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Date: February 18, 2020

Subject: TH 8 Improvement Project
Existing and 2040 No-Build Conditions Memorandum

Introduction

The Trunk Highway (TH) 8 Improvement Project is currently being completed and includes preliminary design and an environmental assessment. The purpose of this memorandum is to inform the project need. The primary needs of the project include vehicle safety and vehicle mobility. The project area is shown in Figure 1.

This memorandum summarizes the existing conditions analysis completed which includes existing data collection, a crash analysis, a traffic operations analysis, an origin-destination analysis, a review of seasonal traffic data, and an access evaluation. In addition, this memorandum summarizes the year 2040 no-build analysis which includes traffic forecasts, a review of volume-to-capacity ratios, and a traffic operations analysis.

Existing Conditions

The existing conditions were reviewed to establish a baseline to identify any future impacts associated with the TH 8 Improvement Project. The evaluation of existing conditions includes existing data collection, a crash analysis, an existing traffic operations analysis, an origin-destination analysis, a review of seasonal traffic data, and an access evaluation.



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Data Collection

Weekday peak period turning movement counts were collected by SRF during April 2019 at the following key intersections:

- TH 8/Goodview Cir
- TH 8/Greenview Ave
- TH 8/Heath Ave
- TH 8/Pioneer Rd
- TH 8/270th St
- TH 8/273rd St
- TH 8/Viking Blvd
- TH 8/Deer Garden Ln
- TH 8/Karmel Ave

In addition to weekday peak period turning movement counts, recreational weekend peak period turning movement counts were collected by SRF during June 2019.

Historical annual average daily traffic (AADT) volumes within the project area were provided by the Minnesota Department of Transportation (MnDOT). Geometric and traffic control information was obtained using aerial imagery and confirmed in the field. Traffic signal timing was obtained from MnDOT. Existing geometrics, traffic controls, and peak period traffic volumes within the project area are shown in Figure 2.

Existing Crash Analysis

Crash data were obtained from MnDOT for January 1, 2016 through December 31, 2018 and was supplemented using MnDOT's Minnesota Crash Mapping Analysis Tool (MnCMAT) for January 1, 2014 through December 31, 2015. The two crash data sets were combined to capture the most recent five-year period available at the time of the analysis. This data was used to establish current crash trends and issues within the project area. There were 117 reported crashes at the project intersections, of which one was a fatal crash and one was an A-severity crash. There were also 119 reported non-intersection crashes on the segments, with no fatal or A-severity crashes.

Intersection and Segment Crash Rates

The first step in the safety evaluation was to review intersection and segment crash rates. The purpose of reviewing crash rates is to determine the statistical significance of the number of crashes at each intersection and segment. Crash rates were calculated and then compared to typical crash rates for intersections and segments with similar characteristics. Published statewide average crash rates from



MnDOT were referenced for comparison purposes. Crash rates are per million entering vehicles (MEV) for intersections and per million vehicle miles (MVM) for segments.

It should be noted that a higher than the statewide average crash rate does not necessarily indicate a crash problem. Therefore, the critical crash rate was also calculated to determine the statistical significance of the crashes at locations that experienced above average crash rates. If the calculated crash rate is below the critical crash rate, crashes that occurred are likely due to the random nature of crashes and not necessarily a geometric design or traffic control issue. A crash rate that is higher than the critical crash rate is an indication of a geometric design or traffic control issue and warrants further evaluation. The critical index is the actual crash rate divided by the critical crash rate. A critical index greater than 1.0 indicates that the actual crash rate is greater than the critical crash rate.

An intersection and segment crash summary that includes the total number of crashes, total number of severe (fatal and A-severity) crashes, the actual crash rate, the statewide average crash rate, the critical crash rate, and the critical index is shown in Table 1 and Table 2, respectively. Maps illustrating the locations of crashes (2014-2018) can be found in Appendix A.

Table 1. Intersection Crash Summary (January 1, 2014-December 31, 2018)

Intersection	Total Crashes	Severe Crashes (K + A)	Actual Crash Rate	Statewide Average	Critical Rate	Critical Index
TH 8 & Goodview Cir	4	0	0.10	0.25	0.46	0.21
TH 8 & Greenway Ave	32	1	0.72	0.45	0.72	1.00
TH 8 & Heath Ave	4	0	0.10	0.25	0.47	0.22
TH 8 & Pioneer Rd	33	0	0.76	0.45	0.73	1.05
TH 8 & 270th St	2	0	0.08	0.25	0.52	0.14
TH 8 & 273rd St	0	0	0.00	0.25	0.52	0.00
TH 8 & Viking Blvd	24	0	0.77	0.45	0.78	0.99
TH 8 & Deer Garden Ln	12	1	0.37	0.25	0.49	0.75
TH 8 & Karmel Ave	6	0	0.18	0.18	0.39	0.46

The TH 8/Greenway Ave and TH 8/Pioneer Road intersections experienced a crash rate greater than or equal to the critical crash rate, indicating a strong likelihood of a geometric design, access, or traffic control issue.

Table 2. Segment Crash Summary (January 1, 2014-December 31, 2018)

Segment	Total Crashes (Segment)	Severe Crashes (K + A)	Actual Crash Rate	Statewide Average	Critical Rate	Critical Index
TH 8 – Goodview Cir to Pioneer Rd	76	0	0.64	0.35	0.69	0.94
TH 8 – Pioneer Rd to Viking Blvd	25	0	0.33	0.35	0.78	0.42
TH 8 – Viking Boulevard to Karmel Ave	18	0	0.37	0.35	0.89	0.42

No segment experienced a crash rate greater than the critical crash rate.

Predominant Crash Types

A review of the manner of collision (i.e., crash diagram) indicates that the predominant types of crashes occurring at the intersections are rear-end (67 percent) and right-angle/left-turn (17 percent) crashes, while the predominant types of non-intersection crashes on the segments are rear-end (53 percent) and runoff road (18 percent) crashes. A summary of the intersection crash types is shown in Table 3 and Figure 3. A summary of the segment crash types is shown in and Table 4 and Figure 4.

