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Existing and Future Traffic Operations Memorandum

To: ***Darren Laesch, PE, MnDOT District 2***

From: ***Jack Corkle, PTP, AICP, WSB & Associates, Inc.***
Sean Delmore, PE, PTOE, WSB & Associates, Inc.

Date: ***September 27, 2015***

Re: ***TH 11 Existing and Future Traffic Operations***
WSB Project No. 03063-000

The purpose of this memo is to document the existing and future traffic operations on TH 11 between Greenbush and Roosevelt in Roseau County that are a part of the TH 11 Corridor Study. The memo is divided into four sections. The first section provides general information on TH 11 and the area in which the study is occurring. The second section provides information on the roadway's characteristics related to traffic at the segment level and at five key intersections. It also identifies any existing capacity constraints at the segment and intersection level. Some of the information in this section includes summaries from the Traffic Characteristics Memo from July 23, 2015. Section three documents future traffic volumes and identifies potential capacity constraints at the intersection and segment level. Section four summarizes problem areas and identifies areas for potential additional study.

1. Study Background Information

TH 11 is the primary east-west route for communities located near the Canadian border including, Greenbush, Badger, Roseau, Warroad and Roosevelt (**Figure 1**). It serves an important connection to international border crossings with Canada – including one that is open year-round, 24 hours a day. The corridor is home to two major employers, Polaris and Marvin Windows, as well as the Seven Clans Casino, which is also a larger employer for the area. In addition, Lake of the Woods borders the corridor in Warroad. Much of the area between the communities along the corridor is largely undeveloped, with a smattering of manufactured home communities, contractor yards, agricultural uses, isolated businesses, residential development and the Roseau Airport.

The corridor study area covers the approximately 60 miles of TH 11 between Greenbush and Roosevelt. As part of the study, existing and future conditions for traffic operations will be evaluated and recommendations for improvements along the corridor will be identified for implementation over the next 20 years. A number of items will be studied including congestion hot spots, safety problem areas, roadway design consistency, infrastructure condition, future growth and development, and American with Disabilities Act requirements. This memo focuses on traffic operations at the segment and intersection level.

2. Existing Traffic Conditions and Operations

This section of the memo identifies and describes characteristics associated with existing traffic on the corridor. Information is first presented for the various corridor segments and then the key intersections. Within the discussion for both the segments and intersections there is information related to existing volumes, planning-level thresholds for congestion, existing congestion levels and any identified problem areas.

Corridor Segments

MnDOT collects a significant amount of data about the characteristics of its roadways. As noted in previous memos, there is information related to speeds, number of travel lanes, number of vehicles using the corridor on a daily basis, number of heavy commercial vehicles using the corridor on a daily basis, shoulder width, etc. MnDOT keeps all of this information in a large database that divides the highway corridor into numerous segments. Segments usually are grouped based upon their characteristics.

For TH 11 there are 25 segments that make up the corridor based upon roadway geometry (number of lanes), posted speeds, and traffic volumes. **Table 1** lists the corridor segments used for the operations analysis. This table includes the segment, the length of the segment, posted speed, number of lanes, design type and most recent traffic volume (2014).

Roseau County

Lake of the Woods

Warroad

Roseau

Roosevelt

Badger

Greenbush

MINNESOTA 313
MINNESOTA 310
MINNESOTA 89
MINNESOTA 11
MINNESOTA 11
MINNESOTA 11
MINNESOTA 89
MINNESOTA 32

N
W E
S

0 10 Miles

Figure 1- Corridor Study Area

MINNESOTA DEPARTMENT OF TRANSPORTATION

Table 1: Existing TH 11 Corridor Segment Information

Segment	From	To	Length (miles)	Posted Speed	No. of Lanes	Design Type*	Most Recent Volume (2014)
1	Western limits of Greenbush	East of Oakview Dr. in Greenbush	0.49	55	2	R-1	2,450
2	East of Oakview Drive	Junction with TH 32 in Greenbush	0.45	30	2	U-1	2,450
3	Junction with TH 32	0.2 miles north/east of TH 32	0.2	40	2	U-1	2,500
4	0.2 miles north/east of TH 32	850 feet south of CSAH 2 in Badger	9.45	55	2	R-1	2,500
5	850 feet south of CSAH 2	CSAH 2	0.16	50	2	R-2	2,500
6	CSAH 2	South of the north junction of CSAH 3 in Badger	0.67	50	2	R-2	2,750
7	South of the north junction of CSAH 3	TH 308	4.98	55	2	R-1	2,750
8	TH 308	Western junction with TH 89	1.00	55	2	R-1	2,800
9	Western Junction with TH 89	CR 120/380th/18th Aves	5.11	55	2	R-1	3,600
10	CR 120/380th/18th Aves	0.2 miles east of CR 120/380th/18th Aves in Roseau	0.20	55	2	R-1	8,700
11	0.2 miles east of CR 120/380th/18th Aves	7th Ave SW in Roseau	0.61	45	3	U-3	8,700
12	7th Ave SW	Junction with TH 310/TH 89/5th Ave	0.18	30	3	U-2	8,700
13	Junction with TH 310/TH 89/5th Ave	Main Ave N in Roseau	0.26	30	3	U-2	7,800
14	Main Ave N	3rd Ave NE in Roseau	0.16	30	3	U-2	6,300
15	3rd Ave NE	CSAH 24/11th Ave in Roseau	0.59	30	3	U-2	5,700
16	CSAH 24/11th Ave	CSAH 46	16.8	55	2	R-1	3,900
17	CSAH 46	TH 313 in Warroad	3.14	55	2	R-1	4,400
18	TH 313	300 feet north of Elk Street NW in Warroad	0.72	40	3	U-3	6,800
19	300 feet north of Elk Street NW	Lake Street NW in Warroad	0.13	30	3	U-2	6,800
20	Lake Street NW	CSAH 74/Lake Street NE in Warroad	0.17	30	3	U-2	7,600
21	CSAH 74/Lake Street NE	Hallberg Street SE in Warroad	0.15	30	2	U-1	7,500
22	Hallberg Street SE	Garfield Street SW in Warroad	0.21	30	2	U-1	6,300
23	Garfield Street SW	200 feet east/south of CSAH 5 in Warroad	0.09	30	2	U-1	3,550
24	200 feet east/south of CSAH 5	CSAH 12	3.12	55	2	R-1	3,550
25	CSAH 12	Roseau/Lake of the Woods County Line	9.37	55	2	R-1	1,550

*U-1 = Two-lane, urban road with 30 - 40 mph speed U-2 = Three-lane, urban road with 30 mph speed

U-3 = Three-lane, urban road with 40 - 45 mph speed R-1 = Two-lane, rural road with 55 mph speed R-2 = Two-lane, rural road with 50 mph speed

Capacity Planning-Level Thresholds – Corridor Segments

As discussed in the draft Traffic Characteristics Memo from July 23, 2015, a roadway's capacity indicates how many vehicles may use a roadway before it experiences congestion. Capacity is dependent upon the number of lanes on a corridor as a starting point. Roadways with three travel lanes generally can accommodate more traffic than those with two lanes, and those with four lanes of traffic can accommodate more traffic than those with two or three lanes. Freeways can accommodate more traffic than non-freeway routes. Additional variation (more or less capacity) on an individual segment is influenced by a number of factors including: amount of access, type of access, peak hour percent of traffic, directional split of traffic, truck percent, opportunities to pass, and amount of turning traffic and availability of dedicated turn lanes. **Table 2** below lists planning-level thresholds that indicate a roadway's capacity.

Table 2 – Planning-level Roadway Capacity

Roadway Type	Maximum Daily Traffic (two-way)
Two-lane, undivided – urban	8,000 – 10,000 vehicles
Two-lane, undivided – rural	14,000 – 15,000 vehicles
Three-lane – urban	14,000 – 17,000 vehicles
Four-lane undivided – urban	18,000 – 22,000 vehicles
Four-lane divided – urban	28,000 – 32,000 vehicles
Four-lane divided – rural	32,000 – 36,000 vehicles

As noted above, actual capacity may vary based upon individual corridor characteristics.

TH 11 is primarily a two-lane, undivided, rural roadway with three-lane segments in Roseau and Warroad. As shown in Table 2, its maximum capacity in the rural area is 14,000 – 15,000 vehicles a day and approximately 17,000 in the urban areas. As shown in Table 1 actual traffic volumes in the more rural areas range from approximately 1,600 between Warroad and Roosevelt to 4,500 just west of Warroad. In the three-lane sections of TH 11 traffic volumes range from approximately 7,000 – 9,000.

Existing Congestion - Segments

A planning-level review of the existing roadway capacity was completed in order to identify potential capacity deficiencies along TH 11. Congestion along a roadway is judged to exist when the ratio of traffic volume to roadway capacity (v/c ratio) approaches or exceeds 1.0. Volume to capacity ratios measure the amount of current traffic (AADT) divided by the maximum daily traffic that can be accommodated. The v/c ratio is used to measure the capacity of a corridor segment. However, it does not provide information on intersection operations (those are discussed later in this section).

At a planning-level, if a v/c ratio is 1.0 or higher, the roadway is considered over capacity and will likely experience routine congestion. A v/c ratio between 0.86 and 0.99 is considered nearing being congested and a v/c ration 0.85 or less is considered uncongested.

A comparative look at the planning-level capacity thresholds shown in Table 2 versus the existing AADT volumes along TH 11 provide a good indication whether the roadway is currently over, near or under capacity. **Table 3** shows existing AADTs as well as the v/c ratios for the corridor.

Table 3 – Existing Segment Volumes and Volume to Capacity Ratios

			Existing Characteristics						
			Length	Posted	No. of	Design	Maximum	2014	
Segment	From	To	(mi)	Speed	Lanes	Type	Capacity	Volume	V/C Ratio
1	Western Limit of Greenbush	East of Oakview Dr. in Greenbush	0.49	55	2	R-1	15,000	2,450	0.16
2	East of Oakview Dr.	Junction with TH 32 in Greenbush	0.45	30	2	U-1	10,000	2,450	0.25
3	Junction with TH 32	0.2 miles north/east of the TH 32 Junction	0.20	40	2	U-1	10,000	2,500	0.25
4	0.2 miles north/east of the TH 32 Junction	850 feet south of CSAH 2/University Ave in Badger	9.45	55	2	R-1	15,000	2,500	0.17
5	850 feet south of CSAH 2/University Avenue	CSAH 2/University Avenue in Badger	0.16	50	2	R-2	15,000	2,500	0.17
6	CSAH 2/University Ave	South of the north junction of CSAH 3	0.67	50	2	R-2	15,000	2,750	0.18
7	South of the north junction of CSAH 3	TH 308	4.98	55	2	R-1	15,000	2,750	0.18
8	TH 308	Western Junction with TH 89	1.00	55	2	R-1	15,000	2,800	0.19
9	Western Junction with TH 89	CR 120/380th/18th Aves	5.11	55	2	R-1	15,000	3,600	0.24
10	CR 120/380th/18th Aves	0.2 miles east of CR 120/380th/18th Aves in Roseau	0.20	55	2	R-1	15,000	8,700	0.58
11	0.2 miles east of CR 120/380th/18th Aves	7th Ave SW in Roseau	0.61	45	3	U-3	17,000	8,700	0.51
12	7th Ave SW	Junction with TH 310/89/5th Ave in Roseau	0.18	30	3	U-2	17,000	8,700	0.51
13	Junction with TH 310/89/5th Ave	Main Ave North in Roseau	0.26	30	3	U-2	17,000	7,800	0.46
14	Main Ave North	3rd Ave NE in Roseau	0.16	30	3	U-2	17,000	6,300	0.37
15	3rd Ave NE	CSAH 24/11th Ave in Roseau	0.59	30	3	U-2	17,000	5,700	0.34
16	CSAH 24/11th Ave	CSAH 46	16.80	55	2	R-1	15,000	3,900	0.26
17	CSAH 46	TH 313 in Warroad	3.14	55	2	R-1	15,000	4,400	0.29
18	TH 313	300 feet north of Elk St NW in Warroad	0.72	40	3	U-3	17,000	6,800	0.40
19	300 feet north of Elk St NW	Lake St NW in Warroad	0.13	30	3	U-2	17,000	6,800	0.40
20	Lake St NW in Warroad	CSAH 74/Lake St NE in Warroad	0.17	30	3	U-2	17,000	7,600	0.45
21	CSAH 74/Lake St NE	Hallberg St SW in Warroad	0.15	30	2	U-1	10,000	7,500	0.75
22	Hallberg St SW	Garfield St SW in Warroad	0.21	30	2	U-1	10,000	6,300	0.63
23	Garfield St SW	200 feet east/south CSAH 5	0.09	30	2	U-1	10,000	3,550	0.36
24	200 feet east/south CSAH 5	CSAH 12	3.12	55	2	R-1	15,000	3,550	0.24
25	CSAH 12	Roseau–Lake of the Woods County Line	9.37	55	2	R-1	15,000	1,550	0.10

*

Code	Definition	Volume Threshold		Code	Definition	Volume Threshold
U-1	Two-lane urban at 30 - 40 mph.	10,000 ADT		R-1	Two-lane rural at 55 - 55+ mph.	15,000 ADT
U-2	Three-lane urban at 30 mph.	17,000 ADT		R-2	Two-lane rural at 50 mph.	15,000 ADT
U-3	Three-lane urban at 40 - 45 mph.	17,000 ADT				

As shown in **Table 3**, all segments are currently considered uncongested. This was verified by travel time runs completed earlier in the summer of 2015 and as documented in the draft Existing Traffic Characteristics Memo dated July 23, 2015.

