

Existing and 2045 No Build Conditions Report TH 210/Washington Street Corridor Study

Brainerd, Minnesota

S.P. No. 1805-80

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Existing and 2045 No Build Conditions Report

TH 210/Washington Street Corridor Study

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1 Background and Purpose

Trunk Highway 210 (TH 210), also called Washington Street, is a major travel corridor spanning west to east in Brainerd, MN. Highway 210 also serves as a major east-west arterial extending across north-central Minnesota.

MnDOT is conducting a corridor planning study along a 3.9 mile segment of TH 210 in order to identify the future vision for highway corridor through Brainerd. Reconstruction of TH 210 between Baxter Drive and Pine Shores Road is anticipated to begin in 2025.

The study corridor extends from Baxter Drive on the west to Pine Shores Road on the east and includes a wide mix of land uses including residential, commercial, industrial, and institutional uses along the corridor. The road has some of the highest traffic volumes in Crow Wing County and is the only continuous east-west corridor in the City; daily traffic volumes ranging from 11,800 up to 32,500 vehicles per day (vpd) in the study area.

There are currently limited provisions for pedestrians and bicyclists to travel along or cross-over the corridor.

The studies Project Management Team (PMT) includes MnDOT, Crow Wing County, and the City of Brainerd. TH 210 is a MnDOT facility that has connections from local city streets, as well as County State Aid Highway (CSAH) connections along the corridor.

The primary purpose of the corridor study is to better understand the community issues, needs and use of the roadway. The results of this study will inform plans for future roadway improvements. The focus of the future improvements is to improve pavement conditions and travel safety, accommodate ADA requirements, and enhance pedestrian and bicyclist accommodations. This report serves to document the existing conditions within the TH 210 corridor study area as well as identify potential problem areas both currently and through the design year 2045.

1.1 Overview

The primary purpose of this study is to identify potential roadway improvements along TH 210, including traffic control changes, capacity improvements, access modifications, and enhanced pedestrian/bicycle accommodations. The following 13 study intersections were of particular importance.

- TH 210 at Baxter Drive – Traffic Signal Control
- TH 210 at NW 4th Street (CSAH 20) – Traffic Signal Control
- TH 210 at N 1st Street/East River Road (MSAS 105) – Minor Street Stop Control
- TH 210 at N 4th Street (MSAS 114) – Traffic Signal Control
- TH 210 at N 6th Street (TH 371B) – Traffic Signal Control
- TH 210 at N 8th Street (MSAS 122) – Traffic Signal Control
- TH 210 at Gillis Avenue (MSAS 134)/13th Street SE (CSAH 45) – Traffic Signal Control
- TH 210 at 4th Avenue NE (MSAS 118) – Traffic Signal Control
- TH 210 at 5th Avenue NE (MSAS 141) – Minor Street Stop Control; ¾ Access
- TH 210 at TH 25 Ramp – Exit Ramp
- TH 210 at 8th Avenue NE (CSAH 3/TH 25) – Traffic Signal Control
- TH 210 at 10th Avenue NE (MSAS 115) – Minor Street Stop Control
- TH 210 at 13th Avenue NE (MSAS 120) – Minor Street Stop Control

This study will look at the existing corridor, crash history, parking along TH 210, origin-destination information, traffic volumes and traffic operations. **Figure 1** shows the segment of TH 210 that will be reconstructed as well as the study intersections.

1.2 Existing TH 210 Corridor

The study corridor is 3.9 miles in length between Baxter Drive on the west to Pine Shores Road on the east. Due to the changes in land use and geometry along the length of the corridor, it was decided that the study area would be divided into 6 basic segments as described below:

- **West Segment:** Baxter Drive to NW 2nd Street, this segment is a 4-lane divided roadway with a raised center concrete median and left turn lanes at all public streets. Right turn lanes are periodically provided including at the NW 3rd Street intersection (westbound only), NW 4th Street intersection, NW 8th Street intersection (westbound only), and Baxter Drive intersection. The west segment is characterized by commercial land uses, continuous sidewalks, and a number of intermediate private driveways. The posted speed limit is 45 mph west of Baxter Drive and 35 mph to the east.
- **River Segment:** NW 2nd Street to Chippewa Street; this segment is a 4-lane divided roadway over the Mississippi River bridge. The posted speed limit is 35 mph. Narrow, approximately 4' wide, raised sidewalks are present along both sides of the bridge.
- **Central Segment:** Chippewa Street to Kingwood Street, this segment is mostly a 5-lane undivided roadway with left turn lanes at all public streets. The central segment is characterized by commercial land uses, many private driveways, and on street parking (westbound direction only). The posted speed limit is 35 mph.

- **Railyard Segment:** Kingwood Street to TH 25, this segment is a 4-lane divided roadway with medians and left turn lanes at all public streets. This segment is characterized by commercial land uses on the north side and the BNSF railyard on the south side; there are also many private driveways, on street parking (westbound direction only), and sidewalk/trail along the north side of the highway corridor. The posted speed limit is 35 mph west of 5th Avenue and 45 mph to the east.
- **TH 25/8th Avenue NE Intersection Segment:** TH 25 to 10th Avenue, this segment is a 4-lane divided roadway with medians and left turn lanes. The TH 210 and TH 25/CSAH 3 intersection is signalized and experiences heavy levels of congestion, especially during peak periods and summer weekends. This segment is characterized as the transition zone between the urban area to the west and the rural areas to the east, commercial retail and office land uses surround the intersection area. An asphalt trail is located on the north side of the highway throughout this segment. The posted speed limit is 45 mph.
- **East Segment:** 10th Avenue to Pine Shores Road, this segment is a 4-lane divided roadway with raised concrete medians and left and right turn lanes at all public street. Intersections. The east segment is characterized by a mix of residential, spot commercial, and open space. The trail continues along the north side of the highway between 10th Avenue and 14th Avenue. The posted speed is 45 mph west of 14th Avenue and transitions to 50 mph east of 14th Avenue.

1.3 Recent Changes and Planned Improvements

As part of the study, a review of recent and planned changes to the corridor were reviewed.

Recently, MnDOT closed the westbound TH 25 approach to TH 210; this was a left turn only movement between 5th Avenue and 8th Avenue. All northbound/westbound TH 25 traffic must now use the 8th Avenue connection to TH 210; this change has put a significant burden on the intersection as the existing signal phasing limits the intersection capacity. The eastbound TH 210 connection to TH 25 still remains open.

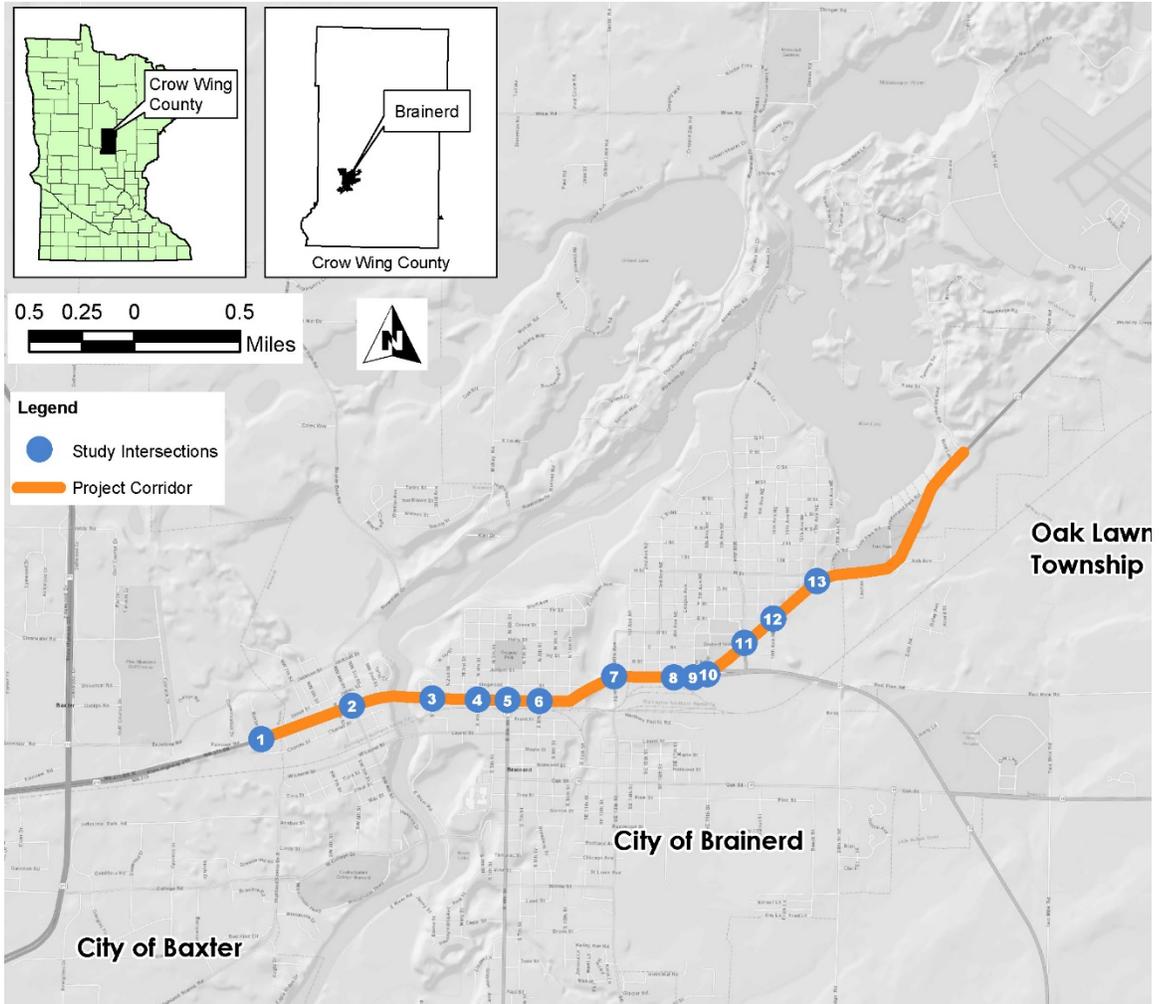
In 2019, MnDOT conducted a traffic signal timing study along both TH 371 and TH 210. Within the study area, the 5 westerly signals were included in the analysis; however during field implementation of the coordinated signals, the intersections of 13th Street/Gillis Avenue and 4th Avenue NE were included in the coordination. The signal timing project improved flow along TH 210, but due to the longer cycle lengths minor street approaches incurred more delay. The timing plan information from this recent change was incorporated into all existing conditions analysis in this study.

The rail crossing of TH 210 at NE 1st Avenue was removed in October 2019. The rail crossing had overhead flashers, but no gate system. The crossing had very limited use; however, buses and other vehicles required to stop at the crossing resulted in unnecessary congestion as well as creating a safety concern for distracted drivers behind the stopping vehicles.

The NW 4th Street intersection with TH 210 was studied in 2017 and includes a reconstruction project programmed for the 2020 construction season. The improvement project will add capacity on the north leg of the intersection and remove the existing split phase signal timing. Additional access restrictions and a roundabout will be constructed along NW 4th Street. This improvement project will be incorporated into all future year analysis for this study.

The Cuyuna Lakes State Trail is currently under planning phases to extend into Brainerd and connect to the Paul Bunyan State Trail. The current alignment is still under study at this time. The changes from this project are not expected to impact the traffic operations and safety of the TH 210 corridor.

Figure 1 – Project Location



2 Crash History

Crash data from January 1, 2014 through December 31, 2018 was provided by MnDOT. The type and severity of crashes were reviewed and crash rates were calculated for each study intersection. There were a total of 526 crashes over the 5 years analyzed along the 3.9 mile section of TH 210.

The crash rate at each intersection is expressed as a number of crashes per million entering vehicles (MEV). The critical crash rate is a statistical value that is unique to each intersection and is based on vehicular exposure and the statewide average crash rate for similar intersections. An intersection with a crash rate higher than the critical rate can indicate a safety concern at the intersection and the site should be further reviewed.

Crash severity is separated into five categories based on injuries sustained during the crash.

- Fatal – Crash that results in a death
- Severity A – Crash that results in an incapacitating injury or serious injury
- Severity B – Crash that results in a non-incapacitating injury or minor injury
- Severity C – Crash that results in possible injury
- Property Damage – Crash that results in property damage only; with no injuries

The following trends are evident from all crashes along TH 210 (all 526 crashes):

- Approximately 50% of all crashes along the corridor are rear end crashes at the 8 signalized intersections; approximately 91% of those are crashes along TH 210 and the remaining 9% occurred on the minor streets. These rear end crashes are likely due to congestion along the corridor.
- Of the rear end crashes on TH 210, half were eastbound and half were westbound, which indicates that there is congestion in both directions during different times of the day. If you look at different segments of TH 210, you can see patterns in the direction of rear ends. In the western segment (Baxter Drive to the Mississippi River Bridge) there were significantly more westbound rear end crashes. In the middle portion of the study area (Mississippi River Bridge to Kingwood Street) there were more eastbound rear end crashes than westbound rear end crashes. The eastern portion of the study area (Kingwood Street to eastern Brainerd City limits) there were almost an equal number of eastbound and westbound rear end crashes.
- Approximately 14% of all crashes along the corridor are right angle/left turn crashes, which could indicate that many vehicles are trying to use gaps in TH 210 traffic that are not long enough during times of congestion or are failing to yield.
- There were 10 crashes involving pedestrians or bicycles along the TH 210 study corridor
- While approximately 59% of crashes along TH 210 occur between noon and 6 PM, there seems to be a higher percentage of crashes during the PM peak (3 to 6 PM, 30%) than during other times of the day.
- Fridays and December were the most common day and month for crashes, however, neither the day of the week or the month of the year had any definitive patterns.
- Approximately 84% of crashes along TH 210 occurred under daylight conditions, therefore, lighting along the corridor does not seem to be a problem.

- 89% of crashes along the corridor occurred in either clear or cloudy conditions, therefore, poor weather road conditions did not contribute significantly to the crash totals.
- Approximately 85% of all crashes along the corridor occurred at an intersection and approximately 15% crashes were non-intersection, segment crashes; this includes segments, driveways and other access locations.