Table 3. Intersection Crash Type Summary (January 1, 2014-December 31, 2018)

Intersection	Right Angle/ Left Turn	Side-swipe Passing	Side-swipe Opposing	Rear End	Head On	Runoff Road	Other/ Unknown
TH 8 & Goodview Cir	0	1	0	1	0	0	2
TH 8 & Greenway Ave	5	3	0	21	0	2	1
TH 8 & Heath Ave	1	0	0	2	0	1	0
TH 8 & Pioneer Rd	10	0	1	18	1	3	0
TH 8 & 270th St	0	0	0	2	0	0	0
TH 8 & 273rd St	0	0	0	0	0	0	0
TH 8 & Viking Blvd	2	0	0	21	1	0	0
TH 8 & Deer Garden Ln	1	0	0	9	0	0	2
TH 8 & Karmel Ave	1	0	0	4	0	1	0
Total	20	4	1	78	2	7	5

Figure 3. Intersection Crash Types (January 1, 2014-December 31, 2018)

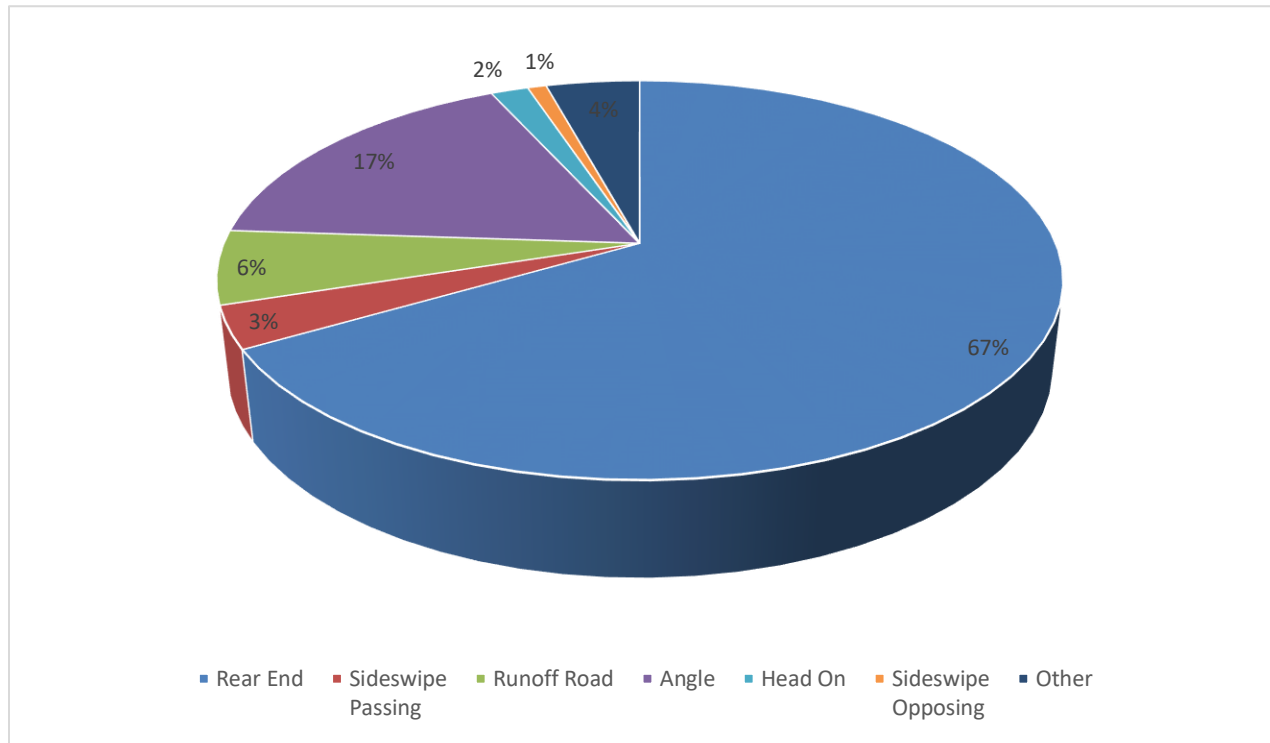
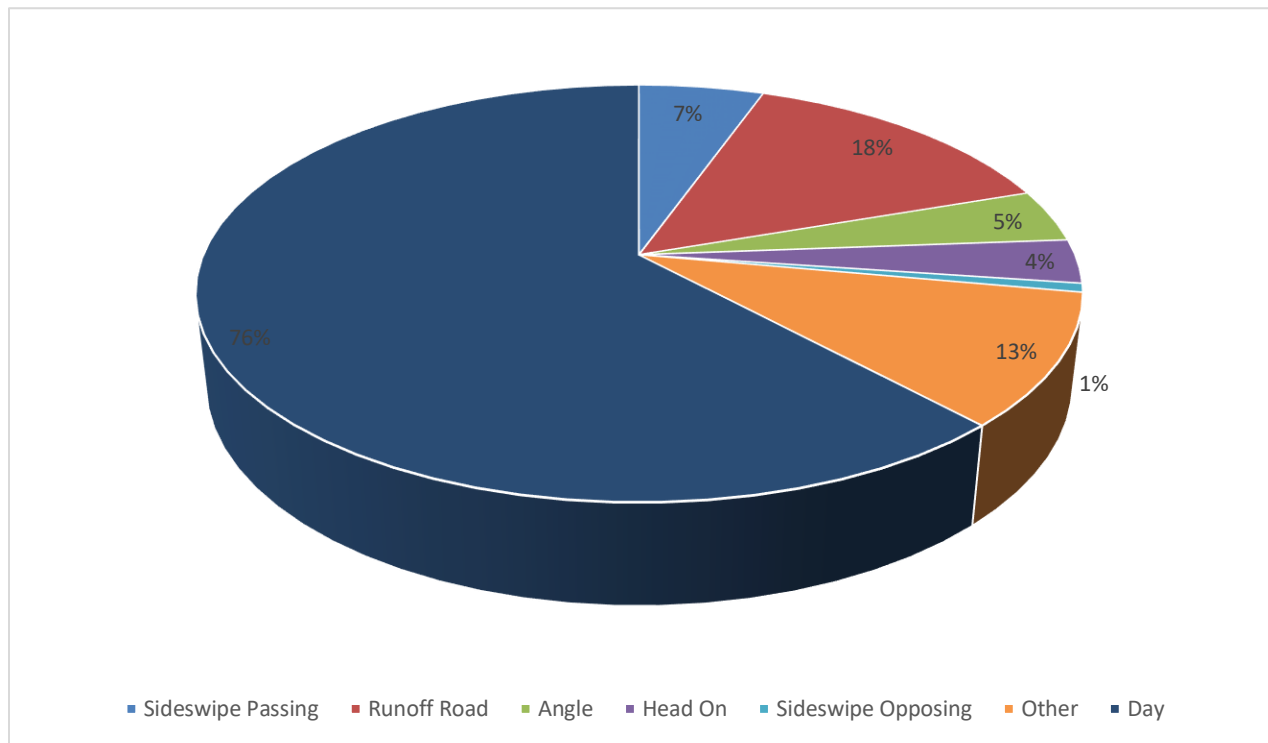


