	NB	50	30	30	110	23.5	C	21.2	C	9.4	A	18.9	B	7.6	A	313	46	121	0			25	**19**	**74**
		SB	20	20	10	50	22.7	C	20.6	C	10.9	B	19.8	B			392	25	79	0			25	5	**47**
		EB	40	430	70	540	22.2	C	5.5	A	3.3	A	6.5	A			427	27	77	125	25	63	0		
		WB	10	730	70	810	11.9	B	6.3	A	5.0	A	6.3	A			291	54	125	120	5	36	0		
	US 61 at Plum St (Signal)	NB	175	40	30	245	13.4	B	10.2	B	3.1	A	11.6	B	12.0	B	300	88	184	0			300	9	31
		SB	10	10	10	30	16.3	B	12.2	B	11.8	B	13.6	B			187	13	61	0			50	10	**68**
		EB	20	400	100	520	24.5	C	10.1	B	6.0	A	9.8	A			291	51	119	120	13	46	0		
		WB	10	705	10	725	21.1	C	13.5	B	11.7	B	13.6	B			312	112	209	150	6	29	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.1	A	0			0			0		
		EB	0	390	20	410	0.0	A	1.1	A	1.2	A	1.1	A			0			0			0		
		WB	10	705	0	715	3.9	A	1.1	A	0.0	A	1.1	A			0			75	4	31	0		
	3rd St at Plum St (Signal)	NB	20	230	70	320	13.3	B	12.1	B	7.6	A	11.2	B	10.9	B	289	76	162	100	9	62	0		
		SB	0	130	20	150	0.0	A	4.5	A	2.1	A	4.2	A			320	30	93	0			0		
		EB	10	30	20	60	23.8	C	20.8	C	7.7	A	17.0	B			287	28	81	0			50	13	**42**
		WB	80	140	15	235	18.9	B	10.4	B	3.7	A	12.9	B			300	35	121	150	30	83	300		
	3rd St at Potter St (2-Way Stop)	NB	0	0	40	40	0.0	A	0.0	A	7.2	A	7.2	A	4.8	A	300			300			25	**20**	**36**
		SB	0	10	10	20	0.0	A	3.7	A	4.2	A	3.8	A			314	9	31	0			314	9	31
		EB	0	100	10	110	0.0	A	0.8	A	0.6	A	0.8	A			0			0			0		
		WB	130	245	0	375	5.9	A	5.8	A	0.0	A	5.8	A			501	16	99	0			0		
	4th St at Plum St (All-Way Stop)	NB	130	270	20	420	11.1	B	9.3	A	5.5	A	9.7	A	8.6	A	348	50	105	150	30	59	0		
		SB	20	180	20	220	6.2	A	8.0	A	4.5	A	7.6	A			289	42	91	125	12	34	0		
		EB	10	30	40	80	5.8	A	7.4	A	8.3	A	7.7	A			342	21	49	0			25	**24**	**55**
		WB	70	70	40	180	6.6	A	7.9	A	8.8	A	7.6	A			325	42	80	0			25	**24**	**49**
	US 61 at US 63 New Intersection (Signal)	NB	0	160	0	160	0.0	A	25.2	C	0.0	A	25.2	C	19.9	B	501	65	167	0			0		
		SB	50	345	415	810	42.4	D	32.0	C	7.0	A	19.5	B			1000	193	391	1000	48	175	1000	86	213
		EB	140	250	0	390	26.1	C	12.6	B	0.0	A	17.8	B			458	34	88	280	45	110	0		
		WB	30	300	20	350	48.0	D	18.9	B	6.0	A	21.1	C			1216	49	123	300	20	71	300	4	36
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	470	60	100	630	43.2	D	20.7	C	16.1	B	34.2	C	22.0	C	339	57	175	339	219	**354**	0		
		SB	30	80	40	150	27.5	C	20.7	C	16.3	B	20.8	C			480	56	140	0			25	**28**	**75**
		EB	40	1130	300	1,470	42.0	D	25.2	C	21.0	C	24.8	C			1201	260	458	125	34	**154**	50	**78**	**100**
		WB	40	880	40	960	43.5	D	11.3	B	10.3	B	12.5	B			427	112	201	125	34	**115**	0		
	US 61 at Bush St (Signal)	NB	90	20	60	170	31.5	C	26.5	C	16.6	B	25.7	C	10.5	B	313	76	182	0			25	**40**	**75**
		SB	50	70	30	150	27.8	C	25.7	C	15.3	B	24.4	C			392	68	176	0			25	**22**	**74**
		EB	20	1100	200	1,320	24.1	C	8.7	A	7.7	A	8.8	A			427	63	166	125	13	51	0		
		WB	10	880	30	920	33.1	C	7.2	A	5.3	A	7.5	A			291	87	145	120	13	75	0		
	US 61 at Plum St (Signal)	NB	255	20	65	340	18.8	B	18.3	B	5.5	A	16.2	B	12.8	B	300	126	**244**	0			300	26	150
		SB	10	70	30	110	26.0	C	16.2	B	10.1	B	14.9	B			187	39	124	0			50	19	**86**
		EB	10	950	200	1,160	18.8	B	14.9	B	12.1	B	14.5	B			291	133	**282**	120	8	87	0		
		WB	5	555	20	580	42.5	D	6.4	A	4.4	A	6.7	A			312	49	108	150	5	25	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.7	A	0			0			0		
		EB	0	990	25	1,015	0.0	A	1.6	A	1.4	A	1.6	A			0			0			0		
		WB	25	550	0	575	10.5	B	1.5	A	0.0	A	1.9	A			0			75	11	53	0		
	3rd St at Plum St (Signal)	NB	60	250	130	440	22.7	C	18.2	B	12.7	B	17.3	B	18.7	B	289	131	**267**	100	38	**133**	0		
		SB	40	250	40	330	14.0	B	7.8	A	4.0	A	8.2	A			320	62	169	75	23	**72**	0		
		EB	20	240	50	310	25.0	C	23.2	C	11.7	B	21.5	C			287	124	**269**	0			50	33	**100**
		WB	100	120	40	260	39.2	D	27.3	C	17.8	B	30.4	C			300	108	218	150	78	**163**	300		
	3rd St at Potter St (2-Way Stop)	NB	10	0	130	140	17.4	C	0.0	A	11.0	B	11.4	B	4.9	A	300			300	8	34	25	**40**	**69**
		SB	0	20	10	30	0.0	A	8.5	A	4.7	A	7.6	A			314	15	52	0			314	9	35
		EB	0	370	20	390	0.0	A	1.9	A	1.1	A	1.9	A			311	2	44	0			0		
		WB	90	225	0	315	6.6	A	5.1	A	0.0	A	5.5	A			499	31	137	0			0		
	4th St at Plum St (All-Way Stop)	NB	140	330	110	580	15.0	C	19.3	C	15.5	C	17.6	C	16.3	C	348	114	237	150	40	**127**	0		
		SB	40	330	30	400	9.7	A	20.4	C	18.1	C	19.2	C			289	104	**249**	125	26	**149**	0		
		EB	60	130	170	360	12.6	B	14.4	B	13.8	B	13.8	B			342	64	142	0			25	**55**	**76**
		WB	70	90	50	210	11.2	B	11.5	B	11.1	B	11.3	B			325	52	99	0			25	**31**	**72**
	US 61 at US 63 New Intersection (Signal)	NB	0	500	0	500	0.0	A	34.4	C	0.0	A	34.4	C	24.3	C	499	271	**459**	0			0		
		SB	35	280	225	540	57.4	E	25.1	C	4.1	A	18.4	B			1000	134	284	1000	31	118	1000	49	138
		EB	505	485	0	990	30.6	C	13.1	B	0.0	A	22.0	C			458	88	174	280	136	**225**	0		
		WB	35	350	45	430	52.4	D	24.5	C	10.1	B	25.4	C			1207	63	144	300	19	68	300	7	59

Table 3a

Concept 5

Build 2022 Four Leg At Grade Roundabout Intersection **US 63 River Bridge 4-Lane**

