Appendix C: Existing Conditions Memo

Appendix C details existing data collection and analysis for the following items:

- Existing Traffic Counts
- Interstate Percentile Speeds
- Origin & Destination Volumes
- Safety Data

METROCOG

FARGO-MOORHEAD METROPOLITAN COUNCIL OF GOVERNMENTS

HDR

Existing Conditions & Data Collection Report

Interstate Operations Study &
Plan for Future Improvements

January 4, 2022

Table of Contents

Appendix Material

- Existing Average Annual Daily Traffic
- Existing Interstate Lane Configuration

Figures

Tables

Introduction

This report details the data collection efforts and existing conditions assessment for the Interstate Operations Analysis and Plan for Future Improvements. The objectives and anticipated outcomes for this study include:

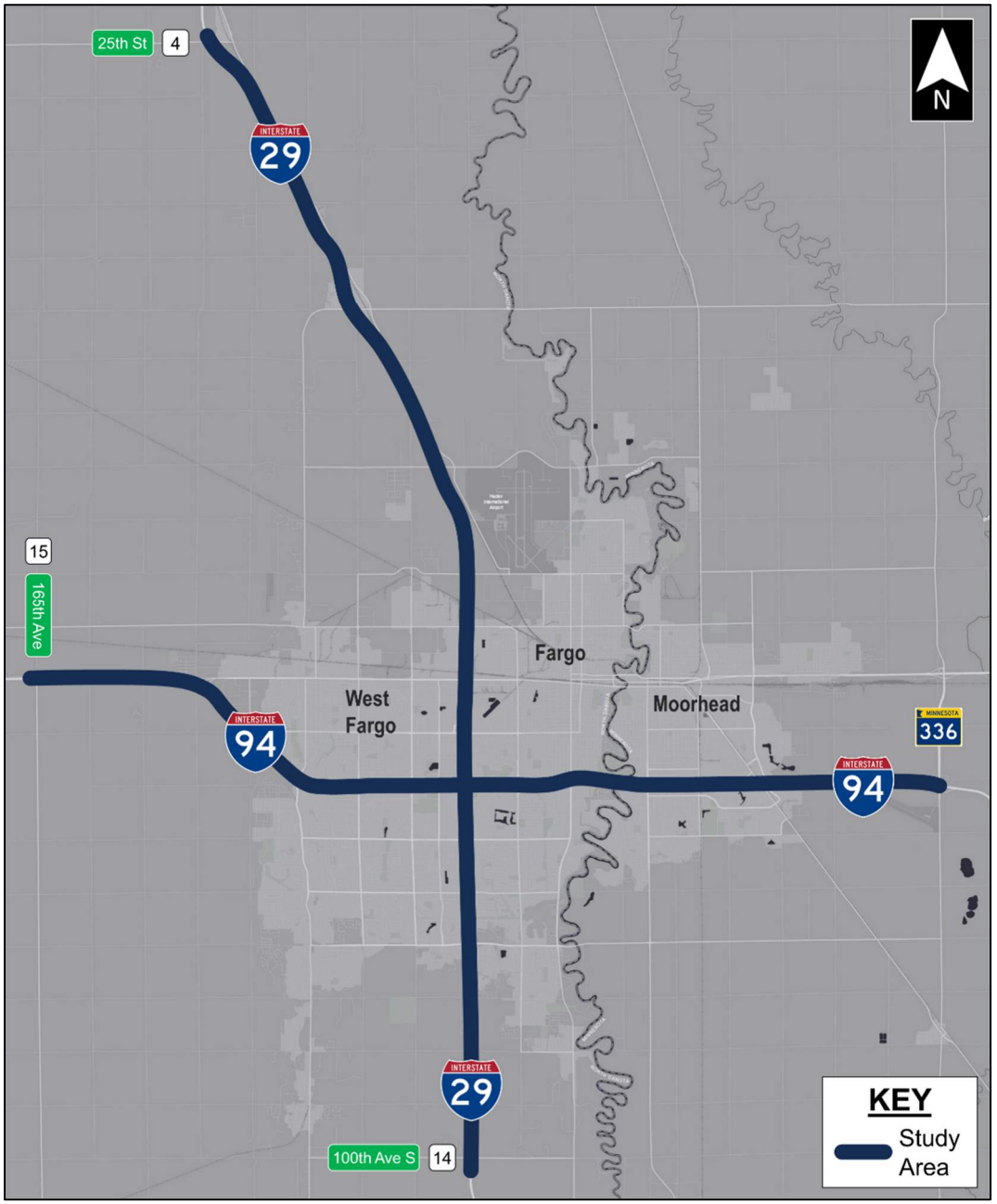
- Present a clear menu of prioritized improvements
  - Including what deficiencies improvements address (operations, safety, reliability, etc.)
- Provide operational and analytical data to assist with later project development phases
- Determine the feasibility of potential ring routes

The project study area is shown in **Figure 1**. It is located in the Fargo-Moorhead Metropolitan Area and is defined by the following limits:

- Interstate 94
  - West Limit: 165th Avenue / Cass County 15
  - East Limit: Minnesota 336
- Interstate 29
  - North Limit: Cass County 4 (Argusville)
  - South Limit: 100th Avenue S / Cass County 14

The study area includes Interstate mainline segment, system ramps, service ramps, rest areas, and ramp terminal intersections along I-29 and I-94.

Figure 1. Interstate Operations Analysis Study Area



Data Collection

The Interstate Operations Analysis scope of work included the following data collection items. The following items were used to establish existing conditions within the study area.

- Peak Travel Times & Speeds
- Traffic Count Data
- Origin & Destination Volumes (Including Freight)
- Safety Data

Peak Travel Times & Speeds

Historical peak travel times from 2019 were collected from the National Performance Management Research Data Set (NPMRDS). This data was used to investigate areas of recurring and non-recurring congestion as part of the existing conditions assessment.

NPMRDS travel times and speeds will also be used to calibrate the microsimulation model later in the study.

Traffic Count Data

Traffic data were collected from the following sources:

- Miovision Counts
- MetroCOG Interstate Counts
- NDDOT Interstate Counts
- Automatic Traffic Recorder Counts
- StreetLight Data

These counts will be used to establish baseline/existing peak hour volumes and future year 2045 peak hour volumes for operational analysis and microsimulation model development which will be discussed in the future conditions report later in the study.

Average Annual Daily Traffic (AADT) maps were developed for I-29 and I-94 mainline and ramp segments. AADT maps are shown in the **Appendix**.

Origin & Destination Volumes

StreetLight data were collected from MetroCOG's StreetLight data subscription. This data was used to analyze potential ring routes (including regional freight movements) as part of the existing conditions assessment.

Streetlight data will also be used to develop seed matrices for OD-Matrix-Estimation and to analyze weaving percentages between interchanges later in the study.

Safety Data

Five years of pre-COVID safety data (2015-2019) was collected from NDDOT and MnDOT. This data was used for crash analysis for all interstate segments, ramps, and ramp terminal intersections. Due to the change in travel patterns since March 2020, safety data from 2020 will be collected as a reference, but not used for crash analysis.

This data was used to analyze patterns in crashes occurring along the study corridors as part of the existing conditions assessment.

Note that crash data was not received from MnDOT for 2015. To keep the number of years consistent for both states, four years of pre-COVID data were used for safety analysis in the study area.

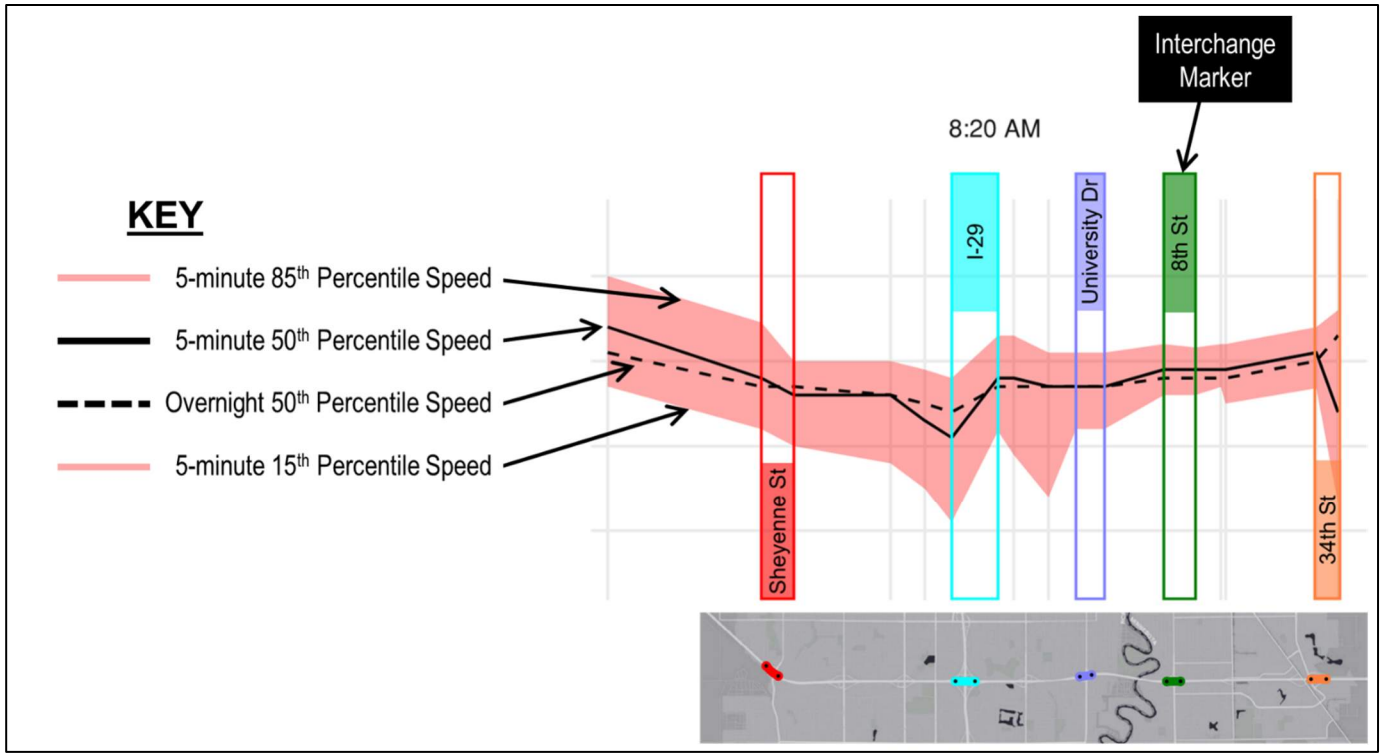
Existing Conditions

Speed Profiles

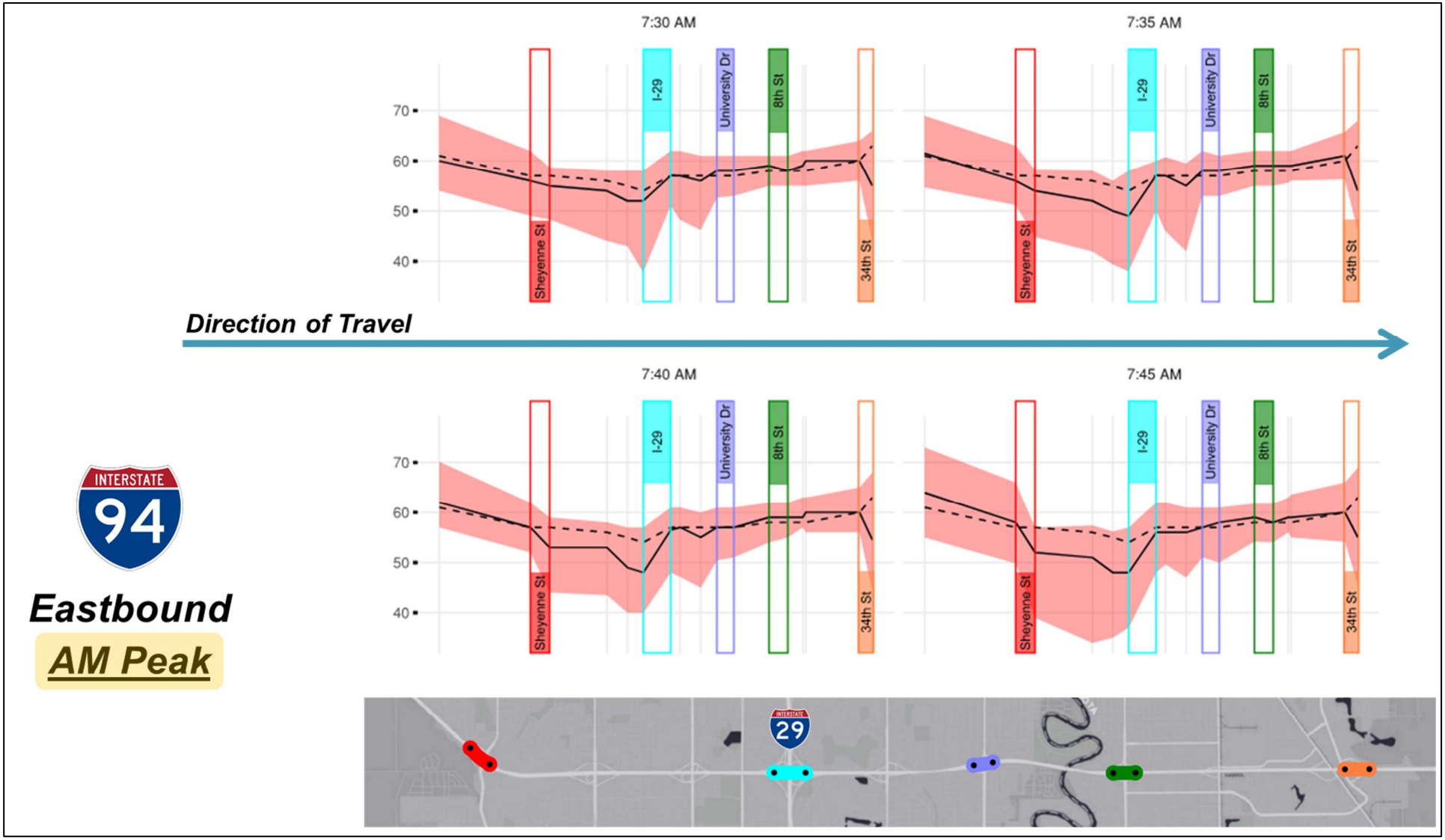
Historical NPMRDS speed data was collected along I-94 and I-29 to establish the limits and duration of recurring congestion within the Fargo-Moorhead Metropolitan Area. This section details the results of the speed profile analysis.

A key for the speed profile analysis is shown in **Figure 2**. Percentile speeds were established by taking the average speed for every weekday in 2019 (Monday through Thursday – excluding holidays) within a specific 5-minute time slice. Percentiles were calculated from these average speeds over 5 minutes. For reference, an overnight 50th percentile speed profile is shown on each figure to represent an average free flow speed.

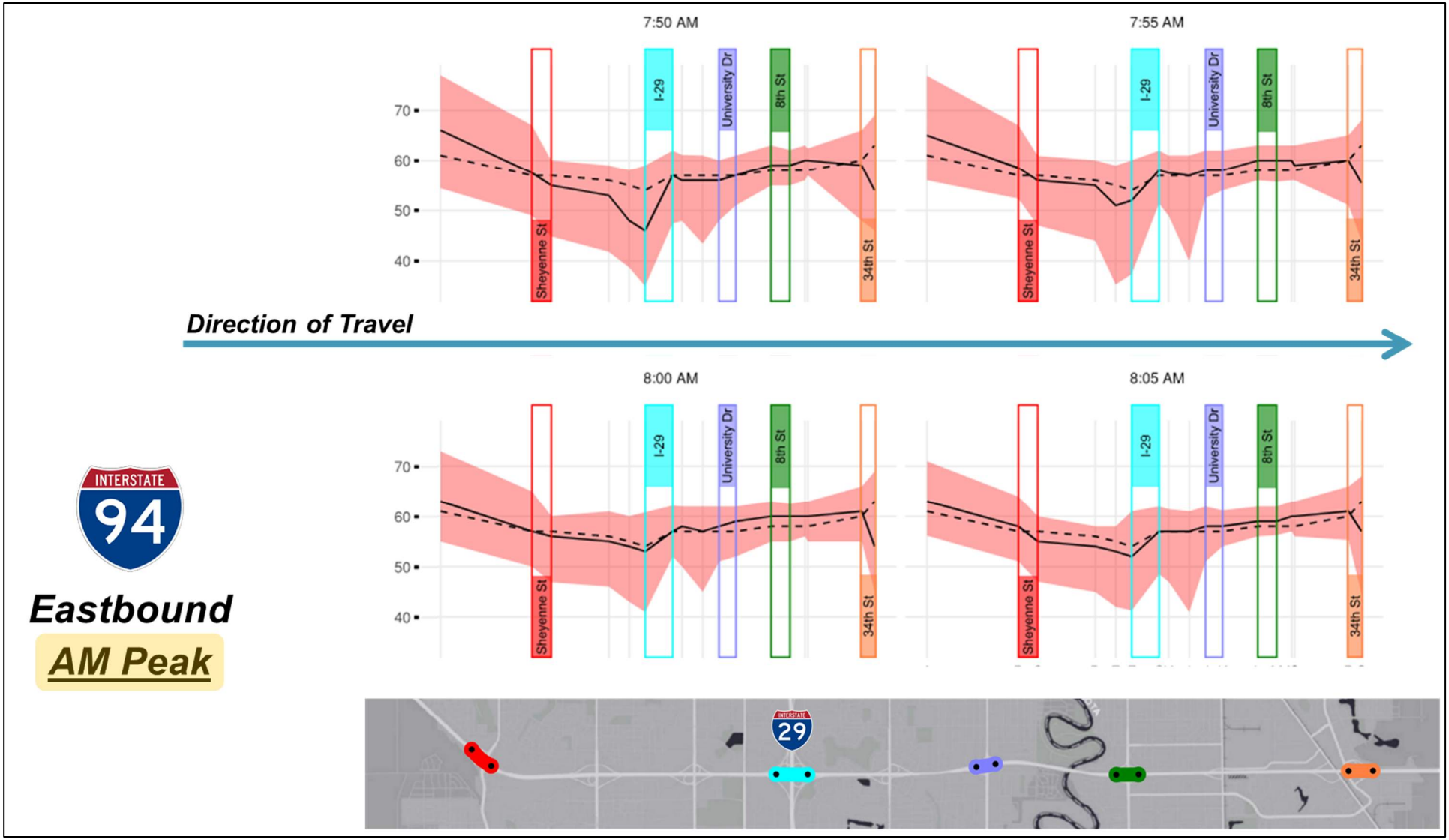
Figure 2. Speed Profile Analysis Key



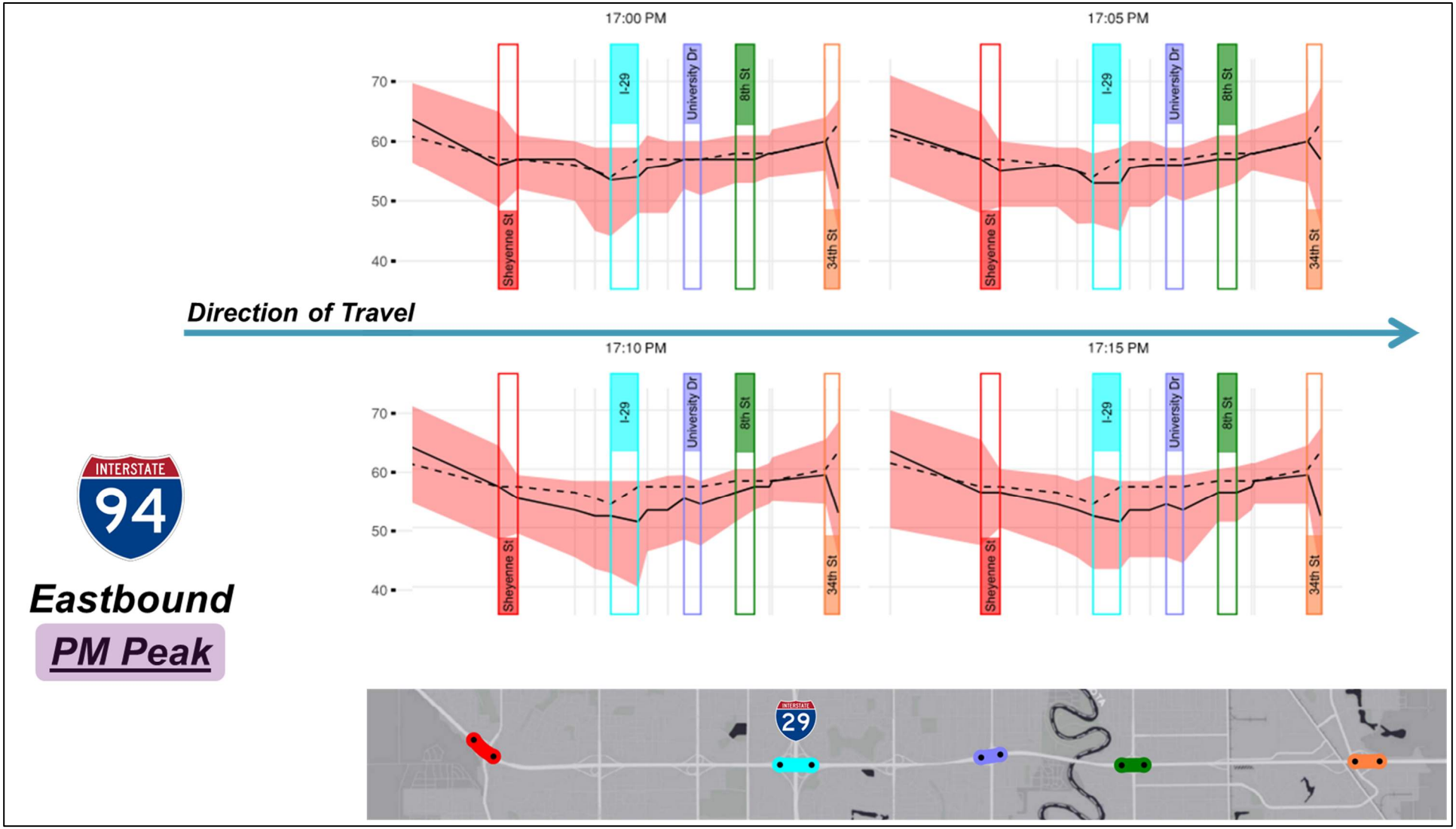
I-94 Eastbound
AM Peak (7:30 – 7:50 AM)