Table 4. Segment Crash Type Summary (January 1, 2014-December 31, 2018)

TH 8	Right Angle/ Left Turn	Side-swipe Passing	Side-swipe Opposing	Rear End	Head On	Runoff Road	Other/ Unknown
Goodview Cir to Pioneer Rd	4	8	1	37	3	14	9
Pioneer Rd to Viking Blvd	1	0	0	12	1	7	4
Viking Boulevard to Karmel Ave	1	0	0	14	1	0	2
Total	6	8	1	63	5	21	15

Figure 4. Segment Crash Types (January 1, 2014-December 31, 2018)



Existing Traffic Operations Analysis

An existing traffic operations analysis was completed for the weekday a.m. and p.m. peak period to establish a baseline condition to which future traffic operations can be compared. The intersections were analyzed using Synchro/SimTraffic (Version 9.2) software. Analysis results identify a Level of Service (LOS), which indicates the quality of traffic flow through an intersection. Intersections are given a ranking from LOS A through LOS F. The LOS results are based on average delay per vehicle, which correspond to the delay threshold values shown in Table 5. LOS A indicates the best traffic operation, with vehicles experiencing minimal delays. LOS F indicates an intersection where demand exceeds capacity, or a breakdown of traffic flow.

Table 5. Level of Service Criteria for Signalized and Unsignalized Intersections

LOS Designation	Signalized Intersection Average Delay/Vehicle (seconds)	Unsignalized Intersection Average Delay/Vehicle (seconds)
A	≤ 10	≤ 10
B	> 10 - 20	> 10 - 15
C	> 20 - 35	> 15 - 25
D	> 35 - 55	> 25 - 35
E	> 55 - 80	> 35 - 50
F	> 80	> 50

For side-street stop and yield controlled intersections, special emphasis is given to providing an estimate for the LOS of the side-street approach. Traffic operations at an unsignalized intersection with side-street stop and yield control can be described in two ways. First, consideration is given to the overall intersection level of service. This considers the total number of vehicles entering the intersection and the capability of the intersection to support these volumes. Second, it is important to consider the delay on the side-street approaches. Since the mainline does not have to stop, most delay is attributed to the side-street approaches. It is typical of intersections with higher mainline traffic volumes to experience high levels of delay (i.e., poor levels of service) on the side-street approaches, but an acceptable overall intersection level of service during peak period conditions.

Results of the existing traffic operations analysis, shown in Table 6, indicate that all intersections operate at an acceptable overall LOS D or better during the a.m. and p.m. peak periods with existing traffic control and geometric layout.

Table 6. Existing Traffic Operations Analysis Results

Intersection	A.M. Peak Period		P.M. Peak Period	
	LOS	Delay	LOS	Delay
TH 8 & Goodview Circle Dr ⁽¹⁾	A / A	9 sec.	A / A	5 sec.
TH 8 & Greenway Ave	C	30 sec.	B	20 sec.
TH 8 & Heath Ave N ⁽¹⁾	A / C	16 sec.	A / C	17 sec.
TH 8 & Pioneer Road	C	31 sec.	C	26 sec.
TH 8 & 270th St ⁽¹⁾	A / B	13 sec.	A / D	29 sec.
TH 8 & 273rd St ⁽¹⁾	A / A	5 sec.	A / B	11 sec.
TH 8 & CSAH 36 (E Viking Blvd/Johnson Ln)	B	12 sec.	C	22 sec.
TH 8 & Deer Garden Ln ⁽¹⁾	A / A	1 sec.	A / B	11 sec.
TH 8 & Karmel Ave/Wyoming Ave ⁽¹⁾	A / C	18 sec.	A / C	22 sec.

(1) Indicates an unsignalized intersection with side-street stop/yield control, where the overall LOS is shown followed by the worst approach LOS. The delay shown represents the worst side-street approach delay.

Results of the analysis indicate that the 95th percentile queues exceeded the length of the turn lanes at the following locations:

AM Peak Period

- TH 8/Greenway Avenue Intersection
 - Northbound Greenway Avenue – 375 feet
 - Westbound TH 8 – 600 feet
- TH 8/Pioneer Road Intersection
 - Northbound Pioneer Road – 425 feet
 - Westbound TH 8 – 450 feet

PM Peak Period

- TH 8/Greenway Avenue Intersection
 - Northbound Greenway Avenue – 325 feet
- TH 8/Pioneer Road Intersection
 - Northbound Pioneer Road – 350 feet
 - Westbound TH 8 – 500 feet

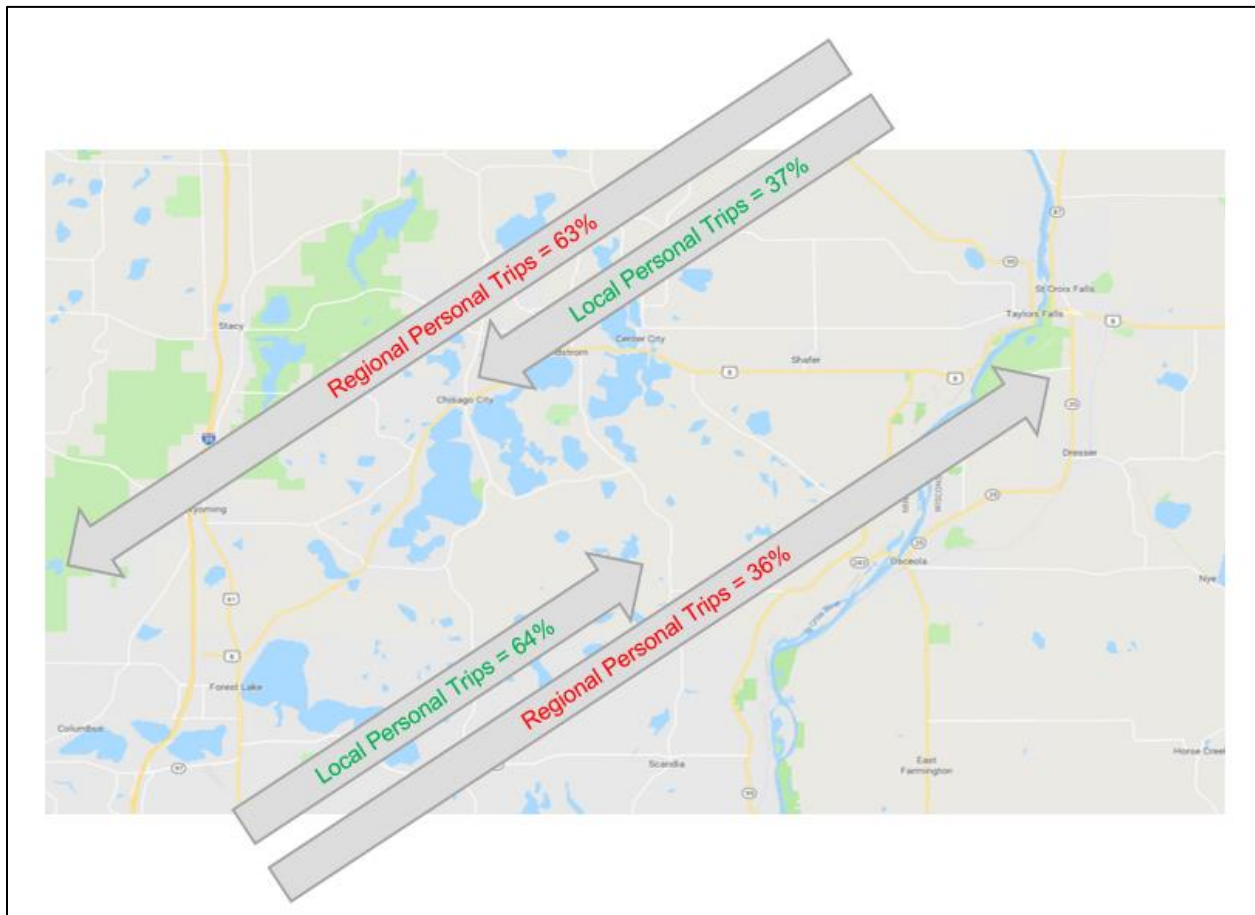
Complete results of the analysis which includes delay and queuing results by approach can be found in Appendix B.