While the following sections discuss the crashes in more detail, **Appendix A** provides more detailed crash tables, crash figures for the corridor, and select intersection crash diagrams.

2.1 Segment Crashes

Segment crashes were reviewed in two separate evaluations. The first evaluation included looking at segment crashes between all of the major, signalized intersections, and the second evaluation included looking at all segment crashes that occurred between all intersections regardless of control.

Between the signalized intersections, there are a total of 9 segments that had a total of 177 crashes; this evaluation does include all unsignalized intersection crashes. Based on this high level analysis, all of the segments have crash rates that are not only below the MnDOT average rates, but well below the critical crash rates indicating there is not a segment crash problem. Based on this analysis no segments have an existing crash issue.

When the segments were evaluated between all intersections, regardless of control type, there are a total of 34 segments that had 82 non-intersection related crashes. Based on this analysis, the majority of segments have a low number of crashes that results in low crash rates below the critical crash rate. However, there is one segment above the critical rate and one segment within 10% of the critical rate:

- Between Chippewa Street and N 1st Street/East River Road: there were 8 non-intersection crashes that occurred on this short segment; the crash rate is 2.09, which is higher than the critical rate of 1.17. With 6 private accesses on this block, 4 of the 8 crashes were related to vehicles entering or exiting the driveways. The remaining 4 crashes were related to lane changes or vehicle malfunction.
- Between N 10th Street and Kingwood Street: there were 7 non-intersection crashes that occurred on this short segment; the crash rate is 1.58, which is just under the critical rate of 1.70. While there are four private accesses on this segment, none of the crashes were related to access. The crashes involved icy conditions (2), vehicles losing control (2), vehicle malfunctions (1), vehicle speeds (1), and driving intoxication (1).

2.2 Intersection Crashes

Table 1 shows the frequency and severity of crashes for the study area intersections, as well as any intersection that had 10 or more crashes during the 5 year analysis period (highlighted in orange). In total, there were 444 intersection crashes with 369 crashes at the 13 study intersections.

Based on the observed crash rates in comparison to the calculated critical rates, only the intersection of TH 210 at N 6th Street has a crash rate above the calculated critical rate (see **Table 1**); this is an indication of a potential safety concern at that intersection.

In addition, there are six intersections with crash rates that are approaching (within 15%) the critical rate. The following TH 210 intersections have a critical index (crash rate divided by critical crash rate) over 0.85 and should continue to be monitored for safety concerns: NW 4th Street, N 4th Street, Gillis Avenue/13th Street SE, 1st Avenue NE, TH 25 Entrance Ramp (Removed in 2018), and 8th Avenue NE.

Table 1 – Intersection Crash History (2014-2018)

TH 210 at:	Crash Severity					Crash Rates	
	Fatal & Severity A	Severity B	Severity C	Property Damage	Total	Int. Rate	Critical Rate
Baxter Dr	0	0	6	27	33	0.69	1.02
NW 4 th St	0	2	9	63	74	0.94	0.95
N 1 st St/East River Rd	0	0	1	4	5	0.09	0.34
N 4 th St	0	1	9	39	49	0.87	0.99
N 6 th St	0	1	10	50	61	1.06	0.99
N 8 th St	0	3	4	24	31	0.61	1.01
Gillis Ave/13 th St SE	0	2	11	38	51	0.99	1.01
1 st Ave NE	0	2	2	10	14	0.30	0.36
4 th Ave NE	0	1	1	20	22	0.47	1.02
5 th Ave NE	0	0	2	5	7	0.15	0.32
TH 25 Exit Ramp	0	0	0	2	2	0.06	0.34
TH 25 Entrance Ramp	1	1	2	8	12	0.36	0.39
8 th Ave NE	0	0	8	20	28	0.74	0.75
10 th Ave NE	1	0	0	3	4	0.17	0.54
13 th Ave NE	0	0	0	2	2	0.09	0.55
TOTAL	2	13	65	315	395	n/a	n/a

Above Critical Rate

Within 15% of Critical Rate

The following trends are evident for each of the main study intersections along TH 210:

- TH 210 at Baxter Drive (Traffic Signal)
 - 29 of the 33 crashes were rear end crashes, likely the result of backups at the intersection, 15 of the rear end crashes were in the westbound direction and 10 were in the eastbound direction, 2 in the northbound direction and 2 southbound. This could indicate that backups are worse for westbound vehicles.
 - 3 of the 33 crashes were sideswipe crashes, likely due to vehicles changing lanes to avoid vehicles that are slowing or stopping during congestion.
- TH 210 at NW 4th Street (Traffic Signal)
 - 53 of the 74 crashes were rear end crashes, likely the result of backups at the intersection. 35 of the rear end crashes were in the westbound direction, 11 were in the eastbound direction, 5 were in the northbound direction, and 2 were southbound, which could indicate that backups are worse for westbound vehicles.

- 14 of the 74 crashes were sideswipe crashes, likely due to vehicles changing lanes to avoid vehicles that are slowing or stopping during congestion.
- TH 210 at N 1st Street/East River Road (Minor Street Stop)
 - With only 5 crashes over the 5 year analysis period, no crash patterns could be identified at this intersection.
- TH 210 at N 4th Street (Traffic Signal)
 - 41 of the 49 crashes were rear end crashes, likely the result of backups at the intersection. 25 of the rear ends were in the eastbound direction, 15 were in the westbound direction, and 1 crash occurred southbound, which could indicate that backups are worse for eastbound vehicles.
- TH 210 at N 6th Street (Traffic Signal)
 - The intersection of TH 210 at N 6th Street has a crash rate above the critical rate with 61 crashes over the 5 year analysis period, indicating a sustained crash problem.
 - 40 of the 61 crashes were rear end crashes, likely the result of backups at the intersection. 20 of the rear ends were in the eastbound direction, 17 were in the westbound direction, and 3 northbound, indicating backups are fairly similar between the eastbound and westbound direction.
 - 12 of the 61 crashes were sideswipe crashes, likely due to vehicles changing lanes to avoid vehicles that are slowing or stopping during congestion.
- TH 210 at N 8th Street (Traffic Signal)
 - 24 of the 31 crashes were rear end crashes, likely the result of backups at the intersection. 16 of the rear ends were in the eastbound direction, 7 were in the westbound direction, and 1 crash was northbound at the intersection., This could indicate that backups are worse for eastbound vehicles.
 - There was one pedestrian crash and one bicycle crash at this intersection.
- TH 210 at Gillis Avenue/13th Street SE (Traffic Signal)
 - 41 of the 51 crashes were rear end crashes, likely the result of backups at the intersection. 24 of the rear ends were in the eastbound direction, 16 were in the westbound direction, and 1 crash was northbound, which could indicate that backups are worse for eastbound vehicles.
- TH 210 at 1st Ave NE (Minor Street Stop)
 - 9 of the 14 crashes were rear end crashes (8 eastbound, 6 westbound, 1 southbound), many of which involved vehicles rear ending buses stopped in traffic at the railroad crossing at the intersection.
 - The railroad crossing at this intersection was removed in October 2019, therefore, the previous safety concern at the intersection has been removed.
 - There was one bicycle crash at this intersection.
- TH 210 at 4th Ave NE (Traffic Signal)
 - 15 of the 22 crashes at this intersection were rear end crashes, likely the result of backups at the intersection, 8 of the rear ends were in the eastbound direction, 6 were in the westbound direction, and 1 crash occurred in the southbound direction, which indicates backups may be fairly similar between the eastbound and westbound direction.
 - There was one bicycle crash at this intersection

- TH 210 at 5th Ave NE (Minor Street Stop)
 - 4 of the 7 crashes at this intersection were right angle/left turn crashes, a majority of which are the result of eastbound left turning vehicles failing to yield to westbound vehicles.
- TH 210 at TH 25 Exit Ramp (Exit Ramp)
 - With only 2 crashes over the 5 year analysis period no crash patterns could be identified at this intersection.
- TH 210 at TH 25 Entrance Ramp (Minor Street Stop) – Removed in 2018
 - 7 of the 12 crashes were right angle crashes, a majority of which involved vehicles taking a left off of TH 25 failing to yield to TH 210 traffic.
 - The TH 25 approach to TH 210 was closed in 2017 and westbound TH 25 traffic is now routed through the 8th Avenue NE intersection (approximately 850 feet east), therefore, any safety concerns for this intersection have been removed.
- TH 210 at 8th Ave NE (Traffic Signal)
 - 22 of the 28 crashes at this intersection were rear end crashes, likely the result of backups at the intersection. 10 of the rear ends were in the westbound direction, 7 were in the eastbound direction, 1 northbound and 4 southbound. The crash data indicates that backups are fairly similar between the eastbound and westbound direction.
- TH 210 at 10th Ave NE (Minor Street Stop)
 - All 4 crashes at this intersection were right angle crashes (one of which resulted in a severity A injury), a majority of which were the result of northbound or southbound vehicles turning onto or crossing TH 210 failing to yield to TH 210 vehicles.
- TH 210 at 13th Ave NE (Minor Street Stop)
 - With only 2 crashes over the 5 year analysis period no crash patterns could be identified at this intersection.

2.3 Fatal and Serious Injury Crashes

A total of 1 fatal crash and 3 severity A crashes occurred during the 5 year analysis period. Below are the locations and a brief description of each fatal or severity A crash.

- TH 210 at NW 3rd Street
 - A westbound left turning vehicle failed to yield to an eastbound motorcycle (fatal crash).
- TH 210 at Chippewa Street
 - An eastbound motorcycle rear ended an eastbound right turning vehicle attempting to access the Dairy Queen (severity A crash).
- TH 210 at TH 25 Entrance Ramp
 - A northbound left turning vehicle failed to yield to an eastbound vehicle (severity A crash).
- TH 210 at 10th Avenue NE
 - A northbound through vehicle failed to yield to an eastbound vehicle (severity A crash).

2.4 Pedestrian and Bicycle Crashes

There were a total of 2 pedestrian and 8 bicycle crashes during the 5 year analysis period. Below are the locations and a brief description of each pedestrian or bicycle crash.

2.4.1 Intersection Pedestrian and Bicycle Crashes

6 of the 10 pedestrian and bicycle crashes occurred at intersections along TH 210.

- TH 210 a N 8th Street
 - A southbound pedestrian failed to yield to a westbound vehicle (severity B crash).
 - Southbound bike failed to yield to a westbound vehicle (severity C crash).
- TH 210 at 1st Avenue NE
 - A southbound right turning vehicle looking for a gap in traffic did not see a bicycle on the north leg of the intersection (severity B crash).
- TH 210 at 2nd Avenue NE
 - A southbound right turning vehicle looking for a gap in traffic did not see a bicycle on the north leg of the intersection (severity B crash).
- TH 210 at 3rd Avenue NE
 - A southbound right turning vehicle looking for a gap in traffic did not see a bicycle on the north leg of the intersection (severity B crash).
- TH 210 at 4th Avenue NE
 - Southbound right turning vehicle looking for a gap in traffic did not see a bicycle on the north leg of the intersection (severity C crash).

2.4.2 Segment Pedestrian and Bicycle Crashes

4 of the 10 pedestrian and bicycle crashes occurred along segments of TH 210.

- TH 210 between NW 5th Street and NW 4th Street
 - A southbound right turning vehicle looking for a gap in traffic to exit a business access did not see a bicyclist riding along the sidewalk on the north side of TH 210 (severity C crash)
- TH 210 between NW 4th Street and NW 3rd Street
 - A southbound right turning vehicle looking for a gap in traffic to exit a business access did not see a bicyclist riding along the sidewalk on the north side of TH 210 (property damage only)
- TH 210 between Chippewa Street and N 1st Street
 - A skate boarder on the north side of TH 210 lost control and entered the roadway and was struck by a passing vehicle (severity B crash)
- TH 210 between N 9th Street and N 10th Street
 - A southbound right turning vehicle looking for a gap in traffic to exit a business access did not see a bicyclist riding along the sidewalk on the north side of TH 210 (severity C crash)

2.5 10-year Crash Comparison

Ten year crash data (January 1, 2009 – December 31, 2018) along the study corridor was also reviewed. As many factors change over time, this range of data is for comparison purposes only.

Over the 10-year period, there was a total of 1,100 crashes along the 3.9 mile section of TH 210; 952 crashes occurred at intersections and 148 segment crashes were reported. Between 2009 and 2013 there was a total of 574 crashes compared to the 526 crashes that occurred in the most recent 5-years between 2014 and 2018.

Table 2 represents a comparison of the main study intersections between the total 10-years of crash data to the most recent 5-years. The right most columns show the average crashes per year in the first 5-year (2009-2013) period compared to the most recent 5-year (2014-2018) period. The results show that crashes have been reduced in recent years. This is also evident in the reduced intersection crashes that are above the critical rates in the 10-year analysis, but only approaching the critical crash rate in the most recent 5-year data.

This trend can be related to many factors, including safety improvement projects and safer vehicles. A trend in the reduction of rear-end collisions at the signalized intersection could be due to the continued reoccurrence of congestion along the corridor that alters driver expectations that they will see congestion.