Intersections

The counterpart to roadway segment capacity is intersection capacity. On TH 11 there are approximately 600 intersections along the corridor (including driveways and field access locations). In terms of public streets, there are approximately 125 intersections. Given the scope of the TH 11 corridor study, it is not possible to evaluate every intersection along the corridor to determine how it operates, nor is it necessary. Most of the impacts in terms of delay or congestion are going to be experienced by those attempting to enter the TH 11 corridor. Unless the cross street/driveway access has heavier traffic volumes, the impacts are expected to be minimal for most users. For example, any given field entrance or private residential driveway is going to have a limited number of users stacked up and waiting to enter the TH 11 traffic stream. As a result, the overall delay (when TH 11 traffic is also considered) is going to be minimal.

Although every intersection is not being evaluated some general conclusions can be made about how intersections along the corridor operate:

- Most field entrances and private driveway entrances experience little delay because the number of vehicles using them at any one time is low.

- In areas outside of the communities of Greenbush, Badger, Roseau and Warroad, there is usually a gap between vehicles on TH 11 sufficient enough that vehicles on cross streets do not have to wait too long to access the TH 11 corridor. This situation is aided by the fact that traffic volumes on roadways in areas outside of Greenbush, Badger, Roseau and Warroad are generally below 400 vehicles a day (there are some exceptions).

- On the fringes of the communities of Warroad and Roseau, users trying to access the TH 11 corridor will experience more delay because traffic volumes on both TH 11 and the intersecting roadways are higher. Overall intersection operations are still acceptable, but the cross streets will experience some delay.

- Within the communities of Roseau and Warroad delay will be higher on local cross streets than in the Cities of Greenbush and Badger due to the amount of traffic on TH 11. Overall operations are still acceptable, but cross streets will experience some delay.

In addition to the general conclusions, MnDOT also asked that five intersections be evaluated to investigate existing operations. MnDOT recognizes that there are locations where some of the intersecting roadways may be experiencing more delay and locations where existing signals are in place that may not be working as efficiently as they could be. The five intersections that were evaluated included:

- TH 11 & TH 32 (Greenbush) (stop on TH 11)

- TH 11 & 18th Ave NW (Roseau) (side street stop)
- TH 11 & TH 89/TH 310 (Roseau) (traffic signal)
- TH 11 & TH 313 (Warroad) (traffic signal)
- TH 11 & Lake St NE (Warroad) (traffic signal)

Turning movement volumes for the five intersections are from counts taken between June 30 and July 2, 2015. Counts were documented for the AM and PM peaks as well as an off-peak period in which traffic volumes were heavier. Due to the Fourth of July holiday, it is expected that volumes are a little higher than normal. **Figures 2 – 7** show turning movements that were collected for the five intersections.

Intersection Operations Modeling Methodology

The capacity/operations analysis of the key intersections was conducted using Synchro/SimTraffic software. The Synchro software is based on the methodologies documented in the Highway Capacity Manual (HCM) 2010. The software was used to evaluate the characteristics of the roadway network including lane geometrics, turning movement volumes, traffic control, and signal timing (where applicable). The Synchro information was then transferred to SimTraffic, a traffic simulation model, to estimate average vehicle delays and queues. The results of the SimTraffic modeling were used to check the adequacy of the traffic control, signal timing, and geometric layout of each intersection.

Intersection Capacity (Level of Service) Thresholds

A level of service (LOS) analysis was conducted for the five intersections previously identified. LOS indicates the quality of traffic flow through an intersection. The LOS results are based on the average delay per vehicle that goes through the intersection. Intersections are given a ranking of LOS A through LOS F. The level of service system is set up similar to a report card with “A” representing the highest quality operations and “F” representing the poorest operations. At LOS A, motorists experience very little delay or interference. On a roadway or intersection with LOS F conditions, motorists would experience severe congestion and extreme delay, i.e., gridlock. Although LOS A conditions represent the best possible level of traffic flow, the cost to construct intersections to such a high standard exceeds the benefit to the user. Within an urbanized or urbanizing area, it is generally regarded that LOS D provides an acceptable level of service.

For intersections, level of service is primarily a function of delay which is dependent on volumes, intersection lane configuration, and traffic control. The intersection analysis was completed using average control delay as defined by the HCM. The threshold delay values for each level of service for unsignalized intersections are slightly less than for signalized intersections because motorists’ expectations of the intersection differ with the type of traffic control. The level of service analysis criteria for signalized and unsignalized intersections are explained in **Table 4** and shown on **Graph 1**.

TH 11 Corridor Improvements

Intersection of TH 11 & TH 32
Minnesota Department of Transportation

Figure 2
Existing Volumes – AM & PM Peak Period

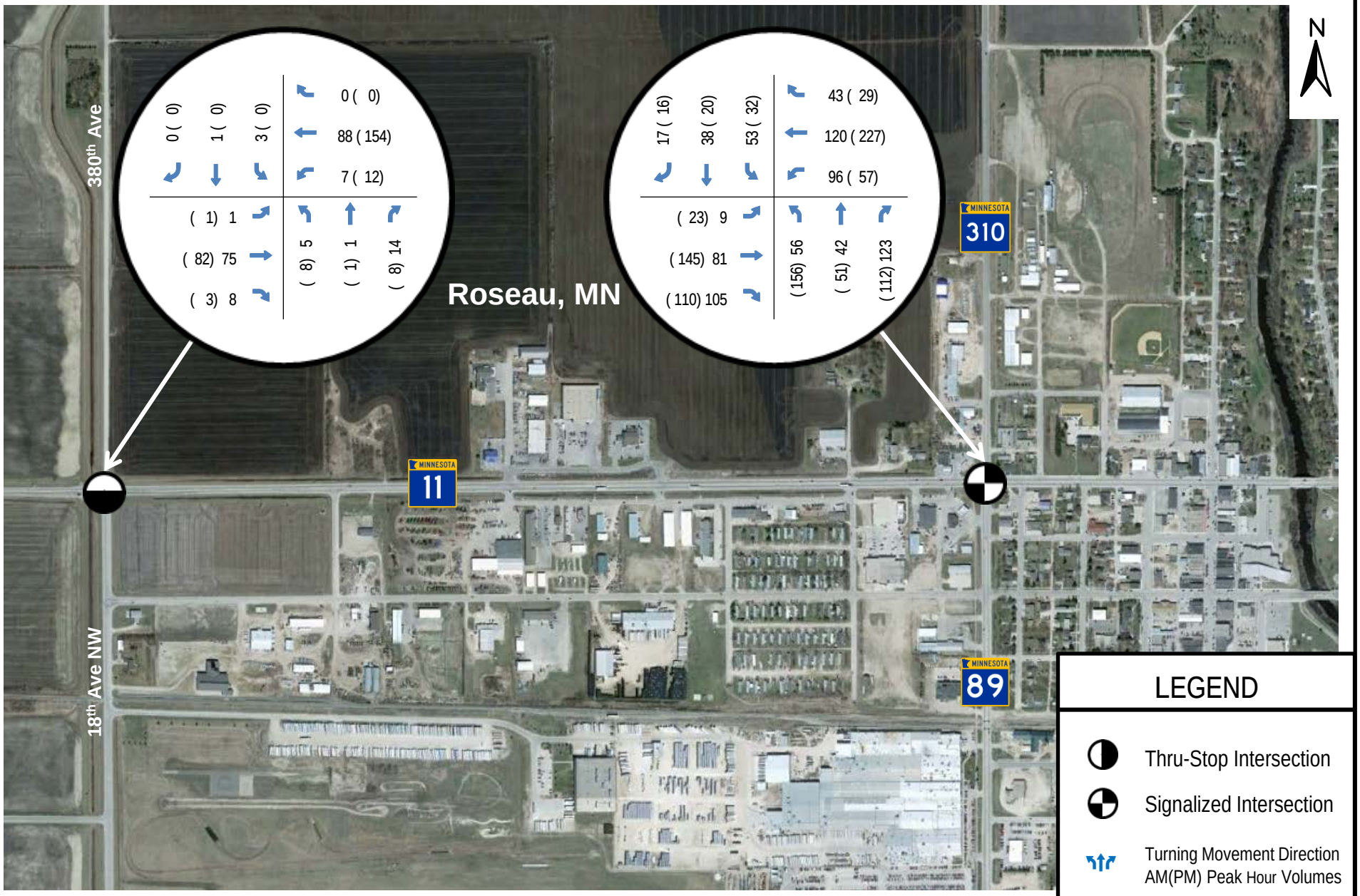
TH 11 Corridor Improvements

Intersection of TH 11 & TH 32

Minnesota Department of Transportation

Figure 3

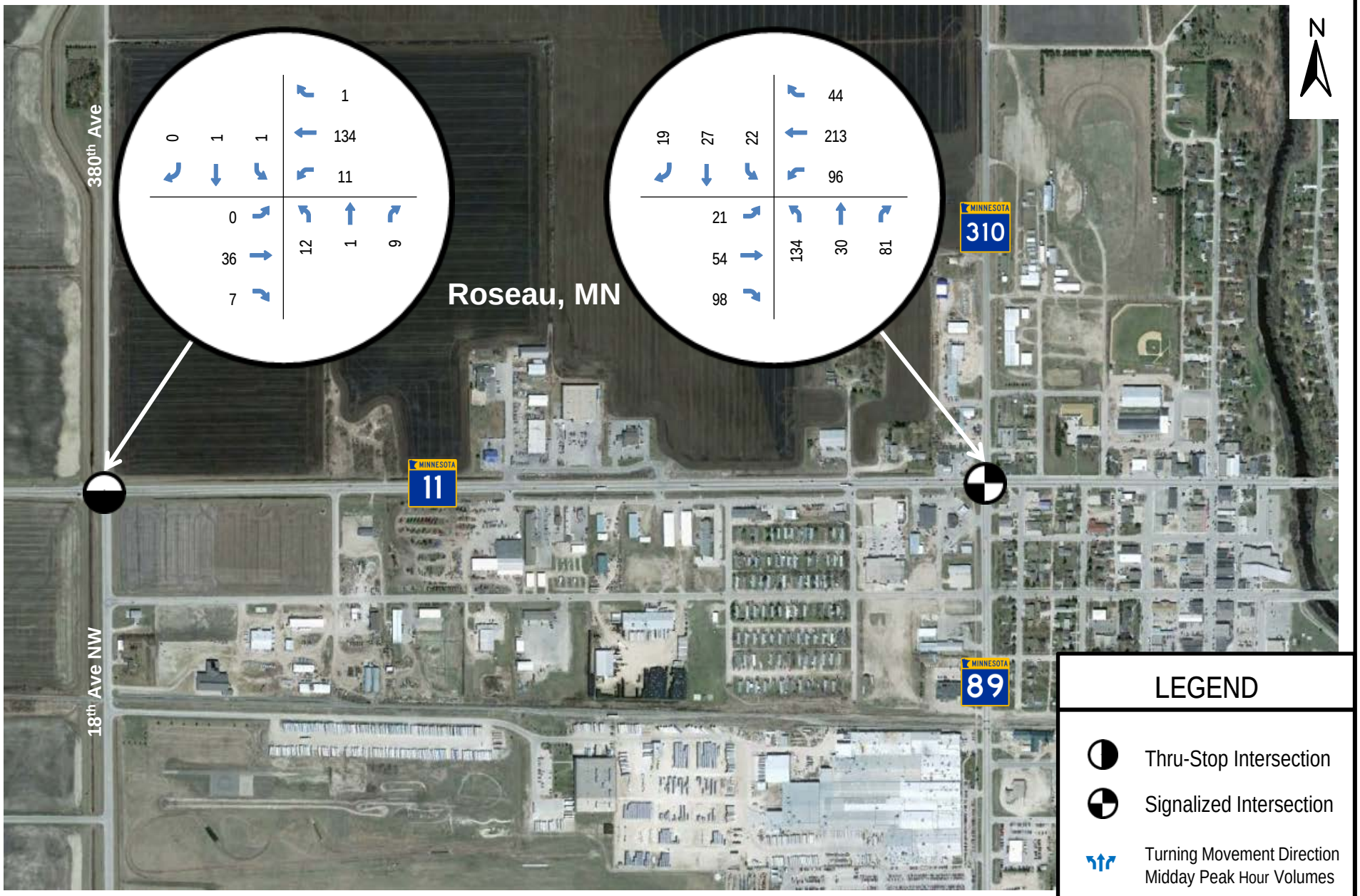
Existing Volumes – Mid-day Peak Period



TH 11 Corridor Improvements

Intersections of TH 11 & 18th Ave NW, TH 11 & TH 89-310
Minnesota Department of Transportation