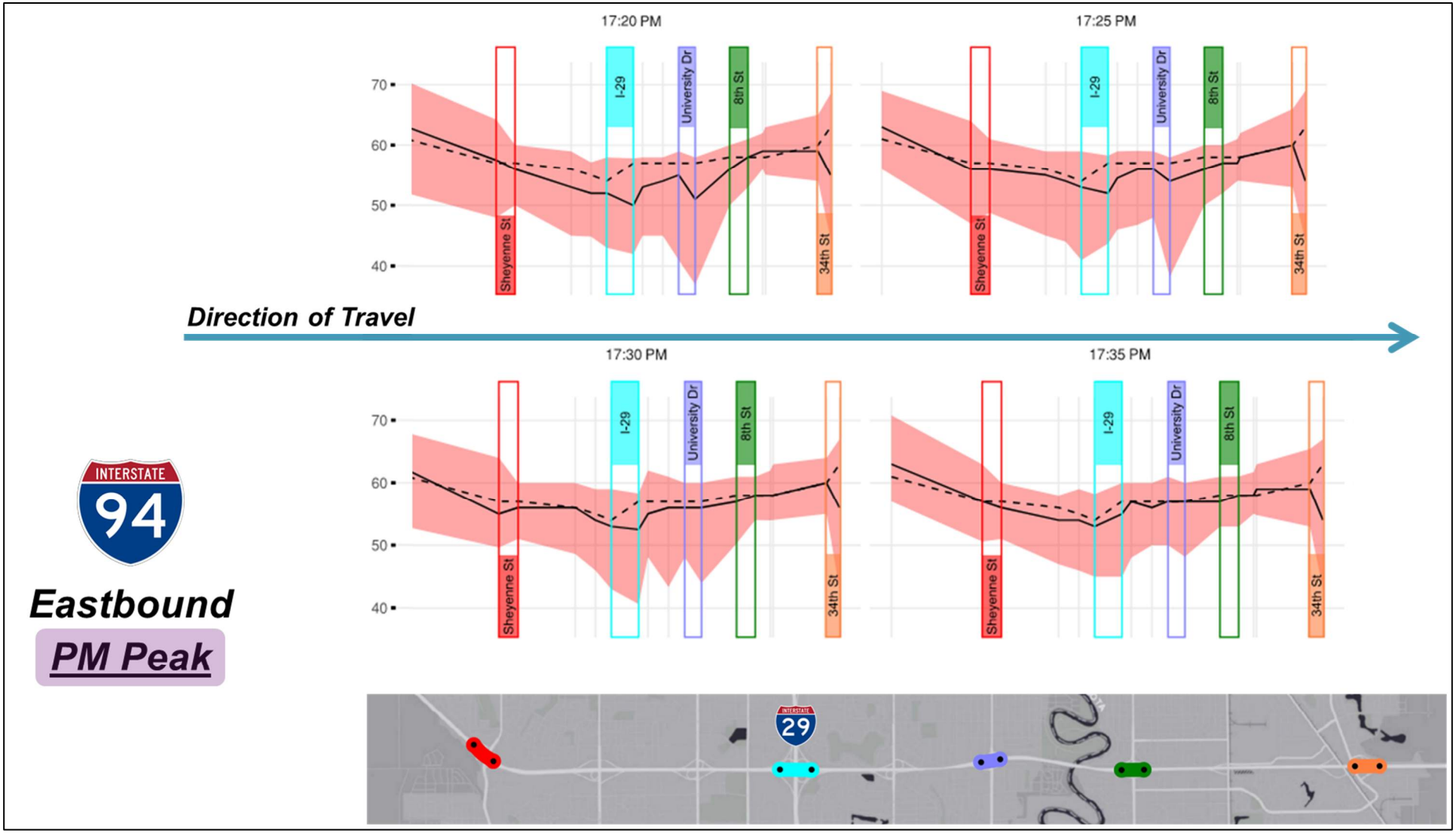
I-94 Eastbound
AM Peak (7:50 – 8:10 AM)



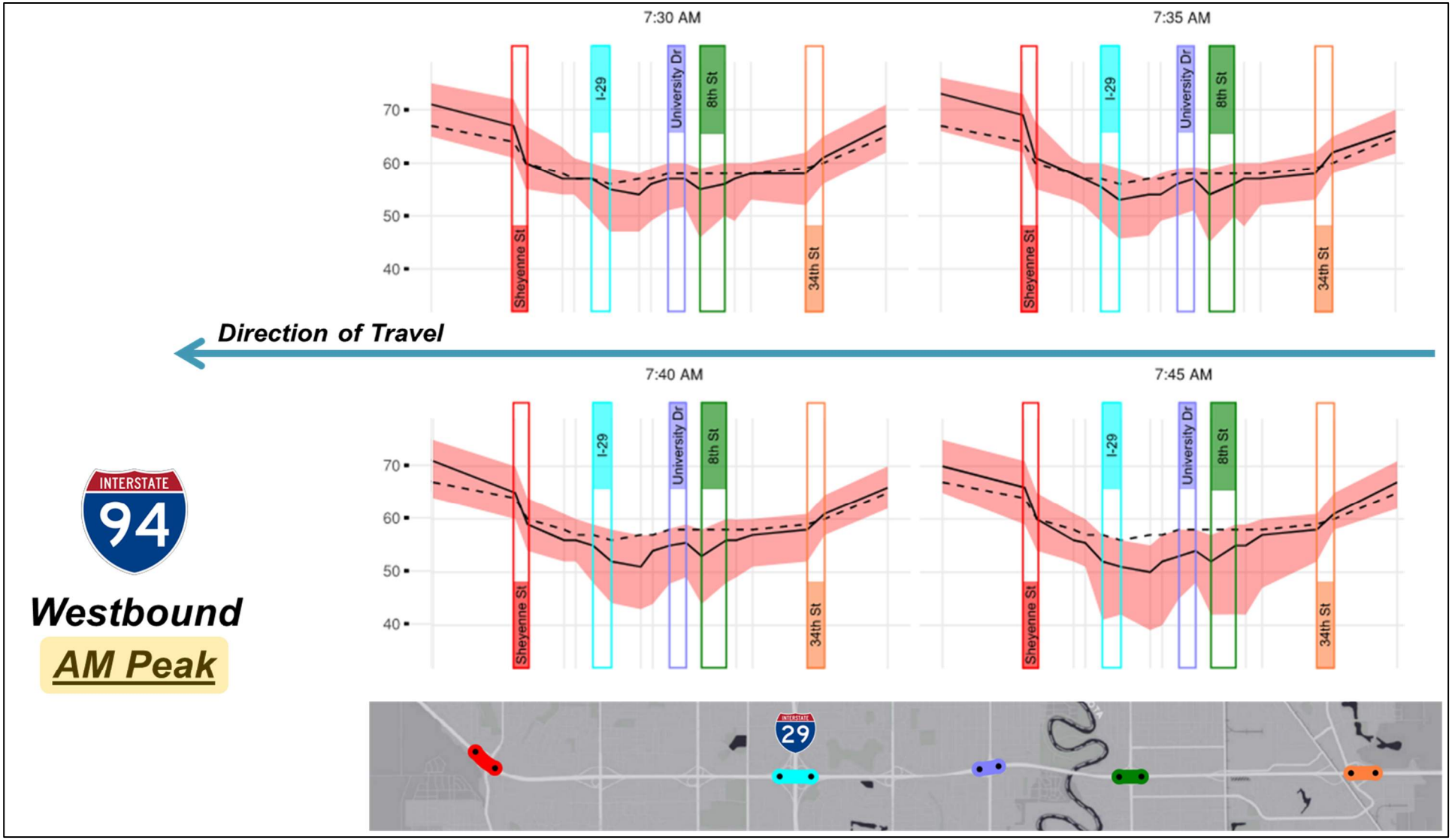
I-94 Eastbound
PM Peak (5:00 – 5:20 PM)



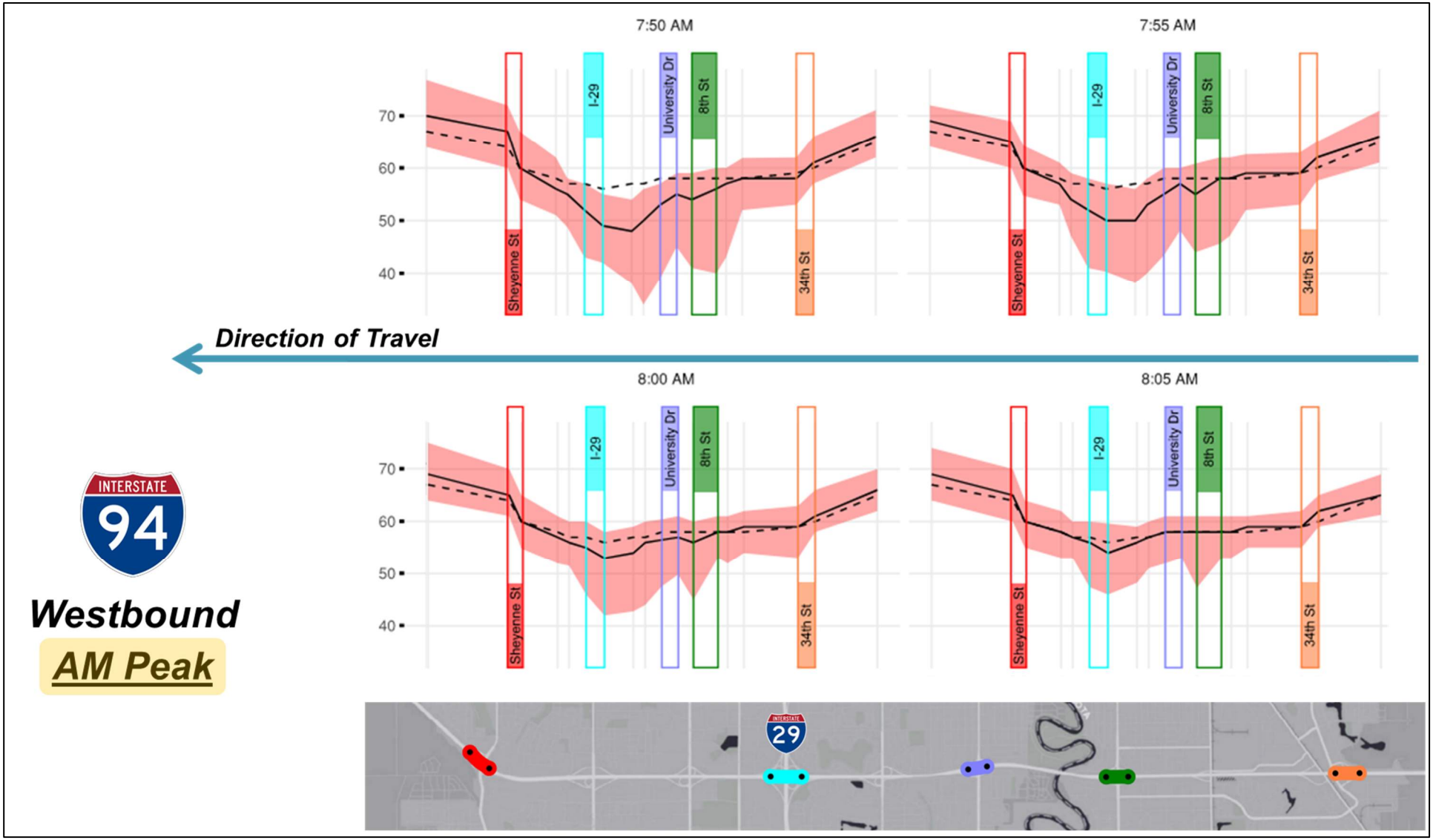
I-94 Eastbound
PM Peak (5:20 – 5:40 PM)



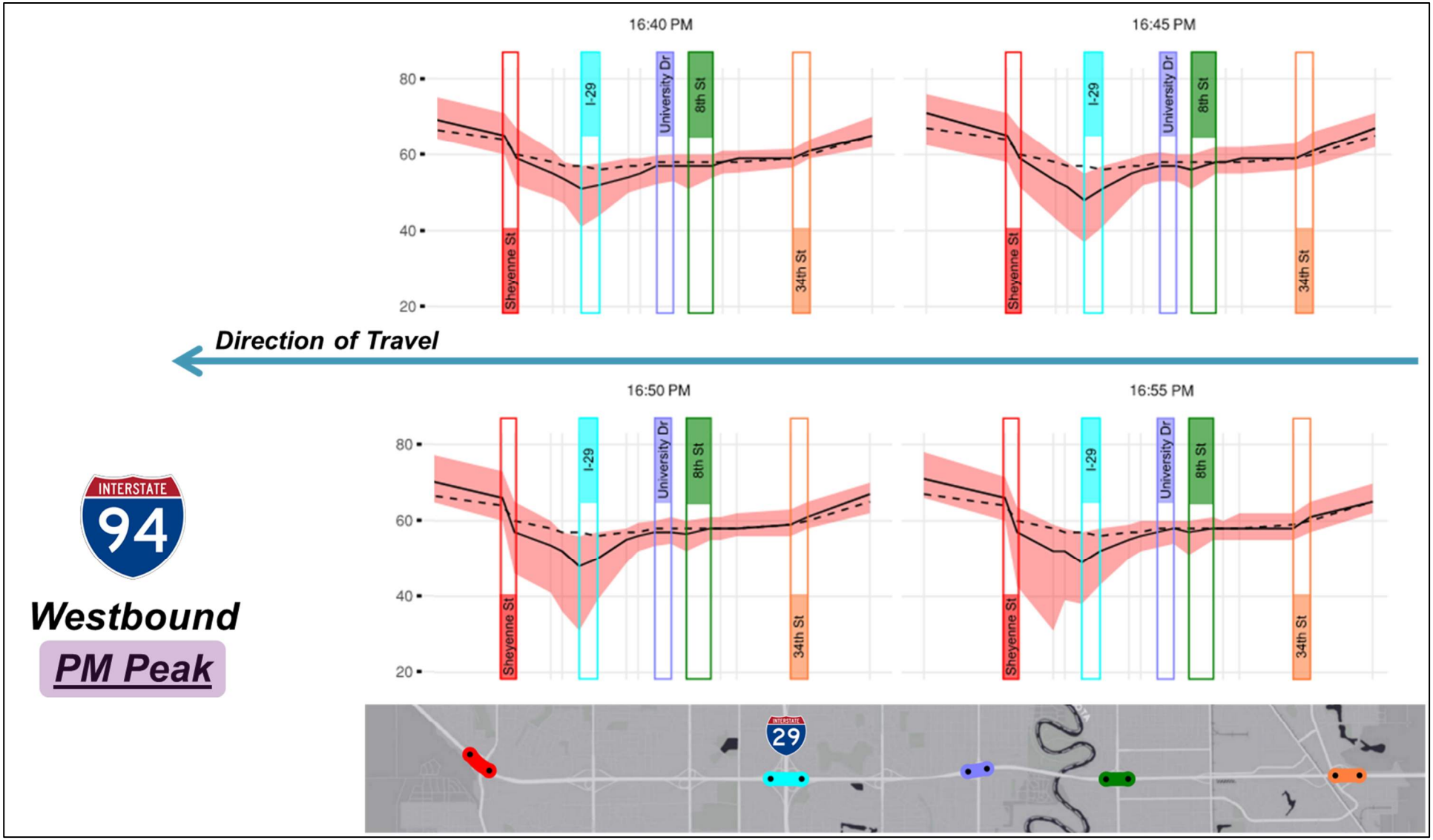
I-94 Westbound
AM Peak (7:30 – 7:50 AM)



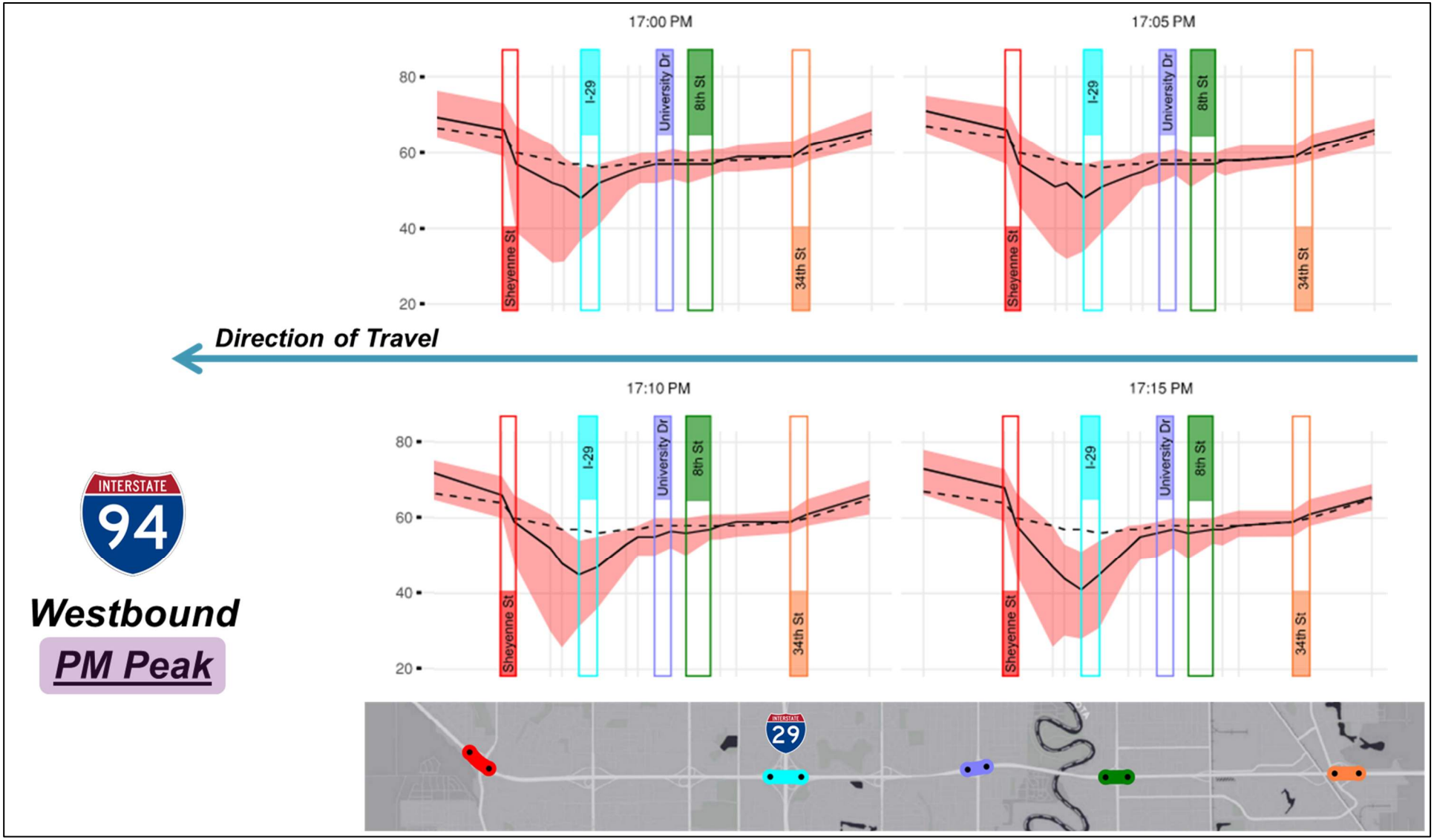
I-94 Westbound
AM Peak (7:50 – 8:10 AM)