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	280	80	20	380	26.3	C	20.0	C	8.2	A	22.9	C	14.6	B	339	46	130	339	84	226	0		
		SB	20	40	20	80	25.9	C	21.0	C	11.2	B	19.9	B			480	41	120	0			25	17	74
		EB	50	440	140	630	29.1	C	13.0	B	8.4	A	13.3	B			1201	76	180	125	41	117	50	42	99
		WB	20	620	40	680	19.5	B	12.0	B	10.0	B	12.1	B			427	98	167	125	13	48	0		
	US 61 at Bush St (Signal)	NB	40	20	30	90	20.4	C	20.1	C	8.6	A	16.3	B	6.7	A	313	32	93	0			25	19	74
		SB	10	20	10	40	20.0	C	17.9	B	9.8	A	16.2	B			392	13	48	0			25	6	31
		EB	40	370	70	480	18.7	B	4.3	A	3.0	A	5.2	A			427	21	70	125	22	58	0		
		WB	10	620	50	680	11.5	B	6.3	A	4.1	A	6.2	A			291	50	100	120	7	55	0		
	US 61 at Plum St (Signal)	NB	145	30	20	195	12.4	B	7.4	A	3.0	A	10.4	B	10.6	B	300	69	156	0			300	8	31
		SB	10	10	10	30	14.0	B	19.7	B	9.7	A	14.5	B			187	15	70	0			50	8	75
		EB	20	335	85	440	24.8	C	8.8	A	4.1	A	8.6	A			291	41	107	120	13	47	0		
		WB	10	585	10	605	18.5	B	11.7	B	10.2	B	11.8	B			312	84	151	150	5	29	0		
	US 61 at Potter St	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.0	A	0			0			0		
	(2-Way Stop)	EB	0	325	10	335	0.0	A	0.9	A	1.0	A	0.9	A			0			0			0		
		WB	10	595	0	605	3.5	A	1.0	A	0.0	A	1.0	A			0			75	4	31	0		
	3rd St at Plum St (Signal)	NB	20	190	60	270	14.7	B	11.6	B	6.5	A	10.6	B	9.2	A	289	63	149	100	9	54	0		
		SB	10	110	10	130	7.2	A	4.1	A	2.2	A	4.1	A			320	23	62	75	5	30	0		
		EB	10	30	20	60	28.2	C	23.3	C	7.2	A	18.0	B			287	25	72	0			50	12	31
		WB	70	110	5	185	10.6	B	6.9	A	0.0	A	8.2	A			300	22	96	150	20	94	300		
	3rd St at Potter St	NB	0	0	30	30	0.0	A	0.0	A	7.0	A	7.0	A	4.4	A	300			300			25	21	31
	(2-Way Stop)	SB	0	10	10	20	0.0	A	5.9	A	3.4	A	4.8	A			314	10	31	0			314	9	31
		EB	0	90	10	100	0.0	A	0.9	A	0.5	A	0.9	A			0			0			0		
		WB	110	200	0	310	5.4	A	5.1	A	0.0	A	5.2	A			509	9	65	0			0		
	4th St at Plum St	NB	110	220	10	340	10.3	B	8.3	A	4.7	A	8.8	A	7.8	A	348	44	87	150	27	45	0		
	(All-Way Stop)	SB	20	150	20	190	5.5	A	7.2	A	4.8	A	6.9	A			289	36	72	125	11	30	0		
		EB	10	20	30	60	5.6	A	6.7	A	7.9	A	7.2	A			342	20	40	0			25	23	70
		WB	60	60	30	150	6.0	A	7.0	A	8.2	A	6.8	A			325	40	70	0			25	20	32
	US 61 at US 63 New Intersection ROUNDABOUT	NB	0	140	0	140							2.8	A	2.8	A									
		SB	40	285	335	660							4.6	A											
		EB	105	220	0	325							2.0	A											
		WB	25	270	15	310							1.9	A											
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	420	50	80	550	32.1	C	19.1	B	11.0	B	26.0	C	20.3	C	339	40	118	339	154	329	0		
		SB	30	70	30	130	20.7	C	16.6	B	13.6	B	16.8	B			480	43	112	0			25	20	73
		EB	40	1010	270	1,320	40.1	D	24.3	C	18.4	B	23.6	C			1201	230	381	125	35	132	50	77	100
		WB	30	780	40	850	37.6	D	12.4	B	9.2	A	13.2	B			427	105	175	125	29	74	0		
	US 61 at Bush St (Signal)	NB	80	20	40	140	26.1	C	23.6	C	12.8	B	22.1	C	9.7	A	313	61	142	0			25	26	75
		SB	40	60	30	130	24.2	C	22.6	C	12.7	B	20.8	C			392	55	142	0			25	20	72
		EB	20	950	180	1,150	13.8	B	7.5	A	7.3	A	7.6	A			427	53	130	125	11	40	0		
		WB	5	750	30	785	27.3	C	8.7	A	5.5	A	8.7	A			291	81	153	120	5	38	0		
	US 61 at Plum St (Signal)	NB	215	10	40	265	16.9	B	13.7	B	3.5	A	14.9	B	11.3	B	300	98	221	0			300	12	90
		SB	10	50	30	90	19.5	B	17.1	B	9.0	A	14.5	B			187	32	92	0			50	16	69
		EB	10	790	170	970	26.2	C	12.7	B	10.4	B	12.4	B			291	103	182	120	7	63	0		
		WB	0	470	10	480	0.0	A	6.3	A	2.3	A	6.2	A			312	50	130	0			0		
	US 61 at Potter St	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.4	A	0			0			0		
	(2-Way Stop)	EB	0	830	10	840	0.0	A	1.2	A	1.3	A	1.2	A			0			0			0		
		WB	20	460	0	480	7.5	A	1.5	A	0.0	A	1.8	A			0			75	6	36	0		
	3rd St at Plum St (Signal)	NB	50	210	110	370	19.8	B	15.7	B	10.9	B	14.7	B	18.3	B	289	96	220	100	25	116	0		
		SB	40	210	40	290	11.4	B	6.9	A	4.4	A	7.2	A			320	59	146	75	20	81	0		
		EB	20	190	50	260	29.6	C	22.7	C	10.8	B	20.9	C			287	105	202	0			50	34	100
		WB	90	100	35	225	41.4	D	33.6	C	19.3	B	34.5	C			300	98	199	150	71	179	300		
	3rd St at Potter St	NB	10	0	110	120	10.0	B	0.0	A	9.6	A	9.6	A	4.1	A	300			300	9	35	25	36	69
	(2-Way Stop)	SB	0	20	10	30	0.0	A	7.4	A	4.3	A	6.1	A			314	13	40	0			314	11	31
		EB	0	300	20	320	0.0	A	1.5	A	1.3	A	1.5	A			311		5	0			0		
		WB	80	190	0	270	5.8	A	4.7	A	0.0	A	5.0	A			502	23	118	0			0		
	4th St at Plum St	NB	120	270	90	480	12.9	B	13.9	B	10.1	B	12.9	B	11.8	B	348	79	174	150	31	65	0		
	(All-Way Stop)	SB	30	280	30	340	7.7	A	12.9	B	9.8	A	12.2	B			289	69	138	125	18	81	0		
		EB	50	110	140	300	9.4	A	11.7	B	11.4	B	11.2	B			342	53	122	0			25	43	74
		WB	60	80	40	180	8.0	A	9.4	A	9.6	A	8.9	A			325	45	72	0			25	24	53
	US 61 at US 63 New Intersection ROUNDABOUT	NB	0	410	0	410							7.7	A	4.5	A									
		SB	30	245	175	450							5.9	A											
		EB	410	420	0	830							3.1	A											
		WB	25	305	40	370							3.0	A											

Table 3b

Concept 5

Build 2042 Four Leg At Grade Roundabout Intersection **US 63 River Bridge is 4-Lanes**

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	320	90	30	440	30.2	C	20.0	C	8.5	A	25.0	C	14.4	B	339	47	116	339	112	247	0		
		SB	20	40	20	80	27.1	C	21.4	C	13.7	B	20.4	C			480	43	132	0			25	**24**	**76**
		EB	50	490	160	700	30.8	C	13.0	B	8.9	A	13.5	B			1201	85	188	125	42	**124**	50	**52**	**100**
		WB	30	690	50	770	18.2	B	10.2	B	8.9	A	10.4	B			427	93	143	125	19	49	0		
	US 61 at Bush St (Signal)	NB	50	30	30	110	23.5	C	21.2	C	9.4	A	18.9	B	7.6	A	313	46	121	0			25	**19**	**74**
		SB	20	20	10	50	22.7	C	20.6	C	10.9	B	19.8	B			392	25	79	0			25	5	**47**
		EB	40	430	70	540	22.2	C	5.5	A	3.3	A	6.5	A			427	27	77	125	25	63	0		
		WB	10	730	70	810	11.9	B	6.3	A	5.0	A	6.3	A			291	54	125	120	5	36	0		
	US 61 at Plum St (Signal)	NB	175	40	30	245	13.4	B	10.2	B	3.1	A	11.6	B	12.0	B	300	88	184	0			300	9	31
		SB	10	10	10	30	16.3	B	12.2	B	11.8	B	13.6	B			187	13	61	0			50	10	**68**
		EB	20	400	100	520	24.5	C	10.1	B	6.0	A	9.8	A			291	51	119	120	13	46	0		
		WB	10	705	10	725	21.1	C	13.5	B	11.7	B	13.6	B			312	112	209	150	6	29	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.1	A	0			0			0		
		EB	0	390	20	410	0.0	A	1.1	A	1.2	A	1.1	A			0			0			0		
		WB	10	705	0	715	3.9	A	1.1	A	0.0	A	1.1	A			0			75	4	31	0		
	3rd St at Plum St (Signal)	NB	20	230	70	320	13.3	B	12.1	B	7.6	A	11.2	B	10.9	B	289	76	162	100	9	62	0		
		SB	0	130	20	150	0.0	A	4.5	A	2.1	A	4.2	A			320	30	93	0			0		
		EB	10	30	20	60	23.8	C	20.8	C	7.7	A	17.0	B			287	28	81	0			50	13	**42**
		WB	80	140	15	235	18.9	B	10.4	B	3.7	A	12.9	B			300	35	121	150	30	83	300		
	3rd St at Potter St (2-Way Stop)	NB	0	0	40	40	0.0	A	0.0	A	7.2	A	7.2	A	4.8	A	300			300			25	**20**	**36**
		SB	0	10	10	20	0.0	A	3.7	A	4.2	A	3.8	A			314	9	31	0			314	9	31
		EB	0	100	10	110	0.0	A	0.8	A	0.6	A	0.8	A			0			0			0		
		WB	130	245	0	375	5.9	A	5.8	A	0.0	A	5.8	A			501	16	99	0			0		
	4th St at Plum St (All-Way Stop)	NB	130	270	20	420	11.1	B	9.3	A	5.5	A	9.7	A	8.6	A	348	50	105	150	30	59	0		
		SB	20	180	20	220	6.2	A	8.0	A	4.5	A	7.6	A			289	42	91	125	12	34	0		
		EB	10	30	40	80	5.8	A	7.4	A	8.3	A	7.7	A			342	21	49	0			25	**24**	**55**
		WB	70	70	40	180	6.6	A	7.9	A	8.8	A	7.6	A			325	42	80	0			25	**24**	**49**
	US 61 at US 63 New Intersection ROUNDABOUT	NB	0	160	0	160							2.7	A	3.9	A		<25	<25						
		SB	50	345	415	810							7.4	A				<25	<25						
		EB	140	250	0	390							2.4	A				<25	<25						
		WB	30	300	20	350							2.2	A				<25	<25						
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	470	60	100	630	43.2	D	20.7	C	16.1	B	34.2	C	22.0	C	339	57	175	339	219	**354**	0		
		SB	30	80	40	150	27.5	C	20.7	C	16.3	B	20.8	C			480	56	140	0			25	**28**	**75**
		EB	40	1130	300	1,470	42.0	D	25.2	C	21.0	C	24.8	C			1201	260	458	125	34	**154**	50	**78**	**100**
		WB	40	880	40	960	43.5	D	11.3	B	10.3	B	12.5	B			427	112	201	125	34	**115**	0		
	US 61 at Bush St (Signal)	NB	90	20	60	170	31.5	C	26.5	C	16.6	B	25.7	C	10.5	B	313	76	182	0			25	**40**	**75**
		SB	50	70	30	150	27.8	C	25.7	C	15.3	B	24.4	C			392	68	176	0			25	**22**	**74**
		EB	20	1100	200	1,320	24.1	C	8.7	A	7.7	A	8.8	A			427	63	166	125	13	51	0		
		WB	10	880	30	920	33.1	C	7.2	A	5.3	A	7.5	A			291	87	145	120	13	75	0		
	US 61 at Plum St (Signal)	NB	255	20	65	340	18.8	B	18.3	B	5.5	A	16.2	B	12.8	B	300	126	**244**	0			300	26	150
		SB	10	70	30	110	26.0	C	16.2	B	10.1	B	14.9	B			187	39	124	0			50	19	**86**
		EB	10	950	200	1,160	18.8	B	14.9	B	12.1	B	14.5	B			291	133	**282**	120	8	87	0		
		WB	5	555	20	580	42.5	D	6.4	A	4.4	A	6.7	A			312	49	108	150	5	25	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.7	A	0			0			0		
		EB	0	990	25	1,015	0.0	A	1.6	A	1.4	A	1.6	A			0			0			0		
		WB	25	550	0	575	10.5	B	1.5	A	0.0	A	1.9	A			0			75	11	53	0		
	3rd St at Plum St (Signal)	NB	60	250	130	440	22.7	C	18.2	B	12.7	B	17.3	B	18.7	B	289	131	**267**	100	38	**133**	0		
		SB	40	250	40	330	14.0	B	7.8	A	4.0	A	8.2	A			320	62	169	75	23	**72**	0		
		EB	20	240	50	310	25.0	C	23.2	C	11.7	B	21.5	C			287	124	**269**	0			50	33	**100**
		WB	100	120	40	260	39.2	D	27.3	C	17.8	B	30.4	C			300	108	218	150	78	**163**	300		
	3rd St at Potter St (2-Way Stop)	NB	10	0	130	140	17.4	C	0.0	A	11.0	B	11.4	B	4.9	A	300			300	8	34	25	**40**	**69**
		SB	0	20	10	30	0.0	A	8.5	A	4.7	A	7.6	A			314	15	52	0			314	9	35
		EB	0	370	20	390	0.0	A	1.9	A	1.1	A	1.9	A			311	2	44	0			0		
		WB	90	225	0	315	6.6	A	5.1	A	0.0	A	5.5	A			499	31	137	0			0		
	4th St at Plum St (All-Way Stop)	NB	140	330	110	580	15.0	C	19.3	C	15.5	C	17.6	C	16.3	C	348	114	237	150	40	**127**	0		
		SB	40	330	30	400	9.7	A	20.4	C	18.1	C	19.2	C			289	104	**249**	125	26	**149**	0		
		EB	60	130	170	360	12.6	B	14.4	B	13.8	B	13.8	B			342	64	142	0			25	**55**	**76**
		WB	70	90	50	210	11.2	B	11.5	B	11.1	B	11.3	B			325	52	99	0			25	**31**	**72**
	US 61 at US 63 New Intersection ROUNDABOUT	NB	0	500	0	500							6.6	A	4.9	A		25	30						
		SB	35	280	225	540							6.7	A				<25	<25						
		EB	505	485	0	990							3.9	A				30	30						
		WB	35	350	45	430							3.7	A				<25	<25						