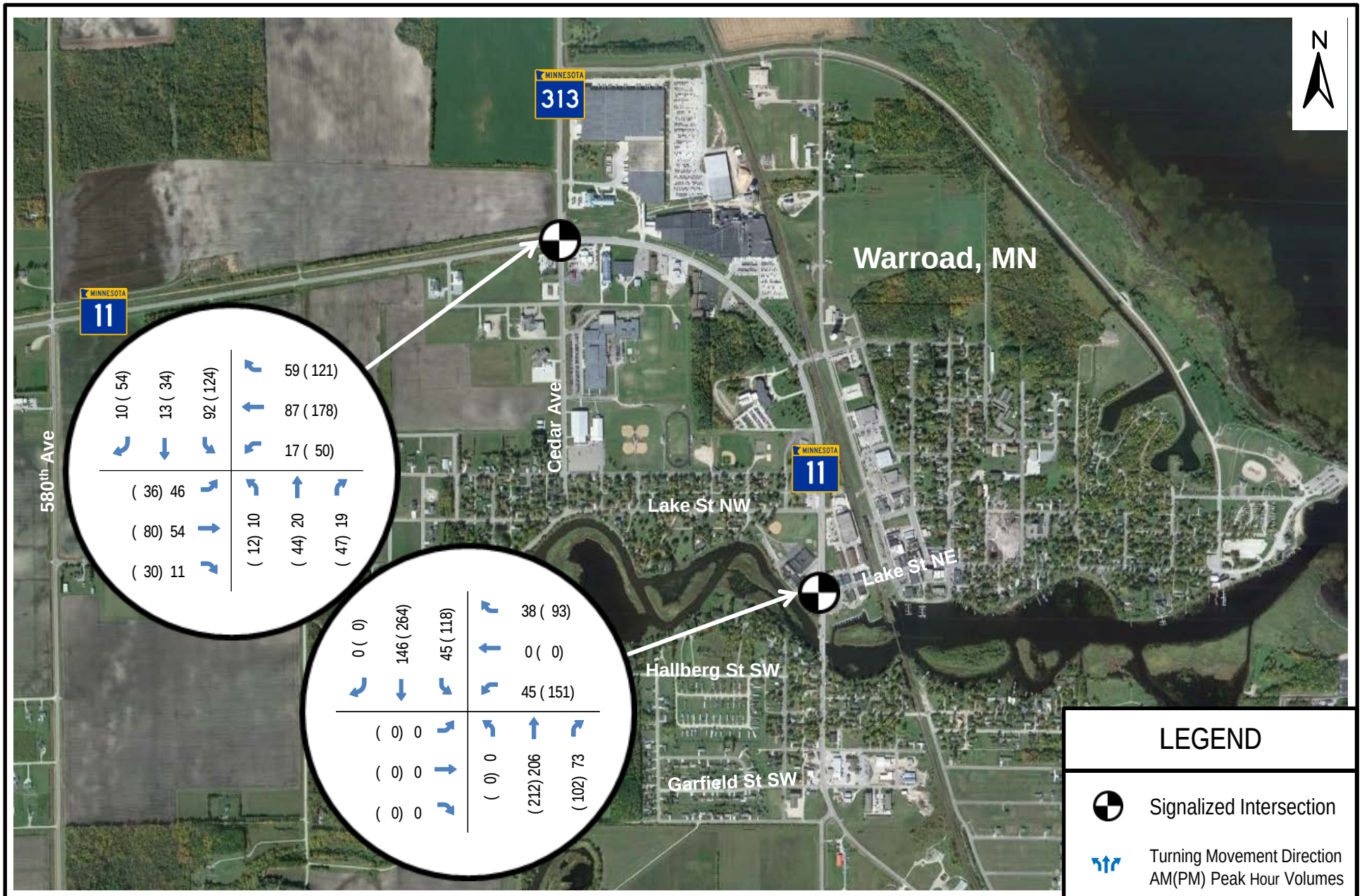
Figure 4
Existing Volumes – AM & PM Peak Period



TH 11 Corridor Improvements

Intersections of TH 11 & 18th Ave NW, TH 11 & TH 89-310
Minnesota Department of Transportation

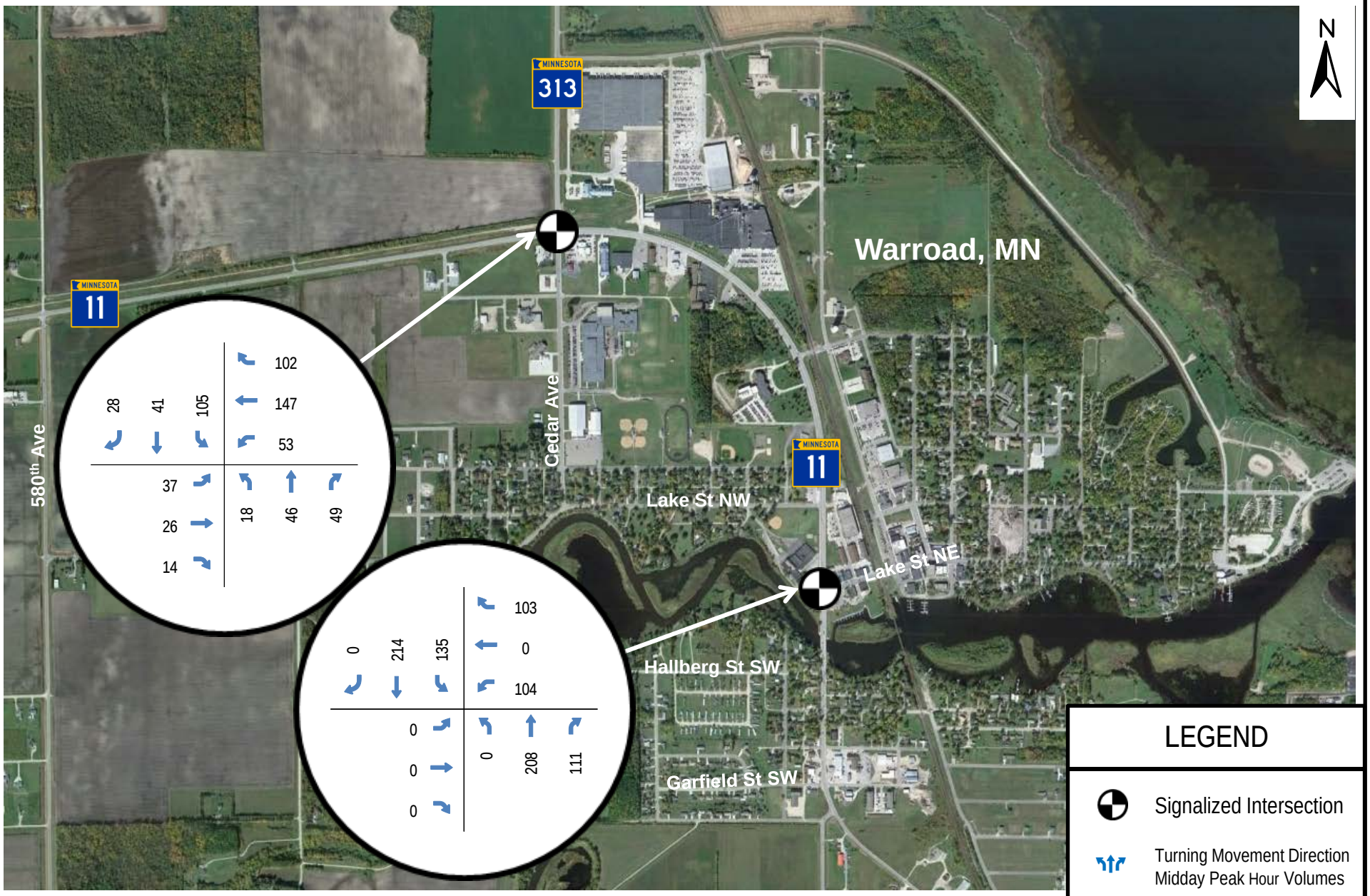
Figure 5
Existing Volumes – Mid-day Peak Period



TH 11 Corridor Improvements

Intersections of TH 11 & TH 313, TH 11 & Lake St NE
Minnesota Department of Transportation

Figure 6
Existing Volumes – AM & PM Peak Period



TH 11 Corridor Improvements

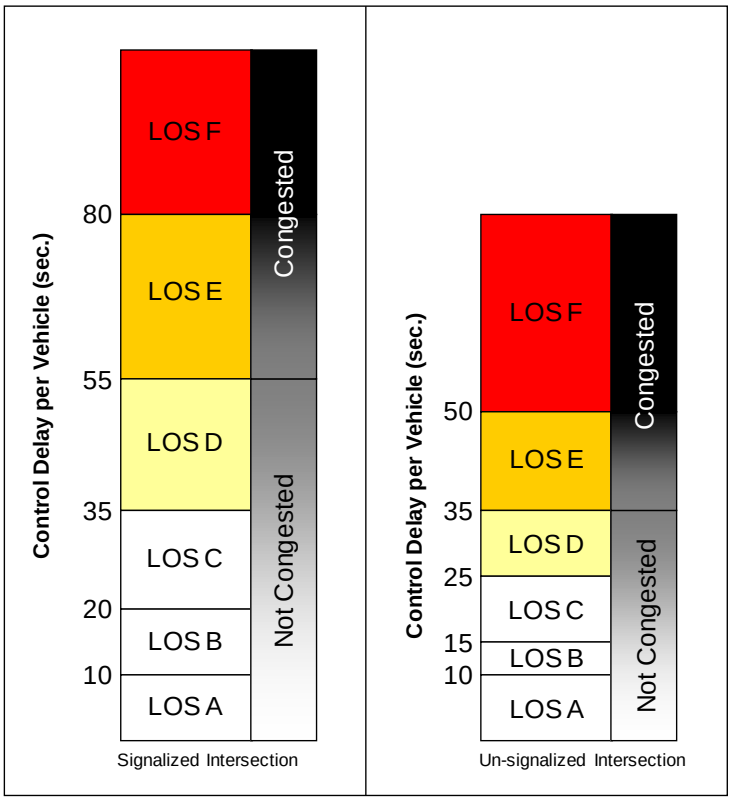
Intersections of TH 11 & TH 313, TH 11 & Lake St NE
Minnesota Department of Transportation

Figure 7
Existing Volumes – Mid-day Peak Period

Table 4 – Level of Service (LOS) Thresholds for Signalized and Unsignalized Intersections

LOS	Signalized Intersection Average Delay/Vehicle (seconds)	Unsignalized Intersection Average Delay/Vehicle (seconds)	Description of Intersection Conditions
A	<10	<10	Stable flow – low delays; at traffic signals most vehicles do not stop; acceptable LOS
B	10 to 20	10 to 15	Stable flow – low delays; at traffic signals some vehicles must stop; acceptable LOS
C	20 to 35	15 to 25	Stable flow – moderate delays; at traffic signals some cycle failures; many vehicles must stop; acceptable LOS
D	35 to 55	25 to 35	Approaching unstable flow – moderate delays; at traffic signals cycle failures become noticeable; many more vehicles must stop; limit of acceptable LOS
E	55 to 80	35 to 50	Unstable flow – significant delays; at traffic signals cycle failures are frequent; most vehicles required to stop; unacceptable LOS
F	>80	>50	Forced flow/failure – significant delays; at traffic signals many cycle failures occur; most or all vehicles must stop; unacceptable LOS

Graph 1 – Level of Service (LOS) Thresholds for Signalized and Unsignalized Intersections



SOURCE: Level of Service thresholds from the Highway Capacity Manual.

K:\Traffic\Level of Service (LOS)\LOS Delay Graphic.ppt

Existing Congestion - Intersections

As previously discussed, the intersection traffic operations analysis utilized Synchro/SimTraffic software. The traffic signal timing used was developed by assigning green time to phases based on a critical lane analysis and not the actual timing of the traffic signal. The delay and level of service for each intersection for the existing condition are summarized in **Table 5**, and detailed modeling results for each studied intersection are provided in **Attachment A**.

The results of the operational analysis show there are no significant delay or queuing issues present at any of the intersections studied. The level of service is at A, B or C for all intersections during all three periods.

Table 5 – Existing Intersection LOS AM Peak, Midday and PM Peak Periods

Intersection			AM Peak				Mid-day				PM Peak			
Control	Location	Approach	Movement Delay* (LOS)			Intersection Delay* (LOS)	Movement Delay* (LOS)			Intersection Delay* (LOS)	Movement Delay* (LOS)			Intersection Delay* (LOS)
			Left	Through	Right		Left	Through	Right		Left	Through	Right	
Thru-Stop	TH 11 & TH 32	NB	2 (A)	1 (A)	0 (A)	2 (A)	2 (A)	1 (A)	0 (A)	3 (A)	2 (A)	1 (A)	0 (A)	2 (A)
		WB	0 (A)	0 (A)	0 (A)		0 (A)	0 (A)	0 (A)		0 (A)	0 (A)	0 (A)	
		SB	0 (A)	1 (A)	1 (A)		0 (A)	1 (A)	1 (A)		0 (A)	1 (A)	1 (A)	
		EB	5 (A)	0 (A)	3 (A)		6 (A)	0 (A)	2 (A)		6 (A)	0 (A)	2 (A)	
Thru-Stop	TH 11 & 18th Ave NW	NB	5 (A)	6 (A)	2 (A)	1 (A)	5 (A)	5 (A)	2 (A)	1 (A)	5 (A)	8 (A)	3 (A)	1 (A)
		WB	1 (A)	1 (A)	0 (A)		1 (A)	2 (A)	1 (A)		1 (A)	2 (A)	0 (A)	
		SB	5 (A)	6 (A)	0 (A)		0 (A)	8 (A)	0 (A)		0 (A)	0 (A)	0 (A)	
		EB	0 (A)	0 (A)	0 (A)		0 (A)	0 (A)	0 (A)		0 (A)	0 (A)	0 (A)	
Signalized	TH 11 & TH 89/TH 310	NB	9 (A)	10 (B)	4 (A)	9 (A)	10 (B)	7 (A)	4 (A)	10 (B)	11 (B)	9 (A)	5 (A)	10 (B)
		WB	12 (B)	11 (B)	4 (A)		12 (B)	13 (B)	5 (A)		13 (B)	14 (B)	4 (A)	
		SB	10 (B)	9 (A)	3 (A)		10 (B)	10 (B)	3 (A)		9 (A)	11 (B)	4 (A)	
		EB	16 (B)	16 (B)	4 (A)		14 (B)	14 (B)	4 (A)		13 (B)	14 (B)	3 (A)	
Signalized	TH 11 & TH 313	NB	6 (A)	4 (A)	2 (A)	9 (A)	6 (A)	5 (A)	3 (A)	9 (A)	6 (A)	7 (A)	3 (A)	12 (B)
		WB	17 (B)	10 (B)	7 (A)		17 (B)	15 (B)	9 (A)		21 (C)	19 (B)	9 (A)	
		SB	4 (A)	4 (A)	1 (A)		7 (A)	7 (A)	3 (A)		8 (A)	8 (A)	3 (A)	
		EB	19 (B)	14 (B)	3 (A)		16 (B)	9 (A)	2 (A)		21 (C)	13 (B)	3 (A)	
Signalized	TH 11 & Lake St	NB	0 (A)	4 (A)	3 (A)	6 (A)	0 (A)	9 (A)	6 (A)	10 (B)	0 (A)	9 (A)	5 (A)	12 (B)
		WB	17 (B)	0 (A)	7 (A)		22 (C)	0 (A)	11 (B)		24 (C)	0 (A)	15 (B)	
		SB	9 (A)	6 (A)	0 (A)		10 (B)	7 (A)	0 (A)		12 (B)	9 (A)	0 (A)	
		EB	0 (A)	0 (A)	0 (A)		0 (A)	0 (A)	0 (A)		0 (A)	0 (A)	0 (A)	

* Delay measured in seconds per vehicle

3. Future Traffic Conditions and Operations

This section of the memo identifies and describes future traffic conditions and operations on the corridor and at key intersections. Like the existing conditions documented in Section 2, information is first presented for the various corridor segments and then the key intersections. Within the discussion for both the segments and intersections there is information related to future volumes and operations. Problem areas are noted at the end of each subsection.