Origin-Destination Analysis

An origin-destination analysis was completed using Streetlight data. The purpose of the analysis was to determine the proportion of trips on TH 8 that are local compared to regional. A local trip is defined as a trip that originates or is destined for a location within the project area, whereas a regional trip is a trip that passes through the project area.

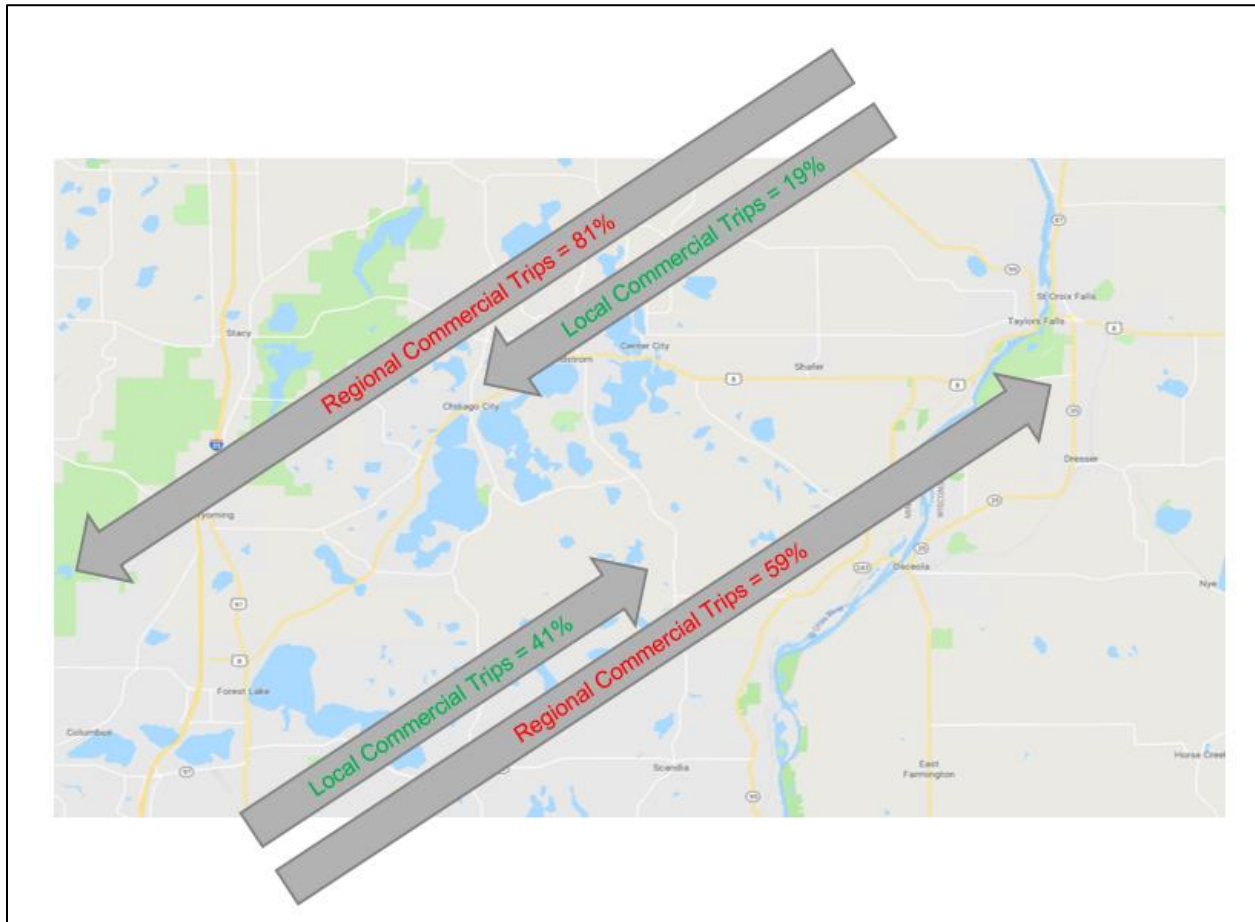
The origin-destination data used included average weekday data for all of 2018 and included both personal and commercial vehicles. The travel patterns for personal and commercial vehicles are illustrated in Figure 5 and Figure 6, respectively.

Figure 5. Origin-Destination Results – Personal Trips



Results of the analysis indicate that the majority (63 percent) of personal trips originating from east of the project area are regional and the majority (64 percent) of personal trips originating from west of the project area are local.