Table 2 – Crash History Comparison (10-year vs 5-year)

TH 210 at:	2009-2018 Crashes (10-Yr)			2014-2018 Crashes (5-Yr)			Average Crashes Per Year	
	Total Crash	Crash Rates		Total Crash	Crash Rates		2009-2013	2014-2018
		Int. Rate	Critical Rate		Int. Rate	Critical Rate		
Baxter Dr	60	0.59	0.93	33	0.69	1.02	5.4	6.6
NW 4 th St	154	0.91	0.88	74	0.94	0.95	16.0	14.8
NW 3 rd St*	29	0.22	0.24	8	0.13	0.30	4.2	1.6
N 1 st St/East River Rd	12	0.10	0.30	5	0.09	0.34	1.4	1.0
N 4 th St	121	1.01	0.91	49	0.87	0.99	14.4	9.8
N 6 th St	139	1.13	0.91	61	1.06	0.99	15.6	12.2
N 8 th St	72	0.66	0.92	31	0.61	1.01	8.2	6.2
Gillis Ave/13 th St SE	97	0.88	0.92	51	0.99	1.01	9.2	10.2
1 st Ave NE	28	0.28	0.31	14	0.30	0.36	2.8	2.8
4 th Ave NE	40	0.40	0.93	22	0.47	1.02	3.6	4.4
5 th Ave NE	19	0.19	0.25	7	0.15	0.32	2.4	1.4
TH 25 Exit Ramp	2	0.03	0.27	2	0.06	0.34	0.0	0.4
TH 25 Entrance Ramp	21	0.30	0.33	12	0.36	0.39	1.8	2.4
8 th Ave NE	54	0.67	0.66	28	0.74	0.75	5.2	5.6
10 th Ave NE	11	0.22	0.46	4	0.17	0.54	1.4	0.8
13 th Ave NE	5	0.11	0.47	2	0.09	0.55	0.6	0.4
TOTAL	864	n/a	n/a	403	n/a	n/a	92.2	80.6

*NW 3rd Street is in addition to Table 1 intersections.

Above Critical Rate
Within 15% of Critical Rate

3 Access Inventory

As part of the existing conditions analysis, all access along the TH 210 corridor was inventoried throughout the 3.9 mile study area.

TH 210 is classified as a Principal Arterial through the City of Brainerd. MnDOT's Access Management Manual provides guidance on access for this type of facility, which is considered a Medium Priority Interregional Corridor within an Urban or Urbanizing Core (Category 2C/2B). From the access manual:

- *State highways and major arterials extending through urban communities serve two groups of customers with somewhat competing needs: the through-trip drivers, who desire to travel through the community without undue speed reductions and signal delays, and the local-trip drivers, who need to cross or travel on a segment of the highway to get to home, work, and services within the community*
- *Within urban/urbanizing areas, MnDOT strongly encourages the development of a complete supporting local road network to serve as an alternative to direct driveway access to the trunk highway system. Urban/urbanizing areas offer the greatest opportunity to improve mobility and safety through access management.*

Along the entire TH 210 study corridor, there are a total of 116 access locations. **Appendix B** provides a series of figures that represent each access and access type along the study corridor. Below is a summary of the access types:

- Full access, traffic signal control: 8 intersections.
- Full access, minor street stop control: 19 intersections.
- $\frac{3}{4}$ access, minor street stop control: 7 intersections.
- Right-In/Right-Out (RI/RO) control: 6 intersections.
- Private Driveways: 75 access driveways.

Based on the classification for TH 210, the recommended access spacing is limited with full access traffic signal spacing at 1/4 mile spacing and public street access at 300 to 660 feet depending on block lengths.

While most of the traffic signal spacing meets the 1/4 mile criteria, the three signals in the Central segment at N 4th Street, N 6th Street, and N 8th Street are spaced approximately 1/8 mile apart. The West Segment has 3/4 access at the public street intersections; however the remaining segments have full access at most public streets.

Driveway access locations are prevalent along the TH 210 study corridor, with some blocks having more than 5 private access locations within a few hundred feet. MnDOT's policy generally prefers to have private access via the local street system, when available, as this is most conducive to safety and mobility; however, property access via the local street system must provide reasonably convenient and suitable access. Further review of the existing driveway locations should be conducted to better understand if modifications (removal or consolidation) may be beneficial to the highway corridor.

4 Parking Study

A parking study was completed along the TH 210 corridor, which included one block north and south of TH 210 from Chippewa Street and 5th Avenue NE. The TH 210 segments west of Chippewa Street and east of 5th Avenue NE are unlikely to have vehicles parked on the roadway and all of the existing businesses appear to have adequate parking without needing on street parking.

West of Chippewa Street, shoulders are provided along most of the corridor and there are no parking restrictions; however all of the existing businesses have adequate off street parking and no vehicles have been observed parked along TH 210 in this area.

East of 5th Avenue NE, TH 210 has a speed increase from 35 mph to 45 mph and as you go further east the roadway transitions to a rural section. As a result, there is unlikely to be consistent parking demand along TH 210 east of 5th Avenue NE.

Figures C1 through C3 summarizing the parking study results can be found in **Appendix C**.

4.1.1 TH 210 Parking

Available on-street parking spaces for each block along TH 210 were inventoried and parking occupancy counts were collected at 4 different times:

- **Thursday November 21, 2019**
 - AM peak period – 7 to 9 AM
 - Mid-day peak period – 11 AM to 1 PM
 - PM peak period – 4 to 6 PM
- **Saturday November 23, 2019**
 - Weekend peak period – 11 AM to 1 PM

Marked, on street parking along TH 210 is limited to only the westbound direction in two of the existing study segments. In the Central Segment, parking is marked between N 1st Street and N 9th Street, in the Railyard Segment, parking is marked between Gillis Avenue and 5th Avenue NE.

Overall, parking along TH 210 was very light, with a maximum of 10 vehicles parked along TH 210 during the weekday mid-day peak period. There were never more than 3 parked vehicles counted on a single block during any of the times counted and parking occupancy on any block was never more than 50%.

The following blocks were seen to have more regular parking demand across the times where occupancy data was collected; all vehicles were parked along westbound TH 210:

- Between N 5th Street and N 6th Street
- Between N 7th Street and N 8th Street
- Between N 8th Street and N 9th Street
- Between 1st Avenue NE and 2nd Avenue NE

4.1.2 Side Street Parking

Available on-street parking spaces one block in the north or south direction along TH 210 were inventoried and parking occupancy counts were collected at the same time as the TH 210 on-street parking counts.

Parking demands on the side streets seem to be higher than those on TH 210 due to the residential land uses along many of the blocks.

Even with the higher parking demands on side streets, no side street blocks ever had less than 3 available parking spaces during any of the time periods counted. That means that the side street blocks could accommodate all of the counted parking demands along TH 210.

4.1.3 Off-street parking

Along with the on-street parking occupancy study, a review of available off-street parking was completed to determine where there are gaps in adequate off street parking for businesses along TH 210.

For the most part, many of the businesses along TH 210 appear to have adequate off-street parking and, therefore, do not need to rely on on-street parking. However, there are some parcels along TH 210 that have limited or no off-street parking for customers and would rely on on-street parking for their customers.

The blocks along TH 210 with parcels that have limited or no off-street parking are shown on the figures in **Appendix C** and are listed below:

- N 5th Street to N 6th Street
- N 6th Street to N 7th Street
- N 8th Street to N 9th Street
- 1st Avenue NE to 2nd Avenue NE

5 Existing Traffic Volumes

Existing traffic volumes throughout the TH 210 study corridor were collected from different sources including previous projects and studies, as well as new field information.

MnDOT, Crow Wing County, and the City of Brainerd collect annual average daily traffic (AADT) volumes on various roadway segments. MnDOT has typically collected AADT volumes on a 2-year cycle, while the City and County typically collect the data every 4-years.

Intersection turning movement counts were also collected throughout the study area; these counts include all of the entering traffic as well as pedestrian and bicycle information. Some of the intersection count information was collected from previous studies and some was collected specifically for this study.

5.1.1 Daily Traffic Volumes

MnDOT's Traffic Mapping Application (<https://www.dot.state.mn.us/traffic/data/tma.html>) was utilized to collect both the most recent and historical AADT information for the study area; MnDOT coordinated with all Cities and Counties to keep their roadway information current.

The most current "official" AADT's in the study area is from 2017 along the MnDOT roadways; however, there are "draft" AADTs for roadways counted in 2019 in the study area. The City and County roadways most current "draft" data is also from 2019. The "draft" 2019 numbers are anticipated to become official in early 2020.

Along TH 210, the current daily traffic volumes range from 11,800 vehicles per day (vpd) on the eastern limits to 32,500 vpd at the Mississippi River Bridge. Many of the minor streets connecting to TH 210 have relatively low daily volumes of less than 5,000 vpd; however there are some roadways with higher volumes.

- NW 4th Street has 12,100 vpd to the north and 9,100 vpd to the south.
- N 6th Street (Business 371) has 11,000 vpd south of TH 210.
- 13th Avenue has 6,900 vpd south of TH 210.
- 8th Avenue (CSAH 3) has 8,400 vpd to the north and 4,950 to the south.

Heavy Commercial AADT (HCAADT) information is available along TH 210 through the study area, daily truck traffic volumes range from 740 vehicles per day (vpd) on the eastern limits, up to 1,250 vpd through the railyard segment, and 880 vpd on the western limits. The HCAADT typically ranges between 4% and 6% of the total traffic volume.

The most current AADT for roadways in the study area are shown in **Table 3**. Mainline TH 210 volumes within the study area range from 11,800 to 32,500. A table of the historical AADT volumes from 2000 through 2019 can be found in **Appendix D**.

Table 3 – 2019 Existing AADTs

Roadway	Description	Year	AADT
TH 210	TH 371 to NW 9 th St	2019	24,100
	NW 9 th St to N 1 st St	2019	32,500
	N 1 st St to N 4 th St	2019	29,500
	N 4 th St to N 6 th St	2019	26,000
	N 6 th St to N 8 th St	2019	26,000
	N 8 th St to 13 th St SE	2019	23,300
	13 th St SE to 4 th Ave NE	2019	25,500
	4 th Ave NE to TH 25 Exit Ramp	2019	23,600
	TH 25 Exit Ramp to 8 th Ave NE	2019	17,100
	8 th Ave NE to Pine Shores Rd	2019	11,800
NW 7 th St	North of TH 210	2019	1,100
NW 4 th St	North of TH 210	2019	12,100
	South of TH 210	2019	9,100
N 1 st St	North of TH 210	2019	350
	South of TH 210	2019	1,700
N 4 th St	North of TH 210	2019	2,400
	South of TH 210	2019	4,200
N 6 th St (TH 371B)	South of TH 210	2019	11,000
N 8 th St	North of TH 210	2019	2,050
	South of TH 210	2019	4,700
Kingwood St	North of TH 210	2019	700
Gillis Ave	North of TH 210	2019	560
13 th St SE	South of TH 210	2019	6,900
4 th Ave NE	North of TH 210	2019	1,200
5 th Ave NE	North of TH 210	2019	4,300
8 th Ave NE	North of TH 210	2019	8,400
	South of TH 210	2019	4,950
10 th Ave NE	South of TH 210	2019	1,400
13 th Ave NE	North of TH 210	2019	910

5.1.2 Intersection Volumes

Traffic volumes at the study intersections along TH 210 were collected from previous studies as well as new count information for this study.

Intersection turning movement counts at five of the study intersections were collected in August 2018 as part of a signal timing project along TH 210 and TH 371. Data was collected on a typical weekday, a Friday, a Saturday, a Sunday, and during a National Hot Rod Association (NHRA) event at the nearby Brainerd International Raceway. The following intersections were counted as part of the signal timing study:

- TH 210 at Baxter Drive
- TH 210 at NW 4th Street
- TH 210 at N 4th Street
- TH 210 at N 6th Street
 - Due to construction along N 6th Street, this intersection was only counted on a weekday in November 2018.
- TH 210 at N 8th Street

Additional counts were completed in October and November 2019 at the remaining 8 study intersection by MnDOT. Data for these intersections was collected on a weekday from 6 AM to 7 PM. The following intersections were counted in 2019:

- TH 210 at N 1st Street/East River Road
- TH 210 at Gillis Avenue/13th Street SE
- TH 210 at 4th Avenue NE
- TH 210 at 5th Avenue NE
- TH 210 at TH 25 Ramp
 - This intersection was a 48-hour roadway count on the ramp connection only.
- TH 210 at 8th Avenue NE
- TH 210 at 10th Avenue NE
- TH 210 at 13th Avenue NE

Passenger vehicle, heavy vehicle, pedestrian, and bicycle data was counted at the majority of study intersections; however, the 2019 counts did not contain separated heavy vehicle information. During the peak hours, the heavy vehicle percentages range from approximately 1% up to 8% of the TH 210 through volumes.

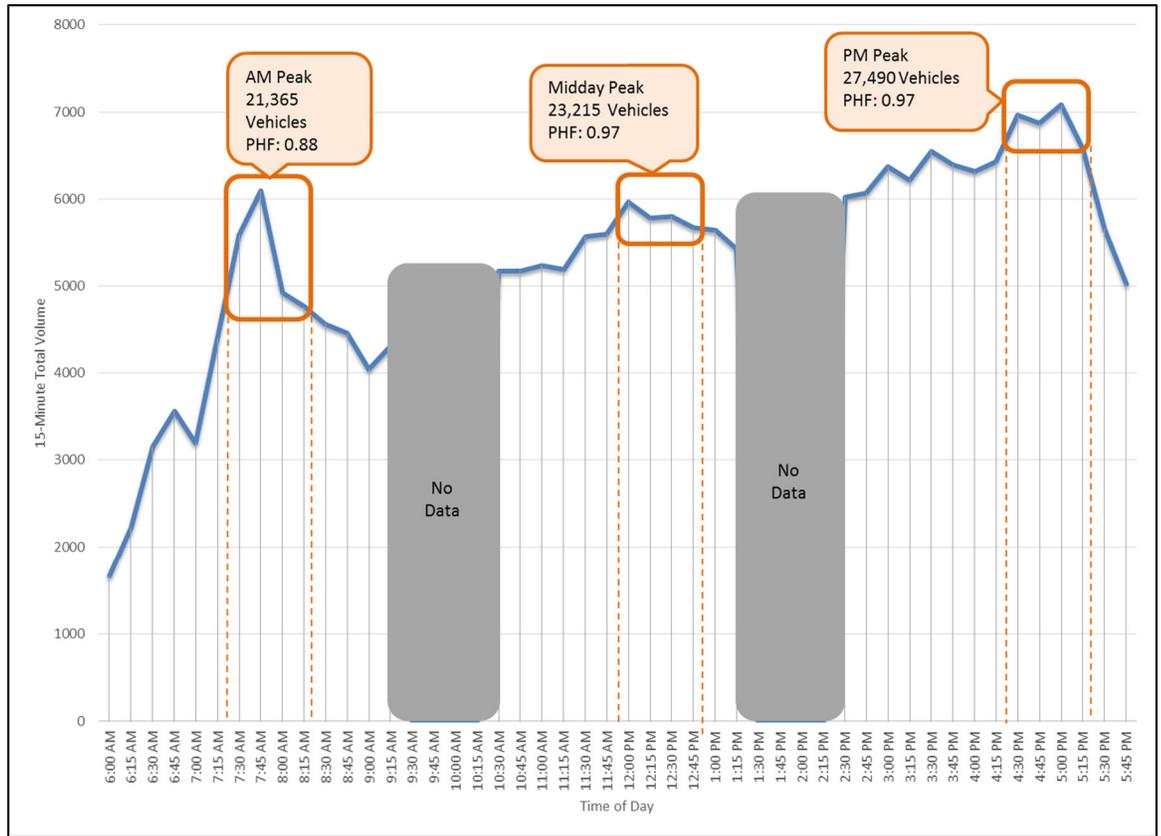
Traffic volumes from the 2018 and 2019 traffic counts were balanced along TH 210 to determine the 2019 existing traffic volumes. From the 2019 existing traffic volumes, the AM peak hour was determined to be 7:30 to 8:30 AM and the PM peak hour was 4:30 to 5:30 PM.