Table 4a

Concept 6

Build 2022 Buttonhook Intersection

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	280	80	20	380	26.3	C	19.3	B	10.4	B	23.3	C	12.2	B	339	39	119	339	93	234	0		
		SB	20	40	20	80	23.7	C	19.7	B	13.3	B	19.1	B			480	42	124	0			25	**19**	**73**
		EB	50	440	140	630	38.4	D	13.1	B	8.8	A	14.0	B			1201	85	184	125	40	**123**	50	**44**	**99**
		WB	40	620	40	700	11.7	B	5.2	A	3.0	A	5.4	A			427	43	105	125	20	66	0		
	US 61 at Bush St (Signal)	NB	40	20	45	105	23.7	C	23.5	C	8.6	A	17.1	B	8.6	A	313	36	98	0			25	**25**	**73**
		SB	10	20	10	40	28.7	C	20.8	C	11.7	B	21.0	C			392	19	74	0			25	6	**40**
		EB	40	370	70	480	21.7	C	8.9	A	5.6	A	9.6	A			427	42	95	125	19	56	0		
		WB	75	640	50	765	11.6	B	6.0	A	4.3	A	6.4	A			291	48	122	120	25	71	0		
	US 61 at Plum St (Signal)	NB	145	30	125	300	21.4	C	9.2	A	5.5	A	12.9	B	10.7	B	300	86	182	0			300	43	110
		SB	10	10	10	30	21.2	C	16.9	B	9.7	A	15.4	B			188	16	74	0			50	12	**66**
		EB	20	350	85	455	20.3	C	15.8	B	13.1	B	15.5	B			291	78	148	120	12	44	0		
		WB	215	670	10	895	14.5	B	5.2	A	2.5	A	7.3	A			312	38	110	150	64	**143**	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	2.1	A	0			0			0		
		EB	0	465	10	475	0.0	A	1.2	A	1.1	A	1.2	A			0			0			0		
		WB	30	885	0	915	5.0	A	2.4	A	0.0	A	2.5	A			0			75	9	36	0		
	3rd St at Plum St (Signal)	NB	20	250	0	270	14.8	B	11.6	B	0.0	A	11.9	B	8.1	A	289	66	161	100	12	54	0		
		SB	100	175	45	320	7.6	A	3.4	A	1.7	A	4.3	A			320	17	84	75	26	**70**	0		
		EB	25	0	20	45	24.5	C	0.0	A	7.4	A	16.1	B			287	17	72	0			50	12	31
		WB	5	0	35	40	0.0	A	0.6	A	3.8	A	3.0	A			300	17	40	0			300		
	3rd St at Potter St (2-Way Stop)	NB	30	0	0	30	3.9	A	0.0	A	0.0	A	3.9	A	2.5	A	300			300	19	36	0		
		SB	0	30	10	40	0.0	A	5.8	A	3.0	A	5.2	A			320	19	45	0			320	8	31
		EB	0	0	100	100	0.0	A	0.0	A	0.7	A	0.7	A			311		2	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St (All-Way Stop)	NB	110	220	10	340	10.1	B	8.1	A	4.2	A	8.6	A	7.7	A	348	42	90	150	26	50	0		
		SB	20	150	20	190	5.5	A	7.6	A	4.0	A	7.0	A			289	38	78	125	14	30	0		
		EB	10	20	30	60	5.2	A	6.8	A	7.8	A	7.1	A			342	21	45	0			25	**22**	**54**
		WB	60	60	30	150	6.1	A	7.1	A	8.3	A	7.0	A			325	37	66	0			25	**19**	**36**
	US 61 at US 63 New Intersection (Signal)	NB	620	0	40	660	32.8	C	0.0	A	9.4	A	31.4	C	18.6	B	1000			1000	160	261	300	24	67
		SB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
		EB	0	220	245	465	0.0	A	12.2	B	2.7	A	7.1	A			1054	61	139	0			0		
		WB	15	295	0	310	16.1	B	7.4	A	0.0	A	7.8	A			658	41	100	300	11	70	0		
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	420	50	80	550	41.7	D	21.2	C	14.6	B	33.3	C	20.0	C	339	52	119	339	184	**354**	0		
		SB	30	70	30	130	22.2	C	19.4	B	14.2	B	18.8	B			480	51	135	0			25	**24**	**75**
		EB	40	1010	270	1,320	37.3	D	23.0	C	20.5	C	22.9	C			1201	234	458	125	32	**117**	50	**86**	**100**
		WB	45	780	40	865	39.3	D	8.3	A	5.7	A	10.0	B			427	78	142	125	43	**108**	0		
	US 61 at Bush St (Signal)	NB	80	20	130	230	31.8	C	28.9	C	18.1	B	23.8	C	13.1	B	313	70	186	0			25	**55**	**76**
		SB	40	60	30	130	28.3	C	26.1	C	12.1	B	23.6	C			392	64	148	0			25	**23**	**75**
		EB	20	950	180	1,150	16.3	B	12.5	B	14.7	B	12.9	B			427	114	**396**	125	11	34	0		
		WB	55	765	30	850	39.0	D	6.3	A	4.6	A	8.7	A			291	68	135	120	40	**106**	0		
	US 61 at Plum St (Signal)	NB	225	10	330	565	30.0	C	7.6	A	13.9	B	19.9	B	19.8	B	300	130	**243**	0			300	121	**324**
		SB	10	50	30	90	25.8	C	21.2	C	10.1	B	18.3	B			188	37	113	0			50	17	**65**
		EB	10	900	150	1,060	17.7	B	21.2	C	23.7	C	21.5	C			291	210	**356**	120	7	**112**	0		
		WB	190	525	10	725	33.7	C	11.3	B	7.3	A	17.2	B			312	111	233	150	98	**189**	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	2.4	A	0			0			0		
		EB	0	1230	10	1,240	0.0	A	2.4	A	3.2	A	2.4	A			312		4	0			0		
		WB	35	705	0	740	10.9	B	1.9	A	0.0	A	2.3	A			0			75	17	52	0		
	3rd St at Plum St (Signal)	NB	50	310	10	370	28.9	C	19.4	B	12.6	B	20.5	C	16.5	B	289	115	**255**	100	30	**109**	0		
		SB	85	290	65	440	20.2	C	14.0	B	9.7	A	14.5	B			320	100	234	75	43	**123**	0		
		EB	110	10	50	170	24.7	C	24.0	C	10.3	B	20.2	C			287	66	135	0			50	28	**90**
		WB	10	15	145	170	23.4	C	21.2	C	6.9	A	9.4	A			300	49	131	150	9	39	300		
	3rd St at Potter St (2-Way Stop)	NB	120	0	0	120	4.3	A	0.0	A	0.0	A	4.3	A	2.9	A	300			300	35	59	0		
		SB	0	35	10	45	0.0	A	6.2	A	3.5	A	5.6	A			320	20	35	0			320	7	31
		EB	0	0	85	85	0.0	A	0.0	A	0.9	A	0.9	A			311		2	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St (All-Way Stop)	NB	120	270	90	480	13.5	B	13.4	B	9.6	A	12.7	B	12.8	B	348	76	184	150	36	**126**	0		
		SB	30	280	30	340	8.7	A	17.0	C	13.4	B	16.0	C			289	98	207	125	18	73	0		
		EB	50	110	140	300	9.7	A	11.4	B	11.2	B	11.0	B			342	49	104	0			25	**43**	**75**
		WB	60	80	40	180	9.0	A	9.7	A	8.9	A	9.3	A			325	48	98	0			25	**24**	**52**
	US 61 at US 63 New Intersection (Signal)	NB	410	0	40	450	36.0	D	0.0	A	9.5	A	33.6	C	12.0	B	1000			1000	109	202	300	22	65
		SB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
		EB	0	410	820	1,230	0.0	A	4.2	A	6.9	A	6.0	A			1054	33	97	0			300	10	115
		WB	40	330	0	370	15.9	B	5.5	A	0.0	A	6.6	A			658	41	107	300	23	80	0		