Figure 6. Origin-Destination Results – Commercial Trips

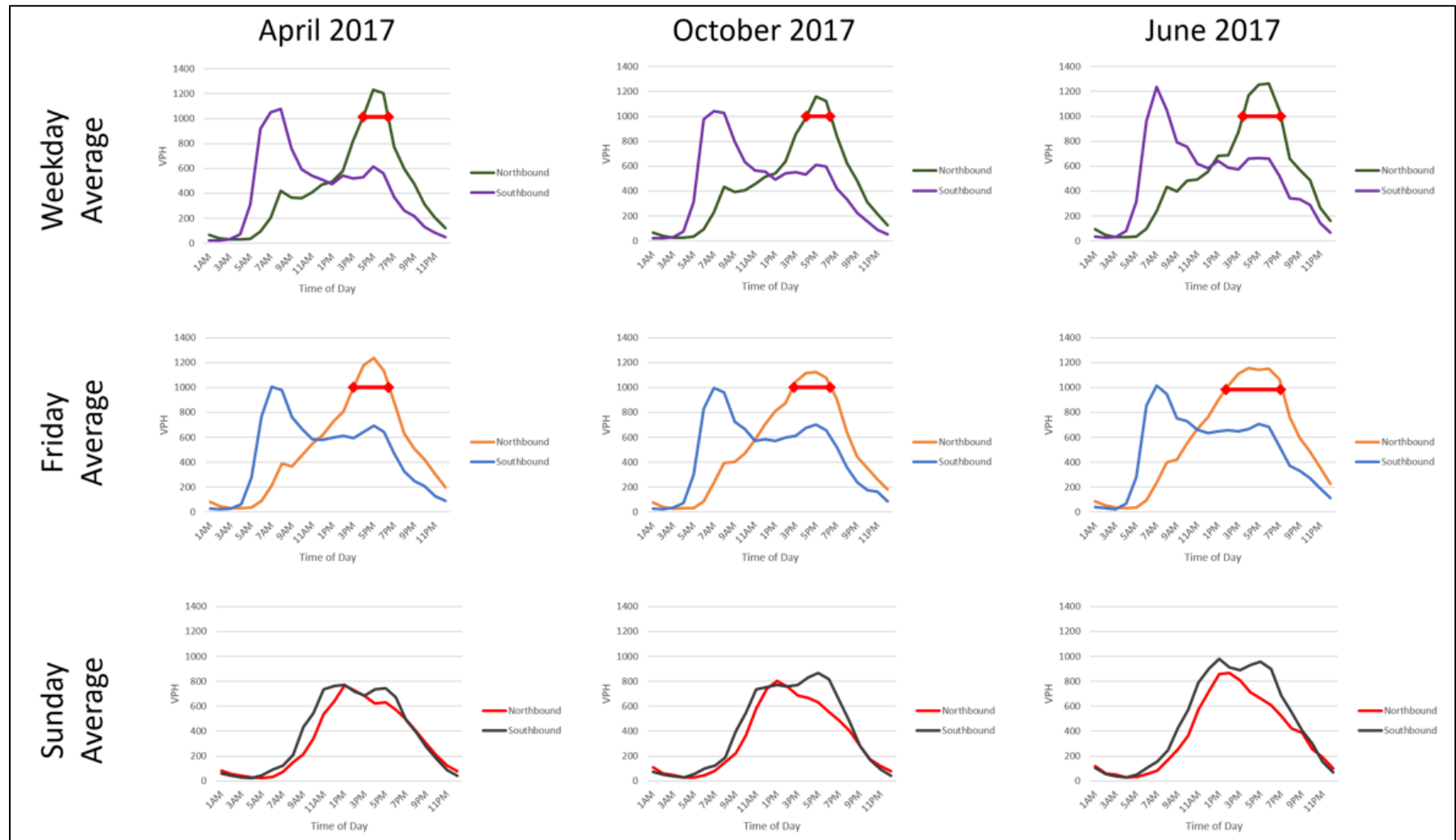


Results of the analysis indicate that the majority (81 percent) of commercial trips originating from east of the project area are regional and the majority (59 percent) of personal trips originating from west of the project area are regional.

Seasonal Traffic Data

Seasonal traffic data was reviewed to determine the variation in traffic volumes between a traditional a.m. and p.m. peak period and recreational peak periods on Fridays and Sundays. Hourly traffic volume data was obtained from MnDOT's ATR #388 located on TH 8 near US 61. Weekday averages for the months of April, October, and June of 2017 were compared to Friday and Sunday averages for the same months. The graphs shown in Figure 7 illustrate the seasonal variation in traffic volumes.

Figure 7. Seasonal Variation in Traffic Volumes



The review indicates that the eastbound direction peaks at approximately 1,200 vehicles per hour during the traditional weekday p.m. peak period and the westbound direction peaks at approximately 1,000-1,200 vehicles per hour during the a.m. peak period. The eastbound direction peaks at approximately 1,200 vehicles during Friday recreational peaks as well, but the duration of the peak is longer.

Access Evaluation

An existing access inventory and evaluation was completed. It provides the framework for developing a consistent access strategy along the corridor.

Access Guidelines

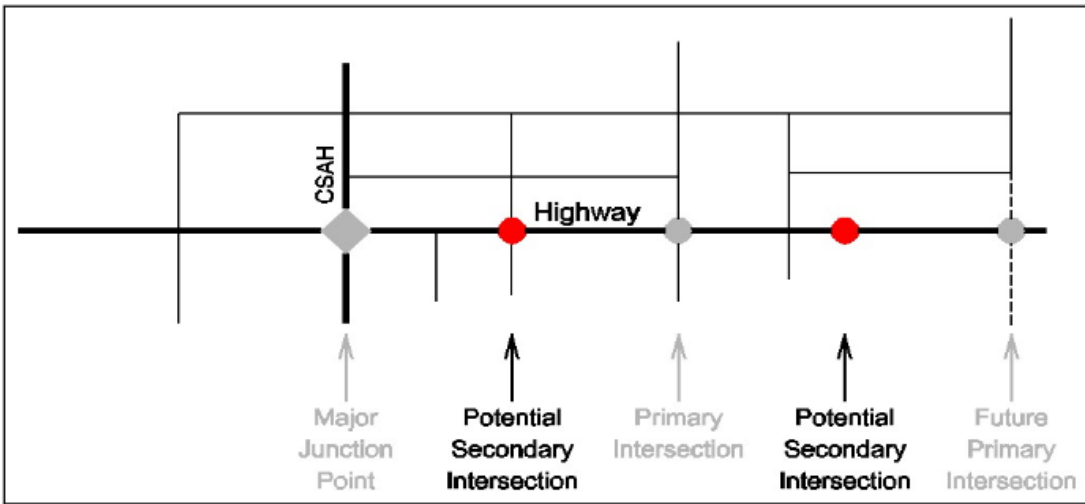
Proper access spacing along roadways promotes better traffic flow and results in lower potential for vehicle collisions. Research documented in NCHRP Report #420 found that on average, each access along a corridor increases crash potential by four percent and decreases corridor travel speeds by 0.25 miles per hour. Since operational and safety benefits are associated with proper access control, MnDOT has developed and published access spacing recommendations for routes on their system.