Figure 2 represents the summation of all traffic data collected at the 13 study intersections represented as a line graph by time of day; this is the total 15-minute demands for all intersections. It should be noted that the times from 9:30 to 10:30 AM and 1:30 to 2:30 PM are marked as “No Data” as not all intersections included every hour.

The PM peak hour has the highest hourly vehicle demands throughout the day when compared to the AM and mid-day peak hours. The PM peak hour is likely to control any roadway

improvements that are needed at the study intersections; for this reason the mid-day peak hour was not analyzed as part of this study.

Figure 2 – 2018/2019 Existing TH 210 Corridor Volumes



The AM peak hour has higher traffic demands in the first 30 minutes of the peak hour when compared to the last 30 minutes; this results in a peak hour factor (PHF) of 0.88. The PM peak hour has more consistent traffic demands throughout the hours with a PHF of 0.97. The PHF is the hourly volume during the peak hour divided by the peak 15-minute traffic volume multiplied by four; the PHF is a measure of traffic demand fluctuations within the peak hour (Hourly Volume/ (Peak 15-min x 4)).

In addition, to weekday counts, the 2018 project included capturing turning movement data on a Friday, Saturday, and Sunday and an NHRA event. All of this traffic count information was analyzed to determine factors to apply to the weekday count data in order to evaluate a Friday and summer peak hour periods.

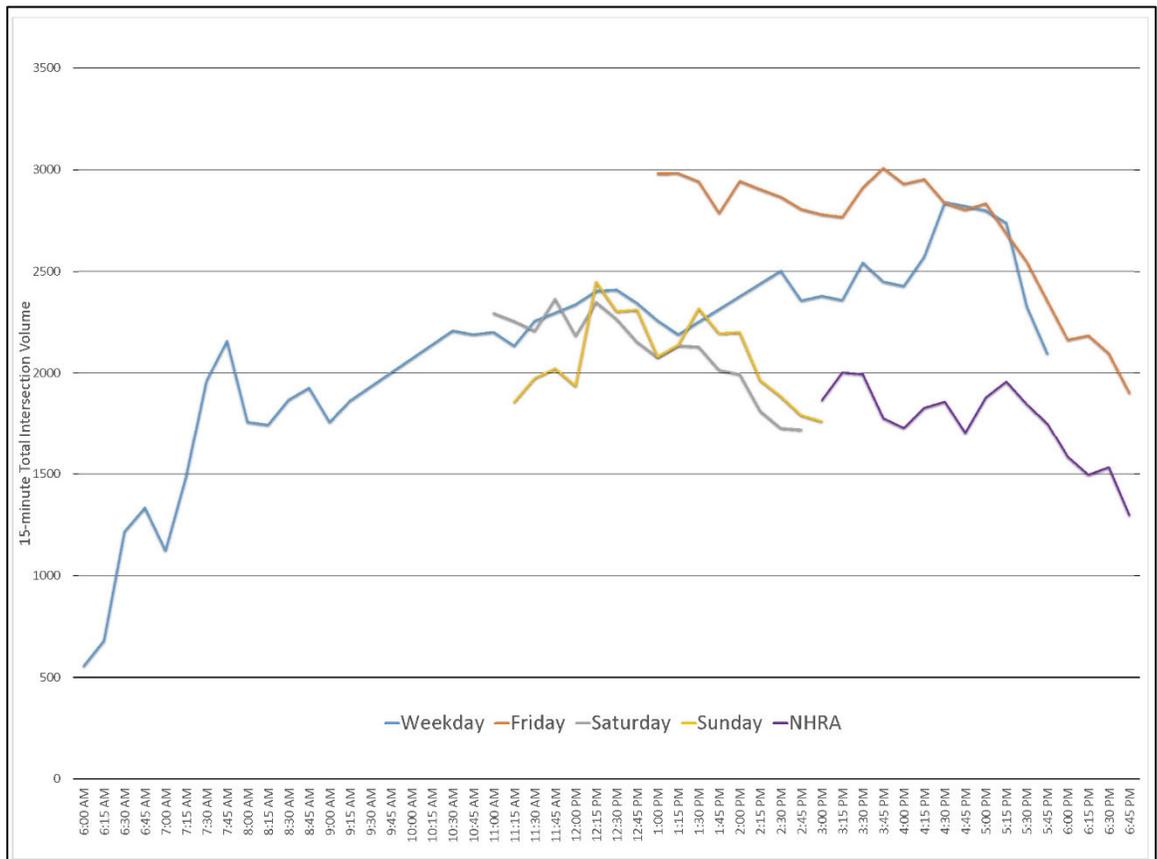
Figure 3 represents the 15-minute total entering traffic demands for the August 2018 count for the weekday, Friday, Saturday, Sunday, and NHRA traffic volumes. The continuous blue line represents the weekday count from approximately 6 am to 6 pm.

From this graph, both the Saturday and Sunday traffic volumes are similar to the weekday afternoon peak period; as these volumes are below the PM peak, no analysis was conducted

under weekend traffic demands. The NHRA event was well below the typical weekday traffic demands; this event has more of an impact on TH 371 traffic.

The Friday traffic volumes are typically higher than the PM peak hour volumes, the peak Friday hour was approximately 5% higher than the PM peak hour. The main difference between the Friday peak period and the PM peak hour is the sustained volumes along the corridor. The PM peak hour on a typical weekday is contained to approximately a 1 ½ hour period of increased traffic along TH 210. In contrast, the Friday count data shows a relatively constant volume between 1 pm through 5 pm. Based on this information, the Friday peak hour traffic for the corridor was developed by increasing the weekday PM peak hour by 5% to match the 2018 comparison.

Figure 3 – August 2018 Day of Week Comparison



While the 2018 data was collected in the summer month of August, some of the fall 2019 data had higher through volumes along TH 210; therefore the summer peak traffic demands were developed using StreetLight data for the study area; the next section will discuss the data and results. Based on the information from StreetLight data, the summer peak traffic demands are approximately a 10% increase in the PM peak hour volumes.

The existing 2019 vehicle turning movement volumes for the AM, PM, Friday, and summer peak hours as well as the existing roadway geometrics are shown in **Figures D1 and D2** in **Appendix D**.

6 Vehicle Origin-Destination Summary

In order to better understand the existing travel patterns along the TH 210 corridor, an origin-destination (OD) study is essential. MnDOT currently has a regional subscription to StreetLight Data (<https://www.streetlightdata.com>) which is a private company that provides “big data” information. The platform uses global positioning system (GPS) information and location based service (LBS) information from connected trucks and cell phones.

A full OD study was conducted along TH 210 in the project study area, full results can be found in the *Technical Memorandum - TH 210 Corridor Study - Origin-Destination Study* can be found attached in **Appendix G**.

The platform allowed for 1-year worth of data to be pulled for the entire TH 210 corridor; a total of 583,000 personal LBS trips and 85,000 commercial GPS trips were captured along the corridor; data was pulled from StreetLight.

The data is sorted out by day of the week and grouped hours throughout the day. For this OD analysis, the weekday trips during the AM and PM peak periods, 6am to 9am and 3pm to 6pm, were tabulated for use in this study evaluation. Weekday trips include Monday through Thursday, Weekend trips include both Saturday and Sunday, and Friday trips were pulled separately.

For the study area along TH 210, all public street connections to TH 210 has OD zones attributed to them in order to capture all traffic entering the corridor between Baxter Drive and Pine Shores Drive. The following are some of the high level results of the OD evaluation:

- Eastbound TH 210 at Baxter Drive: just over 7% of the traffic will travel through the entire project area, this is estimated to be about 1,200 trips per day. Approximately 21% of the trips are destined to N 4th Street, N 6th Street, and N 8th Street in the Central segment; the remaining trips are spread throughout the corridor.
- Westbound TH 210 at Pine Shores Drive: just over 28% of the traffic will travel through the entire project area; however, since the AADT is lower here this is estimated to be about 1,600 trips per day. The next highest destination is traveling north on 8th Avenue with almost 9%, the Central segment had approximately 14% destined to the south side of TH 210.
- NW 4th Street has approximately 25% of the traffic pass over TH 210 and continue along NW 4th Street in both the northbound and southbound directions. Southbound traffic has more destinations to the east, with about 23% destined to the south of TH 210 on the Central segment. Northbound traffic has a higher destination to the west, with about 51% turning left and over 35% continuing along TH 210 towards TH 371.
- Northbound N 6th Street has about 2/3 of the traffic head west and 1/3 head east on TH 210; only a small percentage travel through and continue along N 6th Street. Most of the trips are spread throughout the corridor in both directions, with the largest percentage continuing west towards TH 371 with approximately 35%.
- Southbound 8th Avenue has approximately 27% of the trips travel across TH 210 and continue on to TH 25. Approximately 10% head to the east along TH 210, and the remaining head to the west along TH 210. Trips are spread out along TH 210 to the west, with only approximately 12% continuing on towards TH 371. The Central segment had about 16% of the trips destined to the south, and 13th Street had 9% of the trips destined to the south.

Commercial traffic was also reviewed separately from the personal trips. Along TH 210, there are higher percentages of through trips with 22% of the eastbound trips and 31% of the westbound trips traveling through the entire length of the study area. N 6th Street, 13th Street, and TH 25 are the other major destinations for trucks along the corridor.

6.1 Seasonal Information

StreetLight allows for different time periods to be evaluated as well, therefore the platform can be used to assess different seasonal variations. This was ideal to provide an assessment of the changes to traffic between the seasons as the study area has high summer tourism.

In order to make a good comparison between the summer and fall months, data from 2018 was used; StreetLight data in 2019 has a higher capture rate and at the time of the analysis all of 2019 was not available.

4-months of data was pulled for February, March, October, and November for a spring/fall timeframe. 3-months of data was pulled for June, July, and August for a summer timeframe. Comparing the overall capture of trips, the summer months had an approximate 25% increase in daily trips along the corridor.

Reviewing the AM, Mid-day, and PM peak period data, it was evident the increase is mainly in the mid-day period where traffic volumes are moderate. The PM peak period, 3-hours, had an increase of 18% between the two seasonal periods; therefore it was determined, based on project management team input, to use a 10% increase in the PM peak hour data to account for a “Summer Peak” hour in the operations analysis

6.2 Other Information

The platform can provide non-motorized information for pedestrian and bicyclist. Information for these modes was pulled from the platform and reviewed; however, due to a low volume of trips for each mode the information was determined to not be reasonable to use.

StreetLight can assign a mobile device a home and work location based on the majority of time the device spends each day at various locations. A full year of data was pulled for this analysis and it showed that of all the trips along TH 210, the majority (between 46% and 53%) of device trips either live or work within 5-miles of the corridor, and about 76% of the trips are from within 25-miles.

Two 3-month periods were pulled to see the differences between summer and winter months; the winter months show good correlation to the full year of data with an average of approximately 50% trips from within 5 miles, 30% between 5 and 25 miles, and 20% from further than 25 miles. In the summer months, due to “cabin” traffic, the percentage of trips within 25 miles goes down and the higher distances increase; an average of approximately 45% trips from within 5 miles, 25% between 5 and 25 miles, and 30% from further than 25 miles.

A small OD study was conducted along 5th Avenue due to the operation issues associated with the volumes. Approximately 60% of the trips are destined to the retail area around the East Brainerd Mall, and approximately 8% of the trips use 5th Avenue to avoid the traffic signal at TH 210 and 8th Avenue.

7 Future Conditions

This study includes evaluation of the corridor to determine improvements along TH 210 to serve the long term needs of the corridor and the community. To capture future changes along the corridor, a future year analysis was conducted. Based on the current anticipated project year of 2025, the future design year of 2045 was selected for evaluation.

7.1 Planned Roadway Improvements

MnDOT, Crow Wing County, and the City of Brainerd provided input on planned roadway projects that would be included in all future scenarios of this corridor study. Only one project was determined to be included as part of the No Build alternative.

There are currently improvements planned for the intersection of TH 210 at NW 4th Street as part of a roadway project on the north leg of this intersection. As part of that project, the southbound NW 4th Street approach will be reconstructed to have dual dedicated left turn lanes and a shared through/right turn lane. This will allow for the northbound and southbound left turn signal phases to run concurrently and eliminate the need for the existing split phase signal. As the project is planned for construction in 2020/2021, the improvements at the intersection of TH 210 at NW 4th Street will be included in all future traffic operations analysis scenarios under the No Build alternative.

7.2 Traffic Forecasts

Historical AADT data along TH 210 and surrounding roadways was reviewed to determine recent growth patterns. A linear regression analysis of TH 210 and surrounding roadways results in limited growth on many of the roadways, including some negative values. This indicates that traffic demands have been fairly steady in recent history.