Table 4b
Concept 6
Build 2042 Buttonhook Intersection
Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	320	90	30	440	28.3	C	19.6	B	8.6	A	24.0	C	11.9	B	339	46	121	339	106	228	0		
		SB	20	40	20	80	22.8	C	20.0	C	13.7	B	19.3	B			480	41	132	0			25	18	74
		EB	50	490	160	700	41.3	D	12.4	B	9.6	A	13.8	B			1201	89	201	125	42	105	50	51	100
		WB	55	690	50	795	11.9	B	4.6	A	4.2	A	5.2	A			427	42	105	125	29	83	0		
	US 61 at Bush St (Signal)	NB	50	30	45	125	25.3	C	24.0	C	9.9	A	19.1	B	9.5	A	313	46	138	0			25	26	74
		SB	20	20	10	50	20.5	C	17.5	B	12.3	B	17.8	B			392	22	60	0			25	7	52
		EB	40	430	70	540	28.3	C	9.7	A	7.6	A	10.9	B			427	58	142	125	27	80	0		
		WB	90	755	70	915	14.6	B	6.6	A	4.7	A	7.2	A			291	56	126	120	33	84	0		
	US 61 at Plum St (Signal)	NB	175	40	155	370	22.0	C	13.2	B	5.9	A	13.9	B	12.1	B	300	114	216	0			300	49	142
		SB	10	10	10	30	22.6	C	24.7	C	11.3	B	20.2	C			188	19	87	0			50	8	70
		EB	20	415	100	535	23.9	C	17.7	B	15.2	B	17.5	B			291	102	216	120	12	51	0		
		WB	260	810	10	1,080	18.2	B	5.8	A	5.2	A	8.6	A			312	56	147	150	82	175	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	2.4	A	0			0			0		
		EB	0	550	20	570	0.0	A	1.5	A	1.4	A	1.5	A			0			0			0		
		WB	30	1060	0	1,090	6.2	A	2.7	A	0.0	A	2.8	A			0			75	11	36	0		
	3rd St at Plum St (Signal)	NB	20	300	0	320	16.0	B	12.3	B	0.0	A	12.5	B	9.0	A	289	86	199	100	9	38	0		
		SB	110	210	60	380	9.3	A	4.3	A	1.5	A	5.3	A			320	22	107	75	38	94	0		
		EB	25	0	20	45	26.5	C	0.0	A	7.7	A	16.9	B			287	17	69	0			50	12	31
		WB	0	5	55	60	25.9	C	0.0	A	4.6	A	6.5	A			300	24	49	150	4	31	300		
	3rd St at Potter St (2-Way Stop)	NB	40	0	0	40	3.9	A	0.0	A	0.0	A	3.9	A	2.4	A	300			300	25	41	0		
		SB	0	30	10	40	0.0	A	5.0	A	3.1	A	4.7	A			320	23	40	0			320	8	31
		EB	0	0	120	120	0.0	A	0.0	A	0.8	A	0.8	A			311		5	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St (All-Way Stop)	NB	130	270	20	420	11.0	B	9.4	A	6.6	A	9.7	A	8.6	A	348	54	115	150	28	55	0		
		SB	20	180	20	220	6.6	A	8.0	A	4.7	A	7.6	A			289	42	77	125	12	29	0		
		EB	10	30	40	80	5.8	A	7.2	A	8.5	A	7.7	A			342	24	41	0			25	27	62
		WB	70	70	40	180	6.2	A	7.5	A	9.1	A	7.4	A			325	40	78	0			25	26	56
	US 61 at US 63 New Intersection (Signal)	NB	760	0	50	810	30.5	C	0.0	A	10.0	B	29.3	C	18.9	B	1000			1000	184	280	300	26	69
		SB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
		EB	0	250	300	550	0.0	A	14.6	B	3.1	A	8.3	A			1054	74	140	0			0		
		WB	20	330	0	350	19.4	B	10.4	B	0.0	A	10.9	B			658	55	127	300	15	74	0		
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	470	60	100	630	76.3	E	40.0	D	36.2	D	62.6	E	28.3	C	339	85	289	339	288	358	0		
		SB	30	80	40	150	30.6	C	27.4	C	18.9	B	25.8	C			480	65	173	0			25	31	75
		EB	40	1130	300	1,470	46.4	D	31.0	C	30.0	C	31.2	C			1201	335	617	125	38	174	50	83	100
		WB	60	880	40	980	63.2	E	6.8	A	6.4	A	9.8	A			427	77	162	125	51	130	0		
	US 61 at Bush St (Signal)	NB	90	20	175	285	43.3	D	38.9	D	33.4	C	36.8	D	22.1	C	313	119	278	0			25	68	77
		SB	50	70	30	150	33.8	C	30.8	C	16.3	B	28.5	C			392	71	170	0			25	26	74
		EB	20	1100	200	1,320	23.1	C	27.3	C	38.0	D	28.9	C			427	286	488	125	11	63	0		
		WB	75	900	30	1,005	43.0	D	5.7	A	4.8	A	8.5	A			291	73	143	120	48	106	0		
	US 61 at Plum St (Signal)	NB	270	20	415	705	60.0	E	35.7	D	24.5	C	38.3	D	28.9	C	300	204	250	0			300	236	342
		SB	10	70	30	110	30.8	C	28.9	C	11.3	B	23.9	C			188	51	130	0			50	21	73
		EB	10	1085	180	1,275	26.1	C	29.3	C	34.1	C	30.0	C			291	289	369	120	12	140	0		
		WB	215	625	20	860	38.6	D	14.5	B	10.8	B	20.2	C			312	159	270	150	121	199	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	3.0	A	0			0			0		
		EB	0	1475	25	1,500	0.0	A	3.0	A	3.3	A	3.0	A			312	2	29	0			0		
		WB	45	830	0	875	15.0	C	2.3	A	0.0	A	3.0	A			1054	1	30	75	27	73	0		
	3rd St at Plum St (Signal)	NB	60	370	10	440	38.2	D	30.1	C	22.1	C	31.1	C	26.6	C	289	186	304	100	49	149	0		
		SB	90	335	70	495	27.8	C	20.0	C	14.5	B	20.5	C			320	162	316	75	54	125	0		
		EB	135	10	50	195	53.2	D	45.2	D	25.5	C	45.2	D			287	93	203	0			50	35	99
		WB	15	15	170	200	24.5	C	20.5	C	14.7	B	15.7	B			300	70	161	150	9	40	300		
	3rd St at Potter St (2-Way Stop)	NB	140	0	0	140	4.4	A	0.0	A	0.0	A	4.4	A	3.5	A	300			300	37	67	0		
		SB	0	40	10	50	0.0	A	5.7	A	3.4	A	5.3	A			320	25	53	0			320	9	30
		EB	0	0	90	90	0.0	A	0.8	A	1.0	A	1.0	A			311		5	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St (All-Way Stop)	NB	140	330	110	580	20.2	C	27.2	D	25.1	D	25.2	D	20.6	C	348	140	370	150	62	200	0		
		SB	40	330	30	400	11.2	B	26.1	D	22.8	C	24.4	C			289	137	271	125	35	150	0		
		EB	60	130	170	360	14.9	B	14.5	B	13.8	B	14.2	B			342	68	182	0			25	52	76
		WB	70	90	50	210	10.7	B	11.5	B	12.0	B	11.4	B			325	52	104	0			25	34	75
	US 61 at US 63 New Intersection (Signal)	NB	490	0	50	540	39.0	D	0.0	A	9.6	A	36.2	D	14.1	B	1000			1000	143	254	300	26	72
		SB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
		EB	0	470	1005	1,475	0.0	A	6.2	A	8.5	A	7.8	A			1054	51	122	0			300	19	119
		WB	45	385	0	430	19.4	B	6.2	A	0.0	A	7.5	A			658	48	113	300	30	100	0		