Within the project area, TH 8 is classified as a Principal Arterial. MnDOT has recommended the following street spacing:

- Category 4A – Rural Principal Arterial
 - 1 mile spacing between primary full-movement intersections
 - 1/2 mile spacing between secondary intersections
 - Private driveways are permitted if no reasonable alternative exists. On 55 mph roadways, driveways should be at least 100 feet apart.
- Category 4B – Urban/Urbanizing Principal Arterial
 - 1/2 mile spacing between primary full-movement intersections
 - 1/4 mile spacing between secondary intersections
 - 1/2 mile spacing between signals
 - Private driveways are permitted if no reasonable alternative exists, but MnDOT prefers the development of a supporting roadway network that is more conducive to private access.

Figure 8 illustrates the location of primary intersections along a corridor and the potential locations for secondary intersections, which are typically located half way between the primary intersections.

Figure 8. Access Spacing Concepts (Source: MnDOT)



Evaluation Results

The Deer Garden Lane to Karmel Avenue segment does not meet public access spacing guidelines. All other segments meet public access spacing guidelines. The I-35 to Greenway Avenue segment meets total (public and private) access spacing guidelines. All other segments do not meet total access spacing guidelines.

A summary of the access inventory and access spacing guidelines is shown in Table 7. A detailed inventory of accesses by type is provided in Appendix C in map format. The maps show access thresholds per MnDOT guidelines. Additional supporting data in tabular format for this access evaluation can also be found in Appendix C.

Table 7. Access Spacing Summary

Segment	MnDOT Access Category	Length (Mi)	Public Accesses	Public Accesses/Mile	MnDOT Preferred Accesses/Mile	Total Accesses	Total Accesses/Mile*
TH 8 – I-35 to Greenway Ave	4B	2.0	5	2.7	5 per mile	6	3.2
TH 8 – Greenway Ave to Pioneer Rd/Green Lake Tr	4A	2.4	7	2.9	3 per mile	27	11.0
TH 8 – Pioneer Rd/Green Lake Tr to Deer Garden Ln	4A	4.0	10	2.5	3 per mile	25	6.3
TH 8 – Deer Garden Ln to Karmel Ave	4B	0.2	2	10.3	5 per mile	2	10.3

* Includes private driveways

Year 2040 No-Build Conditions

Year 2040 Traffic Forecasts

Year 2040 forecasts were developed by considering historical traffic growth rates in the project area, travel demand trends observed in the Met Council regional activity-based model (ABM), and Chisago County's traffic projection factor (1.3 percent annual growth). In addition, forecasts were developed using a 1.0 percent and 2.5 percent growth rate to provide a low and high forecast estimate. Year 2040 forecasts at key locations are shown in Figure 9. The Chisago County traffic projection factor volumes were used to develop year 2040 turning movement counts due to the fact that the Met Council regional ABM is not as refined in the project area as it is in other locations throughout the Twin Cities area, but the average growth using the ABM is consistent with the Chisago County traffic projection factor. Year 2040 turning movement forecasts are shown in Figure 10.

Volume-to-Capacity Review

A review of the volume-to-capacity ratios was completed at key locations for the five forecast scenarios. Roadway segments with a volume-to-capacity ratio greater than or equal to 0.85 are considered approaching capacity and values greater than 1.00 are considered over capacity. No-build and build (4-lane roadway) volume-to-capacity ratios are shown in Table 8 and Table 9, respectively.

The calculated no-build volume-to-capacity ratios indicate that TH 8 will be approaching or over capacity under all five forecast scenarios. The calculated build volume-to-capacity ratios indicate that a 4-lane roadway will be able to accommodate the traffic volumes under all but the 2.5 percent growth rate forecast scenario.





Table 8. Year 2040 No-Build Volume-to-Capacity Ratios

Location	Facility Type	Capacity	Existing 2017 ADT	Forecasted 2040 ADT	Growth Rate	2017 Volume-to-Capacity	2040 Volume-to- Capacity
Metropolitan Council ABM							
TH 8 – West of TH 61 (Forest Lake)	4-lane divided	32,000	21,900	29,000	1.20%	0.68	0.91
TH 8 – East of TH 61 (Forest Lake)	2-lane undivided rural	15,000	20,600	26,500	1.10%	1.37	1.77
TH 8 – West of CSAH 36 (Chisago City)	2-lane undivided rural	15,000	14,500	20,500	1.50%	0.97	1.37
TH 8 – East of CSAH 36 (Chisago City)	2-lane undivided rural	15,000	17,700	23,500	1.20%	1.18	1.57
Linear Regression Method							
TH 8 – West of TH 61 (Forest Lake)	4-lane divided	32,000	21,900	23,000	0.20%	0.68	0.72
TH 8 – East of TH 61 (Forest Lake)	2-lane undivided rural	15,000	20,600	27,400	1.20%	1.37	1.83
TH 8 – West of CSAH 36 (Chisago City)	2-lane undivided rural	15,000	14,500	23,500	2.10%	0.97	1.57
TH 8 – East of CSAH 36 (Chisago City)	2-lane undivided rural	15,000	17,700	21,600	0.90%	1.18	1.44
1% Growth Rate Method							
TH 8 – West of TH 61 (Forest Lake)	4-lane divided	32,000	21,900	27,500	1.00%	0.68	0.86
TH 8 – East of TH 61 (Forest Lake)	2-lane undivided rural	15,000	20,600	26,000	1.00%	1.37	1.73
TH 8 – West of CSAH 36 (Chisago City)	2-lane undivided rural	15,000	14,500	18,100	1.00%	0.97	1.21
TH 8 – East of CSAH 36 (Chisago City)	2-lane undivided rural	15,000	17,700	22,300	1.00%	1.18	1.49
1.3% Growth Rate Method							
TH 8 – West of TH 61 (Forest Lake)	4-lane divided	32,000	21,900	29,500	1.30%	0.68	0.92
TH 8 – East of TH 61 (Forest Lake)	2-lane undivided rural	15,000	20,600	27,700	1.30%	1.37	1.85
TH 8 – West of CSAH 36 (Chisago City)	2-lane undivided rural	15,000	14,500	19,500	1.30%	0.97	1.30
TH 8 – East of CSAH 36 (Chisago City)	2-lane undivided rural	15,000	17,700	23,800	1.30%	1.18	1.59
2.5% Growth Rate Method							
TH 8 – West of TH 61 (Forest Lake)	4-lane divided	32,000	21,900	38,600	2.50%	0.68	1.21
TH 8 – East of TH 61 (Forest Lake)	2-lane undivided rural	15,000	20,600	36,400	2.50%	1.37	2.43
TH 8 – West of CSAH 36 (Chisago City)	2-lane undivided rural	15,000	14,500	25,600	2.50%	0.97	1.71
TH 8 – East of CSAH 36 (Chisago City)	2-lane undivided rural	15,000	17,700	31,200	2.50%	1.18	2.08