The population of both the City of Brainerd and of Crow Wing County was also reviewed from Census data as far back as 1990:

- The City of Brainerd has experienced limited population growth between 1990 and 2010, with a total increase of approximately 10% in that time frame. The trend line for the City's population shows between a 0.25 % to 0.5% growth rate from the 2010 census data.
- Crow Wing County population has seen a significant growth rate of over 40% between 1990 and 2010 with the growth occurring in the more rural portions of the County. However, the Minnesota State Demographer provides population projections on the county level and is projecting the future growth in Crow Wing County to slow to between a 0.25% to 0.5% growth rate from the 2010 census data.

Based on the historical AADT data, population data, and input from the Project Management Team (PMT), including MnDOT, a linear growth rate of 0.5% per year was selected and utilized to develop 2045 forecast traffic volumes.

Table 4 shows the 2019 AADTs, the forecasted 2045 AADTs and corresponding linear growth rate for each project roadway. Mainline TH 210 forecasted 2045 AADTs within the study area range from 13,350 to 36,750.

The forecasted 2045 No Build intersection traffic volumes for the AM, PM, Friday, and summer peak hours can be found in **Figures D3 and D4** in **Appendix D**.

Table 4 – 2045 Forecasted AADTs

Roadway	Description	2019 Existing AADT	2045 Forecast AADT	Linear Growth Rate
TH 210	TH 371 to NW 9 th St	24,100	27,250	0.5%
	NW 9 th St to N 1 st St	32,500	36,750	0.5%
	N 1 st St to N 4 th St	29,500	33,350	0.5%
	N 4 th St to N 6 th St	26,000	29,400	0.5%
	N 6 th St to N 8 th St	26,000	29,400	0.5%
	N 8 th St to 13 th St SE	23,300	26,350	0.5%
	13 th St SE to 4 th Ave NE	25,500	28,800	0.5%
	4 th Ave NE to TH 25 Exit Ramp	23,600	26,650	0.5%
	TH 25 Exit Ramp to 8 th Ave NE	17,100	19,300	0.5%
	8 th Ave NE to Pine Shores Rd	11,800	13,350	0.5%
NW 7 th St	North of TH 210	1,100	1,250	0.5%
NW 4 th St	North of TH 210	12,100	13,650	0.5%
	South of TH 210	9,100	10,300	0.5%
N 1 st St	North of TH 210	350	400	0.5%
	South of TH 210	1,700	1,900	0.5%
N 4 th St	North of TH 210	2,400	2,700	0.5%
	South of TH 210	4,200	4,750	0.5%
N 6 th St (TH 371B)	South of TH 210	11,000	12,450	0.5%
N 8 th St	North of TH 210	2,050	2,300	0.5%
	South of TH 210	4,700	5,300	0.5%
Kingwood St	North of TH 210	700	800	0.5%
Gillis Ave	North of TH 210	560	650	0.5%
13 th St SE	South of TH 210	6,900	7,800	0.5%
4 th Ave NE	North of TH 210	1,200	1,350	0.5%
5 th Ave NE	North of TH 210	4,300	4,850	0.5%
8 th Ave NE	North of TH 210	8,400	9,500	0.5%
	South of TH 210	4,950	5,600	0.5%
10 th Ave NE	South of TH 210	1,400	1,600	0.5%
13 th Ave NE	North of TH 210	910	1,050	0.5%

8 Warrant Analysis

Intersection traffic control changes rely on traffic control warrants to assess the different options available at any intersection. To determine the control options, warrants are evaluated to assess where control changes can be made based on traffic volumes. The results are used to aid in the evaluation of traffic safety and traffic operations at any study intersection.

For TH 210, all-way stop warrants were not analyzed due to the high AADT on TH 210 and its designation as a principal arterial where the goal is to move vehicles through the corridor as efficiently as possible. Therefore, only traffic signal warrants were analyzed. Traffic signal warrant analyses were completed at all study intersections except for the eastbound TH 25 ramp, which has no minor street approach and, therefore, cannot meet traffic signal warrants.

8.1 Traffic Signal Warrant Analysis

The Minnesota Manual on Uniform Traffic Control Devices (MnMUTCD) provides guidance on when it may be appropriate to use signal control at an intersection. This guidance is provided in the form of “warrants”, or criteria, and engineering analysis of the intersection’s design factors to determine when signal control may be justified. Signal control should not be installed at an intersection unless a MnMUTCD warrant is met. Meeting a warrant at an intersection does not in itself require the installation of a traffic signal. Installation of a traffic signal also requires an engineering analysis of the intersection’s design in order for it to be justified. A roundabout is considered to be warranted if traffic volumes meet the criteria for either all-way stop or traffic signal control.

8.1.1 Requirements for Installation of a Traffic Signal

For traffic signal installation, MnDOT typically requires volume thresholds for Warrant 1 to be satisfied, which requires 8-hours of combined major approach volumes and the highest minor street approach volume to meet MnMUTCD thresholds. These thresholds vary with the number of approach lanes on the major and minor streets, as well as vehicle speeds. Other warrants may be used as indicators of a need to consider traffic control change; an engineering study that considers factors, including warrants, should be performed to determine the optimum type of control at an intersection.

8.1.2 Requirements for Removal of an Existing Traffic Signal

The MnDOT Traffic Engineering Manual (TEM) provides guidance on volume requirements to remove an existing traffic signal. Based on Chapter 9, section 9-5.02.05 of the TEM, an intersection that meets 80 percent of the volume requirements of Warrant 1 should be considered justified and should not be removed. A signalized intersection that does not meet 60 percent of the volume requirements of Warrant 1, and meets no other Warrant, is an unjustified traffic signal and should be removed.

A signalized intersection that does not meet 80 percent of the volume requirements but does meet 60 percent of the volume requirements of Warrant 1 is in a “gray area” and may be considered for traffic signal removal. Additional studies, findings, engineering judgment and documentation beyond the volume requirements are needed to justify retaining the signal.

8.1.3 Warrant Analysis Assumptions

MnDOT guidelines suggest that for the purpose of warrant analysis, 100% of right turning traffic from the minor leg should be removed because right turning vehicles are typically able to enter the traffic stream with minimal delay or conflict; the right turning traffic would not require a traffic signal to reduce delay or improve safety. In certain circumstances (i.e. high right turn volume, minimum mainline gaps, etc.), MnDOT procedures allow for the inclusion of 50% of the minor street right turning traffic in the analysis. The MnDOT guidance states “if right turning volume exceeds 70% of its potential capacity for any hour for each approach, 50% of the right turning volume for all hours should be added back in.”

- Based upon MnDOT guidance, the analysis of all the study intersections includes the removal of 100% of the right turning traffic on the minor approaches.

MnDOT guidelines suggest that the warrant thresholds may also be reduced based on the roadway speeds and population of the city the intersection is within. If either major approach to the intersection has a posted speed, or 85th percentile speed, that exceeds 40 mph, then a reduction to 70% of the threshold volumes is allowed. If the population of the city is less than 10,000 people, a reduction to 70% threshold volumes is allowed.

- Based upon MnDOT guidance, the analysis of the following 5 intersections along TH 210 were analyzed with the reduction to 70% of the thresholds volumes because the speed limit on TH 210 is 45 mph on at least one of the intersection legs:
 - Baxter Drive
 - 5th Avenue NE
 - 8th Avenue NE
 - 10th Avenue NE
 - 13th Avenue NE
- The remaining 7 intersection along TH 210 (listed below) were analyzed without the reduction in volume thresholds because the speed limit on TH 210 is 35 mph at these intersections and all side streets have speed limits of less than 40 mph.
 - NW 4th Street
 - N 1st Street/East River Road
 - N 4th Street
 - N 6th Street
 - N 8th Street
 - Gillis Avenue/13th Street SE
 - 4th Avenue NE

8.1.4 5th Avenue NE Traffic Signal Warrant Analysis Methodology

5th Avenue NE is currently a 3/4 access intersection with southbound left turns being prohibited. Therefore, when minor street right turns are removed, there is no minor street traffic volume to use in warrant analysis.

Nevertheless, the MnMUTCD states that for intersections with a high volume of left turning traffic from the major street, the traffic signal analysis can be performed with the major street left turns

as the minor street traffic volume. For this analysis, the opposing through traffic is used as the major street traffic volume. Because there are over 130 eastbound left turns every hour between 7 AM and 7 PM, three of which have over 300 left turns, the traffic signal warrant analysis for the intersection of TH 210 at 5th Avenue NE was analyzed using this alternative method with eastbound lefts as the minor street volume and westbound traffic as the major street volume.

8.2 Traffic Signal Warrant Results Summary

Based on the existing and 2045 traffic volumes, the following intersections do not meet any Traffic Signal warrant and should retain their existing minor street stop control (unless other factors dictate a need for an intersection control change):

- TH 210 at N 1st Street/East River Road
- TH 210 at 10th Avenue NE
- TH 210 at 13th Avenue NE

Based on the existing and 2045 traffic volumes, the following intersections meet Traffic Signal warrants and should retain their existing traffic signal control:

- TH 210 at Baxter Drive
- TH 210 at NW 4th Street
- TH 210 at N 4th Street
- TH 210 at N 6th Street
- TH 210 at N 8th Street
- TH 210 at Gillis Avenue/13th Street SE
- TH 210 at 8th Avenue NE

Under the existing and 2045 traffic demands, the traffic volumes at the intersection of TH 210 at 4th Avenue NE do not meet 60% of the traffic signal warrant volume thresholds and, therefore, removal of the existing signal is justified.

Under the existing and 2045 traffic volumes with the eastbound lefts analyzed as the minor street volumes and the westbound vehicles analyzed as the major street volumes, the intersection of TH 210 at 5th Avenue NE meets the traffic signal warrants. Therefore, a traffic signal may be considered at this intersection.

Table 5 provides the traffic signal warrant summary for the 2019 existing and 2045 future volume conditions. Complete traffic signal warrant analyses can be found in **Appendix E**.

Table 5 – Traffic Signal Warrant Analysis Summary

Intersection TH 210 at: (Existing Control)	2019 Existing		2045 Future	
	Warrant 1 (8 Hr)	Notes	Warrant 1 (8 Hr)	Notes
Baxter Dr (Traffic Signal)	MET 11 of 8 hours	Warrants 2 & 3 met ²	MET 11 of 8 hours	Warrants 2 & 3 met ²
NW 4 th St (Traffic Signal)	MET 12 of 8 hours	Warrants 2 & 3 met ²	MET 12 of 8 hours	Warrants 2 & 3 met ²
N 1 st St/East River Rd (Minor Street Stop)	Not Met 0 of 8 hours	Retain stop control	Not Met 0 of 8 hours	Retain stop control
N 4 th St (Traffic Signal)	MET 10 of 8 hours	Warrants 2 & 3 met ²	MET 10 of 8 hours	Warrants 2 & 3 met ²
N 6 th St (Traffic Signal)	MET 11 of 8 hours	Warrants 2 & 3 met ²	MET 11 of 8 hours	Warrants 2 & 3 met ²
N 8 th St (Traffic Signal)	MET 10 of 8 hours	Warrants 2 & 3 met ²	MET 11 of 8 hours	Warrants 2 & 3 met ²
Gillis Ave/13 th St SE (Traffic Signal)	Not Met 6 of 8 hours	Warrants 2 & 3 met ² 80% warrant met ³	MET 8 of 8 hours	Warrants 2 & 3 met ²
4 th Ave NE (Traffic Signal)	Not Met 0 of 8 hours	60% warrant not met ⁴	Not Met 0 of 8 hours	60% warrant not met ⁴
5 th Ave NE ¹ (Minor Street Stop)	MET 11 of 8 hours	Warrants 2 & 3 met ²	MET 11 of 8 hours	Warrants 2 & 3 met ²
8 th Ave NE (Traffic Signal)	MET 12 of 8 hours	Warrants 2 & 3 met ²	MET 12 of 8 hours	Warrants 2 & 3 met ²
10 th Ave NE (Minor Street Stop)	Not Met 0 of 8 hours	Retain stop control	Not Met 0 of 8 hours	Retain stop control
13 th Ave NE (Minor Street Stop)	Not Met 0 of 8 hours	Retain stop control	Not Met 0 of 8 hours	Retain stop control

Notes:

1. The 5th Ave NE traffic signal warrants were analyzed with the eastbound left turn volume as the minor street volume and the westbound volume as the major street volume.
2. Warrant 2 is the 4 hour volume warrant and Warrant 3 is the peak hour volume warrant.
3. Existing signal meets 80% of the volume thresholds for Warrant 1 and is considered justified and should not be removed.
4. 60% of the warrant volume thresholds for Warrant 1 were not met and removal of the existing signal is justified.

9 Traffic Operations Analysis

Existing (2019) and forecast (2045) No Build traffic operations analyses were conducted to determine the level of service (LOS), delay, and queueing information for the AM, PM, Friday, and summer peak hour conditions.

LOS is a qualitative rating system used to describe the efficiency of traffic operations at an intersection. Six LOS levels are defined, designated by letters A through F. LOS A represents the best operating conditions (no congestion), and LOS F represents the worst operating conditions (severe congestion).

For the 13 study intersections, it was assumed that a LOS D or better represents acceptable operating conditions for all approaches and movements and LOS D or better represents acceptable operating conditions for all movements. However, due to the long cycle lengths along TH 210, some movements may have higher delays, LOS E/F, but are still expected to be served within one signal cycle.

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

The traffic operations analyses were conducted using the VISSIM (version 2020) software package; an average of 10 simulation runs was used for each modeling result.

Appendix F includes all relevant operational tables and outputs for the existing and 2045 No Build scenarios that follow.

9.1 2019 Existing Conditions

The following sections summarize the traffic operations for the AM, PM, Friday, and summer peak hours under 2019 existing conditions.

Field observations were conducted in November 2019 to aid in the development of the traffic models, observations were conducted during the AM, mid-day, and PM peak hours. The PMT also provided input on the existing traffic operations, which was taken into consideration during the development of the traffic models.