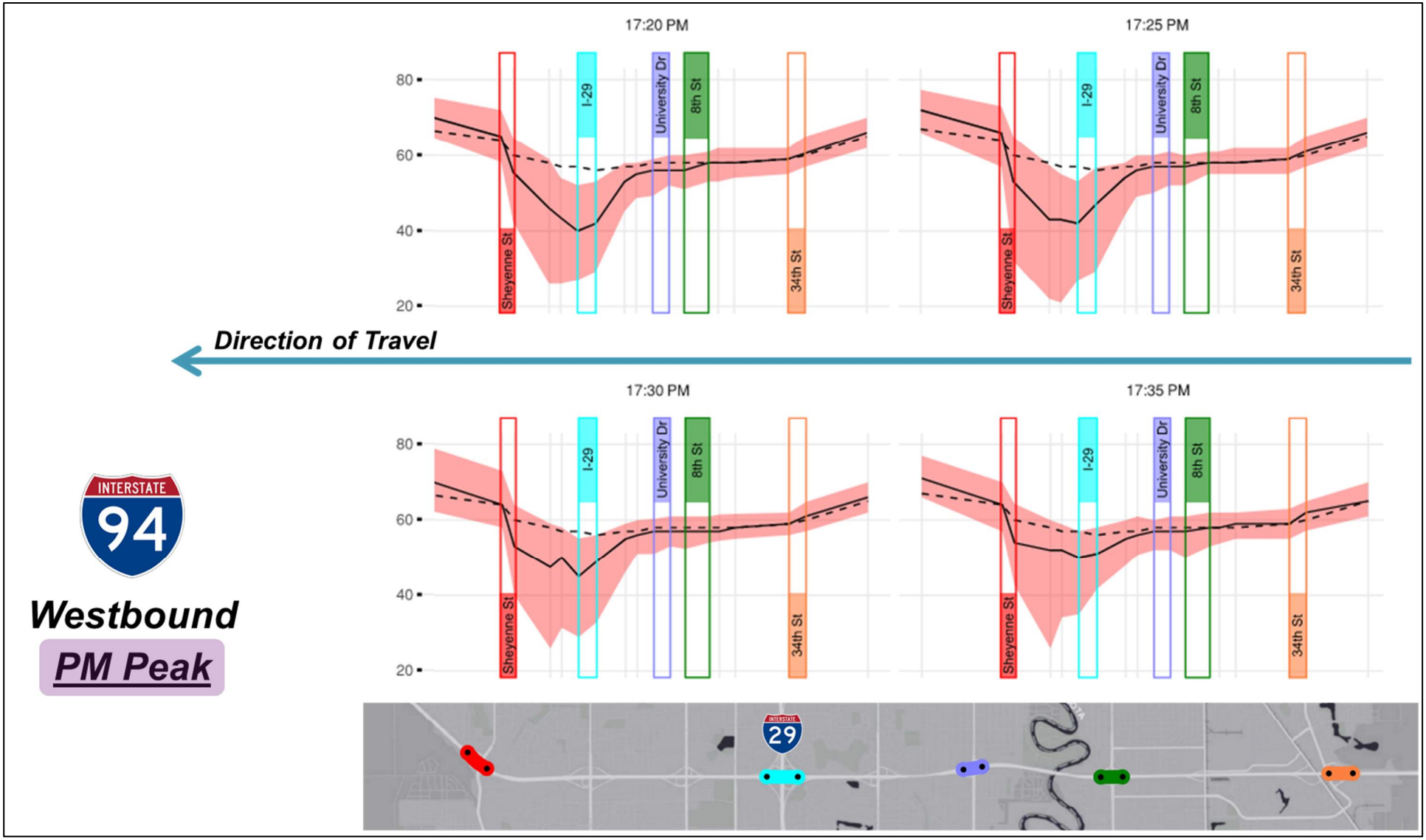
I-94 Westbound
PM Peak (4:40 – 5:00 PM)



I-94 Westbound
PM Peak (5:00 – 5:20 PM)



I-94 Westbound
PM Peak (5:20 – 5:40 PM)



I-94 Summary

AM Eastbound

- Congestion begins: 7:35 AM
- Congestion ends: 7:55 AM
- Peak of AM congestion: 7:45 AM
- Area of congestion: Between Sheyenne Street through I-29
- Peak area of congestion: Between 45th Street to I-29
  - Resulting in 8 mph speed reduction

PM Eastbound

- Congestion begins: 5:10 PM
- Congestion ends: 5:25 PM
- Peak of PM congestion: 5:15 PM
- Area of congestion: Between Sheyenne Street through 8th Street
- Peak area of congestion: Between I-29 to University Drive
  - Resulting in 5 mph speed reduction

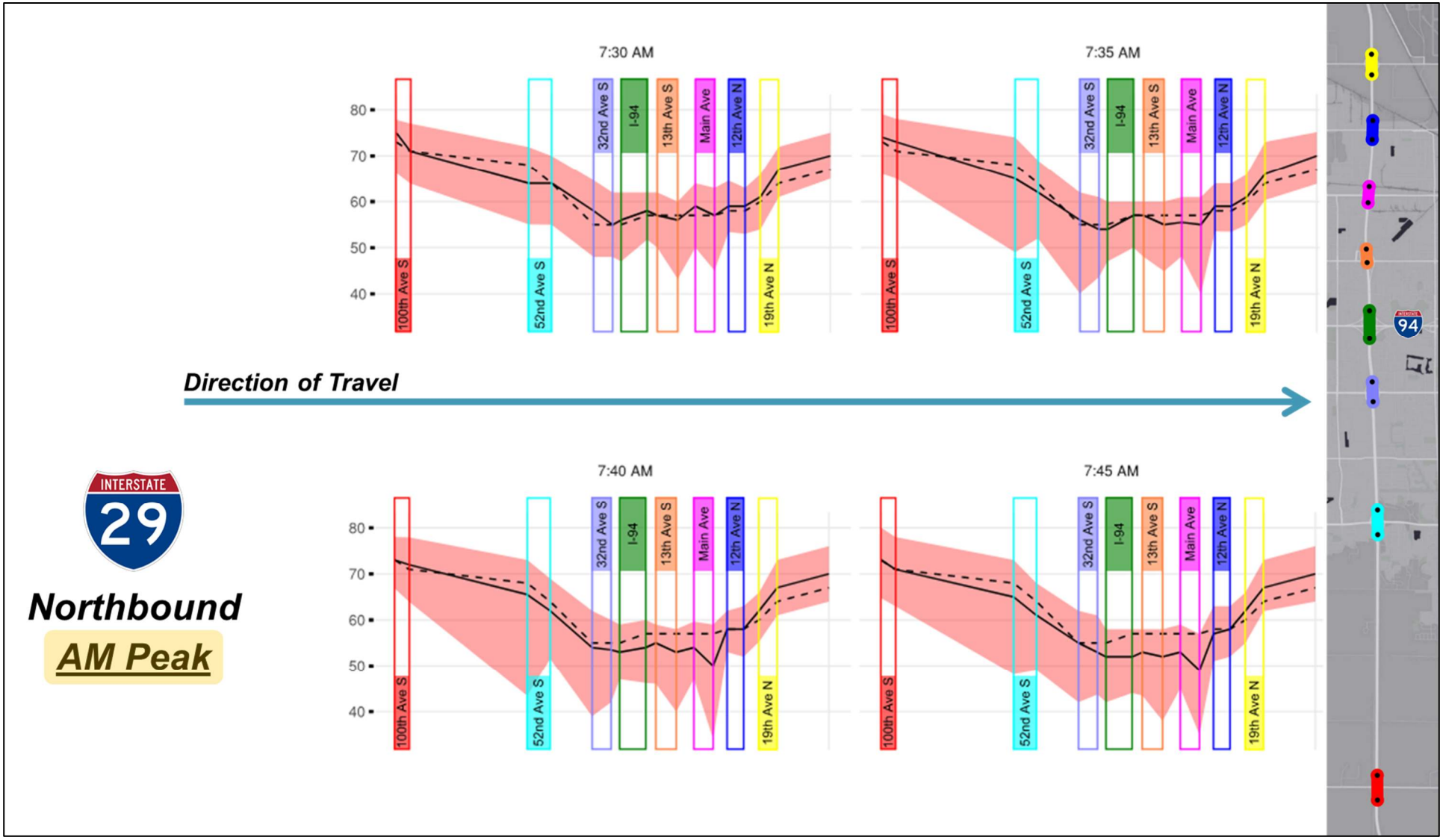
AM Westbound

- Congestion begins: 7:35 AM
- Congestion ends: 8:00 AM
- Peak of AM congestion: 7:50 AM
- Area of congestion: Between 8th Street through 45th Street
- Peak area of congestion: Between 25th Street to I-29
  - Resulting in 9 mph speed reduction

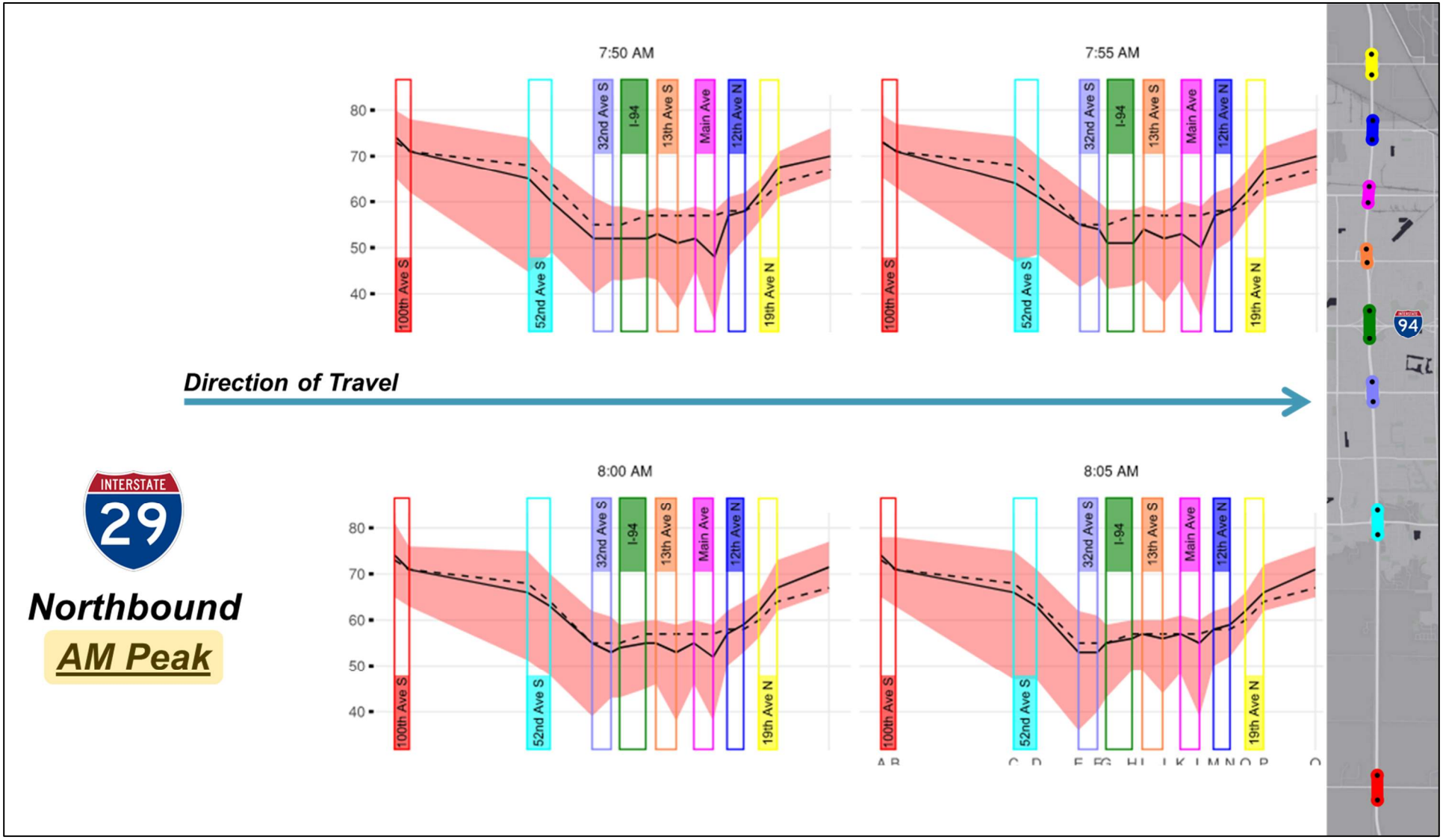
PM Westbound

- Congestion begins: 4:45 PM
- Congestion ends: 5:30 PM
- Peak of AM congestion: 5:20 PM
- Area of congestion: Between 25th Street to Sheyenne Street
- Peak area of congestion: Between 25th Street through 45th Street
  - Resulting in 16 mph speed reduction

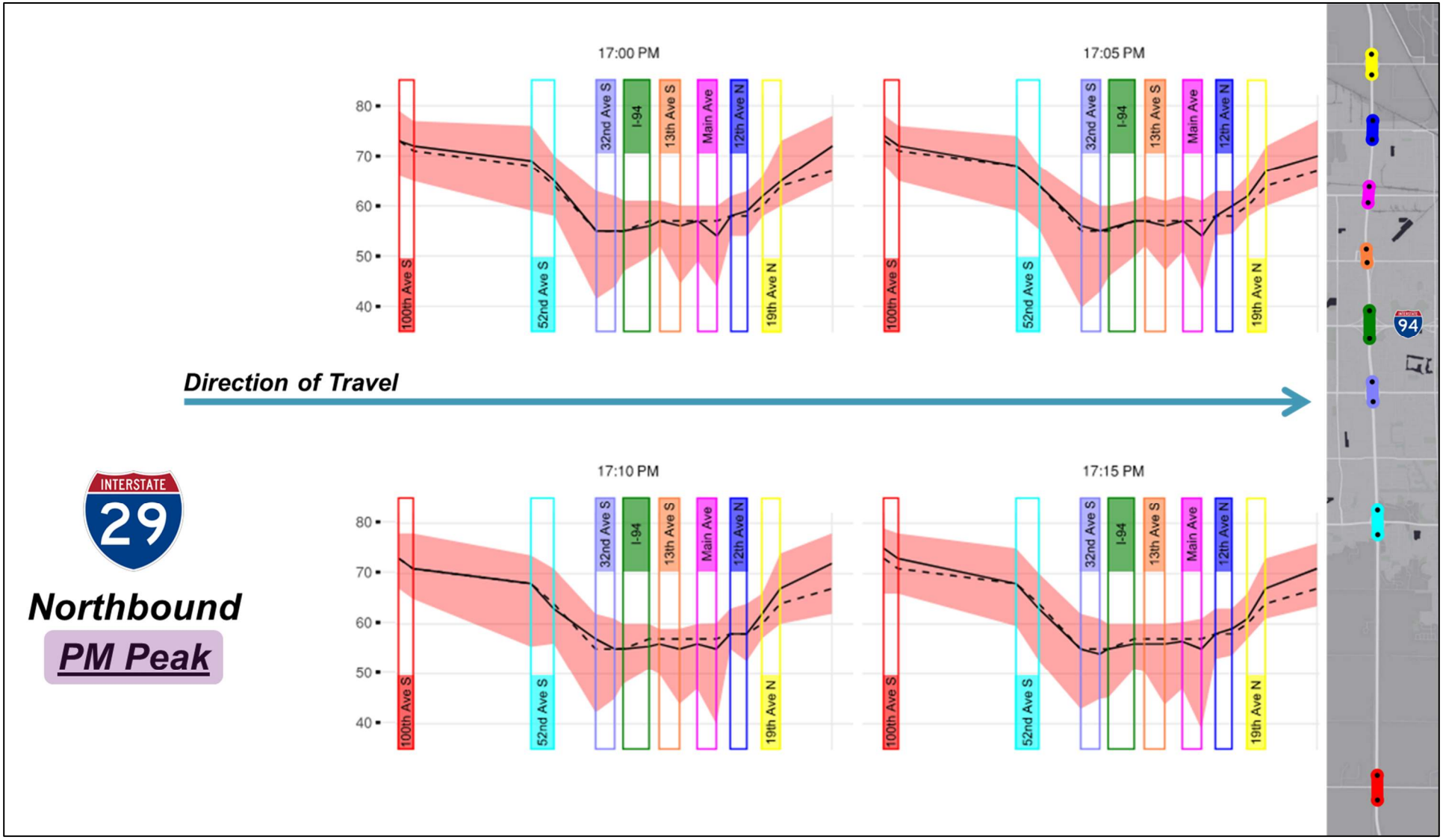
I-29 Northbound
AM Peak (7:30 – 7:50 AM)



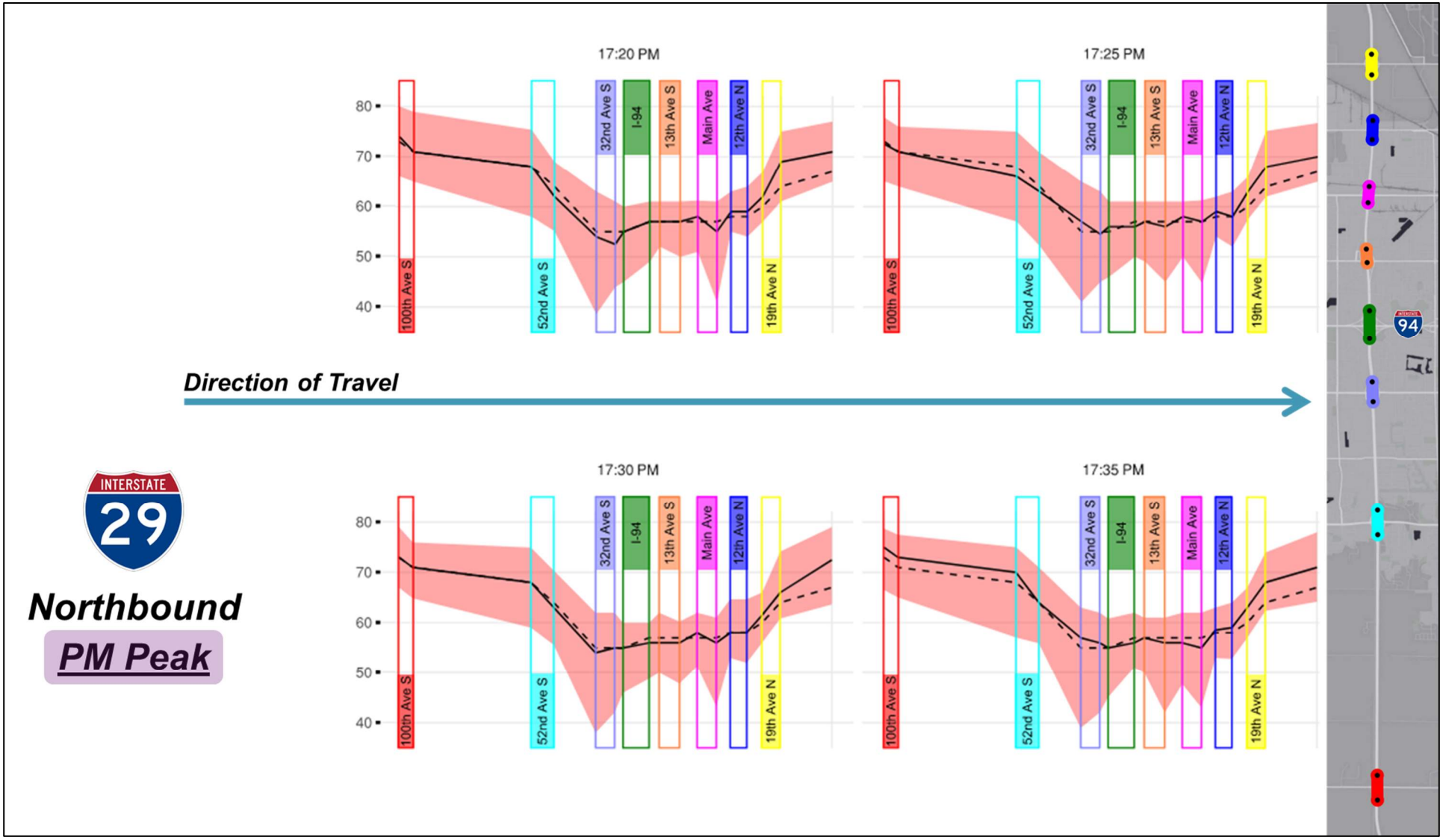
I-29 Northbound
AM Peak (7:50 – 8:10 AM)