Table 9. Year 2040 Build Volume-to-Capacity Ratios

Location	Facility Type	Capacity	Existing 2017 ADT	Forecasted 2040 ADT	Growth Rate	2017 Volume-to-Capacity	2040 Volume-to- Capacity
Metropolitan Council ABM							
TH 8 – West of TH 61 (Forest Lake)	4-lane divided	32,000	21,900	29,000	1.20%	0.68	0.91
TH 8 – East of TH 61 (Forest Lake)	4-lane divided	32,000	20,600	26,500	1.10%	0.64	0.83
TH 8 – West of CSAH 36 (Chisago City)	4-lane divided	32,000	14,500	20,500	1.50%	0.45	0.64
TH 8 – East of CSAH 36 (Chisago City)	4-lane divided	32,000	17,700	23,500	1.20%	0.55	0.73
Linear Regression Method							
TH 8 – West of TH 61 (Forest Lake)	4-lane divided	32,000	21,900	23,000	0.20%	0.68	0.72
TH 8 – East of TH 61 (Forest Lake)	4-lane divided	32,000	20,600	27,400	1.20%	0.64	0.86
TH 8 – West of CSAH 36 (Chisago City)	4-lane divided	32,000	14,500	23,500	2.10%	0.45	0.73
TH 8 – East of CSAH 36 (Chisago City)	4-lane divided	32,000	17,700	21,600	0.90%	0.55	0.68
1% Growth Rate Method							
TH 8 – West of TH 61 (Forest Lake)	4-lane divided	32,000	21,900	27,500	1.00%	0.68	0.86
TH 8 – East of TH 61 (Forest Lake)	4-lane divided	32,000	20,600	26,000	1.00%	0.64	0.81
TH 8 – West of CSAH 36 (Chisago City)	4-lane divided	32,000	14,500	18,100	1.00%	0.45	0.57
TH 8 – East of CSAH 36 (Chisago City)	4-lane divided	32,000	17,700	22,300	1.00%	0.55	0.70
1.3% Growth Rate Method							
TH 8 – West of TH 61 (Forest Lake)	4-lane divided	32,000	21,900	29,500	1.30%	0.68	0.92
TH 8 – East of TH 61 (Forest Lake)	4-lane divided	32,000	20,600	27,700	1.30%	0.64	0.87
TH 8 – West of CSAH 36 (Chisago City)	4-lane divided	32,000	14,500	19,500	1.30%	0.45	0.61
TH 8 – East of CSAH 36 (Chisago City)	4-lane divided	32,000	17,700	23,800	1.30%	0.55	0.74
2.5% Growth Rate Method							
TH 8 – West of TH 61 (Forest Lake)	4-lane divided	32,000	21,900	38,600	2.50%	0.68	1.21
TH 8 – East of TH 61 (Forest Lake)	4-lane divided	32,000	20,600	36,400	2.50%	0.64	1.14
TH 8 – West of CSAH 36 (Chisago City)	4-lane divided	32,000	14,500	25,600	2.50%	0.45	0.80
TH 8 – East of CSAH 36 (Chisago City)	4-lane divided	32,000	17,700	31,200	2.50%	0.55	0.98

Year 2040 No-Build Traffic Operations Analysis

A year 2040 no-build traffic operations analysis was been completed for the weekday a.m. and p.m. peak period. The intersections were analyzed using Synchro/SimTraffic (Version 9.2) software. Signal timing was optimized. All other traffic control and geometry is consistent with existing conditions.

Results of the year 2040 no-build traffic operations analysis, shown in Table 10, indicate that the TH 8/Greenway Avenue and TH 8/Pioneer is expected to operate at an overall LOS E during and p.m. peak period with the existing traffic control and geometric layout. All other intersections are expected to operate at an overall LOS D or better during the a.m. and p.m. peak periods. However, some of the side-street stop controlled intersections would experience long delays on the side streets.

Table 10. Year 2040 No-Build Traffic Operations Analysis Results

Intersection	A.M. Peak Period		P.M. Peak Period	
	LOS	Delay	LOS	Delay
TH 8 & Goodview Circle Dr ⁽¹⁾	A / A	10 sec.	A / A	6 sec.
TH 8 & Greenway Ave	D	46 sec.	E	56 sec.
TH 8 & Heath Ave N ⁽¹⁾	A / D	33 sec.	A / E	37 sec.
TH 8 & Pioneer Rd	D	39 sec.	E	62 sec.
TH 8 & 270th St ⁽¹⁾	A / C	20 sec.	A / E	47 sec.
TH 8 & 273rd St ⁽¹⁾	A / A	7 sec.	A / D	33 sec.
TH 8 & CSAH 36 (E Viking Blvd/Johnson Ln)	C	21 sec.	C	32 sec.
TH 8 & Deer Garden Ln ⁽¹⁾	A / A	4 sec.	A / F	62 sec.
TH 8 & Karmel Ave/Wyoming Ave ⁽¹⁾	A / F	61 sec.	A / F	127 sec.

(1) Indicates an unsignalized intersection with side-street stop/yield control, where the overall LOS is shown followed by the worst approach LOS. The delay shown represents the worst side-street approach delay.

Results of the analysis indicate that the 95th percentile queues are expected to exceed the length of the turn lanes at the following locations:

AM Peak Period

- TH 8/Greenway Ave Intersection
 - Northbound Greenway Ave – 500 feet
 - Westbound TH 8 – 725 feet
- TH 8/Pioneer Rd Intersection
 - Northbound Pioneer Rd – 550 feet
 - Westbound TH 8 – 575feet

- TH 8/Viking Blvd Intersection
 - Westbound TH 8 – 425 feet

PM Peak Period

- TH 8/Greenway Ave Intersection
 - Northbound Greenway Ave – 525 feet
 - Eastbound TH 8 – 2,000 feet
 - Westbound TH 8 – 375 feet
- TH 8/Pioneer Rd Intersection
 - Northbound Pioneer Rd – 600 feet
 - Eastbound TH 8 – 1,350 feet
 - Westbound TH 8 – 375 feet
- TH 8/Viking Blvd
 - Eastbound TH 8 – 625 feet
 - Westbound TH 8 – 425 feet

Complete results of the analysis which, includes delay and queuing by approach and movement, can be found in Appendix D.