Corridor Segments

Future traffic on the corridor was evaluated for the time period between 2020 and 2040 (end of the study) in five-year increments. Several potential methods for projecting traffic were considered to best identify what future traffic will be like. The future volumes needed to take into consideration population and employment growth, changing demographics of the region, pent-up traffic demands, and potential changes to the overall economy and workforce.

Projection Factors - Segments

This study looked at five different methods for projecting future volumes. These included: compounding, straight-line slope growth, a one percent per year growth rate, a two and a half percent growth rate and applying the current MnDOT growth factor.

- The compounding method looks at the change in vehicles from year to year based on historic information and assigns a growth rate to the segment based on the number of years in the series. This process does not show a lot of growth in a corridor if the corridor itself has not experienced a lot of growth in its past. It can also over represent growth if there are periods in time where the corridor experienced a lot of growth.

- The straight line slope growth takes into consideration the growth from the beginning of the historic volumes to the end of the historic volumes (most recent) and applies that change out into the future. This method is good for corridors that experience consistent growth, but can be problematic if traffic volumes have gone down or have fluctuated up and down over time or have experienced a significant amount of growth in recent time compared to most historic volumes.

- The one percent growth rate increases traffic at one percent on an annual basis. This rate is generally good for corridors that have remained relatively stable, do not have large urbanizing areas influencing traffic growth around them and are expected to remain relatively constant. This factor is not good for areas where there is a lot of growth and development or it is surrounded by areas that are developing.

- The two and a half percent growth rate is similar to the one percent in that a single factor is applied on an annual basis. A growth factor of two and a half percent is fairly aggressive and is used in areas where traffic volumes are growing relatively fast. To provide context, a corridor with a three percent growth rate roughly doubles in volume over 20 years. So, a factor of two and half percent is slightly less than doubling over a 25 year period (timeframe of the study). A

growth factor of two and a half percent may overestimate traffic in areas that are not growing as rapidly and may underestimate in areas experiencing rapid growth and development.

- The MnDOT growth factor for Roseau County is 1.3. This factor is developed by MnDOT for each county in the state and takes numerous county-specific changes in traffic volumes, employment, population trends, projected population, etc. The 1.3 factor is a factor for 20 years out. So, for example, if 2015 volumes are 2,000, the existing volume would be multiplied by 1.3 to get the number for 2035. In this case it would be 2,600. This number results in an annual percent increase that is between the one and two and half percent factors noted above.

Table 6 shows the different traffic volumes for the year 2040 based upon the different growth factors. Interim years are not shown. The first set of calculations was completed to determine what method of projection was most appropriate for use on TH 11.

Based on the information collected regarding population and employment growth, changing demographics related to age and employment, it is recommended that the MnDOT growth factor of 1.3 be used to project volumes into the future. The two and half percent growth was considered, but it was determined to be too aggressive for the area and the one percent was considered a little light for the area. Because the MnDOT growth factor is usually only applied to 20-year projections, it was factored for an additional six years to get to 2040.

Geometric Changes – Segments

MnDOT is completing an improvement project at the western limits of the City of Roseau. As part of this project, shoulders are being widened. In addition, the three-lane segment of roadway is being extended to the west to include the CR 120/380th Avenue intersection. This will result in Segment 10 having a design type of U-3, rather than R-1. This means that the capacity will increase from 15,000 to 17,000.

Future Traffic Volumes - Segments

Table 7 shows the projections for the corridor by segment in five-year increments for 2020 – 2040. Future volumes are anticipated to range between approximately 2,200 in the Roosevelt area to approximately 12,300 in Roseau. In general, volumes in the two-lane rural areas range between approximately 4,000 and 6,000 and approximately 8,000 and 12,300 in the three-lane urban sections. There is one two-lane urban section that is over 10,000 cars a day.

Table 6 – Future 2040 Traffic Volumes by Projection Factor

			Future Characteristics				Historical Annual Average Daily Traffic Volumes											2040 Comparison Values				
Segment	From	To	Length (mi)	Posted Speed	No. of Lanes	Design Type*	1994	1996	1998	2000	2002	2004	2006	2008	2010	2012	2014 Volume	Compound	Slope	1%/yr	2.5%/yr	MnDOT Factor 1.3
1	Western Limit of Greenbush	East of Oakview Dr. in Greenbush	0.49	55	2	R-1	2,150	2,550	2,600	2,400	2,650	2,850	2,800	2,700	2,550	2,450	2,450	2,940	2,660	3,170	4,660	3,446
2	East of Oakview Dr.	Junction with TH 32 in Greenbush	0.45	30	2	U-1	2,150	2,550	2,600	2,400	2,650	2,850	2,800	2,700	2,550	2,450	2,450	2,940	2,660	3,170	4,660	3,446
3	Junction with TH 32	0.2 miles north/east of the TH 32 Junction	0.20	40	2	U-1	2,400	2,300	2,450	2,450	2,500	2,700	2,550	2,400	2,450	2,750	2,500	2,630	2,760	3,240	4,750	3,516
4	0.2 miles north/east of the TH 32 Junction	850 feet south of CSAH 2/University Ave in Badger	9.45	55	2	R-1	2,400	2,300	2,450	2,450	2,500	2,700	2,550	2,400	2,450	2,750	2,500	2,630	2,760	3,240	4,750	3,516
5	850 feet south of CSAH 2/University Avenue	CSAH 2/University Avenue in Badger	0.16	50	2	R-2	2,400	2,300	2,450	2,450	2,500	2,700	2,550	2,400	2,450	2,750	2,500	2,630	2,760	3,240	4,750	3,516
6	CSAH 2/University Ave	South of the north junction of CSAH 3	0.67	50	2	R-2	2,400	2,300	2,450	2,450	2,500	2,700	2,550	2,400	2,450	2,750	2,750	3,300	3,170	3,560	5,230	3,868
7	South of the north junction of CSAH 3	TH 308	4.98	55	2	R-1	2,400	2,300	2,450	2,450	2,500	2,700	2,550	2,400	2,450	2,750	2,750	3,300	3,170	3,560	5,230	3,868
8	TH 308	Western Junction with TH 89	1.00	55	2	R-1	3,400	2,100	2,950	3,400	3,200	3,300	2,950	3,200	2,950	2,850	2,800	2,160	2,720	3,630	5,320	3,938
9	Western Junction with TH 89	CR 120/380th/18th Aves	5.11	55	2	R-1	3,750	2,500	4,050	4,250	4,250	4,400	4,000	4,200	3,900	3,400	3,600	3,420	3,830	4,660	6,840	5,063
10	CR 120/380th/18th Aves	0.2 miles east of CR 120/380th/18th Aves in Roseau	0.20	45	2	U-3	6,700	8,000	9,000	8,700	9,300	10,100	8,100	8,700	8,300	7,700	8,700	12,200	9,400	11,300	16,500	12,236
11	0.2 miles east of CR 120/380th/18th Aves	7th Ave SW in Roseau	0.61	45	3	U-3	6,700	8,000	9,000	8,700	9,300	10,100	8,100	8,700	8,300	7,700	8,700	12,200	9,400	11,300	16,500	12,236
12	7th Ave SW	Junction with TH 310/89/5th Ave in Roseau	0.18	30	3	U-2	6,700	8,000	9,000	8,700	9,300	10,100	8,100	8,700	8,300	7,700	8,700	12,200	9,400	11,300	16,500	12,236
13	Junction with TH 310/89/5th Ave	Main Ave North in Roseau	0.26	30	3	U-2	8,300	6,500	9,100	8,700	9,800	10,200	8,600	8,400	8,000	7,800	7,800	7,200	7,500	10,100	14,800	10,970
14	Main Ave North	3rd Ave NE in Roseau	0.16	30	3	U-2	6,800	7,600	8,500	7,700	8,800	9,500	8,700	8,000	6,600	6,800	6,300	5,700	5,000	8,200	12,000	8,861
15	3rd Ave NE	CSAH 24/11th Ave in Roseau	0.59	30	3	U-2	6,300	6,200	6,600	6,000	8,900	7,200	6,100	6,300	6,100	5,900	5,700	5,000	4,800	7,400	10,800	8,017
16	CSAH 24/11th Ave	CSAH 46	16.80	55	2	R-1	3,250	2,800	2,700	2,400	2,600	3,400	3,000	3,150	3,400	3,700	3,900	4,920	5,170	5,050	7,410	5,485
17	CSAH 46	TH 313 in Warroad	3.14	55	2	R-1	4,500	3,900	4,050	4,000	4,350	4,750	4,300	4,250	4,500	4,500	4,400	4,290	4,840	5,700	8,360	6,188
18	TH 313	300 feet north of Elk St NW in Warroad	0.72	40	3	U-3	5,900	6,400	6,100	7,900	6,500	6,400	6,800	6,500	6,500	6,200	6,800	8,200	7,100	8,800	12,900	9,564
19	300 feet north of Elk St NW	Lake St NW in Warroad	0.13	30	3	U-2	5,900	6,400	6,100	7,900	6,500	6,400	6,800	6,500	6,500	6,200	6,800	8,200	7,100	8,800	12,900	9,564
20	Lake St NW in Warroad	CSAH 74/Lake St NE in Warroad	0.17	30	3	U-2	8,300	7,100	8,800	11,100	9,500	9,300	8,400	8,100	7,800	7,700	7,600	6,800	6,300	9,800	14,400	10,689
21	CSAH 74/Lake St NE	Hallberg St SW in Warroad	0.15	30	2	U-1	8,000	8,000	8,800	9,200	9,600	9,100	8,700	8,000	8,100	7,700	7,500	6,900	6,400	9,700	14,300	10,548
22	Hallberg St SW	Garfield St SW in Warroad	0.21	30	2	U-1	6,500	7,000	7,100	8,000	10,200	6,900	6,500	6,300	6,400	6,800	6,300	6,000	5,000	8,200	12,000	8,861
23	Garfield St SW	200 feet east/south CSAH 5	0.09	30	2	U-1	3,450	3,100	4,000	4,950	4,950	4,300	3,550	3,400	3,550	3,400	3,550	3,640	3,060	4,600	6,750	4,993
24	200 feet east/south CSAH 5	CSAH 12	3.12	55	2	R-1	3,450	3,100	4,000	4,950	4,950	4,300	3,550	3,400	3,550	3,400	3,550	3,640	3,060	4,600	6,750	4,993
25	CSAH 12	Roseau–Lake of the Woods County Line	9.37	55	2	R-1	1,800	1,800	1,800	2,250	1,700	1,750	1,650	1,650	1,800	1,650	1,550	1,290	1,190	2,010	2,950	2,180

*

Code	Definition	Volume Threshold	Code	Definition	Volume Threshold
U-1	Two-lane urban at 30 - 40 mph.	10,000 ADT	R-1	Two-lane rural at 55 - 55+ mph.	15,000 ADT
U-2	Three-lane urban at 30 mph.	17,000 ADT	R-2	Two-lane rural at 50 mph.	15,000 ADT
U-3	Three-lane urban at 40 - 45 mph.	17,000 ADT			