9.1.1 2019 Existing Conditions – AM Peak Hour

Current AM peak hour intersection operations are acceptable based on overall delays for all movements; all intersections and approaches operate at LOS D or better. There are 11 movements that operate at LOS E; however these are mostly TH 210 left turning vehicles delayed due to the long traffic signal cycle lengths at these intersections.

While the traffic operations are generally acceptable, there are some queue storage issues due to short storage lanes, these are listed below:

- The maximum westbound left turn queue at N 8th Street extends beyond the available storage.
- The maximum westbound left turn queue at Gillis Avenue/13th Street SE extends beyond the available storage.
- The maximum eastbound left turn queue at 5th Avenue NE extends beyond the available storage
- The maximum northbound queue on 8th Avenue NE extends to the intersection of TH 25 at 8th Avenue NE.

Table 6 represents the 2019 existing traffic operations of the AM peak hour. **Figure F1** in **Appendix F** shows the LOS and queuing information for each study intersection during the 2019 existing AM peak hour.

Table 6 – 2019 Existing Conditions – AM Peak Hour

Intersection	Approach Delay (sec/veh / LOS)				Intersection Delay (sec/veh / LOS)
	Eastbound	Westbound	Northbound	Southbound	
TH 210 at: (Traffic Control)					
Baxter Dr (Traffic Signal)	7.9 / A	6.0 / A	42.0 / D	19.0 / B	9.1 / A
NW 4 th St (Traffic Signal)	18.8 / B	17.2 / B	47.0 / D	45.1 / D	24.6 / C
N 1 st St/East River Rd (Minor Street Stop)	2.7 / A	1.0 / A	10.1 / B	8.2 / A	2.1 / A
N 4 th St (Traffic Signal)	14.4 / B	5.5 / A	36.7 / D	38.2 / D	12.3 / B
N 6 th St (Traffic Signal)	5.0 / A	7.0 / A	32.2 / C		9.1 / A
N 8 th St (Traffic Signal)	5.9 / A	15.4 / B	31.5 / C	39.9 / D	14.3 / B
Gillis Ave/13 th St SE (Traffic Signal)	6.7 / A	10.0 / B	23.8 / C	22.2 / C	11.1 / B
4 th Ave NE (Traffic Signal)	1.2 / A	3.9 / A	43.9 / D	37.5 / D	4.5 / A
5 th Ave NE (Minor Street Stop)	6.4 / A	0.2 / A		10.5 / B	3.3 / A
TH 25 Ramp (Exit Ramp)	0.1 / A	0.2 / A			0.2 / A
8 th Ave NE (Traffic Signal)	33.4 / C	38.7 / D	50.5 / D	27.0 / C	36.7 / D
10 th Ave NE (Minor Street Stop)	1.4 / A	0.3 / A	12.5 / B	10.8 / B	2.3 / A
13 th Ave NE (Minor Street Stop)	0.4 / A	0.2 / A		8.8 / A	1.0 / A

9.1.2 2019 Existing Conditions – PM Peak Hour

There are currently operational issues along TH 210 during the PM peak hour based on delay and LOS as well as queuing. A summary of the operational issues is below:

Delay/LOS Issues:

- TH 210 at NW 4th Street
 - The eastbound left turning movement operates at LOS F.
 - The northbound and southbound approaches operate at LOS E.
- The westbound left turning movement at N 8th Street operates at a LOS F.
- TH 210 at 8th Avenue NE:
 - The eastbound left turning movement operates at LOS F.
 - The northbound approach at 8th Avenue NE operates at LOS E.
- It should be noted that some additional lower volume left turn movements from TH 210 are not included in this summary, these volumes are all served within a single cycle and the delay is caused from the long signal cycle length.

Queuing Issues:

- The maximum southbound right turn queue at Baxter Drive extends beyond the available storage.
- TH 210 at NW 4th Street:
 - The maximum eastbound left turn queue extends beyond the available storage.
 - The maximum westbound queue extends beyond NW 2nd Street.
- The maximum northbound left turn queue at N 4th Street extends beyond the available storage.
- TH 210 at N 8th Street:
 - The maximum westbound left turn queue extends beyond the available storage.
 - The maximum northbound left turn queue extends beyond the available storage.
- The maximum westbound left turn queue at Gillis Avenue/13th Street SE extends beyond the available storage.
- The maximum eastbound left turn queue at 5th Avenue NE extends beyond the available storage.
- TH 210 at 8th Avenue NE:
 - The maximum eastbound left turn queue extends beyond the available storage.
 - The maximum northbound queue extends approximately 720 feet east of 8th Avenue NE on TH 25, a total queue of approximately 1,320 feet.

Table 7 represents the 2019 existing traffic operations of the PM peak hour. **Figure F2** in **Appendix F** shows the LOS and queuing information for each study intersection during the 2019 existing PM peak hour.

Table 7 – 2019 Existing Conditions – PM Peak Hour

Intersection TH 210 at: (Traffic Control)	Approach Delay (sec/veh / LOS)				Intersection Delay (sec/veh / LOS)
	Eastbound	Westbound	Northbound	Southbound	
Baxter Dr (Traffic Signal)	20.8 / C	20.5 / C	45.3 / D	32.2 / C	23.2 / C
NW 4 th St (Traffic Signal)	30.4 / C	41.8 / D	60.0 / E	60.5 / E	43.2 / D
N 1 st St/East River Rd (Minor Street Stop)	1.2 / A	0.6 / A	12.4 / B	20.6 / C	1.2 / A
N 4 th St (Traffic Signal)	11.5 / B	8.1 / A	41.4 / D	47.7 / D	15.3 / B
N 6 th St (Traffic Signal)	4.8 / A	11.4 / B	41.7 / D		13.4 / B
N 8 th St (Traffic Signal)	7.5 / A	28.5 / C	32.8 / C	40.2 / D	21.2 / C
Gillis Ave/13 th St SE (Traffic Signal)	7.4 / A	16.4 / B	29.4 / C	33.7 / C	14.3 / B
4 th Ave NE (Traffic Signal)	1.3 / A	4.3 / A	75.1 / E	37.4 / D	4.1 / A
5 th Ave NE (Minor Street Stop)	4.6 / A	0.2 / A		12.7 / B	3.6 / A
TH 25 Ramp (Exit Ramp)	0.3 / A	0.3 / A			0.3 / A
8 th Ave NE (Traffic Signal)	53.0 / D	54.2 / D	67.3 / E	50.0 / D	55.6 / E
10 th Ave NE (Minor Street Stop)	1.2 / A	0.3 / A	15.3 / C	8.8 / A	1.8 / A
13 th Ave NE (Minor Street Stop)	0.7 / A	0.2 / A		10.7 / B	1.1 / A

9.1.3 2019 Existing Conditions – Friday Peak Hour

Because the Friday peak hour on TH 210 has 5% higher traffic demands than the PM peak hour, the operational issues in the PM peak hour would be worsened with increased traffic on Fridays. A summary of the operational issues is below:

Delay/LOS Issues:

- TH 210 at NW 4th Street
 - The eastbound left turning movement operates at LOS F.
 - The northbound and southbound approaches operate at LOS E.
- The westbound left turning movement at N 8th Street operates at LOS F.
- TH 210 at 8th Avenue NE – the overall intersection operates at a LOS E.
 - The eastbound left turning movement operates at LOS F.
 - The northbound approach at 8th Avenue NE operates at LOS E.
- It should be noted that some additional lower volume left turn movements from TH 210 are not included in this summary, these volumes are all served within a single cycle and the delay is caused from the long signal cycle length.

Queuing Issues:

- The maximum southbound right turn queue at Baxter Drive extends beyond the available storage.
- TH 210 at NW 4th Street:
 - The maximum eastbound left turn queue extends beyond the available storage.
 - The maximum westbound queue extends beyond NW 2nd Street.
- The maximum northbound left turn queue at N 4th Street extends beyond the available storage.
- TH 210 at N 8th Street:
 - The maximum westbound left turn queue extends beyond the available storage.
 - The maximum northbound left turn queue extends beyond the available storage.
- The maximum westbound left turn queue at Gillis Avenue/13th Street SE extends beyond the available storage.
- The maximum eastbound left turn queue at 5th Avenue NE extends beyond the available storage.
- TH 210 at 8th Avenue NE:
 - The maximum eastbound left turn queue extends beyond the available storage.
 - The maximum northbound queue extends approximately 850 feet east of 8th Avenue NE on TH 25, a total queue of approximately 1,450 feet.

Table 8 represents the 2019 existing traffic operations of the Friday peak hour. **Figure F3** in **Appendix F** shows the LOS and queuing information for each study intersection during the 2019 existing Friday peak hour.

Table 8 – 2019 Existing Conditions – Friday Peak Hour

Intersection TH 210 at: (Traffic Control)	Approach Delay (sec/veh / LOS)				Intersection Delay (sec/veh / LOS)
	Eastbound	Westbound	Northbound	Southbound	
Baxter Dr (Traffic Signal)	21.0 / C	21.9 / C	46.0 / D	34.3 / C	24.1 / C
NW 4 th St (Traffic Signal)	33.7 / C	49.7 / D	60.2 / E	60.6 / E	47.4 / D
N 1 st St/East River Rd (Minor Street Stop)	1.1 / A	0.7 / A	12.5 / B	19.9 / C	1.2 / A
N 4 th St (Traffic Signal)	11.7 / B	8.1 / A	41.8 / D	48.3 / D	15.5 / B
N 6 th St (Traffic Signal)	5.0 / A	11.5 / B	41.8 / D		13.6 / B
N 8 th St (Traffic Signal)	8.1 / A	30.8 / C	34.9 / C	42.5 / D	22.7 / C
Gillis Ave/13 th St SE (Traffic Signal)	7.5 / A	17.9 / B	29.0 / C	31.6 / C	14.9 / B
4 th Ave NE (Traffic Signal)	1.5 / A	4.1 / A	74.9 / E	37.7 / D	4.1 / A
5 th Ave NE (Minor Street Stop)	5.1 / A	0.1 / A		13.7 / B	3.9 / A
TH 25 Ramp (Exit Ramp)	0.3 / A	0.3 / A			0.3 / A
8 th Ave NE (Traffic Signal)	59.1 / E	56.6 / E	69.8 / E	53.9 / D	59.6 / E
10 th Ave NE (Minor Street Stop)	1.3 / A	0.3 / A	16.1 / C	8.4 / A	1.9 / A
13 th Ave NE (Minor Street Stop)	0.7 / A	0.2 / A		10.9 / B	1.1 / A

9.1.4 2019 Existing Conditions – Summer Peak Hour

The summer peak hour has 10% higher traffic demands than the PM peak hour and the coordinated cycle length is 10 second longer than the PM peak; therefore, many of the same operational issues seen in the PM and Friday peak hours are worsened in the summer peak hour. A summary of the operational issues is below:

Delay/LOS Issues:

- The northbound approach at Baxter Drive operates at LOS E.
- TH 210 at NW 4th Street – the overall intersection operates at a LOS E.
 - The eastbound left turning movement operates at LOS F.
 - The northbound approaches operate at LOS F.
 - The southbound approaches operate at LOS E.
- The southbound approach at N 4th Street operates at LOS E.
- The westbound left turning movement at N 8th Street operates at LOS F.
- TH 210 at 8th Avenue NE – the overall intersection operates at a LOS E.
 - The eastbound and southbound left turning movements operates at LOS F.
 - All four approaches operate at LOS E.
- It should be noted that some additional lower volume left turn movements from TH 210 are not included in this summary, these volumes are all served within a single cycle and the delay is caused from the long signal cycle length.

Queuing Issues:

- The maximum southbound right turn queue at Baxter Drive extends beyond the available storage.
- TH 210 at NW 4th Street:
 - The maximum eastbound left turn queue extends beyond the available storage.
 - The maximum westbound queue extends beyond NW 2nd Street.
- The maximum northbound left turn queue at N 4th Street extends beyond the available storage.
- TH 210 at N 8th Street:
 - The maximum westbound left turn queue extends beyond the available storage.
 - The maximum northbound left turn queue extends beyond the available storage.
- The maximum westbound left turn queue at Gillis Avenue/13th Street SE extends beyond the available storage.
- The maximum eastbound left turn queue at 5th Avenue NE extends beyond the available storage and into the traffic signal at 4th Avenue NE.
- TH 210 at 8th Avenue NE:
 - The maximum eastbound left turn queue extends beyond the available storage.
 - The maximum northbound queue extends approximately 1,100 feet east of 8th Avenue NE on TH 25, a total queue of approximately 1,700 feet.

Table 9 represents the 2019 existing traffic operations of the summer peak hour. **Figure F4** in **Appendix F** shows the LOS and queuing information for each study intersection during the 2019 existing summer peak hour.

Table 9 – 2019 Existing Conditions – Summer Peak Hour

Intersection	Approach Delay (sec/veh / LOS)				Intersection Delay (sec/veh / LOS)
	Eastbound	Westbound	Northbound	Southbound	
TH 210 at: (Traffic Control)					
Baxter Dr (Traffic Signal)	14.7 / B	16.4 / B	58.1 / E	41.9 / D	20.5 / C
NW 4 th St (Traffic Signal)	37.4 / D	43.4 / D	148.0 / F	67.7 / E	59.9 / E
N 1 st St/East River Rd (Minor Street Stop)	1.5 / A	0.7 / A	14.7 / B	24.7 / C	1.5 / A
N 4 th St (Traffic Signal)	9.9 / A	7.4 / A	45.1 / D	56.2 / E	15.1 / B
N 6 th St (Traffic Signal)	5.2 / A	11.1 / B	46.1 / D		14.1 / B
N 8 th St (Traffic Signal)	7.0 / A	33.7 / C	39.4 / D	47.0 / D	24.4 / C
Gillis Ave/13 th St SE (Traffic Signal)	8.2 / A	19.0 / B	33.2 / C	41.6 / D	16.4 / B
4 th Ave NE (Traffic Signal)	1.2 / A	2.7 / A	71.7 / E	43.5 / D	3.6 / A
5 th Ave NE (Minor Street Stop)	6.5 / A	0.2 / A		15.0 / C	4.8 / A
TH 25 Ramp (Exit Ramp)	0.3 / A	0.4 / A			0.3 / A
8 th Ave NE (Traffic Signal)	66.9 / E	63.2 / E	77.9 / E	59.3 / E	66.6 / E
10 th Ave NE (Minor Street Stop)	1.3 / A	0.4 / A	23.6 / C	8.3 / A	2.4 / A
13 th Ave NE (Minor Street Stop)	0.9 / A	0.2 / A		11.3 / B	1.2 / A

9.2 2045 No Build Conditions

The following sections summarize the traffic operations for the AM, PM, Friday, and summer peak hours under 2045 No Build conditions. The analyses for the 2045 No Build conditions have forecasted traffic volumes with a 0.5% annual growth rate from the existing 2019 conditions.