Summary and Conclusions

The following summary and conclusions are offered for your consideration:

1. Crash data were obtained from MnDOT for January 1, 2016 through December 31, 2018 and was supplemented using MnDOT's Minnesota Crash Mapping Analysis Tool (MnCMAT) for January 1, 2014 through December 31, 2015.
2. There were 117 reported crashes at the project intersections, of which one was a fatal crash and one was an A-severity crash. There were also 119 reported non-intersection crashes on the segments, with no fatal or A-severity crashes.
3. The TH 8/Greenway Ave and TH 8/Pioneer Road intersections experienced a crash rate greater than or equal to the critical crash rate, indicating a strong likelihood of a geometric design, access, or traffic control issue.
4. No segment experienced a crash rate greater than the critical crash rate.
5. A review of the manner of collision (i.e., crash diagram) indicates that the predominant types of crashes occurring at the intersections are rear-end (67 percent) and right-angle/left-turn (17 percent) crashes, while the predominant types of non-intersection crashes on the segments are rear-end (53 percent) and runoff road (18 percent) crashes.
6. Results of the existing traffic operations analysis indicate that all intersections operate at an acceptable overall LOS D or better during the a.m. and p.m. peak periods with the existing traffic control and geometric layout.

7. Results of the existing traffic operations analysis indicate that the 95th percentile queues exceeded the length of the turn lanes at the following locations:
 - a. AM Peak - TH 8/Greenway Avenue Intersection
 - i. Northbound Greenway Avenue – 375 feet
 - ii. Westbound TH 8 – 600 feet
 - b. AM Peak - TH 8/Pioneer Road Intersection
 - i. Northbound Pioneer Road – 425 feet
 - ii. Westbound TH 8 – 450 feet
 - c. PM Peak - TH 8/Greenway Avenue Intersection
 - i. Northbound Greenway Avenue – 325 feet
 - d. PM Peak - TH 8/Pioneer Road Intersection
 - i. Northbound Pioneer Road – 350 feet
 - ii. Westbound TH 8 – 500 feet
8. An origin-destination analysis was completed using Streetlight data. The purpose of the analysis was to determine the proportion of trips on TH 8 that are local compared to regional.
 - a. Results of the analysis indicate that the majority (63 percent) of personal trips originating from east of the project area are regional and the majority (64 percent) of personal trips originating from west of the project area are local.
 - b. Results of the analysis indicate that the majority (81 percent) of commercial trips originating from east of the project area are regional and the majority (59 percent) of personal trips originating from west of the project area are regional.
9. Seasonal traffic data was reviewed to determine the variation in traffic volumes between a traditional a.m. and p.m. peak period and recreational peak periods on Fridays and Sundays.
 - a. The review indicates that the eastbound direction peaks at approximately 1,200 vehicles per hour during the traditional weekday p.m. peak period and the westbound direction peaks at approximately 1,000-1,200 vehicles per hour during the a.m. peak period.
 - b. The eastbound direction peaks at approximately 1,200 vehicles during Friday recreational peaks as well, but the duration of the peak is longer.
10. An existing access inventory and evaluation was completed.
 - a. The Deer Garden Lane to Karmel Avenue segment does not meet public access spacing guidelines. All other segments meet public access spacing guidelines.
 - b. The I-35 to Greenway Avenue segment meets total (public and private) access spacing guidelines. All other segments do not meet total access spacing guidelines.
11. Year 2040 forecasts were developed by considering historical traffic growth rates in the project area, travel demand trends observed in the Met Council regional activity-based model (ABM), and Chisago County's traffic projection factor (1.3 percent annual growth). In addition, forecasts were developed using a 1.0 percent and 2.5 percent growth rate to provide a low and high forecast estimate.
12. The Chisago County traffic projection factor volumes were used to develop year 2040 turning movement counts due to the fact that the Met Council regional ABM is not as refined in the

project area as it is in other locations throughout the Twin Cities area, but the average growth using the ABM is consistent with the Chisago County traffic projection factor.

13. A review of the volume-to-capacity ratios was completed at key locations for the five forecast scenarios.
 - a. The calculated no-build volume-to-capacity ratios indicate that TH 8 will be approaching or over capacity under all five forecast scenarios.
 - b. The calculated build volume-to-capacity ratios indicate that a 4-lane roadway will be able to accommodate the traffic volumes under all but the 2.5 percent growth rate forecast scenario.
14. A year 2040 no-build traffic operations analysis was completed for the weekday a.m. and p.m. peak period. The intersections were analyzed using Synchro/SimTraffic (Version 9.2) software. Signal timing was optimized. All other traffic control and geometry is consistent with existing conditions.
15. Results of the year 2040 no-build traffic operations analysis indicate that the TH 8/Greenway Avenue and TH 8/Pioneer are expected to operate at an overall LOS E during and p.m. peak period with the existing traffic control and geometric layout.
16. Results of the year 2040 no-build traffic operations analysis indicate that the 95th percentile queues are expected to exceed the length of the turn lanes at the following locations:
 - a. AM Peak - TH 8/Greenway Ave Intersection
 - i. Northbound Greenway Ave – 500 feet
 - ii. Westbound TH 8 – 725 feet
 - b. AM Peak - TH 8/Pioneer Rd Intersection
 - i. Northbound Pioneer Rd – 550 feet
 - ii. Westbound TH 8 – 575feet
 - c. AM Peak - TH 8/Viking Blvd Intersection
 - i. Westbound TH 8 – 425 feet
 - d. PM Peak - TH 8/Greenway Ave Intersection
 - i. Northbound Greenway Ave – 525 feet
 - ii. Eastbound TH 8 – 2,000 feet
 - iii. Westbound TH 8 – 375 feet
 - e. PM Peak - TH 8/Pioneer Rd Intersection
 - i. Northbound Pioneer Rd – 600 feet
 - ii. Eastbound TH 8 – 1,350 feet
 - iii. Westbound TH 8 – 375 feet
 - f. PM Peak - TH 8/Viking Blvd
 - i. Eastbound TH 8 – 625 feet
 - ii. Westbound TH 8 – 425 feet