Table 7 – Future Volumes 2020 – 2040 by Segment

Segment	Segment Termini From	To	Existing Characteristics Length (mi)	Posted Speed	No. of Lanes	Design Type*	Most Recent Volume (2014)	2020 - 2040 Projections 2020 Volume	2025 Volume	2030 Volume	2035 Volume	2040 Volume
1	Western Limit of Greenbush	East of Oakview Dr. in Greenbush	0.49	55	2	R-1	2,450	2,651	2,830	3,022	3,227	3,446
2	East of Oakview Dr.	Junction with TH 32 in Greenbush	0.45	30	2	U-1	2,450	2,651	2,830	3,022	3,227	3,446
3	Junction with TH 32	0.2 miles north/east of the TH 32 Junction	0.20	40	2	U-1	2,500	2,705	2,888	3,084	3,293	3,516
4	0.2 miles north/east of the TH 32 Junction	850 feet south of CSAH 2/University Ave in Badger	9.45	55	2	R-1	2,500	2,705	2,888	3,084	3,293	3,516
5	850 feet south of CSAH 2/University Avenue	CSAH 2/University Avenue in Badger	0.16	50	2	R-2	2,500	2,705	2,888	3,084	3,293	3,516
6	CSAH 2/University Ave	South of the north junction of CSAH 3	0.67	50	2	R-2	2,750	2,975	3,177	3,392	3,622	3,868
7	South of the north junction of CSAH 3	TH 308	4.98	55	2	R-1	2,750	2,975	3,177	3,392	3,622	3,868
8	TH 308	Western Junction with TH 89	1.00	55	2	R-1	2,800	3,029	3,235	3,454	3,688	3,938
9	Western Junction with TH 89	CR 120/380th Ave	5.11	55	2	R-1	3,600	3,895	4,159	4,441	4,742	5,063
10	CR 120/380th Ave	0.2 miles east of CR 120/380th Ave in Roseau	0.20	45	2	U-3	8,700	9,412	10,051	10,732	11,459	12,236
11	0.2 miles east of CR 120/380th Ave	7th Ave SW in Roseau	0.61	45	3	U-3	8,700	9,412	10,051	10,732	11,459	12,236
12	7th Ave SW	Junction with TH 310/89/5th Ave in Roseau	0.18	30	3	U-2	8,700	9,412	10,051	10,732	11,459	12,236
13	Junction with TH 310/89/5th Ave	Main Ave North in Roseau	0.26	30	3	U-2	7,800	8,439	9,011	9,622	10,274	10,970
14	Main Ave North	3rd Ave NE in Roseau	0.16	30	3	U-2	6,300	6,816	7,278	7,771	8,298	8,861
15	3rd Ave NE	CSAH 24/11th Ave in Roseau	0.59	30	3	U-2	5,700	6,167	6,585	7,031	7,508	8,017
16	CSAH 24/11th Ave	CSAH 46	16.80	55	2	R-1	3,900	4,219	4,505	4,811	5,137	5,485
17	CSAH 46	TH 313 in Warroad	3.14	55	2	R-1	4,400	4,760	5,083	5,428	5,796	6,188
18	TH 313	300 feet north of Elk St NW in Warroad	0.72	40	3	U-3	6,800	7,357	7,856	8,388	8,957	9,564
19	300 feet north of Elk St NW	Lake St NW in Warroad	0.13	30	3	U-2	6,800	7,357	7,856	8,388	8,957	9,564
20	Lake St NW in Warroad	CSAH 74/Lake St NE in Warroad	0.17	30	3	U-2	7,600	8,222	8,780	9,375	10,010	10,689
21	CSAH 74/Lake St NE	Hallberg St SW in Warroad	0.15	30	2	U-1	7,500	8,114	8,664	9,252	9,879	10,548
22	Hallberg St SW	Garfield St SW in Warroad	0.21	30	2	U-1	6,300	6,816	7,278	7,771	8,298	8,861
23	Garfield St SW	200 feet east/south CSAH 5	0.09	30	2	U-1	3,550	3,841	4,101	4,379	4,676	4,993
24	200 feet east/south CSAH 5	CSAH 12	3.12	55	2	R-1	3,550	3,841	4,101	4,379	4,676	4,993
25	CSAH 12	Roseau–Lake of the Woods County Line	9.37	55	2	R-1	1,550	1,677	1,791	1,912	2,042	2,180

*

Code	Definition	Volume Threshold
U-1	Two-lane urban at 30 – 40 mph.	10,000 ADT
U-2	Three-lane urban at 30 mph.	17,000 ADT
U-3	Three-lane urban at 40 - 45 mph.	17,000 ADT

Code	Definition	Volume Threshold
R-1	Two-lane rural at 55 - 55+ mph.	15,000 ADT
R-2	Two-lane rural at 50 mph.	15,000 ADT

Future Congestion – Segments

A planning-level review of future roadway capacity was completed in order to identify potential future capacity deficiencies. The same v/c ratios that were applied for existing conditions were applied for future conditions. As previously noted, segments with v/c ratios over 1.0 are noted as potentially congested. A v/c ratio between 0.86 and 0.99 is considered nearing congested and a v/c ratio less than 0.85 is considered uncongested.

The first review of the data was completed for 2040 to identify congested segments. Segments that were identified as potentially congested (v/c ratio greater than 1.0) indicated that v/c ratios should be calculated for 2035 to see if the segment was still considered congested at that time. This provides an indication of when problems might start to emerge on the corridor.

Table 8 shows 2040 and 2035 volumes and v/c ratios.

As shown in the table, a majority of the segments remain uncongested and are below the threshold for nearing congestion. There are a few exceptions in Warroad, which includes congestion on the river crossing bridge south of CR 74/Lake Street NE to Hallberg Street SW. This segment shows up as congested in 2040 with traffic volumes slightly over 10,000. It goes over the 0.86 threshold for nearing congestion in 2025 when its volumes are expected to be slightly over 8,600. Because there is limited access in this segment, it should be expected to accommodate volumes projected for 2040, but there is likely to be some queuing back to the traffic signal at CR 74/Lake Street NE.

The next segment to the south/east, Hallberg Street SW to Garfield Street SE is showing as nearing congestion in 2040. In 2035 it is below that threshold, so problems are not likely to emerge before 2040.

The rest of the corridor segments are considered uncongested in 2040.

Table 8 – Future Segment Congestion and V/C Ratios

Segment	Segment Termini From	To	Existing Characteristics Length (mi)	Posted Speed	No. of Lanes	Design Type	Maximum Capacity	2040 Volume	2040 V/C Ratio	2035 Volume	2035 V/C Ratio
1	Western Limit of Greenbush	East of Oakview Dr. in Greenbush	0.49	55	2	R-1	15,000	3,446	0.23	3,227	0.22
2	East of Oakview Dr.	Junction with TH 32 in Greenbush	0.45	30	2	U-1	10,000	3,446	0.34	3,227	0.32
3	Junction with TH 32	0.2 miles north/east of the TH 32 Junction	0.20	40	2	U-1	10,000	3,516	0.35	3,293	0.33
4	0.2 miles north/east of the TH 32 Junction	850 feet south of CSAH 2/University Ave in Badger	9.45	55	2	R-1	15,000	3,516	0.23	3,293	0.22
5	850 feet south of CSAH 2/University Avenue	CSAH 2/University Avenue in Badger	0.16	50	2	R-2	15,000	3,516	0.23	3,293	0.22
6	CSAH 2/University Ave	South of the north junction of CSAH 3	0.67	50	2	R-2	15,000	3,868	0.26	3,622	0.24
7	South of the north junction of CSAH 3	TH 308	4.98	55	2	R-1	15,000	3,868	0.26	3,622	0.24
8	TH 308	Western Junction with TH 89	1.00	55	2	R-1	15,000	3,938	0.26	3,688	0.25
9	Western Junction with TH 89	CR 120/380th Ave	5.11	55	2	R-1	15,000	5,063	0.34	4,742	0.32
10	CR 120/380th Ave	0.2 miles east of CR 120/380th Ave in Roseau	0.20	45	2	U-3	17,000	12,236	0.72	11,459	0.67
11	0.2 miles east of CR 120/380th Ave	7th Ave SW in Roseau	0.61	45	3	U-3	17,000	12,236	0.72	11,459	0.67
12	7th Ave SW	Junction with TH 310/89/5th Ave in Roseau	0.18	30	3	U-2	17,000	12,236	0.72	11,459	0.67
13	Junction with TH 310/89/5th Ave	Main Ave North in Roseau	0.26	30	3	U-2	17,000	10,970	0.65	10,274	0.60
14	Main Ave North	3rd Ave NE in Roseau	0.16	30	3	U-2	17,000	8,861	0.52	8,298	0.49
15	3rd Ave NE	CSAH 24/11th Ave in Roseau	0.59	30	3	U-2	17,000	8,017	0.47	7,508	0.44
16	CSAH 24/11th Ave	CSAH 46	16.80	55	2	R-1	15,000	5,485	0.37	5,137	0.34
17	CSAH 46	TH 313 in Warroad	3.14	55	2	R-1	15,000	6,188	0.41	5,796	0.39
18	TH 313	300 feet north of Elk St NW in Warroad	0.72	40	3	U-3	17,000	9,564	0.56	8,957	0.53
19	300 feet north of Elk St NW	Lake St NW in Warroad	0.13	30	3	U-2	17,000	9,564	0.56	8,957	0.53
20	Lake St NW in Warroad	CSAH 74/Lake St NE in Warroad	0.17	30	3	U-2	17,000	10,689	0.63	10,010	0.59
21	CSAH 74/Lake St NE	Hallberg St SW in Warroad	0.15	30	2	U-1	10,000	10,548	**1.05**	9,879	**0.99**
22	Hallberg St SW	Garfield St SW in Warroad	0.21	30	2	U-1	10,000	8,861	**0.89**	8,298	0.83
23	Garfield St SW	200 feet east/south CSAH 5	0.09	30	2	U-1	10,000	4,993	0.50	4,676	0.47
24	200 feet east/south CSAH 5	CSAH 12	3.12	55	2	R-1	15,000	4,993	0.33	4,676	0.31
25	CSAH 12	Roseau–Lake of the Woods County Line	9.37	55	2	R-1	15,000	2,180	0.15	2,042	0.14

*

Code	Definition	Volume Threshold
U-1	Two-lane urban at 30 - 40 mph	10,000 ADT
U-2	Three-lane urban at 30 mph	17,000 ADT
U-3	Three-lane urban at 40 - 45 mph	17,000 ADT

Code	Definition	Volume Threshold
R-1	Two-lane rural at 55 - 55+ mph	15,000 ADT
R-2	Two-lane rural at 50 mph	15,000 ADT

Intersections

The five intersections that were analyzed in existing conditions were also analyzed for future conditions using volumes projected using the MnDOT growth factor of 1.3 as discussed for the corridor segments. In addition to taking into consideration the future traffic volumes, the future analysis also took into consideration the improvements currently taking place in Roseau and those that are likely going to be incorporated into the signal improvements planned for Warroad in 2019. These include the flashing yellow arrow, which provides some additional capacity to the left-turn moves.

The methodology using Synchro/SimTraffic software that was used for the existing conditions was also used for future conditions, with the improvements of the flashing yellow arrow incorporated.

Future Volumes - Intersections

Future volumes at the intersections are shown in **Figures 8 – 13** and reflect the 1.3 percent growth factor applied in 2040. As shown on the figures there are increases in traffic at all of the intersections—this is to be expected. With a general increase in traffic along the corridor on a daily basis, there will also be an associated increase during the peak periods. While traffic volumes will increase during the peaks, it should be noted that not all of the additional traffic will be on the corridor during these times, so only a portion of it is allocated to these time periods, just as it is today.

Future Congestion – Intersections

A level of service (LOS) analysis was reported for each of the five intersections during AM, PM and off-peak periods for 2040. Intersections and individual movements were rated on a scale from A to F, just as they were for existing conditions. Under existing conditions, the worst individual movement was LOS C, which is acceptable, with all intersections as a whole operating at LOS A or B. These are excellent conditions for intersection operations.

By 2040, conditions are projected to change slightly, with some worsening of individual movements and some intersections experiencing an overall decrease in LOS. **Table 9** summarizes 2040 LOS for the AM peak, midday and PM peak periods. **Attachment B** has the more detailed information.

As shown in the table, the worst individual movement at any of the intersections remains LOS C, with all intersections continuing to operate overall at LOS A or B. Note that results for several individual movements indicate an improvement in operational delay when compared with existing conditions. These improvements result from adjustments in signal timing at the signalized intersections, along with the effects of vehicle platooning and random arrivals.

Overall, the results of the future operations analysis show there are no significant delay or queuing issues anticipated at any of the intersections studied, and that overall operational conditions are anticipated to remain very good in 2040. The level of service is at A, B or C for all intersections during all three periods.