Table 5a

Concept 7

Build 2022 Buttonhook Intersection with Slip Ramp

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	280	80	20	380	26.1	C	19.2	B	7.9	A	22.8	C	11.9	B	339	41	113	339	94	199	0		
		SB	20	40	20	80	23.7	C	19.7	B	11.6	B	18.1	B			480	38	121	0			25	**23**	**75**
		EB	50	440	140	630	35.8	D	12.6	B	9.2	A	13.4	B			1201	84	197	125	37	**106**	50	**46**	**100**
		WB	20	620	40	680	13.9	B	5.3	A	4.6	A	5.5	A			427	44	102	125	15	56	0		
	US 61 at Bush St (Signal)	NB	40	20	45	105	24.0	C	21.9	C	8.5	A	16.7	B	8.8	A	313	37	91	0			25	**26**	**74**
		SB	10	20	10	40	22.5	C	17.3	B	10.0	B	16.9	B			392	18	61	0			25	6	**40**
		EB	40	370	70	480	17.4	B	9.5	A	6.0	A	9.7	A			427	45	116	125	19	60	0		
		WB	20	620	50	690	12.9	B	6.6	A	5.2	A	6.6	A			291	50	101	120	9	78	0		
	US 61 at Plum St (Signal)	NB	145	30	125	300	15.2	B	7.4	A	3.5	A	9.4	A	10.7	B	300	69	159	0			300	30	62
		SB	10	10	10	30	15.9	B	13.0	B	11.0	B	13.5	B			188	14	75	0			50	8	**64**
		EB	20	350	85	455	24.5	C	13.7	B	11.2	B	13.8	B			291	74	174	120	13	43	0		
		WB	25	595	10	630	14.7	B	8.9	A	6.2	A	9.0	A			312	77	149	150	14	62	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.2	A	0			0			0		
		EB	0	465	10	475	0.0	A	1.1	A	1.0	A	1.1	A			0			0			0		
		WB	10	620	0	630	3.9	A	1.2	A	0.0	A	1.3	A			0			75	5	31	0		
	3rd St at Plum St (Signal)	NB	20	250	0	270	12.8	B	12.5	B	0.0	A	12.5	B	14.0	B	289	73	166	100	9	38	0		
		SB	10	110	10	130	11.2	B	5.6	A	1.5	A	5.6	A			307	28	93	75	4	29	0		
		EB	25	0	20	45	29.0	C	0.0	A	7.9	A	19.4	B			287	20	82	0			50	12	**44**
		WB	70	110	35	215	24.4	C	21.7	C	4.5	A	20.0	C			300	56	146	150	42	**121**	300	18	53
	3rd St at Potter St (2-Way Stop)	NB	30	0	0	30	6.2	A	0.0	A	0.0	A	6.2	A	1.9	A	300			300	21	45	0		
		SB	0	10	10	20	0.0	A	5.9	A	3.6	A	4.9	A			320	9	31	0			320	8	31
		EB	0	0	10	10	0.0	A	0.0	A	0.7	A	0.7	A			0			0			0		
		WB	110	175	0	285	1.7	A	0.8	A	0.0	A	1.2	A			301	1	30	0			0		
	4th St at Plum St (All-Way Stop)	NB	110	220	10	340	10.4	B	7.9	A	4.2	A	8.6	A	7.8	A	348	41	94	150	27	48	0		
		SB	20	150	20	190	5.6	A	8.0	A	4.9	A	7.4	A			289	39	110	125	13	34	0		
		EB	10	20	30	60	4.8	A	6.9	A	7.8	A	7.0	A			342	22	50	0			25	**20**	**52**
		WB	60	60	30	150	5.8	A	7.0	A	7.9	A	6.7	A			325	38	75	0			25	**21**	**31**
	US 61 at US 63 New Intersection (Signal)	NB	335	0	40	375	32.4	C	0.0	A	8.7	A	30.0	C	14.3	B	1000			1000	185	339	300	23	128
		SB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
		EB	0	220	245	465	0.0	A	10.4	B	2.4	A	6.2	A			1064	55	144	0			0		
		WB	15	295	0	310	16.9	B	7.2	A	0.0	A	7.6	A			664	48	109	300	10	63	0		
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	420	50	80	550	29.6	C	16.9	B	12.4	B	24.4	C	21.9	C	339	45	123	339	149	**334**	0		
		SB	30	70	30	130	20.7	C	18.2	B	13.8	B	17.9	B			480	48	137	0			25	17	**61**
		EB	40	1010	270	1,320	39.4	D	26.9	C	23.3	C	26.5	C			1201	276	455	125	29	**113**	50	**81**	**100**
		WB	30	780	40	850	43.8	D	12.9	B	11.3	B	13.9	B			427	105	197	125	27	70	0		
	US 61 at Bush St (Signal)	NB	80	20	130	230	27.5	C	29.7	C	15.3	B	20.8	C	11.4	B	313	63	160	0			25	**51**	**76**
		SB	40	60	30	130	25.0	C	20.0	C	12.8	B	20.0	C			392	54	143	0			25	18	**75**
		EB	20	950	180	1,150	17.5	B	9.8	A	11.6	B	10.2	B			427	78	184	125	12	43	0		
		WB	10	750	30	790	33.5	C	9.0	A	7.3	A	9.2	A			291	87	166	120	8	38	0		
	US 61 at Plum St (Signal)	NB	225	10	330	565	25.2	C	7.8	A	14.4	B	18.1	B	14.6	B	300	122	**237**	0			300	119	**267**
		SB	10	50	30	90	18.3	B	16.5	B	8.0	A	13.9	B			188	32	95	0			50	17	**50**
		EB	10	900	150	1,060	19.4	B	13.0	B	14.1	B	13.2	B			291	123	**285**	120	7	29	0		
		WB	20	465	10	495	42.0	D	12.7	B	8.8	A	13.9	B			312	84	175	150	18	87	0		
	US 61 at Potter St (2-Way Stop)	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.9	A	0			0			0		
		EB	0	1230	10	1,240	0.0	A	2.0	A	2.4	A	2.0	A			312	1	26	0			0		
		WB	20	475	0	495	13.6	B	1.2	A	0.0	A	1.8	A			0			75	15	43	0		
	3rd St at Plum St (Signal)	NB	50	310	10	370	21.8	C	17.3	B	11.8	B	17.7	B	16.5	B	289	109	**255**	100	30	**121**	0		
		SB	20	210	40	270	16.8	B	14.2	B	7.5	A	13.4	B			307	65	159	75	9	45	0		
		EB	110	10	50	170	25.9	C	23.9	C	9.6	A	20.8	C			287	62	126	0			50	30	**98**
		WB	90	100	145	335	23.8	C	19.5	B	7.6	A	15.7	B			300	55	160	150	49	100	300	48	100
	3rd St at Potter St (2-Way Stop)	NB	120	0	0	120	6.3	A	0.0	A	0.0	A	6.3	A	2.8	A	300			300	38	86	0		
		SB	0	20	10	30	0.0	A	7.3	A	4.9	A	6.6	A			320	16	48	0			320	9	30
		EB	0	0	20	20	0.0	A	0.7	A	0.8	A	0.7	A			311		2	0			0		
		WB	80	165	0	245	1.7	A	0.7	A	0.0	A	1.0	A			301	2	34	0			0		
	4th St at Plum St (All-Way Stop)	NB	120	270	90	480	12.9	B	12.5	B	9.3	A	12.0	B	11.5	B	348	73	166	150	32	90	0		
		SB	30	280	30	340	8.1	A	13.6	B	9.4	A	12.8	B			289	71	175	125	18	67	0		
		EB	50	110	140	300	10.2	B	10.6	B	11.0	B	10.7	B			342	51	105	0			25	**43**	**75**
		WB	60	80	40	180	8.1	A	9.7	A	9.9	A	9.2	A			325	46	109	0			25	**26**	**70**
	US 61 at US 63 New Intersection (Signal)	NB	165	0	40	205	17.9	B	0.0	A	8.4	A	16.1	B	7.5	A	1000			1000	80	163	300	18	48
		SB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
		EB	0	410	820	1,230	0.0	A	6.2	A	6.7	A	6.5	A			1066	51	99	0			300	8	68
		WB	40	330	0	370	14.8	B	4.9	A	0.0	A	5.9	A			664	42	82	300	24	80	0		