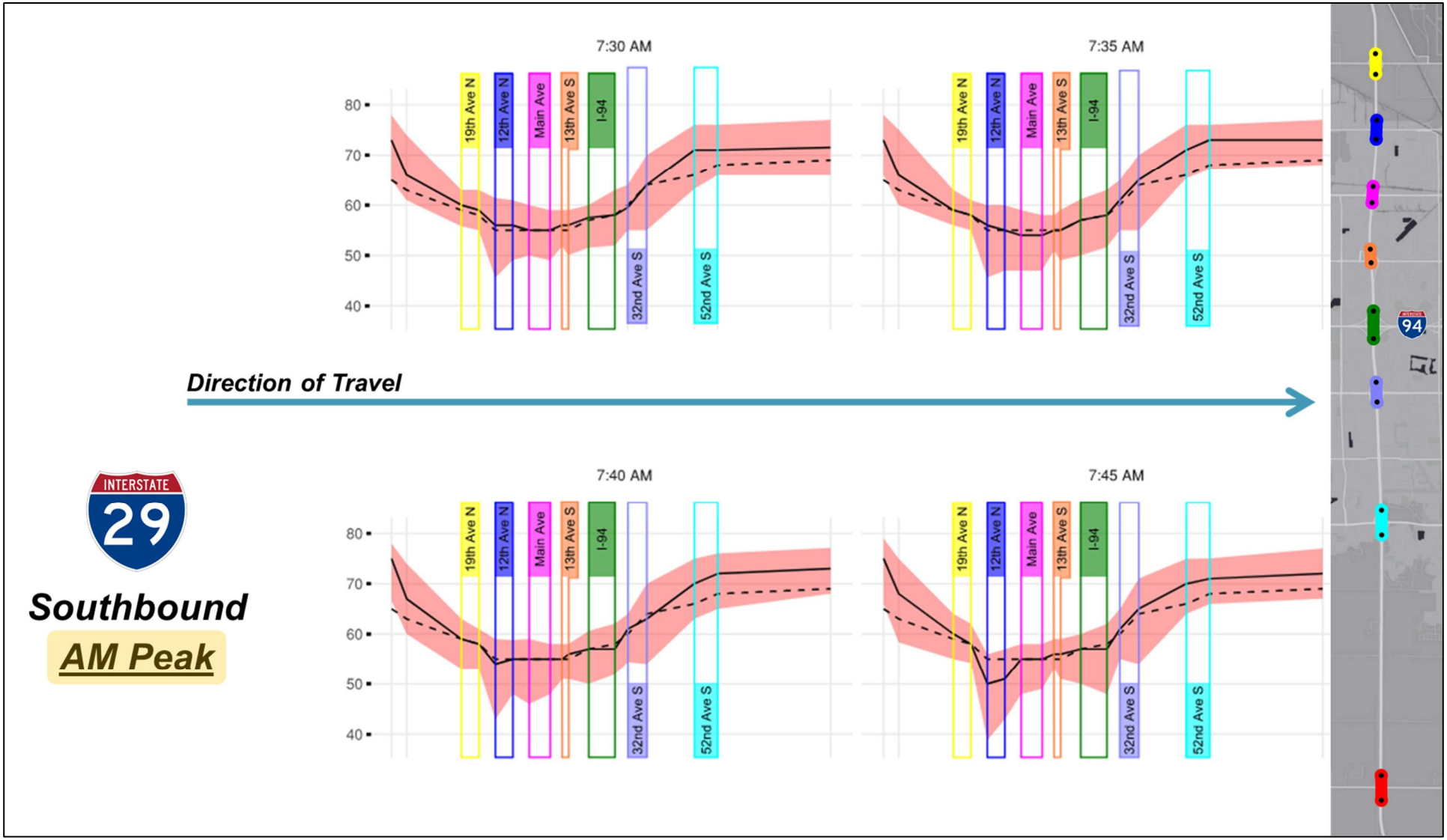
I-29 Northbound
PM Peak (5:00 – 5:20 PM)



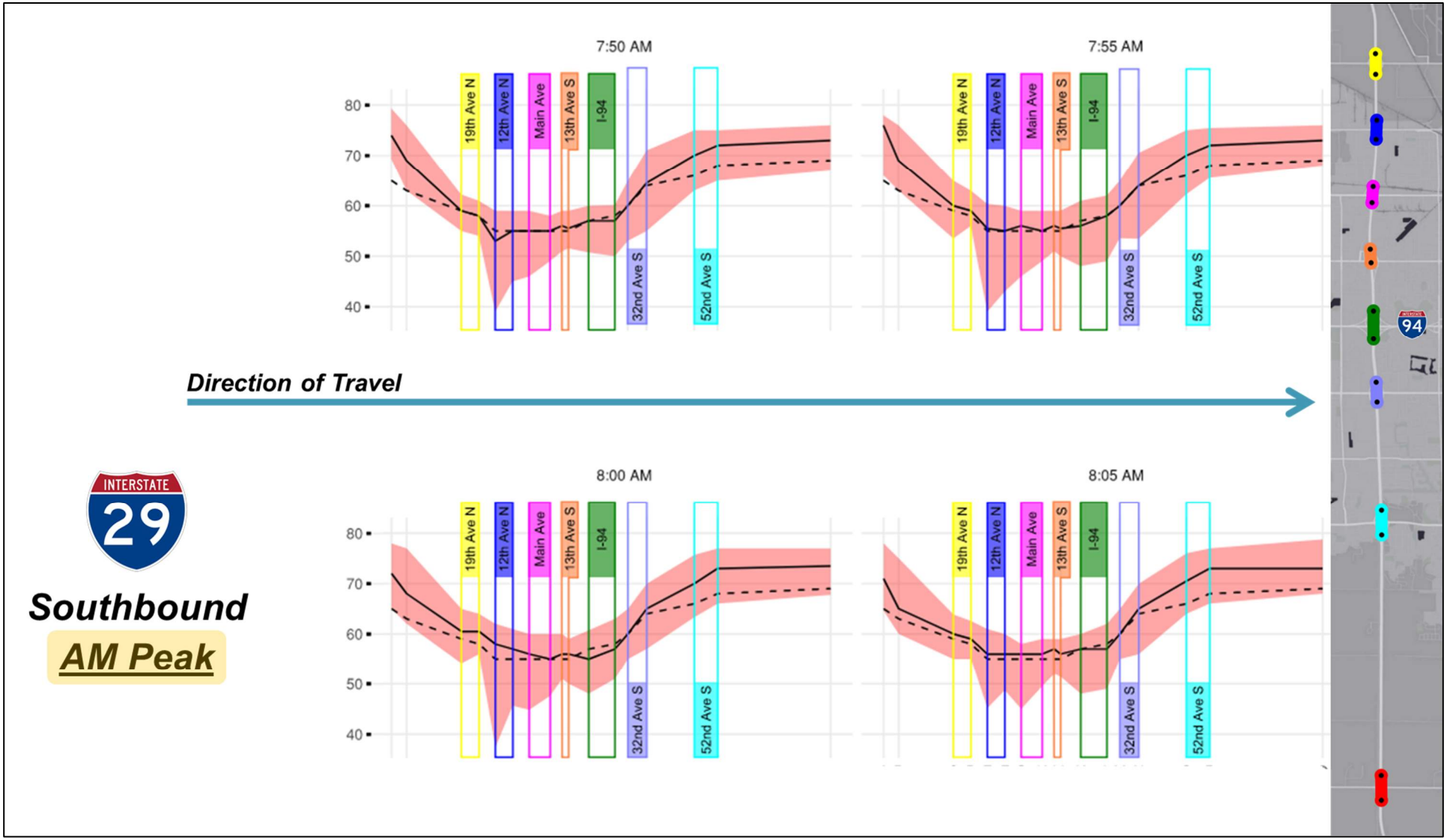
I-29 Northbound
PM Peak (5:20 – 5:40 PM)



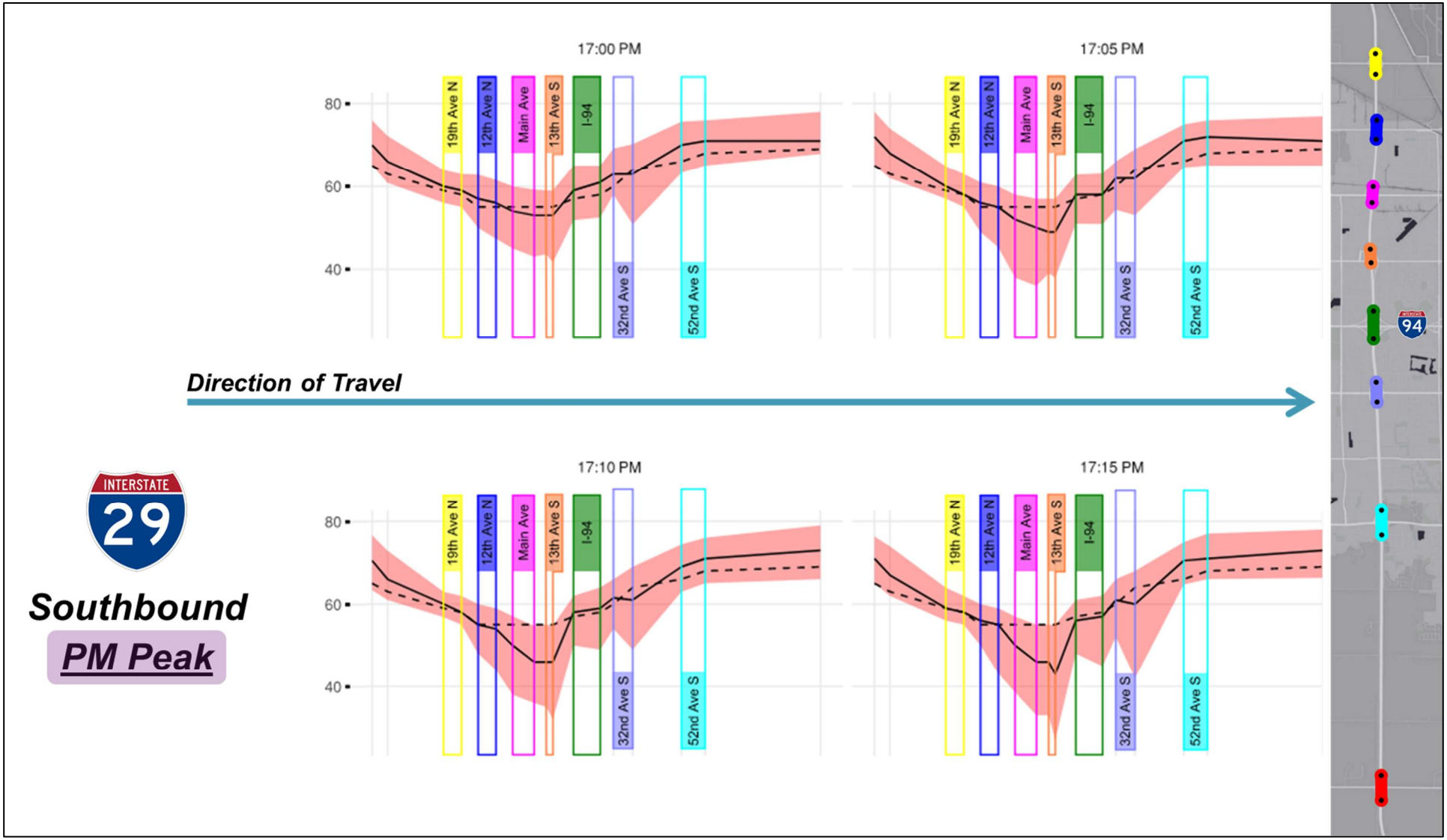
I-29 Southbound
AM Peak (7:30 – 7:50 AM)



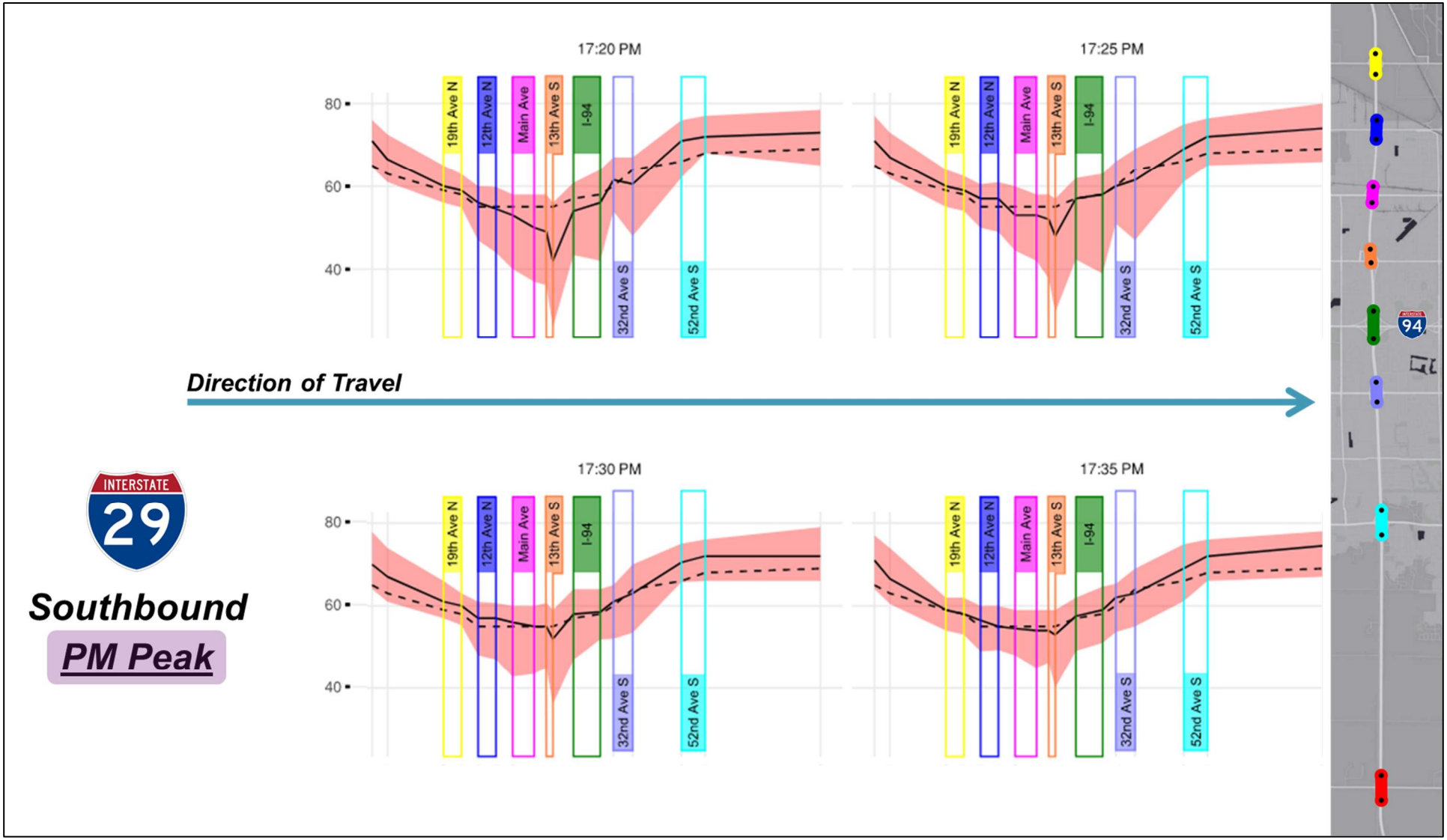
I-29 Southbound
AM Peak (7:50 – 8:10 AM)



I-29 Southbound
PM Peak (5:00 – 5:20 PM)



I-29 Southbound
PM Peak (5:20 – 5:40 PM)



I-29 Summary

AM Northbound

- Congestion begins: 7:40 AM
- Congestion ends: 8:00 AM
- Peak of AM congestion: 7:50 AM
- Area of congestion: Between 32nd Ave S through Main Ave
- Peak area of congestion: At Main Ave
  - Resulting in 8 mph speed reduction

PM Northbound

- No discernable congestion

AM Southbound

- Congestion at 12th Ave N at 7:45 AM w/ around a 5 mph speed reduction

PM Southbound

- Congestion begins: 5:05 PM
- Congestion ends: 5:25 PM
- Peak of PM congestion: 5:15 PM
- Area of congestion Between 12th Ave N to I-94
- Peak area of congestion: At 13th Ave S
  - Resulting in 11 mph speed reduction

Origin & Destination Volumes

Daily origin and destination regional volumes were developed for all vehicles and trucks utilizing I-94 and I-29. This analysis was focused on the potential Ring Route demand.

Methodology

Five zones, shown in **Figure 3**, were created to estimate the number of Interstate trips that pass through the Fargo-Moorhead Metropolitan Area on I-94 or I-29 or stop / originate within the Fargo-Moorhead Metropolitan Area.

External Zones

- I-94 west of 165th Avenue / Cass County 15
- I-94 east of Minnesota 336
- I-29 north of Cass County 4 (Argusville)
- I-29 south of 100th Avenue S / Cass County 14

Internal Zone

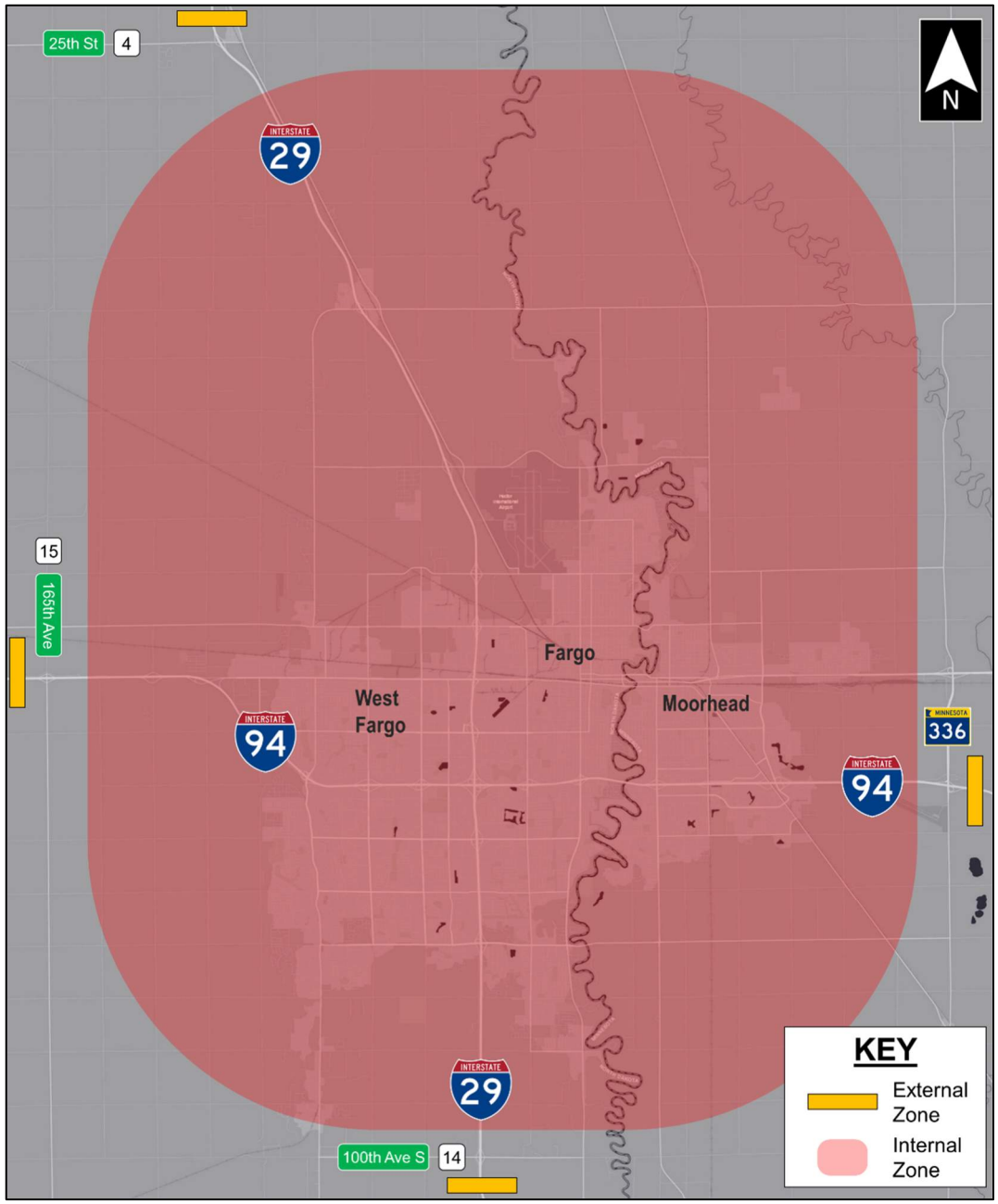
- Fargo-Moorhead Metropolitan Area

Relative percentages were obtained from Streetlight Data between the five zones. These percentages were applied to the Average Annual Daily Traffic at the external zones to estimate the daily trips around the Fargo-Moorhead Metropolitan Area.