Other than the planned improvements at the intersection at TH 210 at NW 4th Street, all intersection control, intersection geometrics, and signal phasing are the same as the existing condition. Signal timing changes were made in an effort to optimize 2045 No Build traffic operations.

9.2.1 2045 No Build Conditions – AM Peak Hour

2045 No Build AM peak hour intersection operations are acceptable based on overall delays for all movements; all approaches and intersections operate at LOS D or better; the only exception is at the intersection of 8th Avenue NE where the northbound approach operates at a LOS E.

There are some queue storage issues, which are listed below:

- The maximum westbound left turn queue at N 4th Street extends beyond the available storage.
- The maximum westbound left turn queue at N 8th Street extends beyond the available storage.
- The maximum westbound left turn queue at 13th St SE extends beyond the available storage.
- The maximum eastbound left turn queue at 5th Ave NE extends beyond the available storage
- The maximum northbound queue extends approximately 300 feet east of 8th Avenue NE on TH 25, a total queue of approximately 900 feet.

Table 10 represents the 2045 No Build traffic operations of the AM peak hour. **Figure F5** in **Appendix F** shows the LOS and queuing information for each study intersection during the 2045 No Build AM peak hour.

Table 10 – 2045 No Build Conditions – AM Peak Hour

Intersection	Approach Delay (sec/veh / LOS)				Intersection Delay (sec/veh / LOS)
TH 210 at: (Traffic Control)	Eastbound	Westbound	Northbound	Southbound	
Baxter Dr (Traffic Signal)	9.0 / A	5.8 / A	43.6 / D	18.8 / B	9.7 / A
NW 4 th St (Traffic Signal)	23.1 / C	21.0 / C	48.8 / D	45.7 / D	27.9 / C
N 1 st St/East River Rd (Minor Street Stop)	3.8 / A	1.3 / A	11.3 / B	9.7 / A	2.8 / A
N 4 th St (Traffic Signal)	11.0 / B	7.4 / A	37.7 / D	36.4 / D	11.6 / B
N 6 th St (Traffic Signal)	8.3 / A	6.8 / A	32.1 / C		10.4 / B
N 8 th St (Traffic Signal)	5.9 / A	14.2 / B	30.7 / C	38.4 / D	13.7 / B
Gillis Ave/13 th St SE (Traffic Signal)	5.3 / A	10.9 / B	24.0 / C	26.1 / C	11.2 / B
4 th Ave NE (Traffic Signal)	5.1 / A	4.5 / A	46.8 / D	40.0 / D	6.7 / A
5 th Ave NE (Minor Street Stop)	11.6 / B	0.2 / A		12.0 / B	5.6 / A
TH 25 Ramp (Exit Ramp)	0.1 / A	0.2 / A			0.2 / A
8 th Ave NE (Traffic Signal)	42.8 / D	48.5 / D	60.6 / E	33.5 / C	45.5 / D
10 th Ave NE (Minor Street Stop)	1.5 / A	0.4 / A	14.9 / B	13.1 / B	2.8 / A
13 th Ave NE (Minor Street Stop)	0.7 / A	0.2 / A		8.9 / A	1.1 / A

9.2.2 2045 No Build Conditions – PM Peak Hour

The 2045 No Build PM peak hour operational issues will continue to degrade with increased traffic volumes. A summary of the operational issues is below:

Delay/LOS Issues:

- TH 210 at NW 4th Street
 - The eastbound left turning movement operates at LOS F.
 - The northbound and southbound approaches operate at LOS E.
- The southbound stopped approach at N 1st Street/East River Road operates at a LOS E.
- The westbound left turning movement at N 8th Street operates at LOS F.
- TH 210 at 8th Avenue NE – the overall intersection operates at a LOS E.
 - All left turning movements operates at LOS F.
 - The northbound approach operates at LOS F.
 - The other three approaches operate at LOS E.
- It should be noted that some additional lower volume left turn movements from TH 210 are not included in this summary, these volumes are all served within a single cycle and the delay is caused from the long signal cycle length.

Queuing Issues:

- The maximum southbound right turn queue at Baxter Drive extends beyond the available storage.
- TH 210 at NW 4th Street:
 - The maximum eastbound left turn queue extends beyond the available storage.
 - The maximum westbound queue extends beyond NW 2nd Street.
- The maximum northbound left turn queue at N 4th Street extends beyond the available storage.
- TH 210 at N 8th Street:
 - The maximum westbound left turn queue extends beyond the available storage.
 - The maximum northbound left turn queue extends beyond the available storage.
- The maximum westbound left turn queue at Gillis Avenue/13th Street SE extends beyond the available storage.
- The maximum eastbound left turn queue at 5th Avenue NE extends beyond the available storage and into the traffic signal at 4th Avenue NE.
- TH 210 at 8th Avenue NE:
 - The maximum eastbound left turn queue extends beyond the available storage.
 - The maximum northbound queue extends approximately 1,550 feet east of 8th Avenue NE on TH 25, a total queue of approximately 2,150 feet.

Table 11 represents the 2045 No Build traffic operations of the PM peak hour. **Figure F6** in **Appendix F** shows the LOS and queuing information for each study intersection during the 2045 No Build PM peak hour.

Table 11 – 2045 No Build Conditions – PM Peak Hour

Intersection TH 210 at: (Traffic Control)	Approach Delay (sec/veh / LOS)				Intersection Delay (sec/veh / LOS)
	Eastbound	Westbound	Northbound	Southbound	
Baxter Dr (Traffic Signal)	17.0 / B	14.6 / B	52.7 / D	43.0 / D	20.6 / C
NW 4 th St (Traffic Signal)	31.7 / C	33.5 / C	72.5 / E	60.4 / E	42.1 / D
N 1 st St/East River Rd (Minor Street Stop)	1.2 / A	0.6 / A	14.1 / B	44.0 / E	1.3 / A
N 4 th St (Traffic Signal)	15.0 / B	7.9 / A	44.5 / D	52.0 / D	17.3 / B
N 6 th St (Traffic Signal)	6.7 / A	11.2 / B	42.9 / D		14.4 / B
N 8 th St (Traffic Signal)	9.1 / A	29.3 / C	38.1 / D	43.5 / D	23.3 / C
Gillis Ave/13 th St SE (Traffic Signal)	6.7 / A	19.6 / B	33.4 / C	38.9 / D	15.9 / B
4 th Ave NE (Traffic Signal)	1.9 / A	3.1 / A	73.2 / E	40.6 / D	4.0 / A
5 th Ave NE (Minor Street Stop)	7.9 / A	0.2 / A		16.3 / C	5.7 / A
TH 25 Ramp (Exit Ramp)	0.3 / A	0.4 / A			0.3 / A
8 th Ave NE (Traffic Signal)	72.6 / E	64.8 / E	83.5 / F	61.6 / E	70.6 / E
10 th Ave NE (Minor Street Stop)	1.4 / A	0.4 / A	25.1 / D	8.1 / A	2.6 / A
13 th Ave NE (Minor Street Stop)	0.9 / A	0.2 / A		11.0 / B	1.2 / A

9.2.3 2045 No Build Conditions – Friday Peak Hour

Because the Friday peak hour having higher traffic demands than the PM peak hour, the operational issues in the PM peak hour would be worsened with increased traffic on Fridays just like in the existing conditions. A summary of the operational issues is below:

Delay/LOS Issues:

- TH 210 at NW 4th Street
 - The eastbound and westbound left turning movement operates at LOS F.
 - The northbound approaches operate at LOS F.
 - The southbound approaches operate at LOS E
- The southbound stopped approach at N 1st Street/East River Road operates at a LOS F.
- The westbound left turning movement at N 8th Street operates at LOS F.
- TH 210 at 8th Avenue NE – the overall intersection operates at a LOS F.
 - All left turning movements operates at LOS F.
 - The northbound and eastbound approaches operates at LOS F.
 - The westbound and southbound approaches operate at LOS E.
- It should be noted that some additional lower volume left turn movements from TH 210 are not included in this summary, these volumes are all served within a single cycle and the delay is caused from the long signal cycle length.

Queuing Issues:

- The maximum southbound right turn queue at Baxter Drive extends beyond the available storage.
- TH 210 at NW 4th Street:
 - The maximum eastbound and westbound left turn queue extends beyond the available storage.
 - The maximum westbound queue extends beyond NW 2nd Street.
- TH 210 at N 4th Street:
 - The maximum westbound left turn queue extends beyond the available storage.
 - The maximum northbound left turn queue extends beyond the available storage.
- TH 210 at N 8th Street:
 - The maximum westbound left turn queue extends beyond the available storage.
 - The maximum northbound left turn queue extends beyond the available storage.
- The maximum westbound left turn queue at Gillis Avenue/13th Street SE extends beyond the available storage.
 - The maximum westbound queue extends into the 2nd Avenue NE intersection.
- The maximum eastbound left turn queue at 5th Avenue NE extends beyond the available storage and into the traffic signal at 4th Avenue NE.
- TH 210 at 8th Avenue NE:
 - The maximum eastbound left turn queue extends beyond the available storage.
 - The maximum northbound queue extends approximately 1,800 feet east of 8th Avenue NE on TH 25, a total queue of approximately 2,400 feet.

Table 12 represents the 2045 No Build traffic operations of the Friday peak hour. **Figure F7** in **Appendix F** shows the LOS and queuing information for each study intersection during the 2045 No Build Friday peak hour.

Table 12 – 2045 No Build Conditions – Friday Peak Hour

Intersection	Approach Delay (sec/veh / LOS)				Intersection Delay (sec/veh / LOS)
	Eastbound	Westbound	Northbound	Southbound	
Baxter Dr (Traffic Signal)	17.3 / B	15.1 / B	53.2 / D	49.2 / D	21.6 / C
NW 4 th St (Traffic Signal)	36.3 / D	46.7 / D	84.1 / F	63.0 / E	50.9 / D
N 1 st St/East River Rd (Minor Street Stop)	4.2 / A	2.6 / A	33.5 / D	75.7 / F	4.3 / A
N 4 th St (Traffic Signal)	15.6 / B	7.9 / A	42.8 / D	50.4 / D	17.2 / B
N 6 th St (Traffic Signal)	7.1 / A	11.4 / B	45.2 / D		15.1 / B
N 8 th St (Traffic Signal)	10.8 / B	30.3 / C	37.8 / D	43.7 / D	24.3 / C
Gillis Ave/13 th St SE (Traffic Signal)	7.0 / A	21.7 / C	37.1 / D	37.9 / D	17.3 / B
4 th Ave NE (Traffic Signal)	2.6 / A	3.4 / A	68.7 / E	44.0 / D	4.7 / A
5 th Ave NE (Minor Street Stop)	8.9 / A	0.2 / A		16.5 / C	6.2 / A
TH 25 Ramp (Exit Ramp)	0.5 / A	0.4 / A			0.5 / A
8 th Ave NE (Traffic Signal)	91.4 / F	71.7 / E	88.4 / F	64.8 / E	80.1 / F
10 th Ave NE (Minor Street Stop)	1.3 / A	0.5 / A	29.1 / D	8.8 / A	2.8 / A
13 th Ave NE (Minor Street Stop)	0.9 / A	0.2 / A		11.1 / B	1.2 / A

9.2.4 2045 No Build Operations – Summer Peak Hour

The summer peak hour has 10% higher traffic demands than the PM peak hour and the coordinated cycle length is 10 second longer than the PM peak; therefore, many of the same operational issues seen in the PM and Friday peak hours are worsened in the summer peak hour, just as they are in the existing conditions. A summary of the operational issues is below:

Delay/LOS Issues:

- The northbound and southbound approaches at Baxter Drive operates at LOS E.
- TH 210 at NW 4th Street – the overall intersection operates at LOS E.
 - The eastbound left turning movement operates at LOS F.
 - The northbound approaches operate at LOS F.
 - The southbound approaches operate at LOS E
- The southbound stopped approach at N 1st Street/East River Road operates at a LOS F.
- The westbound left turning movement at N 8th Street operates at LOS F.
- The westbound left turning movement at Gillis Avenue/13th Street NE operates at LOS F.
- TH 210 at 8th Avenue NE – the overall intersection operates at a LOS F.
 - All left turning movements operates at LOS F.
 - The northbound and eastbound approaches operates at LOS F.
 - The westbound and southbound approaches operate at LOS E.
- It should be noted that some additional lower volume left turn movements from TH 210 are not included in this summary, these volumes are all served within a single cycle and the delay is caused from the long signal cycle length.

Queuing Issues:

- The maximum southbound right turn queue at Baxter Drive extends beyond the available storage.
- TH 210 at NW 4th Street:
 - The maximum eastbound and westbound left turn queue extends beyond the available storage.
 - The maximum westbound queue extends beyond NW 2nd Street.
- TH 210 at N 4th Street:
 - The maximum westbound left turn queue extends beyond the available storage.
 - The maximum northbound left turn queue extends beyond the available storage.
- TH 210 at N 8th Street:
 - The maximum westbound left turn queue extends beyond the available storage.
 - The maximum northbound left turn queue extends beyond the available storage.
- The maximum westbound left turn queue at Gillis Avenue/13th Street SE extends beyond the available storage.
 - The maximum westbound queue extends into the 2nd Avenue NE intersection.
- The maximum eastbound left turn queue at 5th Avenue NE extends beyond the available storage and through the traffic signal at 4th Avenue NE.