Table 5b

Concept 7

Build 2042 Buttonhook Intersection with Slip Ramp

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	320	90	30	440	29.5	C	21.0	C	9.1	A	25.2	C	12.4	B	339	52	125	339	116	239	0		
		SB	20	40	20	80	26.5	C	23.1	C	13.5	B	21.5	C			480	44	145	0			25	21	71
		EB	50	490	160	700	43.9	D	12.4	B	9.5	A	14.0	B			1201	94	200	125	49	127	50	54	100
		WB	30	690	50	770	14.3	B	4.8	A	4.1	A	5.1	A			427	45	96	125	18	70	0		
	US 61 at Bush St (Signal)	NB	50	30	45	125	23.8	C	18.5	B	8.9	A	17.0	B	9.0	A	313	46	111	0			25	23	75
		SB	20	20	10	50	23.1	C	18.9	B	9.9	A	18.9	B			392	27	86	0			25	7	45
		EB	40	430	70	540	23.9	C	9.6	A	6.1	A	10.2	B			427	56	117	125	21	72	0		
		WB	20	730	70	820	12.9	B	6.6	A	5.2	A	6.6	A			291	62	114	120	11	54	0		
	US 61 at Plum St (Signal)	NB	175	40	155	370	14.7	B	8.5	A	4.1	A	9.4	A	11.0	B	300	84	186	0			300	35	99
		SB	10	10	10	30	20.7	C	11.4	B	10.7	B	14.4	B			188	13	64	0			50	8	64
		EB	20	415	100	535	26.7	C	14.1	B	10.9	B	14.0	B			291	89	191	120	13	46	0		
		WB	30	715	10	755	16.1	B	9.3	A	7.1	A	9.5	A			312	95	173	150	20	70	0		
	US 61 at Potter St	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	1.4	A	0			0			0		
	(2-Way Stop)	EB	0	550	20	570	0.0	A	1.2	A	1.2	A	1.2	A			0			0			0		
		WB	10	735	0	745	5.4	A	1.5	A	0.0	A	1.6	A			0			75	5	25	0		
	3rd St at Plum St (Signal)	NB	20	300	0	320	15.5	B	12.1	B	0.0	A	12.3	B	13.9	B	289	86	188	100	8	39	0		
		SB	0	130	20	150	0.0	A	4.8	A	2.2	A	4.4	A			307	29	96	0			0		
		EB	25	0	20	45	25.4	C	0.0	A	7.6	A	16.9	B			287	18	66	0			50	12	31
		WB	80	140	55	275	25.0	C	23.2	C	6.0	A	20.8	C			300	75	161	150	42	104	300	26	89
	3rd St at Potter St	NB	40	0	0	40	6.2	A	0.0	A	0.0	A	6.2	A	1.9	A	300			300	25	44	0		
	(2-Way Stop)	SB	0	10	10	20	0.0	A	3.4	A	3.8	A	3.5	A			320	8	31	0			320	8	31
		EB	0	0	10	10	0.0	A	0.0	A	0.1	A	0.1	A			0			0			0		
		WB	130	215	0	345	1.7	A	1.0	A	0.0	A	1.3	A			301	1	21	0			0		
	4th St at Plum St	NB	130	270	20	420	10.8	B	9.2	A	5.7	A	9.5	A	8.4	A	348	52	103	150	29	53	0		
	(All-Way Stop)	SB	20	180	20	220	6.2	A	7.8	A	4.2	A	7.4	A			289	40	86	125	11	29	0		
		EB	10	30	40	80	5.2	A	7.1	A	8.4	A	7.5	A			342	25	54	0			25	26	65
		WB	70	70	40	180	6.6	A	7.2	A	8.6	A	7.3	A			325	42	72	0			25	23	45
	US 61 at US 63 New Intersection (Signal)	NB	415	0	50	465	31.5	C	0.0	A	9.6	A	29.3	C	15.7	B	1000			1000	234	428	300	26	85
		SB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
		EB	0	250	300	550	0.0	A	15.1	B	2.7	A	8.2	A			1064	71	144	0			0		
		WB	20	330	0	350	19.5	B	8.6	A	0.0	A	9.2	A			664	54	121	300	17	92	0		
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	470	60	100	630	44.8	D	21.5	C	18.5	B	35.4	D	25.6	C	339	62	134	339	223	353	0		
		SB	30	80	40	150	24.1	C	19.7	B	14.6	B	19.4	B			480	56	144	0			25	25	75
		EB	40	1130	300	1,470	48.1	D	31.9	C	31.0	C	32.1	C			1201	345	610	125	37	151	50	87	100
		WB	40	880	40	960	51.3	D	11.3	B	11.3	B	12.6	B			427	113	202	125	33	107	0		
	US 61 at Bush St (Signal)	NB	90	20	175	285	32.4	C	27.0	C	24.0	C	26.8	C	14.6	B	313	96	205	0			25	66	75
		SB	50	70	30	150	26.6	C	24.4	C	13.6	B	23.0	C			392	66	143	0			25	22	73
		EB	20	1100	200	1,320	20.1	C	14.2	B	17.0	B	14.7	B			427	137	409	125	13	51	0		
		WB	20	880	30	930	48.1	D	8.7	A	7.0	A	9.4	A			291	101	157	120	18	84	0		
	US 61 at Plum St (Signal)	NB	270	20	415	705	29.8	C	20.8	C	19.2	B	23.3	C	21.8	C	300	165	249	0			300	171	317
		SB	10	70	30	110	23.4	C	18.2	B	9.9	A	16.3	B			188	40	131	0			50	18	60
		EB	10	1085	180	1,275	21.2	C	20.7	C	24.6	C	21.3	C			291	222	364	120	7	83	0		
		WB	30	550	20	600	74.3	E	19.5	B	13.6	B	22.1	C			312	126	250	150	34	112	0		
	US 61 at Potter St	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	2.4	A	0			0			0		
	(2-Way Stop)	EB	0	1475	25	1,500	0.0	A	2.6	A	2.9	A	2.6	A			312	1	22	0			0		
		WB	25	570	0	595	19.5	C	1.2	A	0.0	A	2.0	A			0			75	19	62	0		
	3rd St at Plum St (Signal)	NB	60	370	10	440	25.0	C	19.2	B	12.4	B	19.8	B	17.0	B	289	138	260	100	35	149	0		
		SB	20	250	40	310	14.7	B	10.0	B	6.1	A	9.8	A			307	56	147	75	12	66	0		
		EB	135	10	50	195	29.1	C	24.9	C	11.3	B	23.9	C			287	78	186	0			50	34	100
		WB	100	120	170	390	22.2	C	20.1	C	10.7	B	16.6	B			300	64	168	150	50	120	300	58	100
	3rd St at Potter St	NB	140	0	0	140	7.0	A	0.0	A	0.0	A	7.0	A	3.0	A	300			300	41	79	0		
	(2-Way Stop)	SB	0	20	10	30	0.0	A	5.5	A	4.7	A	5.3	A			320	16	40	0			320	10	31
		EB	0	0	20	20	0.0	A	0.7	A	0.7	A	0.7	A			311		2	0			0		
		WB	90	190	0	280	1.7	A	0.8	A	0.0	A	1.1	A			301	1	27	0			0		
	4th St at Plum St	NB	140	330	110	580	17.0	C	21.6	C	18.5	C	19.9	C	17.4	C	348	122	316	150	55	182	0		
	(All-Way Stop)	SB	40	330	30	400	9.6	A	21.1	C	16.8	C	19.7	C			289	101	242	125	29	148	0		
		EB	60	130	170	360	12.3	B	15.1	C	14.0	B	14.1	B			342	64	189	0			25	56	76
		WB	70	90	50	210	10.7	B	11.6	B	10.7	B	11.1	B			325	51	105	0			25	31	72
	US 61 at US 63 New Intersection (Signal)	NB	210	0	50	260	35.0	D	0.0	A	9.6	A	30.1	C	9.8	A	1000			1000	150	329	300	27	77
		SB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
		EB	0	470	1005	1,475	0.0	A	5.6	A	7.7	A	7.0	A			1066	49	109	0			300	9	127
		WB	45	385	0	430	15.3	B	5.4	A	0.0	A	6.4	A			664	46	95	300	28	87	0		

Table 6a

Concept 8

Build 2022 Buttonhook Intersection Roundabout

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	280	80	20	380	26.3	C	19.3	B	10.4	B	23.3	C	12.2	B	339	39	119	339	93	234	0		
		SB	20	40	20	80	23.7	C	19.7	B	13.3	B	19.1	B			480	42	124	0			25	**19**	**73**
		EB	50	440	140	630	38.4	D	13.1	B	8.8	A	14.0	B			1201	85	184	125	40	**123**	50	**44**	**99**
		WB	40	620	40	700	11.7	B	5.2	A	3.0	A	5.4	A			427	43	105	125	20	66	0		
	US 61 at Bush St (Signal)	NB	40	20	45	105	23.7	C	23.5	C	8.6	A	17.1	B	8.6	A	313	36	98	0			25	**25**	**73**
		SB	10	20	10	40	28.7	C	20.8	C	11.7	B	21.0	C			392	19	74	0			25	6	**40**
		EB	40	370	70	480	21.7	C	8.9	A	5.6	A	9.6	A			427	42	95	125	19	56	0		
		WB	75	640	50	765	11.6	B	6.0	A	4.3	A	6.4	A			291	48	122	120	25	71	0		
	US 61 at Plum St (Signal)	NB	145	30	125	300	21.4	C	9.2	A	5.5	A	12.9	B	10.7	B	300	86	182	0			300	43	110
		SB	10	10	10	30	21.2	C	16.9	B	9.7	A	15.4	B			188	16	74	0			50	12	**66**
		EB	20	350	85	455	20.3	C	15.8	B	13.1	B	15.5	B			291	78	148	120	12	44	0		
		WB	215	670	10	895	14.5	B	5.2	A	2.5	A	7.3	A			312	38	110	150	64	**143**	0		
	US 61 at Potter St	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	2.1	A	0			0			0		
	(2-Way Stop)	EB	0	465	10	475	0.0	A	1.2	A	1.1	A	1.2	A			0			0			0		
		WB	30	885	0	915	5.0	A	2.4	A	0.0	A	2.5	A			0			75	9	36	0		
	3rd St at Plum St (Signal)	NB	20	250	0	270	14.8	B	11.6	B	0.0	A	11.9	B	8.1	A	289	66	161	100	12	54	0		
		SB	100	175	45	320	7.6	A	3.4	A	1.7	A	4.3	A			320	17	84	75	26	**70**	0		
		EB	25	0	20	45	24.5	C	0.0	A	7.4	A	16.1	B			287	17	72	0			50	12	31
		WB	5	0	35	40	0.0	A	0.6	A	3.8	A	3.0	A			300	17	40	0			300		
	3rd St at Potter St	NB	30	0	0	30	3.9	A	0.0	A	0.0	A	3.9	A	2.5	A	300			300	19	36	0		
	(2-Way Stop)	SB	0	30	10	40	0.0	A	5.8	A	3.0	A	5.2	A			320	19	45	0			320	8	31
		EB	0	0	100	100	0.0	A	0.0	A	0.7	A	0.7	A			311		2	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St	NB	110	220	10	340	10.1	B	8.1	A	4.2	A	8.6	A	7.7	A	348	42	90	150	26	50	0		
	(All-Way Stop)	SB	20	150	20	190	5.5	A	7.6	A	4.0	A	7.0	A			289	38	78	125	14	30	0		
		EB	10	20	30	60	5.2	A	6.8	A	7.8	A	7.1	A			342	21	45	0			25	**22**	**54**
		WB	60	60	30	150	6.1	A	7.1	A	8.3	A	7.0	A			325	37	66	0			25	**19**	**36**
		NB	620	0	40	660							2.6	A	4.6	A		25	25						
	US 61 at US 63 New Intersection	SB	0	0	0	0																			
	ROUNDABOUT	EB	0	220	245	465							4.3	A				<25	<25						
		WB	15	295	0	310							9.1	A				25	25						
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	420	50	80	550	41.7	D	21.2	C	14.6	B	33.3	C	20.0	C	339	52	119	339	184	**354**	0		
		SB	30	70	30	130	22.2	C	19.4	B	14.2	B	18.8	B			480	51	135	0			25	**24**	**75**
		EB	40	1010	270	1,320	37.3	D	23.0	C	20.5	C	22.9	C			1201	234	458	125	32	**117**	50	**86**	**100**
		WB	45	780	40	865	39.3	D	8.3	A	5.7	A	10.0	B			427	78	142	125	43	**108**	0		
	US 61 at Bush St (Signal)	NB	80	20	130	230	31.8	C	28.9	C	18.1	B	23.8	C	13.1	B	313	70	186	0			25	**55**	**76**
		SB	40	60	30	130	28.3	C	26.1	C	12.1	B	23.6	C			392	64	148	0			25	**23**	**75**
		EB	20	950	180	1,150	16.3	B	12.5	B	14.7	B	12.9	B			427	114	**396**	125	11	34	0		
		WB	55	765	30	850	39.0	D	6.3	A	4.6	A	8.7	A			291	68	135	120	40	**106**	0		
	US 61 at Plum St (Signal)	NB	225	10	330	565	30.0	C	7.6	A	13.9	B	19.9	B	19.8	B	300	130	**243**	0			300	121	**324**
		SB	10	50	30	90	25.8	C	21.2	C	10.1	B	18.3	B			188	37	113	0			50	17	**65**
		EB	10	900	150	1,060	17.7	B	21.2	C	23.7	C	21.5	C			291	210	**356**	120	7	**112**	0		
		WB	190	525	10	725	33.7	C	11.3	B	7.3	A	17.2	B			312	111	233	150	98	**189**	0		
	US 61 at Potter St	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	2.4	A	0			0			0		
	(2-Way Stop)	EB	0	1230	10	1,240	0.0	A	2.4	A	3.2	A	2.4	A			312		4	0			0		
		WB	35	705	0	740	10.9	B	1.9	A	0.0	A	2.3	A			0			75	17	52	0		
	3rd St at Plum St (Signal)	NB	50	310	10	370	28.9	C	19.4	B	12.6	B	20.5	C	16.5	B	289	115	**255**	100	30	**109**	0		
		SB	85	290	65	440	20.2	C	14.0	B	9.7	A	14.5	B			320	100	234	75	43	**123**	0		
		EB	110	10	50	170	24.7	C	24.0	C	10.3	B	20.2	C			287	66	135	0			50	28	**90**
		WB	10	15	145	170	23.4	C	21.2	C	6.9	A	9.4	A			300	49	131	150	9	39	300		
	3rd St at Potter St	NB	120	0	0	120	4.3	A	0.0	A	0.0	A	4.3	A	2.9	A	300			300	35	59	0		
	(2-Way Stop)	SB	0	35	10	45	0.0	A	6.2	A	3.5	A	5.6	A			320	20	35	0			320	7	31
		EB	0	0	85	85	0.0	A	0.0	A	0.9	A	0.9	A			311		2	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St	NB	120	270	90	480	13.5	B	13.4	B	9.6	A	12.7	B	12.8	B	348	76	184	150	36	**126**	0		
	(All-Way Stop)	SB	30	280	30	340	8.7	A	17.0	C	13.4	B	16.0	C			289	98	207	125	18	73	0		
		EB	50	110	140	300	9.7	A	11.4	B	11.2	B	11.0	B			342	49	104	0			25	**43**	**75**
		WB	60	80	40	180	9.0	A	9.7	A	8.9	A	9.3	A			325	48	98	0			25	**24**	**52**
		NB	410	0	40	450							2.5	A	5.2	A		<25	<25						
	US 61 at US 63 New Intersection	SB	0	0	0	0																			
	ROUNDABOUT	EB	0	410	820	1,230							5.7	A				25	25						
		WB	40	330	0	370							7.9	A				25	25						