Streetlight defines a "Trip End" as a stop greater than 5 minutes

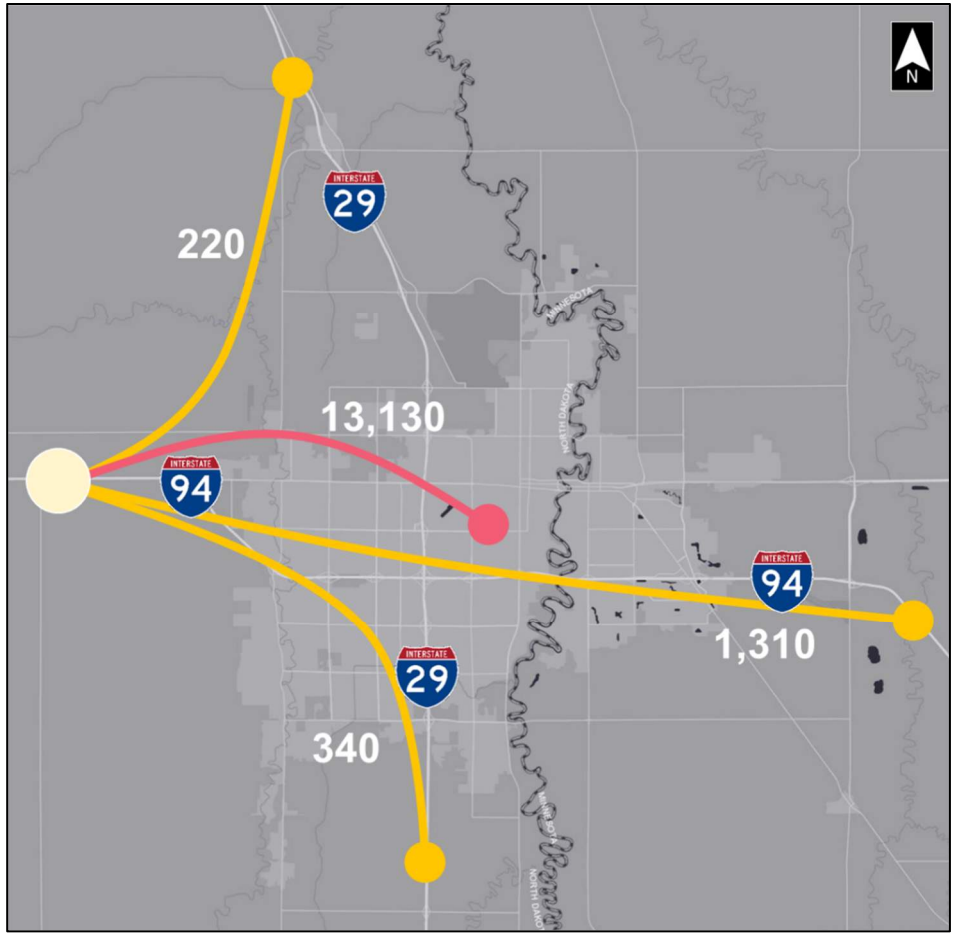
(i.e. Users that stops at a gas station to fill up for greater than 5 minutes is considered a trip from an external station to the internal metro area station)

Figure 3. Streetlight Zone Setup



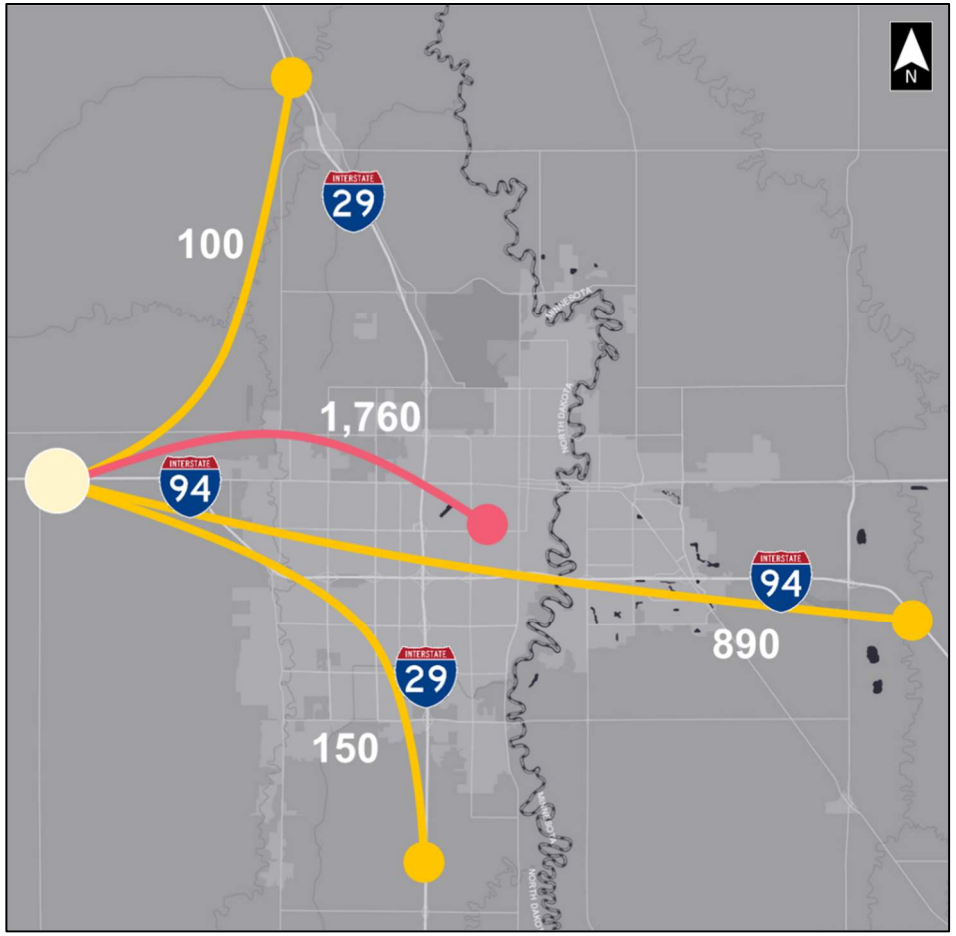
Results

West External



All Vehicles

- 88% of all vehicles have an Origin / Destination in the Metro Area

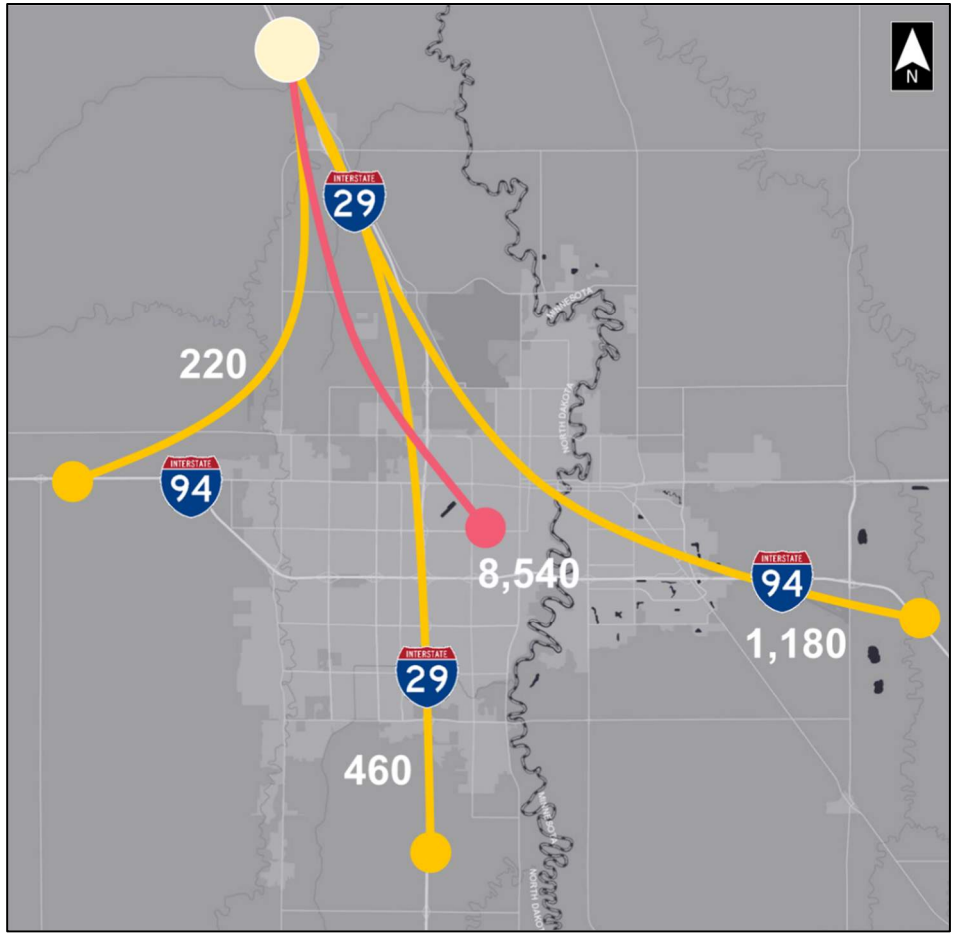


Trucks

- 61% of trucks have an Origin / Destination in the Metro Area

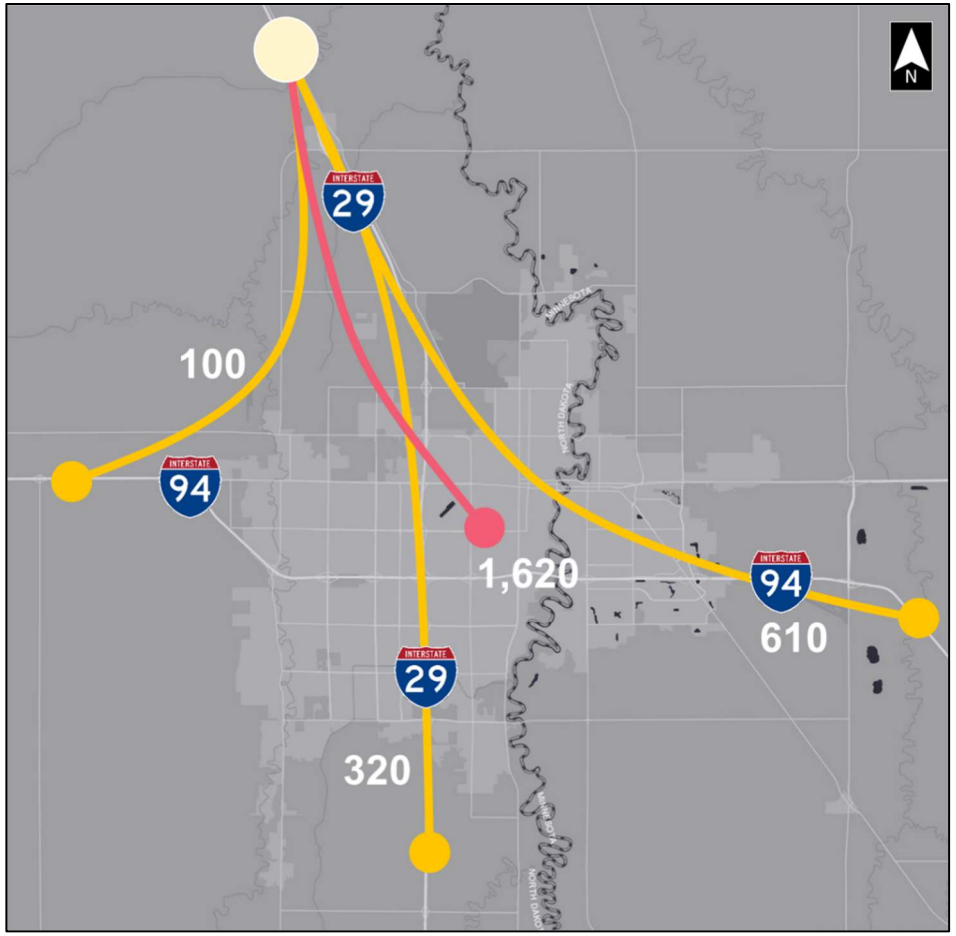
Note that paths are 2-way flows (e.g. 110 vehicles travel from I-94 EB to I-29 NB and 110 vehicles travel from I-29 SB to I-94 WB)

North External



All Vehicles

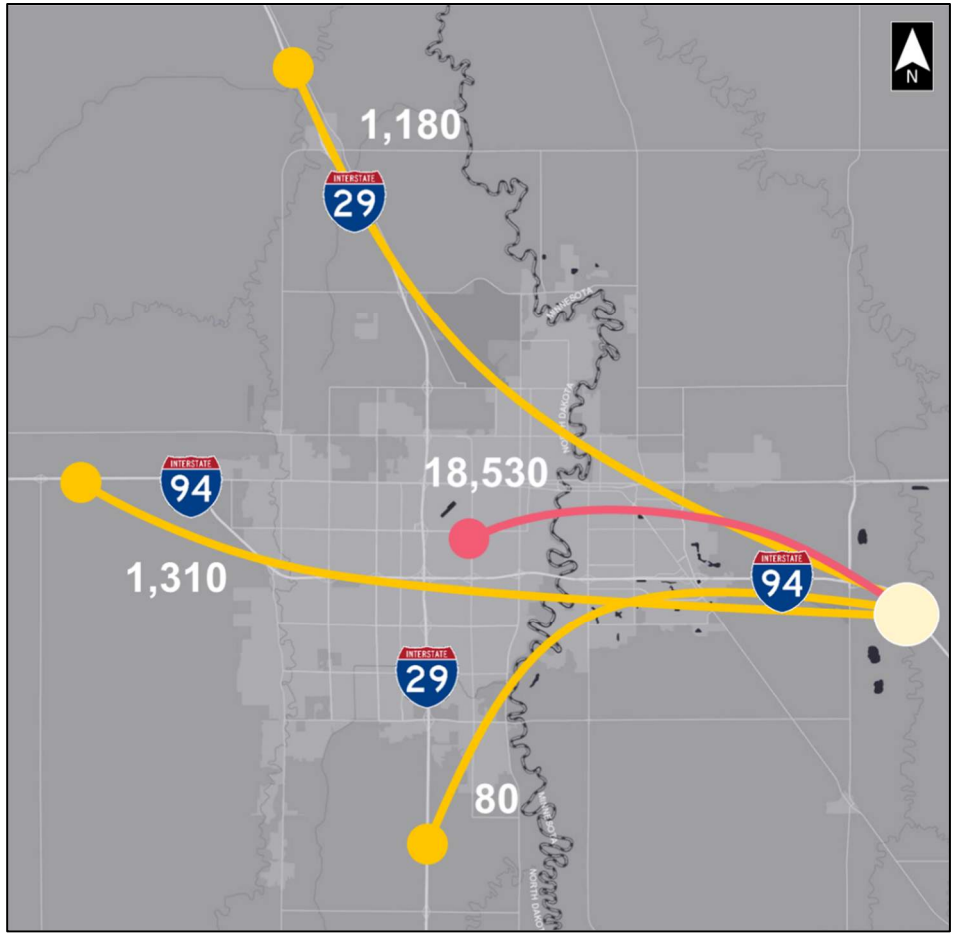
- 82% of all vehicles have an Origin / Destination in the Metro Area



Trucks

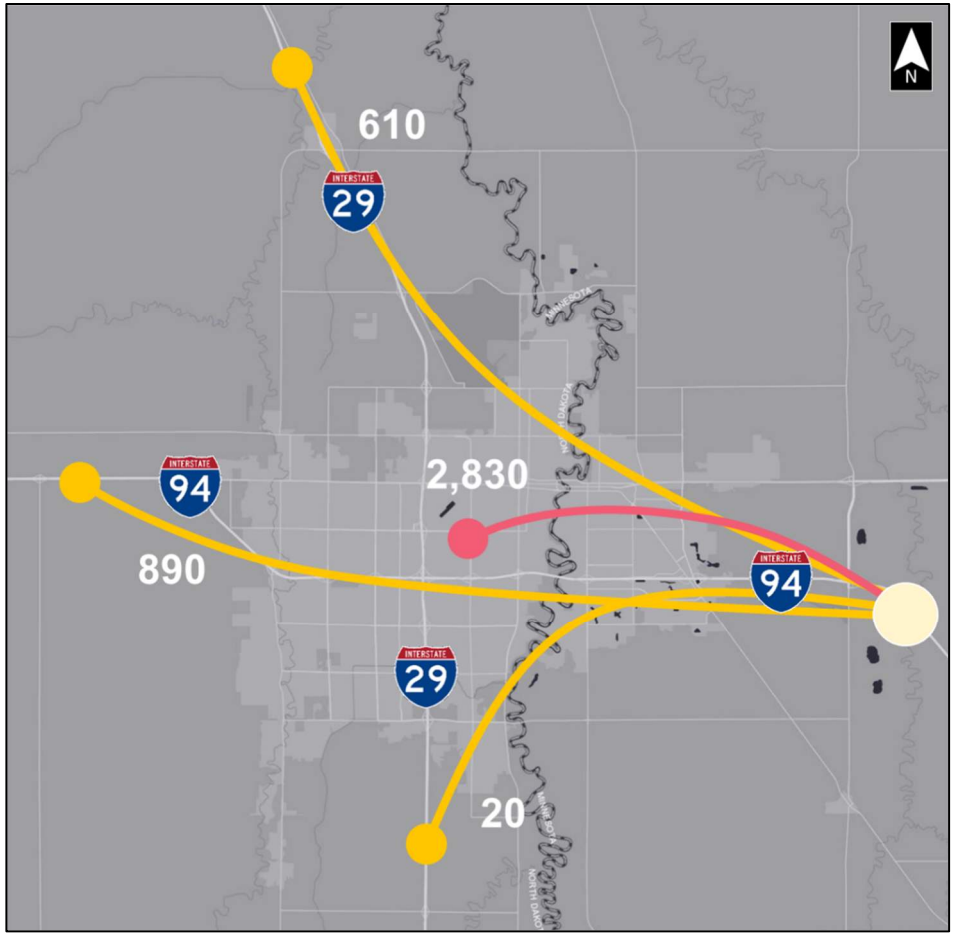
- 61% of trucks have an Origin / Destination in the Metro Area