TH 11 Corridor Improvements

Intersection of TH 11 & TH 32
Minnesota Department of Transportation

Figure 8
2040 Volumes – AM & PM Peak Period

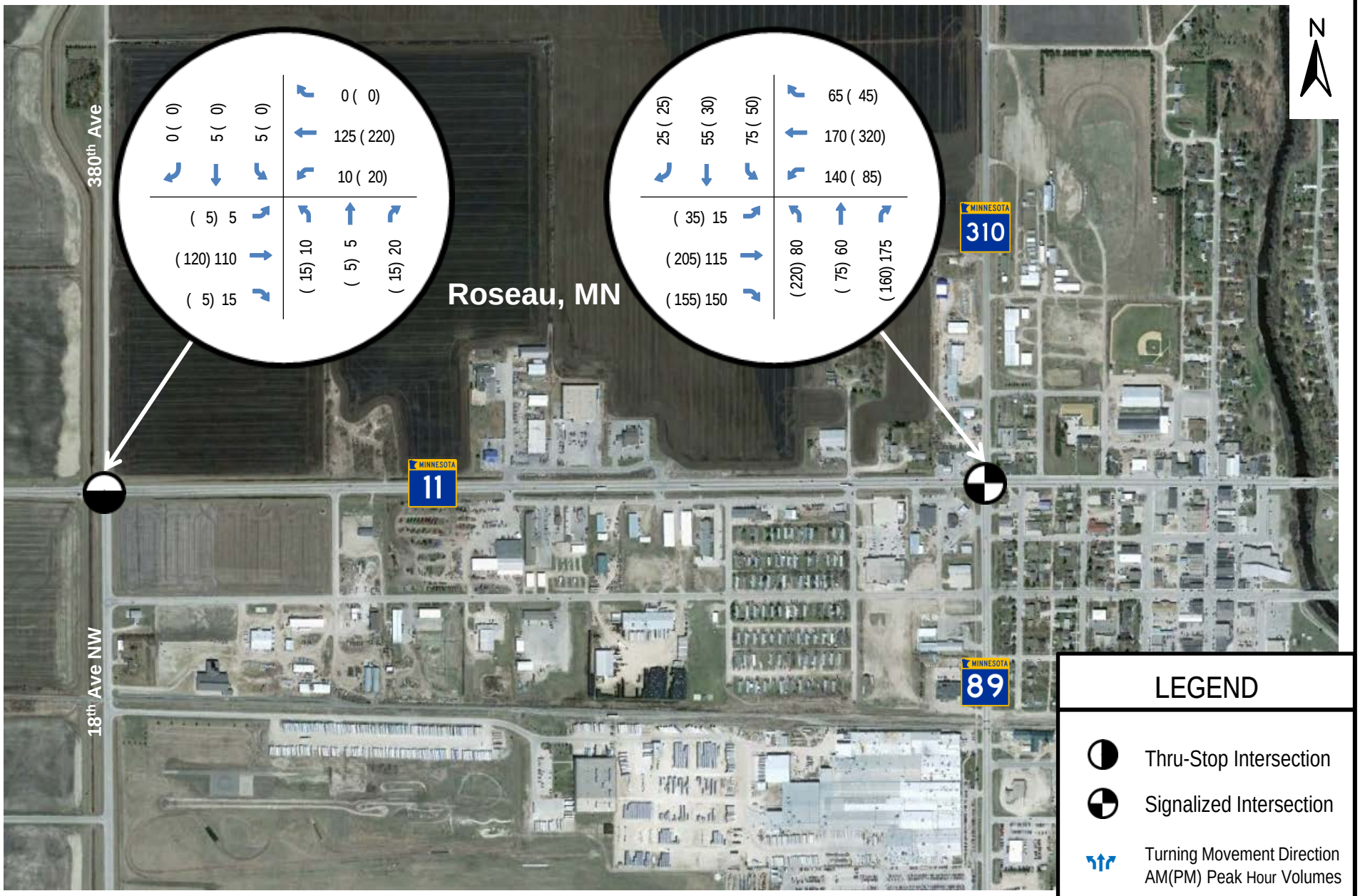
TH 11 Corridor Improvements

Intersection of TH 11 & TH 32

Minnesota Department of Transportation

Figure 9

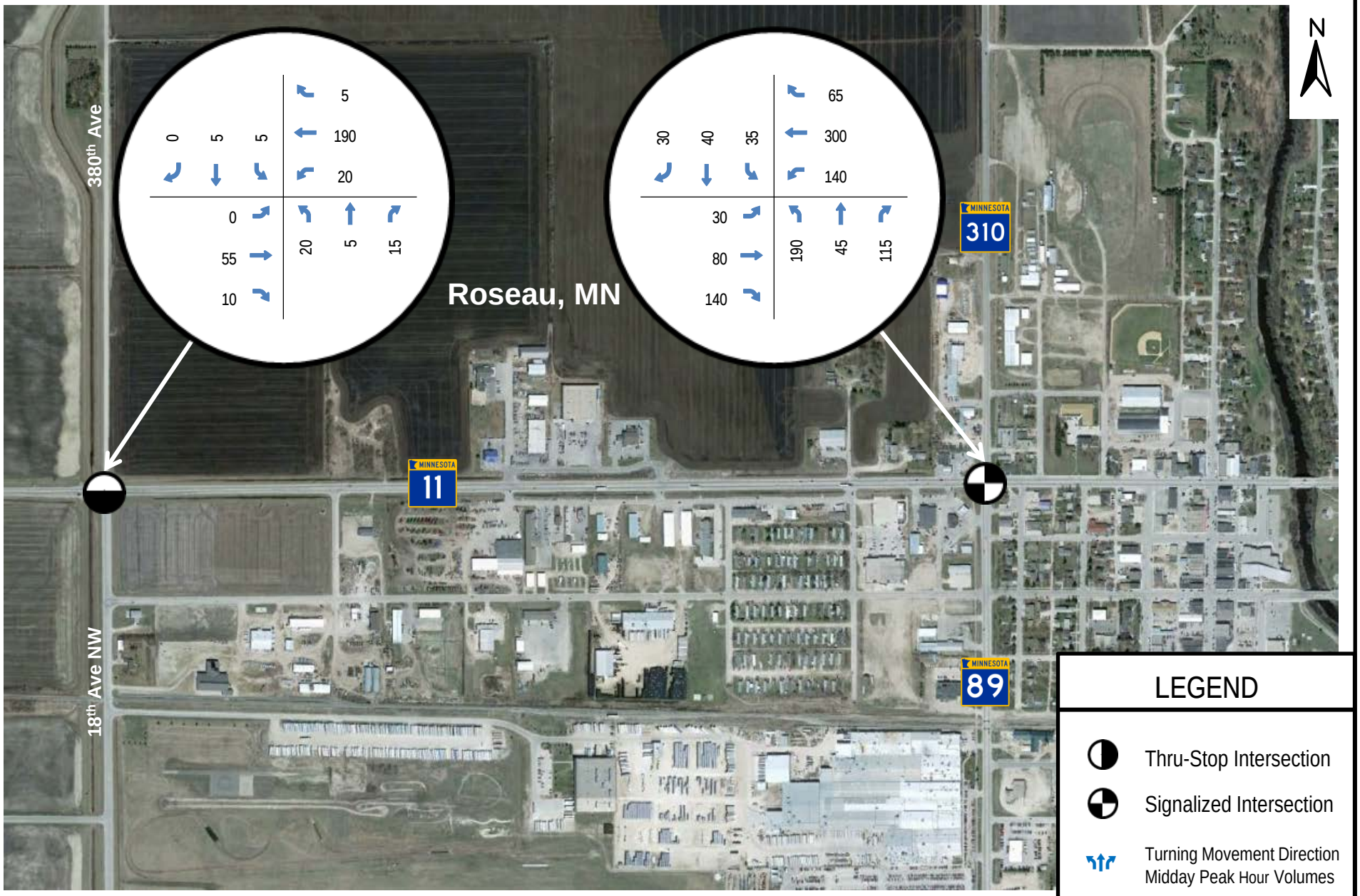
2040 Volumes – Midday Peak Period



TH 11 Corridor Improvements

Intersections of TH 11 & 18th Ave NW, TH 11 & TH 89-310
Minnesota Department of Transportation

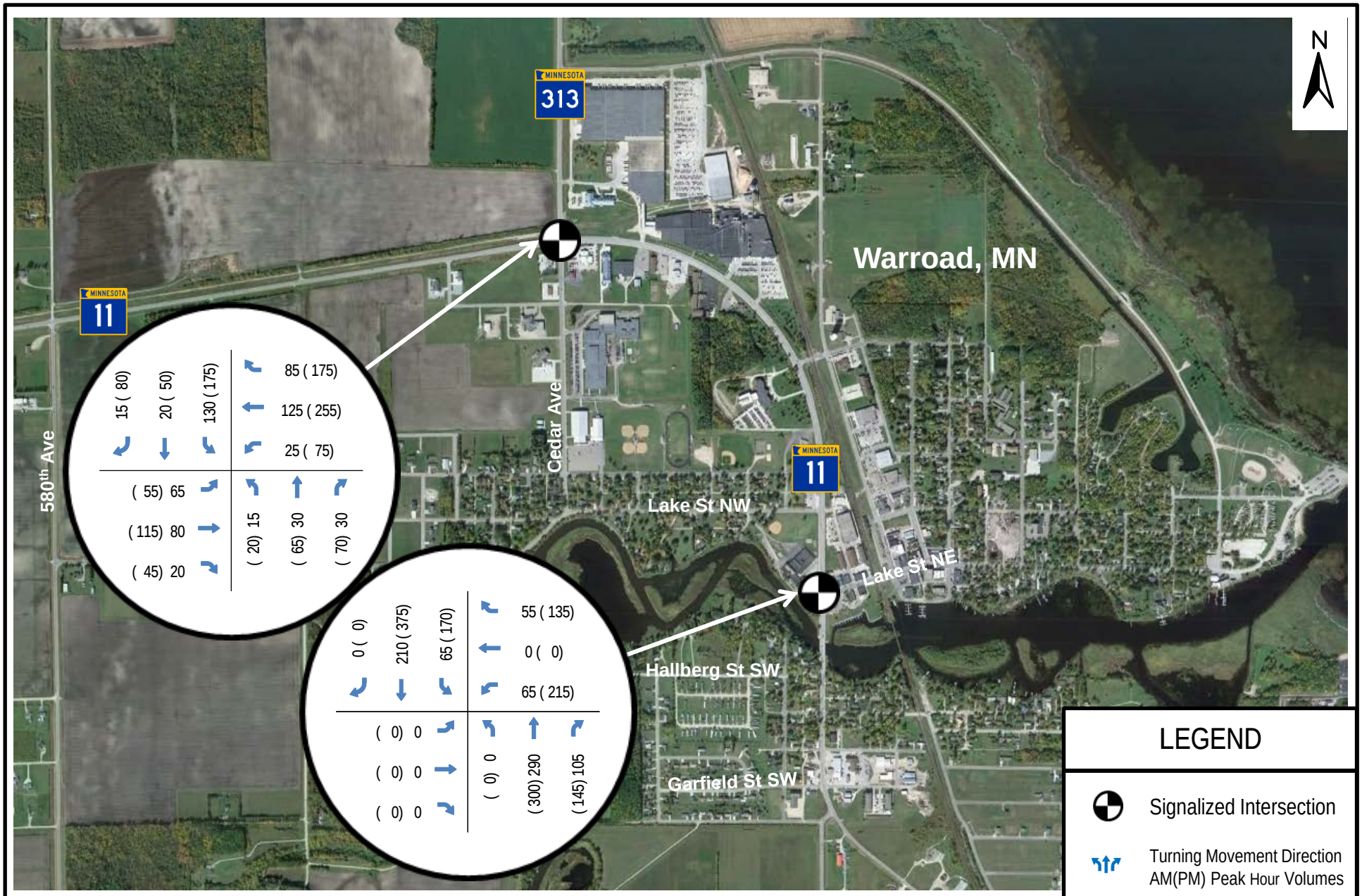
Figure 10
2040 Volumes – AM & PM Peak Period



TH 11 Corridor Improvements

Intersections of TH 11 & 18th Ave NW, TH 11 & TH 89-310
Minnesota Department of Transportation

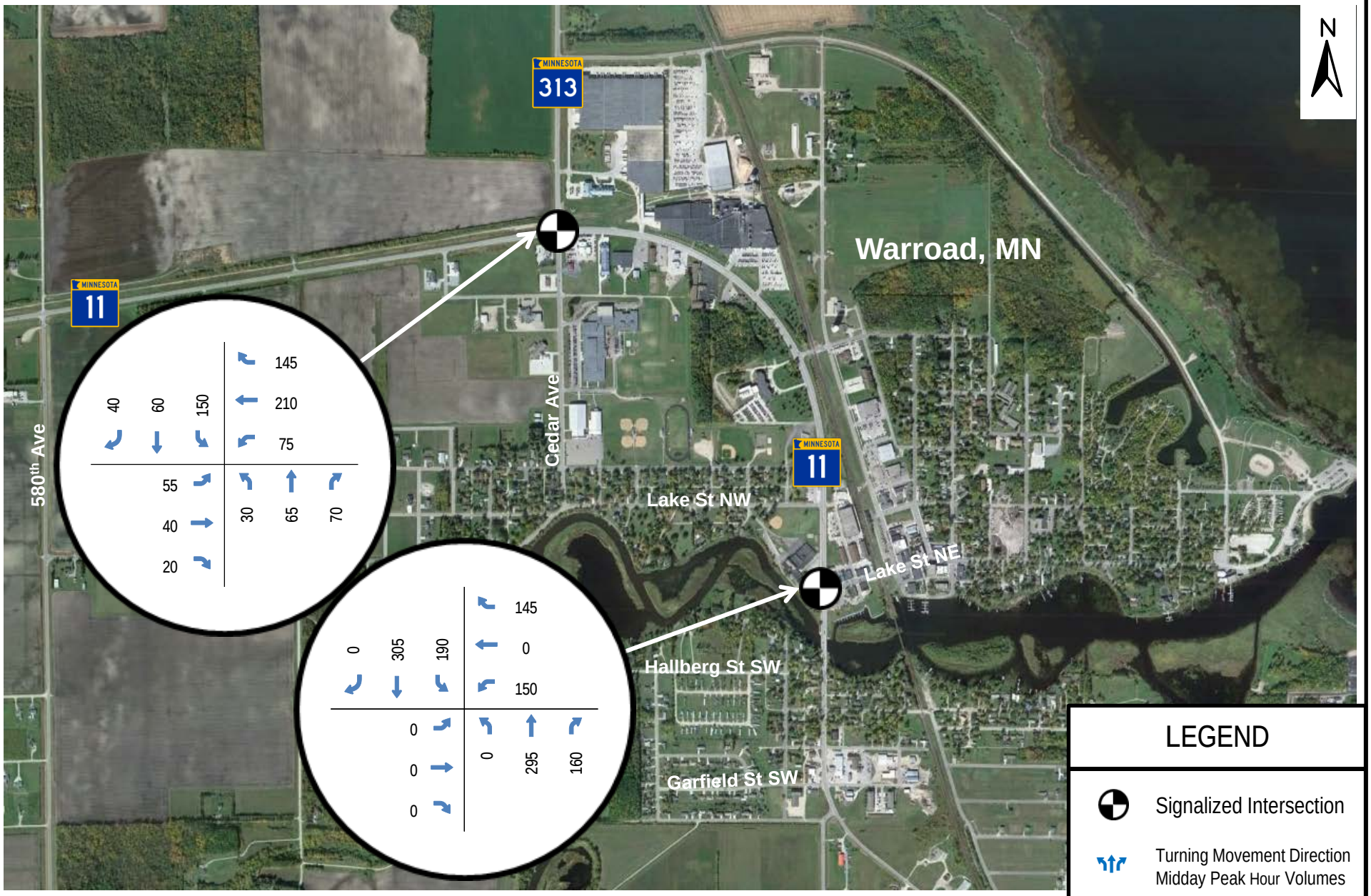
Figure 11
2040 Volumes – Midday Peak Period