- TH 210 at 8th Avenue NE:
 - The maximum eastbound left turn queue extends beyond the available storage.
 - The maximum northbound queue extends approximately 2,200 feet east of 8th Avenue NE on TH 25, a total queue of approximately 2,800 feet.

Table 13 represents the 2045 No Build traffic operations of the summer peak hour. **Figure F8** in **Appendix F** shows the LOS and queuing information for each study intersection during the 2045 No Build summer peak hour.

Table 13 – 2045 No Build Conditions – Summer Peak Hour

Intersection TH 210 at: (Traffic Control)	Approach Delay (sec/veh / LOS)				Intersection Delay (sec/veh / LOS)
	Eastbound	Westbound	Northbound	Southbound	
Baxter Dr (Traffic Signal)	18.1 / B	16.5 / B	58.8 / E	58.2 / E	23.7 / C
NW 4 th St (Traffic Signal)	35.1 / D	42.0 / D	242.4 / F	65.1 / E	70.5 / E
N 1 st St/East River Rd (Minor Street Stop)	3.7 / A	1.5 / A	42.4 / E	51.4 / F	3.6 / A
N 4 th St (Traffic Signal)	18.7 / B	8.6 / A	47.4 / D	53.8 / D	19.5 / B
N 6 th St (Traffic Signal)	9.5 / A	15.1 / B	47.5 / D		18.0 / B
N 8 th St (Traffic Signal)	10.9 / B	35.4 / D	41.3 / D	47.3 / D	27.0 / C
Gillis Ave/13 th St SE (Traffic Signal)	6.8 / A	25.9 / C	41.8 / D	41.9 / D	19.7 / B
4 th Ave NE (Traffic Signal)	5.4 / A	3.3 / A	69.7 / E	45.0 / D	6.1 / A
5 th Ave NE (Minor Street Stop)	12.4 / B	0.3 / A		19.6 / C	8.4 / A
TH 25 Ramp (Exit Ramp)	2.5 / A	0.4 / A			1.5 / A
8 th Ave NE (Traffic Signal)	117.4 / F	75.2 / E	99.4 / F	70.0 / E	92.6 / F
10 th Ave NE (Minor Street Stop)	1.2 / A	0.5 / A	36.4 / E	9.2 / A	3.3 / A
13 th Ave NE (Minor Street Stop)	0.9 / A	0.2 / A		14.3 / B	1.4 / A

10 Conclusions

MnDOT is planning to reconstruct TH 210/Washington Street between Baxter Drive and PineShores Road beginning in 2025. MnDOT is currently studying the corridor to better understand the community issues, needs and use of the roadway.

While the overall study will inform plans for the future of the roadway, this document provides information for the existing conditions of the corridor. The following conditions were evaluated:

- Crash History
- Access Inventory
- Parking Study
- Traffic Volumes (Existing and Future No Build)
- Vehicle Origins and Destinations
- Traffic Control Warrants
- Traffic Operations (Existing and Future No Build)

Crash History

Based on the 5-year crash history along the study corridor, the intersection of TH 210 at N 6th Street has a crash rate that is above the critical rate and, therefore, is considered to have a sustained crash problem. The intersections of TH 210 at NW 4th Street, N 4th Street, Gillis Avenue/13th Street SE, and 8th Avenue NE have crash rates that are approaching the critical rate, which could indicate that there are safety concerns at those intersections. Two additional intersections approaching the critical rate have been improved or closed and should no longer have safety concerns, these include 1st Avenue NE and the TH 25 Entrance Ramp intersection.

Nearly 50% of crashes along the TH 210 corridor were rear end crashes at the 8 signalized intersections (91% of those on TH 210), which are likely due to congestion along the corridor during peak traffic demand periods. There were a total of 10 pedestrian or bicycle crashes during the 5-year analysis period.

The 2018/2019 signal timing and coordination project completed along TH 210 should improve some of the congestion and thus improve safety with a possible reduction in rear-end collisions.

Access Inventory

The 3.9 mile study corridor has a total 116 access locations along the TH 210 principal arterial. There are 8 signalized intersections, 19 full access minor street stop controlled intersections, and 13 reduced access (3/4 access or RI/RO) intersections. There are a total of 75 private driveways spread out along the corridor.

Signal spacing along the principal arterial meets the recommended ¼ mile spacing for the majority of the corridor; however, the spacing in the Central segment between N 4th Street and N 8th Street does not meet the spacing guidelines.

The Central segment of the TH 210 corridor also has the most private driveways, with 53% of the total corridor driveways in a short 3/4 mile segment. Access modifications should be considered throughout the study corridor.

Parking Study

Based on the parking study along the TH 210 corridor, parking demands on TH 210 are low throughout the day and there is adequate on-street parking on the side streets to accommodate the parking needs for the businesses along TH 210 that have no or limited off street parking if parking were to be restricted on TH 210.

Traffic Volumes

Intersection traffic counts were collected at 13 intersections along the TH 210 corridor in both 2018 and 2019. The 2018 counts not only included weekday peaks, but Friday, Saturday, and Sunday data as well.

Based on the 2018 data, the weekend days only had peak volumes that are typical of the weekday mid-day time period and therefore not considered for analysis. The Friday peak period resulted in approximately a 5% increase of the weekday PM peak hour; however it should be noted this volume is sustained from before 1pm through 5pm.

Based on the StreetLight data, a summer peak hour was determined to be approximately 10% greater than the weekday PM peak hour.

Based on historical AADT data, population trends, and input from the PMT, a growth rate of 0.5% per year was used to evaluate the future 2045 conditions. All existing intersection peak hour data was increased by the growth rate to develop the 2045 No Build traffic volumes.

Vehicle Origins and Destinations

MnDOT's regional subscription to StreetLight was used to assess different traffic patterns in the project area.

A corridor wide OD study was done to better understand traffic patterns as well as input into the operations analysis for the study. The results shows that the total "through" trips, trips traveling from one end to the other, along TH 210 is relatively low. Eastbound through trips is about 7% of the daily which is estimated to be about 1,200 vehicles per day; westbound through trips have a higher percentage, 28%, but with a lower AADT the trips are estimated to be about 1,600 vehicles per day.

The highest destinations along the corridor are related to the roadways with higher volumes including the three main intersections in the Central segment of N 4th Street, N 6th Street, N 8th Street, and the TH 25/8th Avenue intersection.

A small OD analysis of the 5th Avenue traffic was completed and showed this roadway is used heavily as a back entrance in the retail area as well as a bypass of the 8th Avenue signal.

Seasonal information was analyzed to compare spring/fall months to summer months to see the impact the "cabin" traffic has on the corridor. The results show that summer months have approximately 25% more traffic throughout the day as a typical month; however sorting through the data by peak periods resulted in an approximate 10% increase of the PM peak hour to account for a "summer" peak hour in the operations analysis.

Traffic Control Warrants

Based on both the existing and future traffic volumes, the majority of intersections along the TH 210 study corridor may retain their existing intersection control.

Based on the warrant analysis, the removal of the existing traffic signal at the intersection of TH 210 at 4th Avenue NE is warranted, as the traffic volumes in 2019 and 2045 do not meet 60% of the traffic signal volume warrant thresholds.

The intersection of TH 210 at 5th Avenue NE does meet traffic signal warrants when the eastbound left turns are analyzed as the minor street volume and the westbound volumes are analyzed as the major street volume. Therefore, a traffic signal at the intersection of TH 210 at 5th Avenue NE is a viable option and should be considered further.

All other intersections along the corridor should maintain their existing traffic control based on the warrant analysis.

Traffic Operations

The study corridor was modeled in the VISSIM (version 2020) traffic operations platform. This model provides realistic interactions between vehicles, pedestrians, and bicyclists along the corridor. The existing and future traffic volumes were modeled for the AM, PM, Friday and summer peak hours. Due to the increased volumes in the summer peak, this analysis period has the overall worst traffic operations in both the existing and future year analysis.

Based upon the traffic operations analysis, the following intersections do not have any major delay or queueing issues during the AM, PM, Friday, or summer peak hours in either the existing or 2045 No Build conditions.

- **TH 210 at N 1st Street/East River Road (Minor Street Stop)**
 - In 2045 the minor approaches will operate at LOS E/F due to limited gaps on TH 210.
- **TH 210 at N 6th Street (Traffic Signal)**
 - Due to the reduced intersection movements and existing capacity, this intersection will operate well through 2045.
- **TH 210 at 4th Avenue NE (Traffic Signal)**
 - Due to low volumes, this intersection will operate at acceptable levels through 2045. The only exception is when the 5th Avenue NE left turn queue spills into this intersection.
- **TH 210 at TH 25 Ramp (Exit Ramp)**
 - The eastbound right turn movement is free and has no delay issues.
- **TH 210 at 10th Avenue NE (Minor Street Stop)**
 - In 2045 the northbound approach will operate at a LOS E/F due to limited gaps on TH 210.
- **TH 210 at 13th Avenue NE (Minor Street Stop)**
 - The intersection will operate at acceptable levels of service through 2045.

The following intersections have operational and/or queueing issues under 2019 existing conditions that should be considered for potential improvements.

- **TH 210 at Baxter Drive (Traffic Signal)**
 - Overall the intersection operates at a LOS C or better.
 - The northbound and southbound approaches operates with movements at LOS E and LOS F during the Friday and summer peak hours.
 - The maximum southbound right turn queue extends beyond the available storage during the PM, Friday, and summer peak hours and blocks some driveways.
 - The maximum northbound left turn queue extends beyond the available storage; however, through and right turning vehicles can bypass the queue.
- **TH 210 at NW 4th Street (Traffic Signal)**
 - Overall the intersection operates at a LOS D, but does reach a LOS E during the summer peak. The intersection has increased delays due to the split signal phasing for the minor street approaches.
 - The TH 210 eastbound left turn has delay issues and the maximum eastbound left turn queue extends beyond the available storage.
 - The northbound and southbound minor street approaches have delay issues with LOS F and LOS E, respectively, due to higher traffic volumes.
 - The maximum westbound TH 210 queue extends beyond NW 2nd Street during periods of higher volumes and can extend onto the river bridge.
- **TH 210 at N 4th Street (Traffic Signal)**
 - Overall the intersection operates at a LOS B or better.
 - The southbound approach has delay issues during the summer peak hour.
 - The maximum northbound left turn queue extends beyond the available storage during the Friday and summer peak hours; storage is limited due to the rail crossing.
- **TH 210 at N 8th Street (Traffic Signal)**
 - Overall the intersection operates at a LOS C or better.
 - The westbound TH 210 left turn movement experiences delay issues and the maximum queue extends beyond the available storage during all peak hours; the queue extends through the N 9th Street intersection.
 - The maximum northbound left turn queue extends beyond the available storage during the PM, Friday, and summer peak hours; storage is limited due to rail crossing.
- **TH 210 at Gillis Avenue/13th Street SE (Traffic Signal)**
 - Overall the intersection operates at a LOS B or better.
 - The maximum westbound left turn queue extends beyond the available storage during the AM, PM, Friday, and summer peak hours; the queue extends through the 1st Avenue NE intersection.
- **TH 210 at 5th Avenue NE (Minor Street Stop, ¾ Access)**
 - Overall the intersection operates at a LOS A; however, the eastbound left turn operates at a LOS D or better.

- The maximum eastbound left turn queue extends beyond the available storage during the AM, PM, Friday, and summer peak hours; the queue can extend into the 4th Avenue NE intersection.
- **TH 210 at 8th Avenue NE (Traffic Signal)**
 - Overall the intersection operates at a LOS E or better. The intersection has increased delays due to the split phasing for the minor street approaches and limited capacity on the minor approaches.
 - The eastbound left turn has delay issues and the maximum left turn queue extends beyond the available storage.
 - The northbound approach has delay issues and the maximum northbound queue extends beyond the intersection of TH 25 at 8th Avenue NE.
 - The higher volume peaks create LOS F for all left turn movements and LOS E operations on all approaches.

With increased traffic demands in the 2045 No Build scenarios, many of the same delay and queueing issues are intensified. The only programmed intersection improvements along TH 210 is at NW 4th Street, which was included in the forecast scenario. All other existing intersection geometry and signal phasing was carried forward; however, signal timings were modified to account for the increased traffic volumes.

In addition to the operational issues in the 2019 existing conditions, the following additional delay and queueing issues have been identified in the 2045 No Build analysis.

- **TH 210 at Baxter Drive (Traffic Signal)**
 - Overall the intersection still operates at a LOS C or better
 - The northbound and southbound delays and queues increased.
- **TH 210 at NW 4th Street (Traffic Signal)**
 - Overall the intersection would still operate at a LOS D, but does reach a LOS E during the summer peak. While, the intersection improvement removed the split phasing, the limited northbound approach capacity operates with long delays.
- **TH 210 at N 4th Street (Traffic Signal)**
 - Overall the intersection still operates at a LOS B or better.
 - The maximum northbound left turn queue still extends beyond the available storage during the PM peak hour.
 - The maximum westbound left turn queue extends beyond the available storage during the AM, Friday and summer peak hours.
- **TH 210 at N 8th Street (Traffic Signal)**
 - Overall the intersection still operates at a LOS C or better.
 - The westbound left turn and northbound left turn queues continue to extend beyond the available storage.
- **TH 210 at Gillis Avenue/13th Street SE (Traffic Signal)**
 - Overall the intersection still operates at a LOS B or better.
 - The maximum westbound left turn queue extends further beyond the available storage; the queue can extend into the 2nd Avenue NE intersection.
- **TH 210 at 5th Avenue NE (Minor Street Stop, ¾ Access)**

- Overall the intersection operates at a LOS A; however, the eastbound left turn operates at a LOS E or better.
- The maximum eastbound left turn queue extends beyond the available storage during the AM, PM, Friday, and summer peak hours; the queue extends into the 4th Avenue NE intersection.
- **TH 210 at 8th Avenue NE (Traffic Signal)**
 - Overall intersection operates under failing conditions, LOS F.
 - All existing operational issues are increased with long delays on all four approaches.