East External



All Vehicles

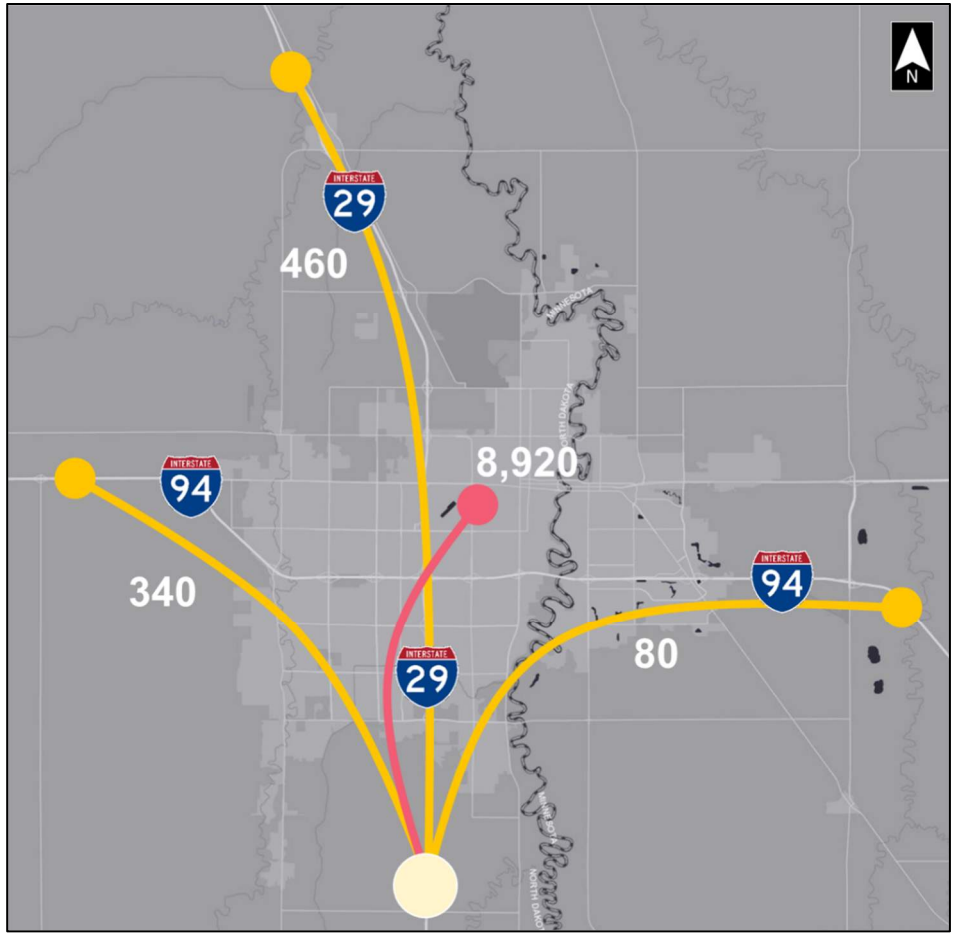
- 88% of all vehicles have an Origin / Destination in the Metro Area



Trucks

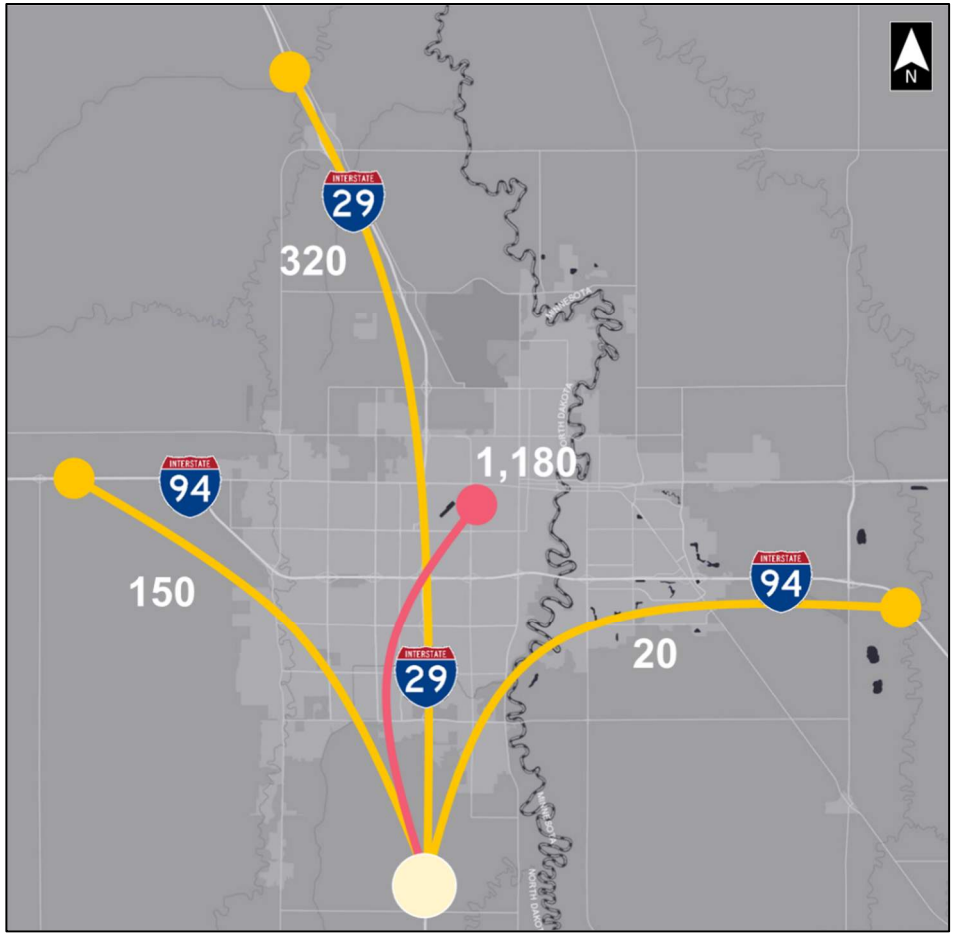
- 65% of trucks have an Origin / Destination in the Metro Area

South External



All Vehicles

- 91% of all vehicles have an Origin / Destination in the Metro Area



Trucks

- 71% of trucks have an Origin / Destination in the Metro Area

Safety Analysis

The study team split the safety analysis into 3 parts including:

- **Crash Concentration Mapping**: A heat map was developed for the study area focused on crash frequency.
- **Descriptive Analysis**: Crash data was reviewed to look at trends within the study area including:
  - Severity of Crashes
  - Vehicle Count and Type
  - Manner of Crash
  - Contribution Circumstances (e.g. road surface conditions)
  - Timeframe (e.g. time of day, day of week, month of year)
- **Crash Dashboard**: A Tableau Dashboard was developed to filter, investigate, and spot trends in available crash data.

Crash Concentration Mapping

A heat map illustrating the "hot spots" or locations where crashes occurred the most within the study area is shown in **Figure 4**. Crash concentration mapping was performed for the entire study area, shown in **Figure 5**, but all of the "hot spots" occur within the urban section of the interstate system bounded by the following interchanges:

- Interstate 94
  - West Limit: Sheyenne Street
  - East Limit: 34th Street
- Interstate 29
  - North Limit: 19th Avenue N
  - South Limit: 52nd Avenue S

These hot spots were used to pinpoint locations where the crash dashboard was used to investigate and spot trends within the available crash data.

Figure 4: Study Area Crash Density "Hot Spots"

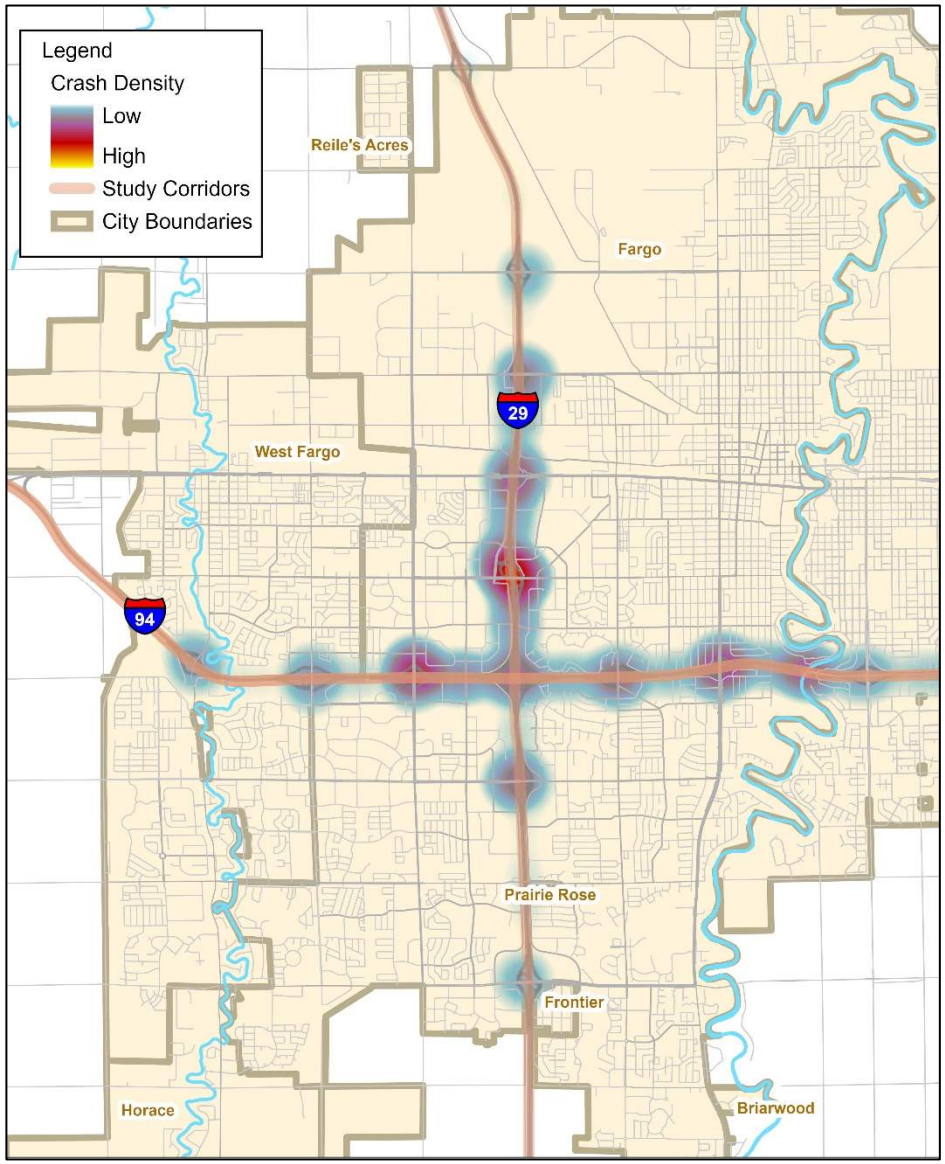
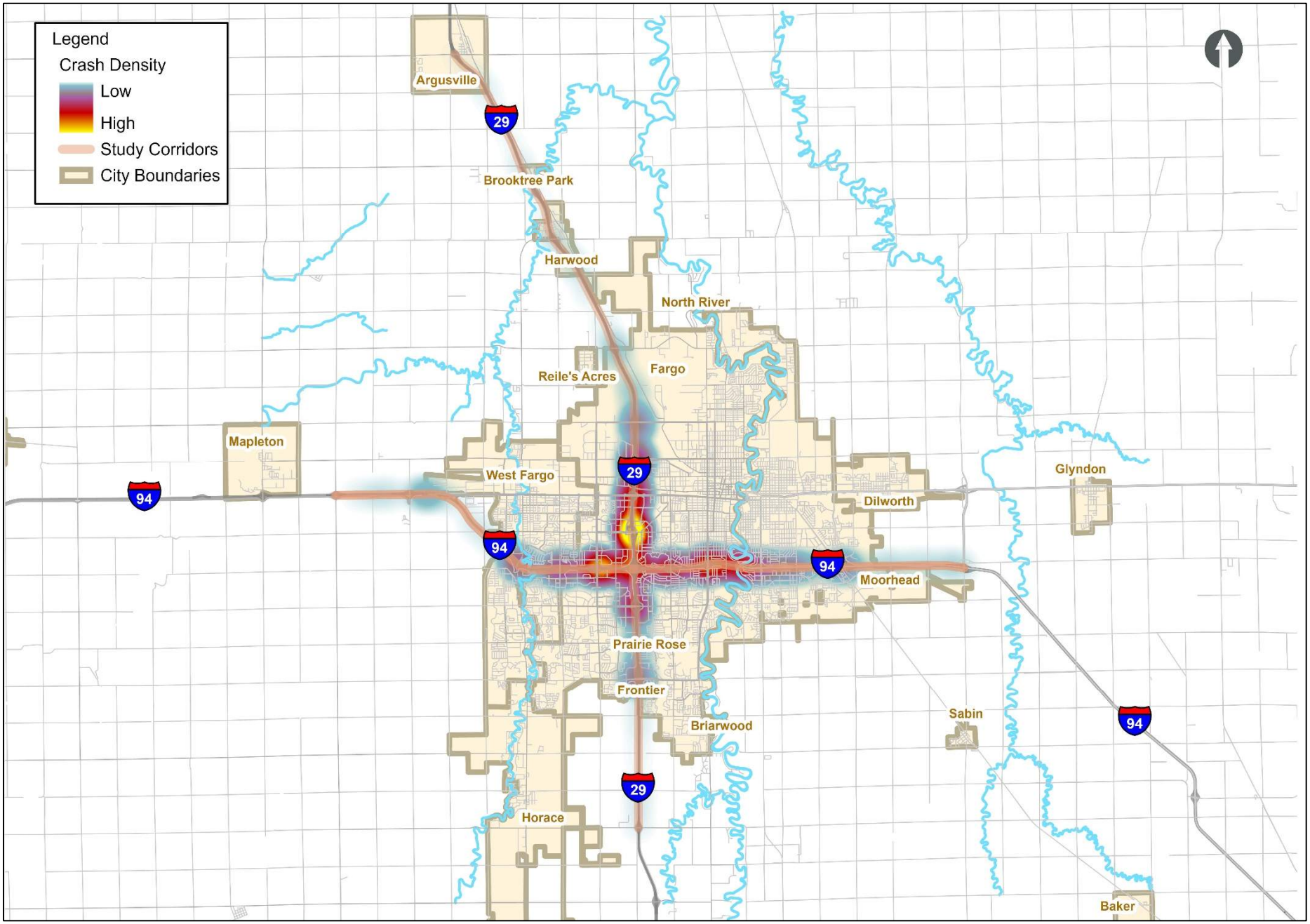


Figure 5: Study Area Crash Density, 2016-2019



Descriptive Analysis

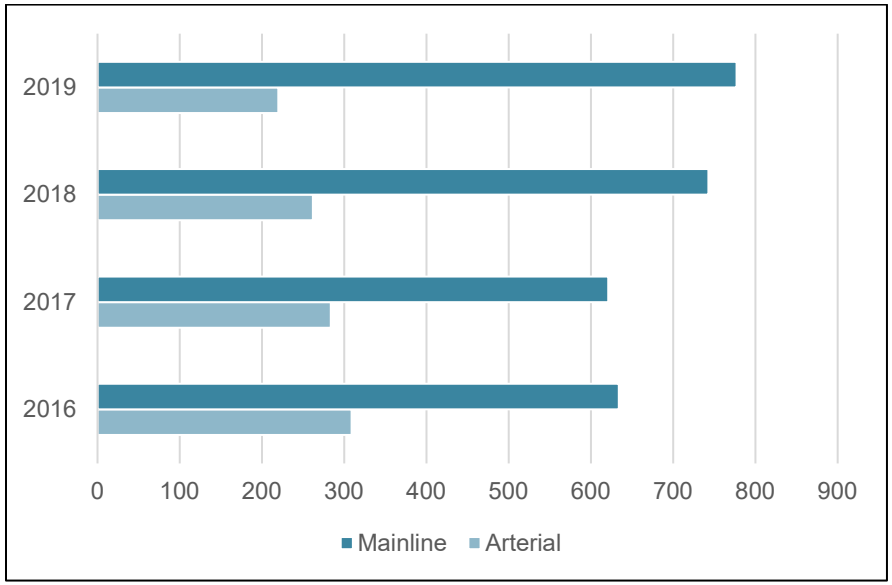
As mentioned in the Data Collection section, crash data was not received from MnDOT for 2015. To keep the number of years consistent for both states, four years of pre-COVID data were used for all safety analysis in the study area.

Mainline versus Arterial

Crashes occurring within the study area were categorized into mainline and arterial crashes based on the recorded location of the incident. Arterial crashes are defined as those occurring on any arterial road that intersects a study area service interchange ramp (including 200' on either side of the ramp terminal intersection and between ramp terminals) while mainline crashes are those occurring on system ramps, service ramps, and mainline segments.

Figure 6 shows the breakdown of study area crashes on the mainline and arterial networks. As shown in **Figure 6**, the number of mainline and arterial crashes remained relatively consistent between 2016 and 2019, with a slight increase in mainline crashes and a slight decrease in arterial crashes during the four-year period.

Figure 6. Study Area Mainline and Arterial Crashes, 2016 - 2019



Crash Severity

Crash severities for study area crashes were reviewed to understand the frequency with which injury-causing crashes occur within the study area. Crash severities are classified based on injury sustained to any individual involved in the incident. The classifications are based on FHWA guidance and include:

- **Fatal**: one or more deaths occur at the scene or within 30 days of the crash
- **Serious Injury**: one or more people receive incapacitating injuries that prevent them performing their normal activities for 24 hours
- **Minor Injury**: one or more people receive non-incapacitating injuries that are apparent at the scene
- **Possible Injury**: one or more people complain of pain or momentary unconsciousness, but injury is not visible or obvious at the scene
- **Property Damage Only**: no one is injured, only property is damaged as a result of the crash

Table 1 shows the crash severities for mainline and arterial crashes within the study area. Nine (9) fatal crashes occurred in the study between 2016 and 2019, while 34 crashes resulting in serious injury were observed.

Table 1: Study Area Crash Severity

Crash Severity	Total (2016-2019)	
	Mainline	Arterial
Fatal	7	2
Serious Injury	27	7
Minor Injury	198	79
Possible Injury	234	166
Property Damage Only	2309	821
Total	**2775**	**1075**

Manner of Crash

The manner of how vehicles involved in study area crashes came into contact was reviewed to understand how these crashes typically occurred. By understanding what kind of crashes are happening along I-29 and I-94, effective crash countermeasures can be identified for implementation. **Table 2** summarizes manner of crash measures for the mainline and arterial crashes within the study area.

On the interstate system, the most frequent type of crash that occurred was a non-collision with a motor vehicle (i.e. single vehicle accident) followed by rear-end collisions. These two crash types account for 80% of the total interstate mainline crashes.

At the ramp terminal intersections, the most frequent type of crash that occurred was rear-end collisions followed by angle-type crashes. These two crash types account for 78% of the total arterial crashes from 2016-2019.

Table 2: Study Area Manner of Crash

Manner of Crash	Total (2016-2019)	
	Mainline	Arterial
Front to Rear	912	591
Non-Collision with Motor Vehicle / Unknown	1315	98
Sideswipe (Same Direction)	378	99
Angle	113	256
Front to Front	25	21
Rear to Side	15	4
Sideswipe (Opposing Direction)	10	5
Rear to Rear	7	1
Total	**2775**	**1075**

Surface Condition

Surface conditions reported for study area crashes were reviewed to understand the degree to which road surface condition could have contributed to crash events. **Table 3** summarizes road surface conditions for study area mainline and arterial crashes. Over 50% of crashes occurred on dry road surfaces while nearly 40% of crashes occurred during winter conditions.

Table 3: Study Area Surface Conditions

Surface Conditions	Total (2016-2019)	
	Mainline	Arterial
Dry	1376	683
Winter Conditions*	1210	295
Wet	189	97
Total	**2775**	**1075**

*Winter conditions include snow, ice / compacted snow, and slush

Lighting Conditions

Lighting conditions reported for study area crashes were reviewed to understand the degree to which daytime and/or nighttime lighting conditions could have contributed to crash events. **Table 4** summarizes lighting conditions for study area mainline and arterial crashes. Most study area crashes occurred during daylight hours. The second most common light conditions for study area crashes were on lighted roads during the dark.

Table 4: Study Area Light Conditions

Light Conditions	Total (2016-2019)	
	Mainline	Arterial
Daylight	1835	803
Dark (Road Lighted)	401	197
Dark (Road Unlighted)	346	13
Dawn	83	24
Unknown	77	13
Dusk	33	25
Total	**2775**	**1075**

Month, Time of Day, and Day of Week

The temporal nature of the study area crashes was reviewed to understand the potential impact of seasonality, time of day, and day of week on crash events.