TH 11 Corridor Improvements

Intersections of TH 11 & TH 313, TH 11 & Lake St NE
Minnesota Department of Transportation

Figure 12
2040 Volumes – AM & PM Peak Period



TH 11 Corridor Improvements

Intersections of TH 11 & TH 313, TH 11 & Lake St NE
Minnesota Department of Transportation

Figure 13
2040 Volumes – Midday Peak Period

Table 9 – Future Intersection LOS AM Peak, Midday and PM Peak Periods

Intersection			AM Peak				Mid-day				PM Peak			
Control	Location	Approach	Movement Delay[1] (LOS)			Intersection Delay[1] (LOS)	Movement Delay[1] (LOS)			Intersection Delay[1] (LOS)	Movement Delay[1] (LOS)			Intersection Delay[1] (LOS)
			Left	Through	Right		Left	Through	Right		Left	Through	Right	
Thru-Stop	TH 11 & TH 32	NB	2 (A)	1 (A)	0 (A)	3 (A)	3 (A)	1 (A)	0 (A)	3 (A)	3 (A)	1 (A)	0 (A)	3 (A)
		WB	0 (A)	0 (A)	0 (A)		0 (A)	0 (A)	0 (A)		0 (A)	0 (A)	0 (A)	
		SB	0 (A)	1 (A)	1 (A)		0 (A)	1 (A)	1 (A)		0 (A)	1 (A)	1 (A)	
		EB	6 (A)	0 (A)	3 (A)		7 (A)	0 (A)	3 (A)		7 (A)	0 (A)	3 (A)	
Thru-Stop	TH 11 & 18th Ave NW	NB	6 (A)	7 (A)	3 (A)	2 (A)	6 (A)	8 (A)	2 (A)	2 (A)	6 (A)	8 (A)	2 (A)[2]	2 (A)
		WB	1 (A)	1 (A)	0 (A)		1 (A)	2 (A)	1 (A)		1 (A)	2 (A)	1 (A)	
		SB	5 (A)	6 (A)	0 (A)		5 (A)	7 (A)[2]	0 (A)		5 (A)	7 (A)	0 (A)	
		EB	1 (A)	1 (A)	0 (A)		0 (A)	1 (A)	0 (A)		0 (A)	1 (A)	0 (A)	
Signalized	TH 11 & TH 89/TH 310	NB	11 (B)	11 (B)	5 (A)	10 (B)	13 (B)	11 (B)	5 (A)	13 (B)	13 (B)	11 (B)	5 (A)	12 (B)
		WB	14 (B)	12 (B)	5 (A)		16 (B)	16 (B)	6 (A)		15 (B)	15 (B)	6 (A)	
		SB	11 (B)	11 (B)	4 (A)		14 (B)	18 (B)	6 (A)		12 (B)	14 (B)	5 (A)	
		EB	15 (B)[3]	18 (B)	5 (A)		15 (B)	20 (C)	5 (A)		16 (B)	17 (B)	5 (A)	
Signalized	TH 11 & TH 313	NB	6 (A)	6 (A)	3 (A)	9 (A)	10 (B)	9 (A)	4 (A)	12 (B)	9 (A)	8 (A)	4 (A)	14 (B)
		WB	16 (B)[3]	11 (B)	9 (A)		20 (C)	19 (B)	11 (B)		26 (C)	23 (C)	10 (B)	
		SB	6 (A)	8 (A)	2 (A)		10 (B)	11 (B)	3 (A)		12 (B)	13 (B)	4 (A)	
		EB	17 (B)[3]	11 (B)[3]	3 (A)		19 (B)	10 (B)	3 (A)		26 (C)	14 (B)	3 (A)	
Signalized	TH 11 & Lake St	NB	0 (A)	7 (A)	5 (A)	8 (A)	0 (A)	16 (B)	12 (B)	16 (B)	0 (A)	18 (B)	13 (B)	18 (B)
		WB	19 (B)	0 (A)	9 (A)		31 (C)	0 (A)	21 (C)		28 (C)	0 (A)	21 (C)	
		SB	11 (B)	7 (A)	0 (A)		16 (B)	10 (B)	0 (A)		19 (B)	13 (B)	0 (A)	
		EB	0 (A)	0 (A)	0 (A)		0 (A)	0 (A)	0 (A)		0 (A)	0 (A)	0 (A)	

[1] Delay measured in seconds per vehicle

[2] Improvement in operational delay from existing conditions resulted from adjustments in signal timing at the adjacent signalized intersection and the effects of platooning and random arrivals

[3] Improvement in operational delay from existing conditions resulted from adjustments in signal timing to accommodate future volumes

4. Future Problem Areas/Areas for Potential Additional Study

The good news for the TH 11 corridor is that a majority of the corridor is expected to function at a high level well into the future. Only one segment (River Crossing between Lake Street SE and Hallberg Street SW) is expected to be congested by 2040. The segment immediately to the south/east (Hallberg Street SW to Garfield Street SW) is nearing congestion at that same time. The river crossing segment is expected to reach the nearing congestion mark by 2025 when volumes are expected to be about 8,600.

At the intersection level, most intersections are still expected to operate at LOS B or better. However, there are movements that will have a lower level of service and motorists will have to wait longer than they are currently accustomed to waiting. This could result in some driver impatience in the future.

Recommendations

Based on the above analysis, it is recommended that the two segments in Warroad that were identified as near congested and congested be considered for future evaluation in the needs assessment and alternatives analysis phases of this study based on potential future congestion.

Additionally, at the intersection level, it is recommended that the proposed signal improvements in Warroad—including the flashing yellow and signal timing adjustments—be implemented as planned to provide additional capacity to the left-turn moves and to accommodate additional volumes on TH 11. However, it does not appear that additional evaluations are required for maintaining acceptable operational conditions at intersections within the corridor.

Although the intersection at the Seven Clans Casino was not evaluated in this memo (intersection was undergoing improvements with dedicated left- and right-turn lanes). It is recommended that this intersection be monitored by MnDOT as additional casino activities begin to grow. The casino is relatively new (within the past year) and additional growth on the campus (including spa, marina expansion, etc.) is expected in the future. Time frames for expansion have not been solidified, so it is challenging to predict when future changes may occur, and their impact on their primary access. As a result, ongoing monitoring and coordination with the tribe will continue to be important.

Attachment A – Detailed Intersection Information – Existing Conditions

Table A1: Intersection LOS AM and PM Periods – Existing Conditions

AM Peak Hour		Northbound Approach			Southbound Approach			Eastbound Approach			Westbound Approach		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
TH 11 & TH 32													
Approach Name		**TH 32 NB**			**TH 11 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		31	31	0	0	38	67	56	0	45	0	0	0
Lane Configuration													
Storage Length (ft)		300								335			
Thru-Stop	Average Queue (ft)	3						23		21			
	Max Queue (ft)	29						49		63			
	Movement Delay (s)	2.0	1.0	0.0	0.0	1.0	1.0	5.0	0.0	3.0	0.0	0.0	0.0
	Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
	Intersection Delay (LOS)	2.0 (A)											
TH 11 & 18th Ave NW													
Approach Name		**18th Ave NW NB**			**18th Ave NW SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		5	1	14	3	1	0	1	75	8	7	88	0
Lane Configuration													
Storage Length (ft)											250		
Thru-Stop	Average Queue (ft)		11			4							
	Max Queue (ft)		30			26					12		
	Movement Delay (s)	5.0	6.0	2.0	5.0	6.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0
	Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
	Intersection Delay (LOS)	1.0 (A)											
TH 11 & TH 89/TH 310													
Approach Name		**TH 89/TH 310 NB**			**TH 89/TH 310 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		56	42	123	53	38	17	9	81	105	96	120	43
Lane Configuration													
Storage Length (ft)		300*		105	100		100	300*		475	300*		200
Traffic Signal	Average Queue (ft)	23	15	27	24	14	7	6	36	27	39	38	11
	Max Queue (ft)	67	62	83	61	47	28	37	94	71	91	100	40
	Movement Delay (s)	9.0	10.0	4.0	10.0	9.0	3.0	16.0	16.0	4.0	12.0	11.0	4.0
	Movement LOS	A	B	A	B	A	A	B	B	A	B	B	A
	Intersection Delay (LOS)	9.0 (A)											
TH 11 & TH 313													
Approach Name		**TH 313 NB**			**TH 313 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		10	20	19	92	13	10	46	54	11	17	87	59
Lane Configuration													
Storage Length (ft)							160	250		250	300*		215
Traffic Signal	Average Queue (ft)		11			19	1	28	28	6	11	39	27
	Max Queue (ft)		45			55	12	72	67	35	47	91	65
	Movement Delay (s)	6.0	4.0	2.0	4.0	4.0	1.0	19.0	14.0	3.0	17.0	10.0	7.0
	Movement LOS	A	A	A	A	A	A	B	B	A	B	B	A
	Intersection Delay (LOS)	9.0 (A)											
TH 11 & Lake St													
Approach Name		**TH 11 NB**			**TH 11 SB**			**Lake St EB**			**Lake St WB**		
Approach Volume		0	206	73	45	146	0	0	0	0	45	0	38
Lane Configuration													
Storage Length (ft)					300*								
Traffic Signal	Average Queue (ft)		37		18	19					38		
	Max Queue (ft)		118		60	88					93		
	Movement Delay (s)	0.0	4.0	3.0	9.0	6.0	0.0	0.0	0.0	0.0	17.0	0.0	7.0
	Movement LOS	A	A	A	A	A	A	A	A	A	B	A	A
	Intersection Delay (LOS)	6.0 (A)											

PM Peak Hour		Northbound Approach			Southbound Approach			Eastbound Approach			Westbound Approach		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
TH 11 & TH 32													
Approach Name		**TH 32 NB**			**TH 11 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		44	54	0	0	39	91	99	0	24	0	0	0
Lane Configuration													
Storage Length (ft)		300					360			335			
Thru-Stop	Average Queue (ft)	6						33		13			
	Max Queue (ft)	37					7	70		30			
	Movement Delay (s)	2.0	1.0	0.0	0.0	1.0	1.0	6.0	0.0	2.0	0.0	0.0	0.0
	Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
	Intersection Delay (LOS)	2.0 (A)											
TH 11 & 18th Ave NW													
Approach Name		**18th Ave NW NB**			**18th Ave NW SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		8	1	8	0	0	0	1	82	3	12	154	0
Lane Configuration													
Storage Length (ft)								150			250		
Thru-Stop	Average Queue (ft)		10										
	Max Queue (ft)		33					4			12		
	Movement Delay (s)	5.0	8.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	0.0
	Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
	Intersection Delay (LOS)	1.0 (A)											
TH 11 & TH 89/TH 310													
Approach Name		**TH 89/TH 310 NB**			**TH 89/TH 310 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		156	51	112	32	20	16	23	145	110	57	227	29
Lane Configuration													
Storage Length (ft)		300*		105	100		100	300*		475	300*		200
Traffic Signal	Average Queue (ft)	49	15	24	18	9	7	12	49	26	28	70	11
	Max Queue (ft)	107	62	61	54	38	24	48	127	73	66	163	45
	Movement Delay (s)	11.0	9.0	5.0	9.0	11.0	4.0	13.0	14.0	3.0	13.0	14.0	4.0
	Movement LOS	B	A	A	A	B	A	B	B	A	B	B	A
	Intersection Delay (LOS)	10.0 (B)											
TH 11 & TH 313													
Approach Name		**TH 313 NB**			**TH 313 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		12	44	47	124	34	54	36	80	30	50	178	121
Lane Configuration													
Storage Length (ft)							160	250		250	300*		215
Traffic Signal	Average Queue (ft)		29			34	9	24	30	14	27	64	36
	Max Queue (ft)		72			91	41	72	84	57	103	148	72
	Movement Delay (s)	6.0	7.0	3.0	8.0	8.0	3.0	21.0	13.0	3.0	21.0	19.0	9.0
	Movement LOS	A	A	A	A	A	A	C	B	A	C	B	A
	Intersection Delay (LOS)	12.0 (B)											
TH 11 & Lake St													
Approach Name		**TH 11 NB**			**TH 11 SB**			**Lake St EB**			**Lake St WB**		
Approach Volume		0	212	102	118	264	0	0	0	0	151	0	93
Lane Configuration													
Storage Length (ft)					300*								
Traffic Signal	Average Queue (ft)		71		43	51					102		
	Max Queue (ft)		170		105	151					199		
	Movement Delay (s)	0.0	9.0	5.0	12.0	9.0	0.0	0.0	0.0	0.0	24.0	0.0	15.0
	Movement LOS	A	A	A	B	A	A	A	A	A	C	A	B
	Intersection Delay (LOS)	12.0 (B)											

* 300 ft was used because existing shared left-turn lane provides extended storage capacity