Table 6b

Concept 8

Build 2042 Buttonhook Intersection Roundabout

Red Wing, MN

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Queing Information (feet)								
																	Through			Left Turn			Right Turn		
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Link Length	Avg.	Max	Storage	Avg.	Max	Storage	Avg.	Max
AM Peak Hour	US 61 at East/West Ave (Signal)	NB	320	90	30	440	28.3	C	19.6	B	8.6	A	24.0	C	11.9	B	339	46	121	339	106	228	0		
		SB	20	40	20	80	22.8	C	20.0	C	13.7	B	19.3	B			480	41	132	0			25	18	74
		EB	50	490	160	700	41.3	D	12.4	B	9.6	A	13.8	B			1201	89	201	125	42	105	50	51	100
		WB	55	690	50	795	11.9	B	4.6	A	4.2	A	5.2	A			427	42	105	125	29	83	0		
	US 61 at Bush St (Signal)	NB	50	30	45	125	25.3	C	24.0	C	9.9	A	19.1	B	9.5	A	313	46	138	0			25	26	74
		SB	20	20	10	50	20.5	C	17.5	B	12.3	B	17.8	B			392	22	60	0			25	7	52
		EB	40	430	70	540	28.3	C	9.7	A	7.6	A	10.9	B			427	58	142	125	27	80	0		
		WB	90	755	70	915	14.6	B	6.6	A	4.7	A	7.2	A			291	56	126	120	33	84	0		
	US 61 at Plum St (Signal)	NB	175	40	155	370	22.0	C	13.2	B	5.9	A	13.9	B	12.1	B	300	114	216	0			300	49	142
		SB	10	10	10	30	22.6	C	24.7	C	11.3	B	20.2	C			188	19	87	0			50	8	70
		EB	20	415	100	535	23.9	C	17.7	B	15.2	B	17.5	B			291	102	216	120	12	51	0		
		WB	260	810	10	1,080	18.2	B	5.8	A	5.2	A	8.6	A			312	56	147	150	82	175	0		
	US 61 at Potter St	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	2.4	A	0			0			0		
	(2-Way Stop)	EB	0	550	20	570	0.0	A	1.5	A	1.4	A	1.5	A			0			0			0		
		WB	30	1060	0	1,090	6.2	A	2.7	A	0.0	A	2.8	A			0			75	11	36	0		
	3rd St at Plum St (Signal)	NB	20	300	0	320	16.0	B	12.3	B	0.0	A	12.5	B	9.0	A	289	86	199	100	9	38	0		
		SB	110	210	60	380	9.3	A	4.3	A	1.5	A	5.3	A			320	22	107	75	38	94	0		
		EB	25	0	20	45	26.5	C	0.0	A	7.7	A	16.9	B			287	17	69	0			50	12	31
		WB	0	5	55	60	25.9	C	0.0	A	4.6	A	6.5	A			300	24	49	150	4	31	300		
	3rd St at Potter St	NB	40	0	0	40	3.9	A	0.0	A	0.0	A	3.9	A	2.4	A	300			300	25	41	0		
	(2-Way Stop)	SB	0	30	10	40	0.0	A	5.0	A	3.1	A	4.7	A			320	23	40	0			320	8	31
		EB	0	0	120	120	0.0	A	0.0	A	0.8	A	0.8	A			311		5	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St	NB	130	270	20	420	11.0	B	9.4	A	6.6	A	9.7	A	8.6	A	348	54	115	150	28	55	0		
	(All-Way Stop)	SB	20	180	20	220	6.6	A	8.0	A	4.7	A	7.6	A			289	42	77	125	12	29	0		
		EB	10	30	40	80	5.8	A	7.2	A	8.5	A	7.7	A			342	24	41	0			25	27	62
		WB	70	70	40	180	6.2	A	7.5	A	9.1	A	7.4	A			325	40	78	0			25	26	56
	US 61 at US 63 New Intersection	NB	760	0	50	810							3.0	A	5.6	A		<25	<25						
	ROUNDABOUT	SB	0	0	0	0																			
		EB	0	250	300	550							4.4	A				<25	<25						
		WB	20	330	0	350							12.5	B				30	50						
PM Peak Hour	US 61 at East/West Ave (Signal)	NB	470	60	100	630	76.3	E	40.0	D	36.2	D	62.6	E	28.3	C	339	85	289	339	288	358	0		
		SB	30	80	40	150	30.6	C	27.4	C	18.9	B	25.8	C			480	65	173	0			25	31	75
		EB	40	1130	300	1,470	46.4	D	31.0	C	30.0	C	31.2	C			1201	335	617	125	38	174	50	83	100
		WB	60	880	40	980	63.2	E	6.8	A	6.4	A	9.8	A			427	77	162	125	51	130	0		
	US 61 at Bush St (Signal)	NB	90	20	175	285	43.3	D	38.9	D	33.4	C	36.8	D	22.1	C	313	119	278	0			25	68	77
		SB	50	70	30	150	33.8	C	30.8	C	16.3	B	28.5	C			392	71	170	0			25	26	74
		EB	20	1100	200	1,320	23.1	C	27.3	C	38.0	D	28.9	C			427	286	488	125	11	63	0		
		WB	75	900	30	1,005	43.0	D	5.7	A	4.8	A	8.5	A			291	73	143	120	48	106	0		
	US 61 at Plum St (Signal)	NB	270	20	415	705	60.0	E	35.7	D	24.5	C	38.3	D	28.9	C	300	204	250	0			300	236	342
		SB	10	70	30	110	30.8	C	28.9	C	11.3	B	23.9	C			188	51	130	0			50	21	73
		EB	10	1085	180	1,275	26.1	C	29.3	C	34.1	C	30.0	C			291	289	369	120	12	140	0		
		WB	215	625	20	860	38.6	D	14.5	B	10.8	B	20.2	C			312	159	270	150	121	199	0		
	US 61 at Potter St	NB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A	3.0	A	0			0			0		
	(2-Way Stop)	EB	0	1475	25	1,500	0.0	A	3.0	A	3.3	A	3.0	A			312	2	29	0			0		
		WB	45	830	0	875	15.0	C	2.3	A	0.0	A	3.0	A			1054	1	30	75	27	73	0		
	3rd St at Plum St (Signal)	NB	60	370	10	440	38.2	D	30.1	C	22.1	C	31.1	C	26.6	C	289	186	304	100	49	149	0		
		SB	90	335	70	495	27.8	C	20.0	C	14.5	B	20.5	C			320	162	316	75	54	125	0		
		EB	135	10	50	195	53.2	D	45.2	D	25.5	C	45.2	D			287	93	203	0			50	35	99
		WB	15	15	170	200	24.5	C	20.5	C	14.7	B	15.7	B			300	70	161	150	9	40	300		
	3rd St at Potter St	NB	140	0	0	140	4.4	A	0.0	A	0.0	A	4.4	A	3.5	A	300			300	37	67	0		
	(2-Way Stop)	SB	0	40	10	50	0.0	A	5.7	A	3.4	A	5.3	A			320	25	53	0			320	9	30
		EB	0	0	90	90	0.0	A	0.8	A	1.0	A	1.0	A			311		5	0			0		
		WB	0	0	0	0	0.0	A	0.0	A	0.0	A	0.0	A			0			0			0		
	4th St at Plum St	NB	140	330	110	580	20.2	C	27.2	D	25.1	D	25.2	D	20.6	C	348	140	370	150	62	200	0		
	(All-Way Stop)	SB	40	330	30	400	11.2	B	26.1	D	22.8	C	24.4	C			289	137	271	125	35	150	0		
		EB	60	130	170	360	14.9	B	14.5	B	13.8	B	14.2	B			342	68	182	0			25	52	76
		WB	70	90	50	210	10.7	B	11.5	B	12.0	B	11.4	B			325	52	104	0			25	34	75
	US 61 at US 63 New Intersection	NB	490	0	50	540							2.8	A	6.0	A		<25	<25						
	ROUNDABOUT	SB	0	0	0	0																			
		EB	0	470	1005	1,475							6.2	A				<25	<25						
		WB	45	385	0	430							9.9	A				30	40						