Figure 7 plots the frequency of study area mainline and arterial crashes based on the month they occurred. There is substantial difference between the number of mainline crashes occurring during winter months (December, January, and February) compared to other months. Winter month mainline crashes account for 43% of total crashes throughout the year.

Figure 8 shows the distribution of crashes by the time of day that they occurred. As shown in the figure, study area crashes peaked during the 7 AM and 5 PM hours. These times reflect the AM and PM peak traffic hours, coinciding with higher traffic volumes on the interstate system. **Figure 9** shows the distribution of crashes during winter months, with a majority of the crashes occurring during the AM peak period.

No unusual day-of-week trends were found. Crash trends followed the total daily traffic observations on the interstate system, with more crashes occurring on workdays compared to weekends.

Figure 7: Study Area Crashes by Month

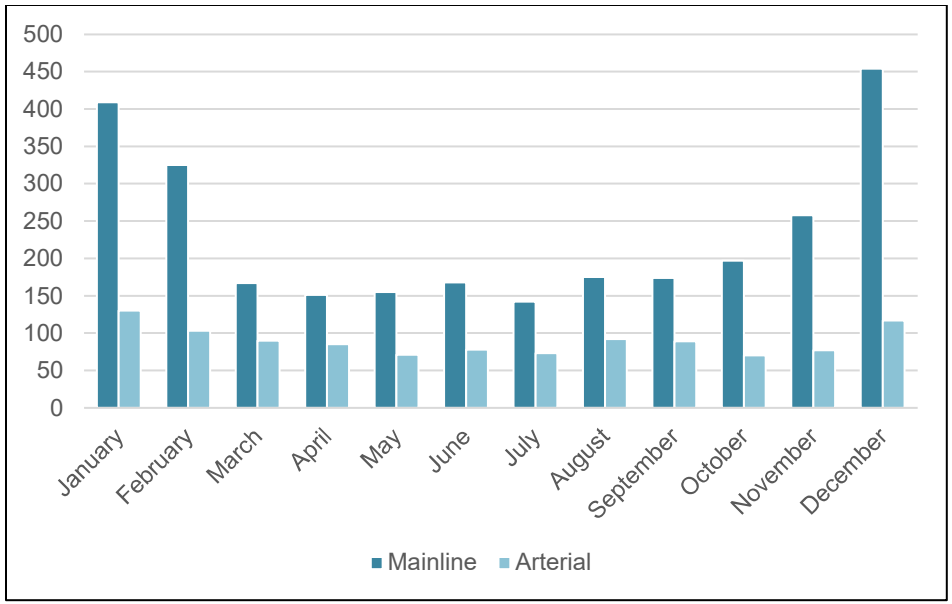


Figure 8. Study Area Crashes by Time-of-Day (Mainline & Arterial)

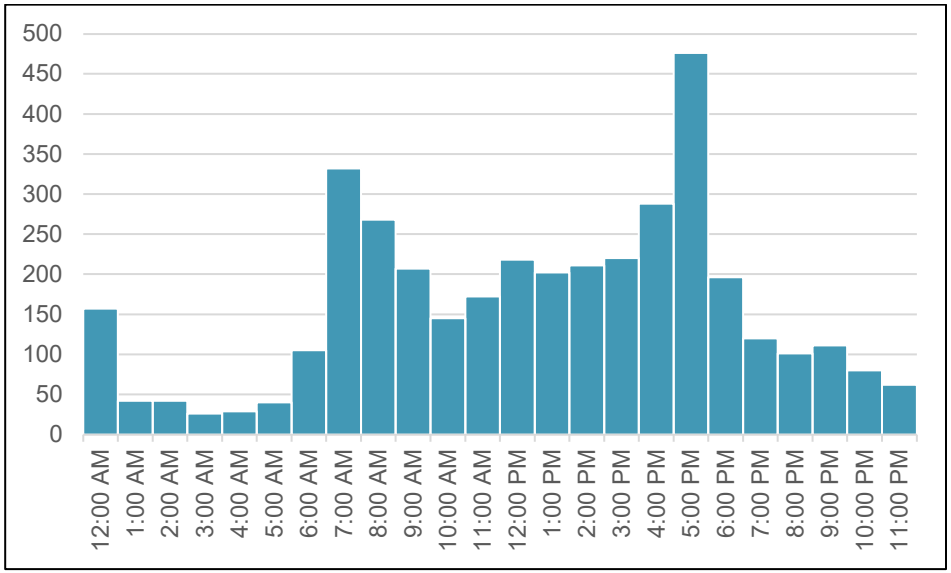
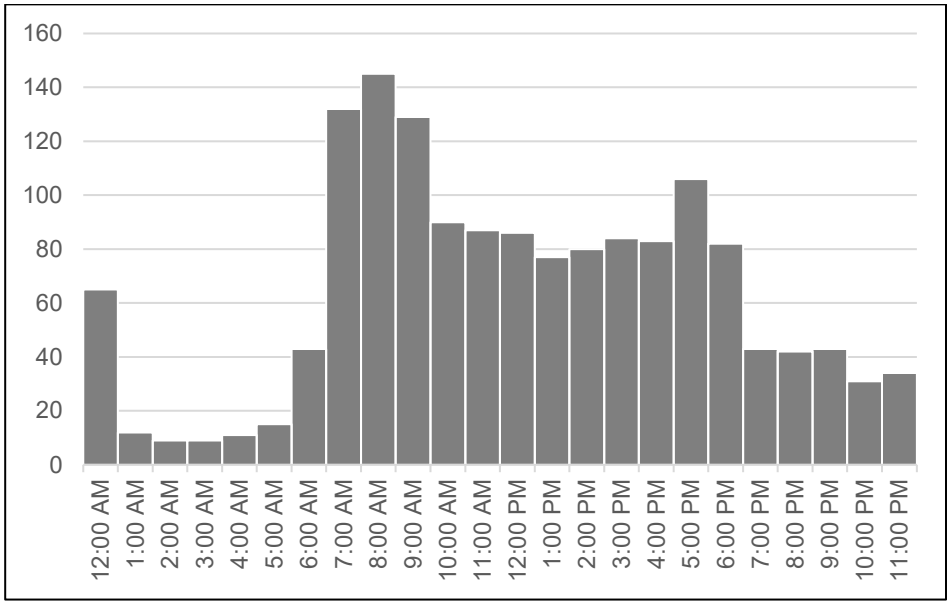


Figure 9: Winter Study Area Crashes by Time-of-Day (Mainline & Arterial)



State Strategic Highway Safety Planning

The North Dakota and Minnesota Departments of Transportation (DOT) have developed Strategic Highway Safety Plans (SHSP) that articulate the vision, mission, and goals for each agency as they seek to improve safety on state and local roads. Both DOTs utilize a data-driven approach to identify their 6 key safety areas addressed by their SHSP, which are:

- North Dakota DOT SHSP
  - Lane Departures
  - Intersections
  - Alcohol and / or Drug Use
  - Unbelted Vehicle Occupants
  - Speeding / Aggressive Driving
  - Young Drivers
- Minnesota DOT SHSP
  - Inattentive Drivers
  - Intersections
  - Unbelted Vehicle Occupants
  - Impaired Roadway Users
  - Speed
  - Lane Departures

Key safety areas and select strategies from these plans will be incorporated into future study phases and strategy development for the study area.

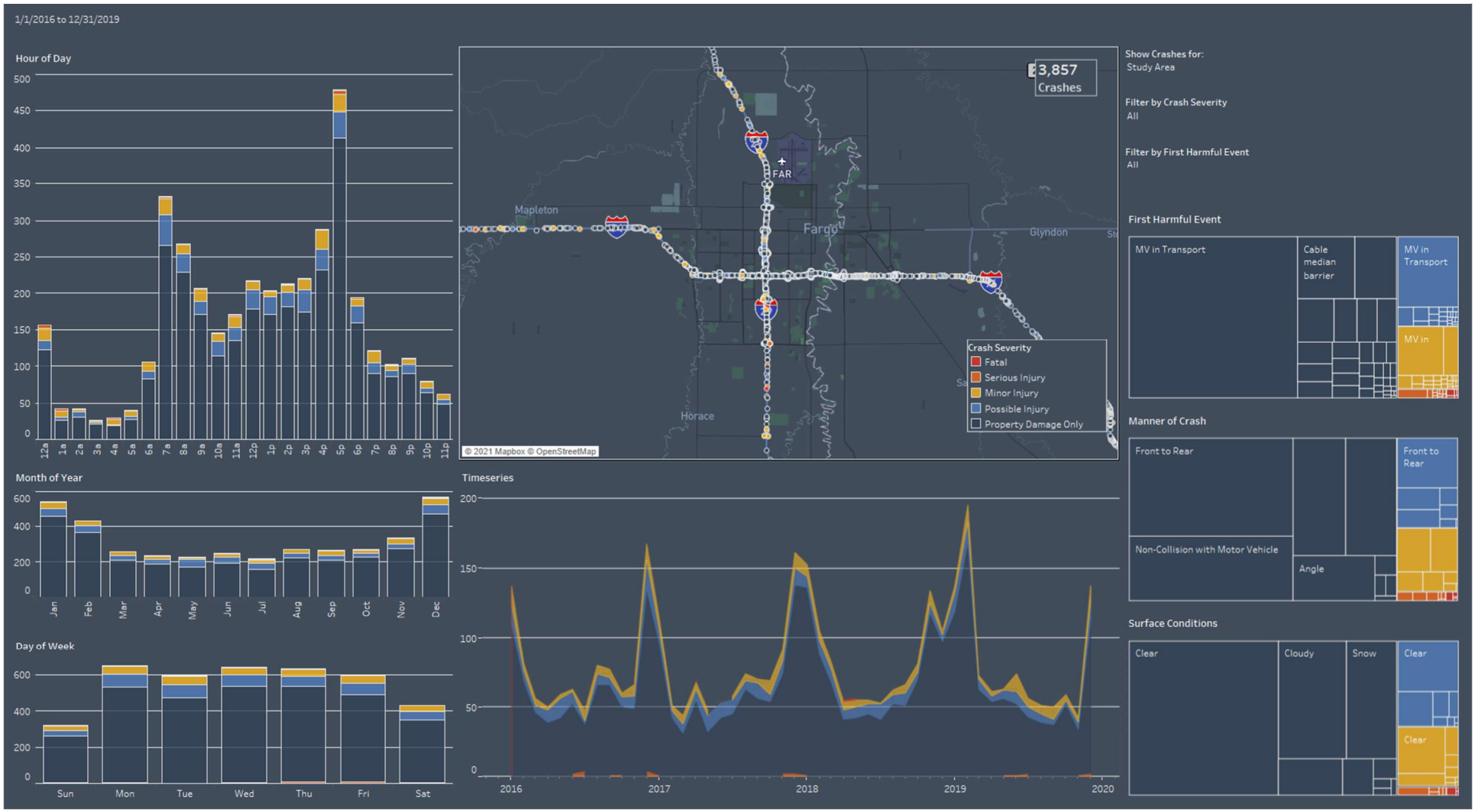
Crash Dashboard Analysis

Specific locations along the study corridors were selected for a detailed review of safety conditions to better understand the types of crashes that occurred and the factors that could be contributing to crash events at these locations. The crash dashboard was developed by the study team in Tableau and is included as an electronic deliverable that accompanies this existing conditions report. A screenshot of the Tableau interface is provided in **Figure 10**.

The locations were selected for the crash dashboard analysis from discussions with the Study Review Committee (SRC) and detailed investigation of crash concentration maps. The following locations were reviewed in detail on the following pages:

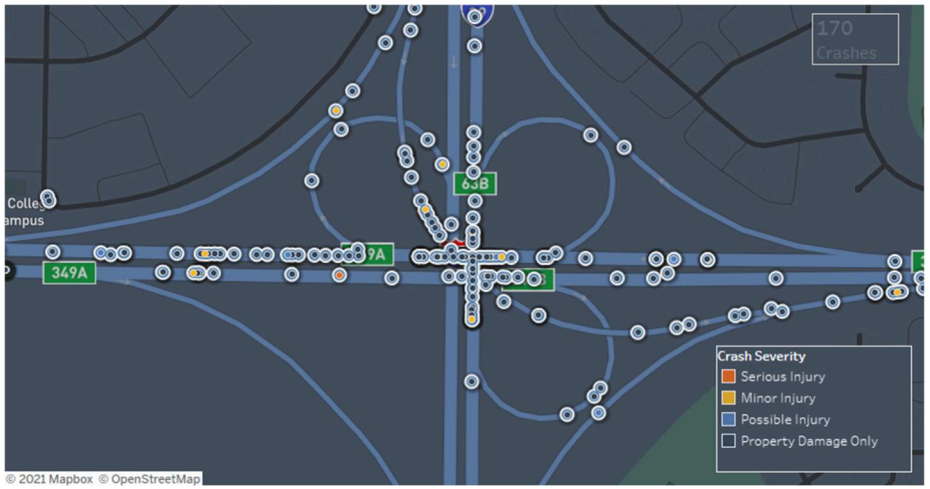
- I-29 and I-94 System Interchange
- I-29 NB from 13th Avenue S to Main Avenue
- 13th Avenue S SB on-ramp merge to I-29 SB
- I-29 SB from 13th Avenue S to I-94
- I-29 NB from I-94 to 13th Avenue S
- I-29 SB approaching 52nd Avenue S
- I-94 near Main Avenue
- I-94 near Sheyenne Street*
- I-94 WB from 45th Street to Veterans Boulevard
- I-94 between 45th Street and I-29
- I-94 WB at University Drive
- I-94 at Red River Bridge
- Crashes during PM Peak Period

Figure 10. Crash Dashboard Tableau Interface



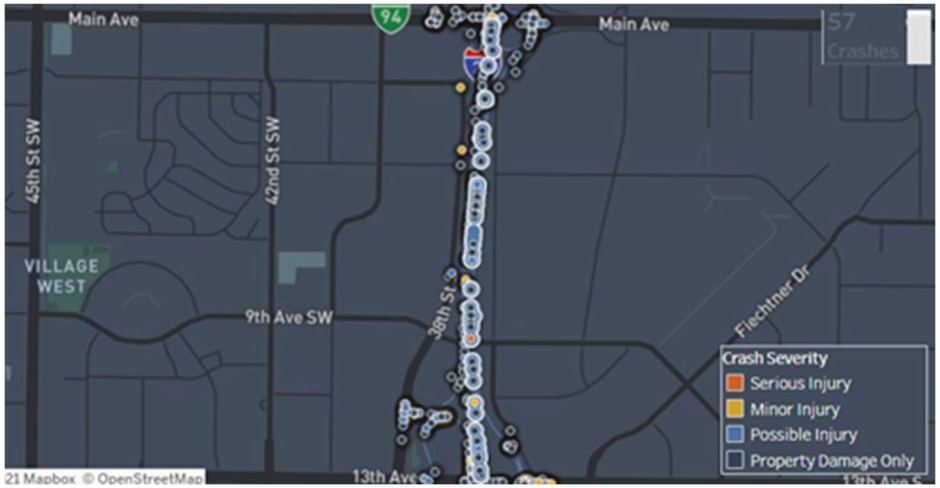
I-29 and I-94 System Interchange

- 37 crashes on I-94 WB (between loop ramps)
  - Primarily around PM peak period
- 23 crashes on I-29 NB (between loop ramps)
  - Primarily around AM peak period
- 21 crashes on I-29 SB to I-94 EB flyover
  - Primarily around AM peak period
  - Primarily in January
- Manner of Crashes (Top 3)
  - 58 rear-end
  - 56 non-collision with vehicle
  - 25 sideswipes



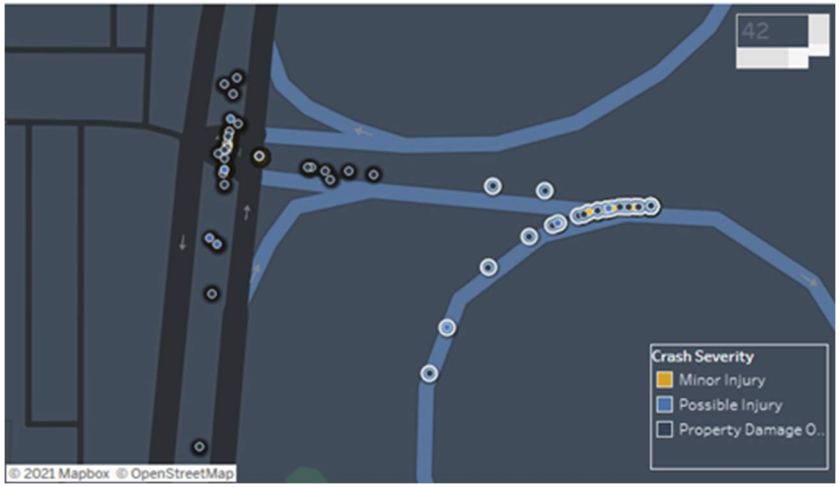
I-29 NB from 13th Avenue S to Main Avenue

- 57 crashes
  - Primarily around AM peak period
  - Primarily in winter months
- Manner of Crashes (Top 3)
  - 35 non-collision with vehicle
  - 15 rear-end
  - 5 sideswipes



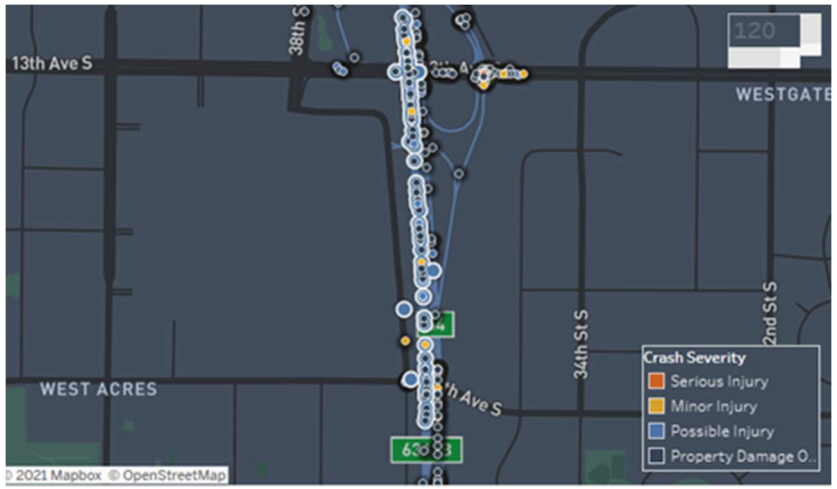
13th Avenue S SB on-ramp merge to I-29 SB

- 42 crashes
  - Primarily during lunch hour and PM peak period
- Manner of crashes
  - 42 rear-end



I-29 SB from 13th Avenue S to I-94

- 120 crashes
  - Primarily around PM peak period
  - Primarily in December and January
- Manner of Crashes (Top 3)
  - 51 rear-end
  - 28 non-collision with vehicle
  - 16 sideswipes



I-29 NB from I-94 to 13th Avenue S

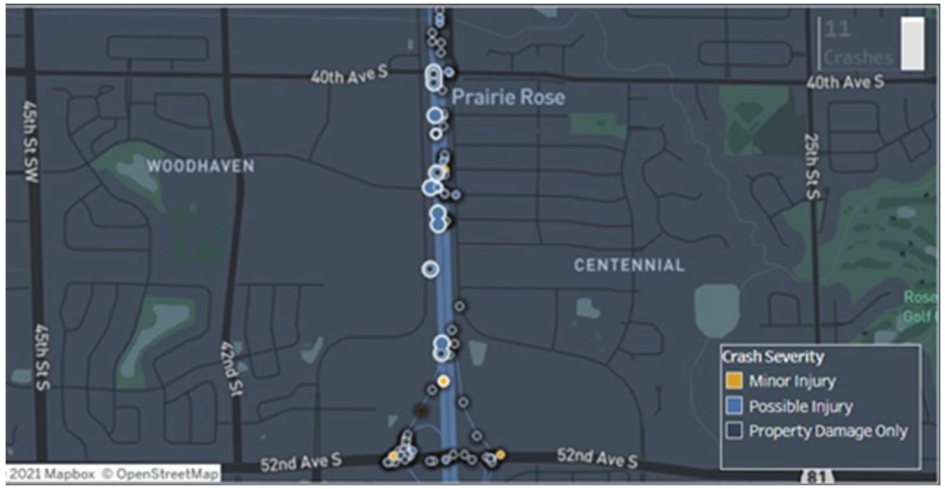
- 31 crashes
  - Primarily around AM peak period
  - Primarily in January
- Manner of crashes (Top 3)
  - 13 non-collision with vehicle
  - 9 side-swipes
  - 7 rear-end

Crash Dashboard location recommendation from the SRC.