Table A2: Intersection LOS Mid-day Period – Existing Conditions

Mid-day		Northbound Approach			Southbound Approach			Eastbound Approach			Westbound Approach		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
TH 11 & TH 32													
Approach Name		**TH 32 NB**			**TH 11 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		25	40	0	0	34	78	86	0	35	0	0	0
Lane Configuration													
Storage Length (ft)		300					360			335			
Thru-Stop	Average Queue (ft)	2						30		19			
	Max Queue (ft)	28					4	67		61			
	Movement Delay (s)	2.0	1.0	0.0	0.0	1.0	1.0	6.0	0.0	2.0	0.0	0.0	0.0
	Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
	Intersection Delay (LOS)	3.0 (A)											
TH 11 & 18th Ave NW													
Approach Name		**18th Ave NW NB**			**18th Ave NW SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		12	1	9	1	1	0	0	36	7	11	134	1
Lane Configuration													
Storage Length (ft)											250		
Thru-Stop	Average Queue (ft)		10			2					1		
	Max Queue (ft)		29			22					18		
	Movement Delay (s)	5.0	5.0	2.0	0.0	8.0	0.0	0.0	0.0	0.0	1.0	2.0	1.0
	Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
	Intersection Delay (LOS)	2.0 (A)											
TH 11 & TH 89/TH 310													
Approach Name		**TH 89/TH 310 NB**			**TH 89/TH 310 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		134	30	81	22	27	19	21	54	98	96	213	44
Lane Configuration													
Storage Length (ft)		300*		105	100		100	300*		475	300*		200
Traffic Signal	Average Queue (ft)	43	11	16	13	11	6	14	23	25	39	61	14
	Max Queue (ft)	99	42	52	42	45	24	41	63	69	92	141	48
	Movement Delay (s)	10.0	7.0	4.0	10.0	10.0	3.0	14.0	14.0	4.0	12.0	13.0	5.0
	Movement LOS	B	A	A	B	B	A	B	B	A	B	B	A
	Intersection Delay (LOS)	10.0 (B)											
TH 11 & TH 313													
Approach Name		**TH 313 NB**			**TH 313 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		18	46	49	105	41	28	37	26	14	53	147	102
Lane Configuration													
Storage Length (ft)							160	250		250	300*		215
Traffic Signal	Average Queue (ft)		25			33	5	25	14	7	26	47	36
	Max Queue (ft)		78			105	37	62	59	26	78	101	82
	Movement Delay (s)	6.0	5.0	3.0	7.0	7.0	3.0	16.0	9.0	2.0	17.0	15.0	9.0
	Movement LOS	A	A	A	A	A	A	B	A	A	B	B	A
	Intersection Delay (LOS)	9.0 (A)											
TH 11 & Lake St													
Approach Name		**TH 11 NB**			**TH 11 SB**			**Lake St EB**			**Lake St WB**		
Approach Volume		0	208	111	135	214	0	0	0	0	104	0	103
Lane Configuration													
Storage Length (ft)					300*								
Traffic Signal	Average Queue (ft)		65		42	36					79		
	Max Queue (ft)		151		100	101					167		
	Movement Delay (s)	0.0	9.0	6.0	10.0	7.0	0.0	0.0	0.0	0.0	22.0	0.0	11.0
	Movement LOS	A	A	A	B	A	A	A	A	A	C	A	B
	Intersection Delay (LOS)	10.0 (B)											

* 300 ft was used because existing shared left-turn lane provides extended storage capacity

Attachment B – Detailed Intersection Information – Future Conditions

Table B1: Intersection LOS AM and PM Periods – 2040 Volumes (Existing Geometry)

AM Peak Hour		Northbound Approach			Southbound Approach			Eastbound Approach			Westbound Approach		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
TH 11 & TH 32													
Approach Name		**TH 32 NB**			**TH 11 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		45	45	0	0	55	95	80	0	65	0	0	0
Lane Configuration													
Storage Length (ft)		300					360			335			
Thru-Stop	Average Queue (ft)	7						29		24			
	Max Queue (ft)	40					4	66		62			
	Movement Delay (s)	2.0	1.0	0.0	0.0	1.0	1.0	6.0	0.0	3.0	0.0	0.0	0.0
	Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
	Intersection Delay (LOS)	3.0 (A)											
TH 11 & 18th Ave NW													
Approach Name		**18th Ave NW NB**			**18th Ave NW SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		10	5	20	5	5	0	5	110	15	10	125	0
Lane Configuration													
Storage Length (ft)								150			250		
Thru-Stop	Average Queue (ft)		16			6					1		
	Max Queue (ft)		46			26		12			21		
	Movement Delay (s)	6.0	7.0	3.0	5.0	6.0	0.0	1.0	1.0	0.0	1.0	1.0	0.0
	Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
	Intersection Delay (LOS)	2.0 (A)											
TH 11 & TH 89/TH 310													
Approach Name		**TH 89/TH 310 NB**			**TH 89/TH 310 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		80	60	175	75	55	25	15	115	150	140	170	65
Lane Configuration													
Storage Length (ft)		300*		105	100		100	300*		475	300*		200
Traffic Signal	Average Queue (ft)	31	22	35	32	19	10	9	44	36	56	49	16
	Max Queue (ft)	75	67	66	90	69	42	34	98	83	107	129	49
	Movement Delay (s)	11.0	11.0	5.0	11.0	11.0	4.0	15.0	18.0	5.0	14.0	12.0	5.0
	Movement LOS	B	B	A	B	B	A	B	B	A	B	B	A
	Intersection Delay (LOS)	10.0 (B)											
TH 11 & TH 313													
Approach Name		**TH 313 NB**			**TH 313 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		15	30	30	130	20	15	65	80	20	25	125	85
Lane Configuration													
Storage Length (ft)							160	250		250	300*		215
Traffic Signal	Average Queue (ft)		21			30	2	38	28	9	14	48	32
	Max Queue (ft)		58			86	16	83	73	31	53	110	76
	Movement Delay (s)	6.0	6.0	3.0	6.0	8.0	2.0	17.0	11.0	3.0	16.0	11.0	9.0
	Movement LOS	A	A	A	A	A	A	B	B	A	B	B	A
	Intersection Delay (LOS)	9.0 (A)											
TH 11 & Lake St													
Approach Name		**TH 11 NB**			**TH 11 SB**			**Lake St EB**			**Lake St WB**		
Approach Volume		0	290	105	65	210	0	0	0	0	65	0	55
Lane Configuration													
Storage Length (ft)					300*								
Traffic Signal	Average Queue (ft)		70		29	33					52		
	Max Queue (ft)		173		72	102					119		
	Movement Delay (s)	0.0	7.0	5.0	11.0	7.0	0.0	0.0	0.0	0.0	19.0	0.0	9.0
	Movement LOS	A	A	A	B	A	A	A	A	A	B	A	A
	Intersection Delay (LOS)	8.0 (A)											

PM Peak Hour		Northbound Approach			Southbound Approach			Eastbound Approach			Westbound Approach		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
TH 11 & TH 32													
Approach Name		**TH 32 NB**			**TH 11 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		65	80	0	0	55	130	140	0	35	0	0	0
Lane Configuration													
Storage Length (ft)		300					360			335			
Thru-Stop	Average Queue (ft)	13					1	41		19			
	Max Queue (ft)	52					11	78		60			
	Movement Delay (s)	3.0	1.0	0.0	0.0	1.0	1.0	7.0	0.0	3.0	0.0	0.0	0.0
	Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
	Intersection Delay (LOS)	3.0 (A)											
TH 11 & 18th Ave NW													
Approach Name		**18th Ave NW NB**			**18th Ave NW SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		15	5	15	0	0	0	5	120	5	20	220	0
Lane Configuration													
Storage Length (ft)											250		
Thru-Stop	Average Queue (ft)		18			8					1		
	Max Queue (ft)		45			26					20		
	Movement Delay (s)	6.0	8.0	2.0	5.0	7.0	0.0	0.0	1.0	0.0	1.0	2.0	1.0
	Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
	Intersection Delay (LOS)	2.0 (A)											
TH 11 & TH 89/TH 310													
Approach Name		**TH 89/TH 310 NB**			**TH 89/TH 310 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		220	75	160	50	30	25	35	205	155	85	320	45
Lane Configuration													
Storage Length (ft)		300*		105	100		100	300*		475	300*		200
Traffic Signal	Average Queue (ft)	63	16	28	19	16	12	16	34	34	51	85	18
	Max Queue (ft)	135	64	72	57	49	49	45	95	68	102	194	80
	Movement Delay (s)	13.0	11.0	5.0	12.0	14.0	5.0	16.0	17.0	5.0	15.0	15.0	6.0
	Movement LOS	B	B	A	B	B	A	B	B	A	B	B	A
	Intersection Delay (LOS)	12.0 (B)											
TH 11 & TH 313													
Approach Name		**TH 313 NB**			**TH 313 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		20	65	70	175	50	80	55	115	45	75	255	175
Lane Configuration													
Storage Length (ft)							160	250		250	300*		215
Traffic Signal	Average Queue (ft)		38			59	13	33	43	18	37	96	44
	Max Queue (ft)		102			150	49	83	95	46	92	189	84
	Movement Delay (s)	9.0	8.0	4.0	12.0	13.0	4.0	26.0	14.0	3.0	26.0	23.0	10.0
	Movement LOS	A	A	A	B	B	A	C	B	A	C	C	B
	Intersection Delay (LOS)	14.0 (B)											
TH 11 & Lake St													
Approach Name		**TH 11 NB**			**TH 11 SB**			**Lake St EB**			**Lake St WB**		
Approach Volume		0	300	145	170	375	0	0	0	0	215	0	135
Lane Configuration													
Storage Length (ft)					300*								
Traffic Signal	Average Queue (ft)		145		65	90					152		
	Max Queue (ft)		267		162	252					274		
	Movement Delay (s)	0.0	18.0	13.0	19.0	13.0	0.0	0.0	0.0	0.0	28.0	0.0	21.0
	Movement LOS	A	B	B	B	B	A	A	A	A	C	A	C
	Intersection Delay (LOS)	18.0 (B)											

* 300 ft was used because existing shared left-turn lane provides extended storage capacity

Table B2: Intersection LOS Mid-day Period – 2040 Volumes (Existing Geometry)

Mid-day		Northbound Approach			Southbound Approach			Eastbound Approach			Westbound Approach		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
TH 11 & TH 32													
Approach Name		**TH 32 NB**			**TH 11 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		40	60	0	0	50	110	125	0	50	0	0	0
Lane Configuration													
Storage Length (ft)		300					360			335			
Thru-Stop	Average Queue (ft)	7					1	37		21			
	Max Queue (ft)	44					11	70		61			
	Movement Delay (s)	3.0	1.0	0.0	0.0	1.0	1.0	7.0	0.0	3.0	0.0	0.0	0.0
	Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
	Intersection Delay (LOS)	3.0 (A)											
TH 11 & 18th Ave NW													
Approach Name		**18th Ave NW NB**			**18th Ave NW SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		20	5	15	5	5	0	0	55	10	20	190	5
Lane Configuration													
Storage Length (ft)											250		
Thru-Stop	Average Queue (ft)		17			8					1		
	Max Queue (ft)		42			26					18		
	Movement Delay (s)	6.0	8.0	2.0	5.0	7.0	0.0	0.0	1.0	0.0	1.0	2.0	1.0
	Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A
	Intersection Delay (LOS)	2.0 (A)											
TH 11 & TH 89/TH 310													
Approach Name		**TH 89/TH 310 NB**			**TH 89/TH 310 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		190	45	115	35	40	30	30	80	140	140	300	65
Lane Configuration													
Storage Length (ft)		300*		105	100		100	300*		475	300*		200
Traffic Signal	Average Queue (ft)	65	15	25	20	20	11	16	36	34	51	91	17
	Max Queue (ft)	131	63	72	56	63	40	47	102	66	106	225	98
	Movement Delay (s)	13.0	11.0	5.0	14.0	18.0	6.0	15.0	20.0	5.0	16.0	16.0	6.0
	Movement LOS	B	B	A	B	B	A	B	C	A	B	B	A
	Intersection Delay (LOS)	13.0 (B)											
TH 11 & TH 313													
Approach Name		**TH 313 NB**			**TH 313 SB**			**TH 11 EB**			**TH 11 WB**		
Approach Volume		30	65	70	150	60	40	55	40	20	75	210	145
Lane Configuration													
Storage Length (ft)							160	250		250	300*		215
Traffic Signal	Average Queue (ft)		43			49	8	32	19	10	33	70	41
	Max Queue (ft)		110			116	33	92	61	30	79	142	84
	Movement Delay (s)	10.0	9.0	4.0	10.0	11.0	3.0	19.0	10.0	3.0	20.0	19.0	11.0
	Movement LOS	B	A	A	B	B	A	B	B	A	C	B	B
	Intersection Delay (LOS)	12.0 (B)											
TH 11 & Lake St													
Approach Name		**TH 11 NB**			**TH 11 SB**			**Lake St EB**			**Lake St WB**		
Approach Volume		0	295	160	190	305	0	0	0	0	150	0	145
Lane Configuration													
Storage Length (ft)					300*								
Traffic Signal	Average Queue (ft)		131		64	62					129		
	Max Queue (ft)		305		132	148					252		
	Movement Delay (s)	0.0	16.0	12.0	16.0	10.0	0.0	0.0	0.0	0.0	31.0	0.0	21.0
	Movement LOS	A	B	B	B	B	A	A	A	A	C	A	C
	Intersection Delay (LOS)	16.0 (B)											

* 300 ft was used because existing shared left-turn lane provides extended storage capacity