Appendix D

Detour Cost Tables

Table 1
US 63 Bridge Construction
Detour Closure Costs

	No Closure		8-Hour Closure (9PM to 5AM)		Single Lane Closure (24-hrs/day)	
TRAFFIC DATA[1]	AUTO	TRUCKS (9%)	AUTO	TRUCKS (9%)	AUTO	TRUCKS (9%)
2019 Weekday Traffic (Average Mon-Fri)	13830	1370	12290	1220	13055	1290
2019 Weekend Traffic (Average Sat-Sun)	12370	1230	10660	1060	12370	1230
Impacted Weekday Traffic	**0**	**0**	**1540**	**150**	**775**	**80**
Impacted Weekend Traffic	**0**	**0**	**1710**	**170**	**0**	**0**
DURATION OF CLOSURE[2]						
Total Number of Weeks	0		66		62	
Total Number of Weekdays	0		330		310	
Total Number of Weekends	0		128		120	
Total Closure Days	0		458		430	
DETOUR INFORMATION [3]						
Percentage Detour to US 10/61	0%	0%	50%	70%	50%	70%
Detour Length (miles)	50	50	50	50	50	50
Detour Travel Time (hours)	1.2	1.2	1.2	1.2	1.2	1.2
Percentage Detour to STH 25	0%	0%	30%	10%	30%	10%
Detour Length (miles)	65	65	65	65	65	65
Detour Travel Time (hours)	1.6	1.6	1.6	1.6	1.6	1.6
Percentage Not Making Trip	0%	0%	20%	20%	20%	20%
VMT & VHT Reduction Factor[4]	0%	0%	66%	66%	66%	66%
Weekday Detour VMT (miles)	0	0	45,230	4,109	22,762	2,191
Weekend Detour VMT (miles)	0	0	50,223	4,656	0	0
Weekday Detour VHT (hours)	0	0	1,098	99	552	53
Weekend Detour VHT (hours)	0	0	1,219	112	0	0
INCREASED DELAY[5]						
Weekday Delay Increase (VHT)	0	0	0	0	1,148	114
Weekend Delay Increase (VHT)	0	0	0	0	711	70
					Northbound	Southbound
Weekday Queues Average/Maximum	0	0	0	0	640' / 1200'	2100' / 3800'
Weekend Queues Average/Maximum	0	0	0	0	640' / 1100'	1200' / 1800'
COSTS[6]						
Vehicle Miles Traveled (VMT) Cost	$ 0.31	$ 0.95	$ 0.31	$ 0.95	$ 0.31	$ 0.95
Vehicle Hours Traveled (VHT) Cost	$ 15.60	$ 26.90	$ 15.60	$ 26.90	$ 15.60	$ 26.90
Vehicle Occupancy Rate (applied to VHT)	1.49	1.12	1.49	1.12	1.49	1.12
AVERAGE DAILY WEEKDAY COSTS						
Daily VMT Costs	$ -	$ -	$ 14,021.24	$ 3,903.08	$ 7,056.14	$ 2,081.64
Daily VHT Costs	$ -	$ -	$ 25,515.22	$ 2,982.67	$ 39,524.56	$ 5,022.99
Total Daily Costs	**$**	**-**	**$**	**46,422.20**	**$**	**53,685.34**
TOTAL DETOUR DURATION COSTS	**$**	**-**	**$**	**15,319,326.90**	**$**	**16,642,454.00**
AVERAGE DAILY WEEKEND DAY COSTS						
Weekend Daily VMT Costs	$ -	$ -	$ 15,569.04	$ 4,423.49	$ -	$ -
Weekend Daily VHT Costs	$ -	$ -	$ 19,014.65	$ 3,018.18	$ 11,091.60	$ 1,882.85
Total Daily Costs	**$**	**-**	**$**	**42,025.35**	**$**	**12,974.45**
TOTAL DETOUR DURATION COSTS	**$**	**-**	**$**	**5,379,245.40**	**$**	**1,556,934.10**
ADDITIONAL DAILY COSTS [7]						
Flaggers/Signal Control (4 at 24/hrs/Day)	0	$ -	0	$ -	4.0	$ 2,400.00
Daily Set Up/Signing Costs				$ 1,500.00		
Total Daily Costs	**$**	**-**	**$**	**1,500.00**	**$**	**2,400.00**
TOTAL DETOUR DURATION COSTS	**$**	**-**	**$**	**687,000.00**	**$**	**1,032,000.00**
TOTAL DETOUR USER COSTS	**$**	**-**	**$**	**21,385,572.30**	**$**	**19,231,388.10**

NOTES:
1: August 2012 Wavetronix Data factored to 2019 forecast demands
2: Assumes Closure for 2 Construction Seasons (April 1st to November 15th)
3: Detour Route between Downtown Red Wing, MN and US 63/STH 35 in WI.
4: VMT & VHT Reduction Factor applied since not all traffic will realize the full detour length
5: Delay/Queue based on SimTraffic Simulation analysis; Northbound queue not to exceed 1300' before impacting downtown.
6: MnDOT Office of Capital Programs and Performance Measures
7: Flagger Cost Per Day assumes $25/Hr for 24 Hours/Day per person = $600/Day

Information:
2019 Forecast Demands
24-hr Volumes and Capacity Analysis

Monday through Friday

																85%	PM Peak Reduced to.....										
																162	200	192	175	126						REDUCED DEMANDS	855
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Sum		
Volume (NB)	**104**	**71**	**36**	**37**	**36**	**47**	**102**	**199**	**245**	**256**	**292**	**364**	**403**	**440**	**457**	**566**	**771**	**762**	**686**	**453**	**322**	**276**	**197**	**166**	**7288**		
Volume (SB)	**78**	**34**	**30**	**26**	**32**	**117**	**459**	**519**	**565**	**483**	**423**	**435**	**452**	**455**	**468**	**511**	**564**	**516**	**483**	**389**	**298**	**233**	**190**	**148**	**7908**		
DELAY NB	85	85	85	85	85	85	304	304	304	304	304	127	127	127	127	120	120	120	120	120	127	127	127	127			
DELAY SB	92	92	92	92	92	92	158	158	158	158	158	296	296	296	296	914	914	914	914	914	296	296	296	296			
DELAY (sec)	16016	9163	5820	5537	6004	14759	103530	142498	163750	154138	155602	174988	184973	190560	196567	534974	608016	563064	523782	409906	129102	104020	81259	64890	4542918.0	Seconds	
DELAY (min)	266.9	152.7	97.0	92.3	100.1	246.0	1725.5	2375.0	2729.2	2569.0	2593.4	2916.5	3082.9	3176.0	3276.1	8916.2	10133.6	9384.4	8729.7	6831.8	2151.7	1733.7	1354.3	1081.5	75715.3	Minutes	
																									1262	**Hours**	

Saturday and Sunday

Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Sum		
Volume (NB)	**147**	**88**	**59**	**42**	**23**	**35**	**37**	**84**	**149**	**213**	**323**	**456**	**512**	**539**	**512**	**505**	**509**	**487**	**433**	**374**	**298**	**237**	**179**	**138**	**5814**		
Volume (SB)	**131**	**67**	**58**	**52**	**26**	**44**	**78**	**111**	**190**	**292**	**432**	**500**	**556**	**552**	**561**	**551**	**574**	**558**	**505**	**429**	**348**	**263**	**207**	**157**	**6595**		
DELAY NB	85	85	85	85	85	85	85	85	304	304	304	127	127	127	127	127	127	127	127	127	127	127	127	127			
DELAY SB	92	92	92	92	92	92	92	92	158	158	158	296	296	296	296	296	296	296	296	296	296	296	296	296			
DELAY (sec)	24547	13644	10351	8354	4347	7023	10321	17352	75316	110888	166448	205912	229600	231845	231080	227231	234547	227017	204471	174482	140854	107947	84005	63998	2811580.0	Seconds	
DELAY (min)	409.1	227.4	172.5	139.2	72.5	117.1	172.0	289.2	1255.3	1848.1	2774.1	3431.9	3826.7	3864.1	3851.3	3787.2	3909.1	3783.6	3407.9	2908.0	2347.6	1799.1	1400.1	1066.6	46859.7	Minutes	
																									781	**Hours**	

All Times determined from Synchro/SimTraffic Analysis
75 Second Crossing Time/Delay Time

	All Served?	NB Delay	SB Delay	
2019 AM Peak Hour Analysis	YES	304	158	Seconds
Similar or Less		5.07	2.63	Minutes
2019 PM Peak Hour Analysis	85%	120	914	Seconds
Similar or Less		2.00	15.23	Minutes
2019 Mid Day Peak Analyis	YES	127	296	Seconds
Similar or Less		2.12	4.93	Minutes
2019 AM LOW VOLUME Analyis	YES	85	92	Seconds
Similar or Less		1.42	1.53	Minutes

NOTE:
Synchro/SimTraffic analysis performed to determine bridge delays and queues.
All timings were set up to not allow the Northbound bridge traffic to back into downtown Red Wing and cause gridlock.
Bridge Crossing assumed at 2200'. At 20 mph clearance time of 75 seconds was used.