I-29 SB approaching 52nd Avenue S

- 11 crashes
  - No Time-of-Day trend
  - Primarily in winter months
- Manner of Crashes (Top 3)
  - 9 non-collision with vehicle
  - 1 sideswipes
  - 1 rear-end

Crash Dashboard location recommendation from the SRC, but no major trends were observed.



I-94 near Main Avenue

- 44 crashes
  - No Time-of-Day trend
  - Primarily in winter months
- Manner of Crashes (Top 2)
  - 37 non-collision with vehicle
  - 3 sideswipes

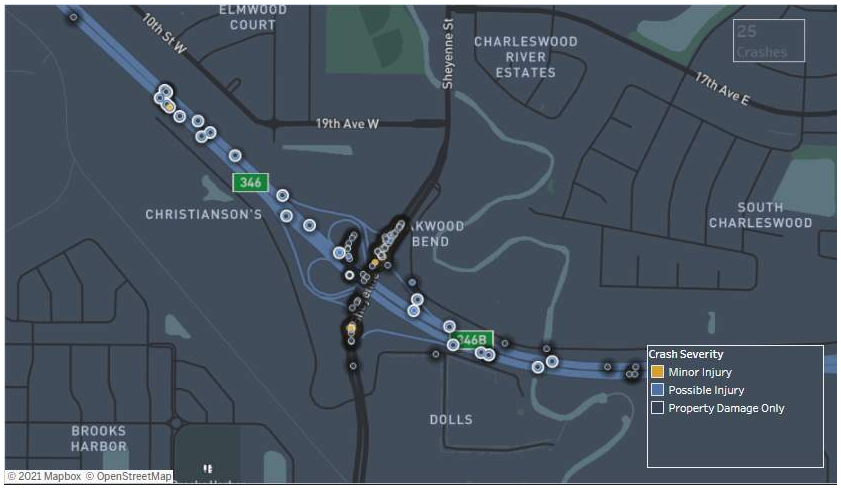
Crash Dashboard location recommendation from the SRC, but no major trends were observed.

I-94 near Sheyenne Street*

- 25 crashes
  - No Time-of-Day or Month-of-Year trends
- Manner of Crashes (Top 3)
  - 13 non-collision with vehicle
  - 7 rear-end
  - 4 sideswipes

*Crash data from 2016-2019 corresponds with prior interchange configuration at Sheyenne Street. The SRC noted speed differential concerns on EB I-94. This location should be monitored with the new EB ramp configuration.

Crash Dashboard location recommendation from the SRC, but no major trends were observed.



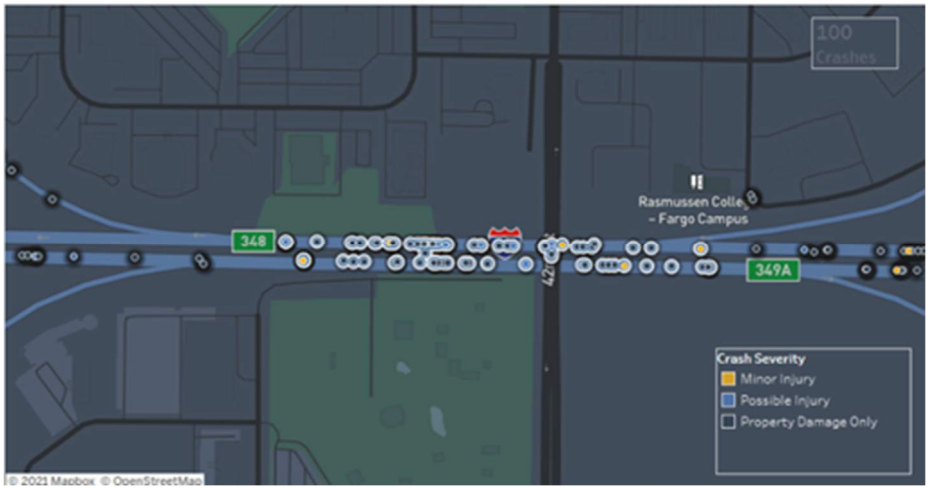
I-94 WB from 45th Street to Veterans Boulevard

- 25 crashes
  - Primarily around PM peak period
  - Primarily during winter months
- Manner of Crashes (Top 3)
  - 14 rear-end
  - 6 non-collision with vehicle
  - 5 sideswipes

Crash Dashboard location recommendation from the SRC. The SRC noted recent backups from Veterans Boulevard onto WB I-94. Historical crash data is from 2016-2019, so safety concerns from recent backups are likely not reflected in the dashboard.

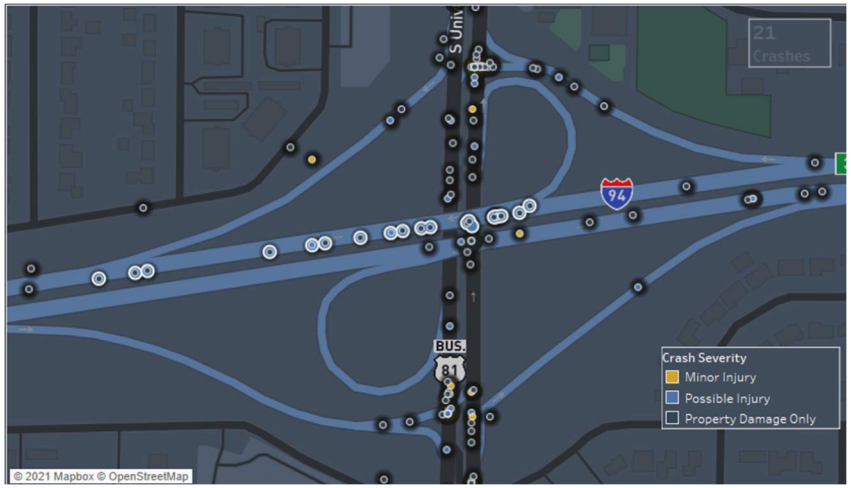
I-94 between 45th Street and I-29

- 100 crashes
  - 42 EB crashes
    - Primarily around AM peak period
  - 64 WB crashes
    - Primarily around PM peak period
- Manner of Crashes (Top 2)
  - 64 rear-end
  - 13 side-swipe



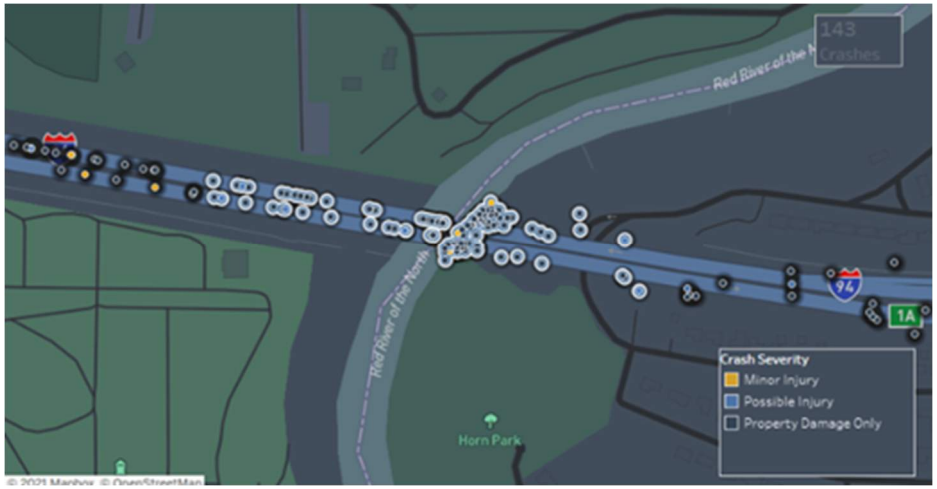
I-94 WB at University Drive

- 21 crashes on I-94 WB
  - Primarily around AM peak period
  - Primarily during winter months
- Manner of crashes (Top 3)
  - 8 non-collision with vehicle
  - 4 rear-end
  - 2 side-swipe



I-94 at Red River Bridge

- 143 crashes
  - Primarily at AM and PM peak periods
  - Primarily during winter months
- Manner of crashes (Top 3)
  - 62 non-collision with vehicle
  - 36 rear-end
  - 15 side-swipes

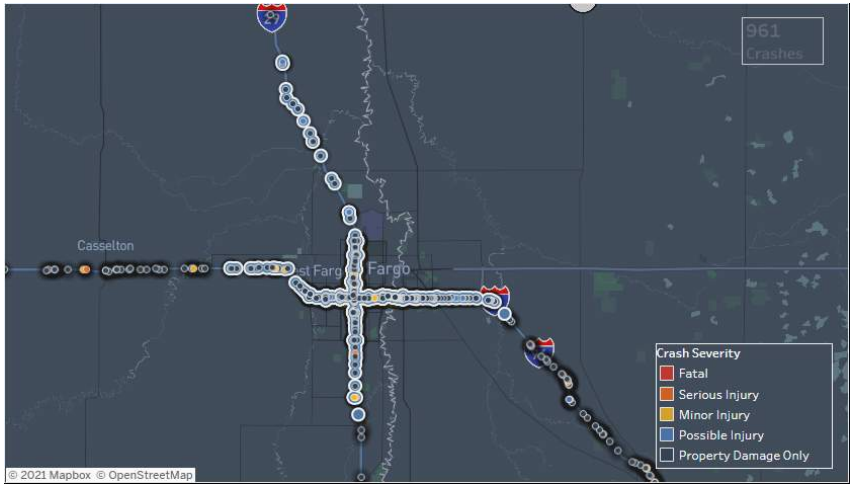


Crashes during PM Peak Period*

- 961 crashes (25% of total crashes)
  - 56% rear-end
  - 14% non-collision
- Location
  - I-29 between I-94 and 12th Avenue N
  - I-94 between 45th and 8th Street

*PM Peak Period: 4 PM - 7 PM

Crash Dashboard location recommendation from the SRC.



Recurring vs Non-Recurring Congestion

As shown in the speed profiles section, 15th and 85th percentile speeds can vary considerably during the peak house on I-29 and I-94. 15th percentile speeds are typically impacted by root causes of congestion that is not purely capacity. FHWA defines the seven root causes of congestion by the following:

- Physical Bottlenecks (Capacity)
- Traffic Incidents / Crashes
- Work Zones
- Weather
- Traffic Control Devices
- Special Events
- Fluctuations in Normal Traffic

FHWA's national estimates for recurring and non-recurring congestion in urban areas is shown on the right side of **Figure 11**.

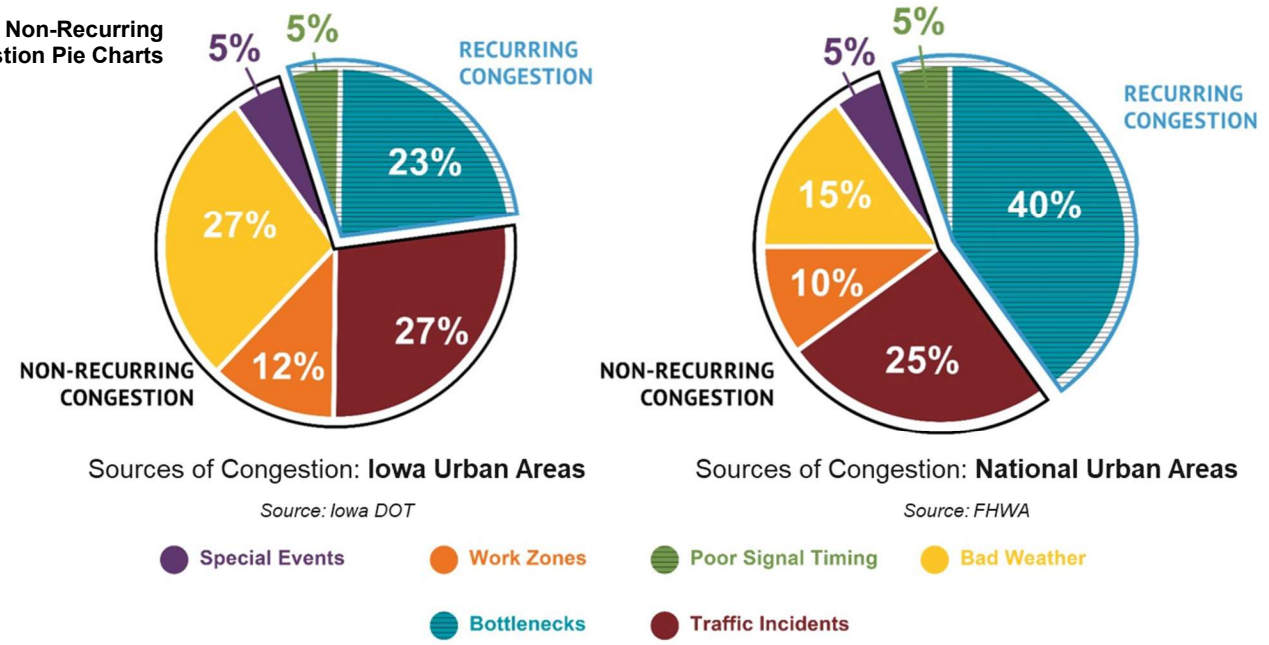
- 45% of congestion is recurring (Bottlenecks & Poor Signal Timing)
- 55% of congestion is non-recurring

Local sources of congestion for urban areas can vary substantially depending on a number of factors, with weather conditions playing a large role in the amount of non-recurring congestion. As discussed in the safety section, 43% of total crashes within the study area occur during December, January, and February. These crashes have residual effects on interstate congestion depending on location, severity, and crash clearance times.

Iowa DOT developed their own pie chart that breaks down recurring and non-recurring congestion, shown on the left side of **Figure 11**. This data-intensive process showed that less than 30% of congestion is recurring in Iowa Urban Areas.

The study team estimates that the percent recurring congestion in the Fargo-Moorhead metro area is 20%-30%.

Figure 11. Recurring and Non-Recurring Congestion Pie Charts



Conclusion & Next Steps

The existing conditions assessment resulted in the following findings.

Peak Hour Slowdowns

- I-94
  - AM Peak Hour
    - EB: Between Sheyenne Street through I-29
    - WB: Between 8th Street through 45th Street
  - PM Peak Hour
    - EB: Between Sheyenne Street through 8th Street
    - WB: Between 25th Street and Sheyenne Street

  Largest speed reduction (~16 mph) occurs during the WB PM peak hour between 25th Street through 45th Street.

- I-29
  - AM Peak Hour
    - NB: Between 32nd Avenue S through Main Avenue
    - SB: Near 12th Ave N
  - PM Peak Hour
    - NB: No Discernable Congestion
    - SB: Between 12th Ave N and I-94

  Largest speed reduction (~11 mph) occurs during the SB PM peak hour near 13th Avenue S.

Travel Patterns

A majority of users entering the metro area via I-29 or I-94 do not travel through the area without stopping. StreetLight Data was used to estimate daily external trips through the metro area. Results are summarized in **Table 5**. StreetLight Data will be used to develop Origin-Destination patterns for microsimulation model development to test various interstate strategies on I-94 and I-29.

Table 5. Streetlight Origin-Destination Analysis at External Stations

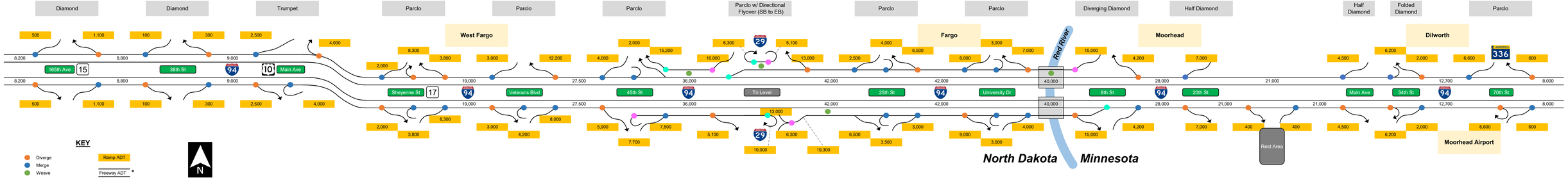
External Station	Percent of Users that Have an Origin / Destination in the Metro Area	
	All Vehicles	Trucks
I-94 West External	88%	61%
I-94 East External	88%	65%
I-29 North External	82%	61%
I-29 South External	91%	71%

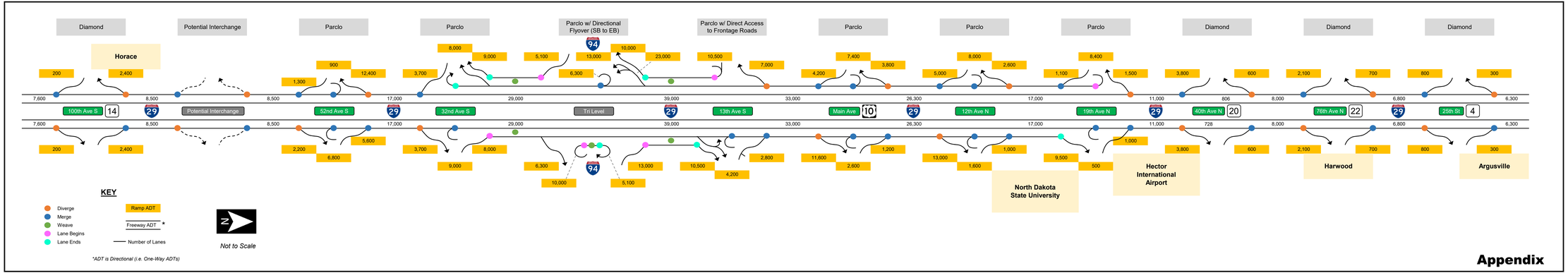
Safety

- Most mainline crashes are concentrated:
  - On I-94 between Sheyenne Street and 34th Street
  - On I-29 between 19th Avenue N and 52nd Avenue S
- Winter crashes
  - 43% of all mainline crashes occur in December, January, and February
  - 40% of all crashes occurred during winter weather conditions (snow, ice, slush)
- 80% of total interstate mainline crashes were either single vehicle accidents and rear-end collisions
- 25% of total crashes occurred during the PM peak period (4 PM – 7 PM)
  - 56% of crashes during the PM peak period were rear-end crashes
- Hot Spot Locations
  - I-94 near Red River Bridge
  - I-94 / I-29 System Interchange
  - I-29 SB from 13th Avenue S to I-94
  - I-94 between 45th Street and I-29
  - 13th Avenue S & I-29 Interchange
  - 45th Street & I-94 Interchange
  - University Drive & I-94 Interchange

Appendix

- Existing Average Annual Daily Traffic
- Existing Interstate Lane Configuration


Diamond
Diamond
Trumpet
Parclo
Parclo
Parclo
Parclo w/ Directional Flyover (SB to EB)
Parclo
Parclo
Diverging Diamond
Half Diamond
Half Diamond
Folded Diamond
Parclo
West Fargo
Fargo
Moorhead
Dilworth
Red River
North Dakota
Minnesota
165th Ave
38th St
Main Ave
Sheyenne St
Veterans Blvd
45th St
Tri Level
25th St
University Dr
8th St
20th St
Main Ave
34th St
70th St
Rest Area
Moorhead Airport
KEY
Diverge
Merge
Weave
Lane Begins
Lane Ends
Ramp ADT
Freeway ADT *
Number of Lanes
N
Not to Scale
*ADT is Directional (i.e. One-Way ADTs)
Appendix


Diamond
Potential Interchange
Parclo
Parclo
Parclo w/ Directional Flyover (SB to EB)
Parclo w/ Direct Access to Frontage Roads
Parclo
Parclo
Parclo
Diamond
Diamond
Diamond
Horace
100th Ave S
14
29
Potential Interchange
52nd Ave S
29
32nd Ave S
Tri Level
29
13th Ave S
Main Ave
10
29
12th Ave N
19th Ave N
29
40th Ave N
20
76th Ave N
22
29
25th St
4
94
94
North Dakota State University
Hector International Airport
Harwood
Argusville
KEY
Diverge
Merge
Weave
Lane Begins
Lane Ends
Ramp ADT
Freeway ADT *
Number of Lanes
Not to Scale
*ADT is Directional (i.e. One-Way ADTs)

Appendix