

Using National Performance Management Research Data Set (NPMRDS) to Generate Statewide Performance Measures

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CTS Research Conference, May 21-22, 2014



UNIVERSITY OF MINNESOTA

Driven to DiscoverSM

Outline

- NPMRDS introduction
- Performance measures (mobility, reliability, delay, and others)
- Data analysis NPMRDS
- Truck GPS data analysis
- Concluding remarks
- Q & A



What is NPMRDS?

- Vehicle probe-based travel time data set acquired by the Federal Highway Administration (FHWA)
- Average travel times every 5 minutes, 24/7 on the National Highway System (NHS)
- Data is provided by HERE traffic (formerly Nokia/Navteq)
- Truck probe data is from ATRI
- Data set is available on monthly basis (July 2013 – April 2014)
- Archived dataset Oct. 2010 – June 2013



NPMRDS Static Data

- Distance (length of TMC in miles)
- Road Number and local Name
- Latitude/Longitude
- Road direction (Northbound, Southbound, Westbound, Eastbound)
- Shapefile of coverage based on NHS



NPMRDS Monthly Data

- TMC code (traffic code for road segment)
- Country
- State
- County
- Date (MMDDYYYY)
- EPOCH (five-minute increment)
- Travel Time – All vehicles (seconds)
- Travel Time – Passenger vehicles (seconds)
- Travel Time – Freight vehicles (seconds)



Sample NPMRDS Data

TMC	Date	Epoch	Travel time All vehicles	Travel time Passenger vehicles	Travel time Freight trucks
118N04174	11132013	180	113	115	113
118N04174	11132013	181	108	105	115
118N04174	11132013	182	110		110
118N04174	11132013	183	113	110	113
118N04174	11132013	184	117	115	122
118N04174	11132013	185	113	112	114
118N04174	11132013	186	109	108	110
118N04174	11132013	187	111	111	113





Performance Measures



Performance Measures

Truck Mobility

Percent of freight corridor miles in TCMA with average speed < 45 MPH in AM or PM Peak

Travel Time Reliability Index

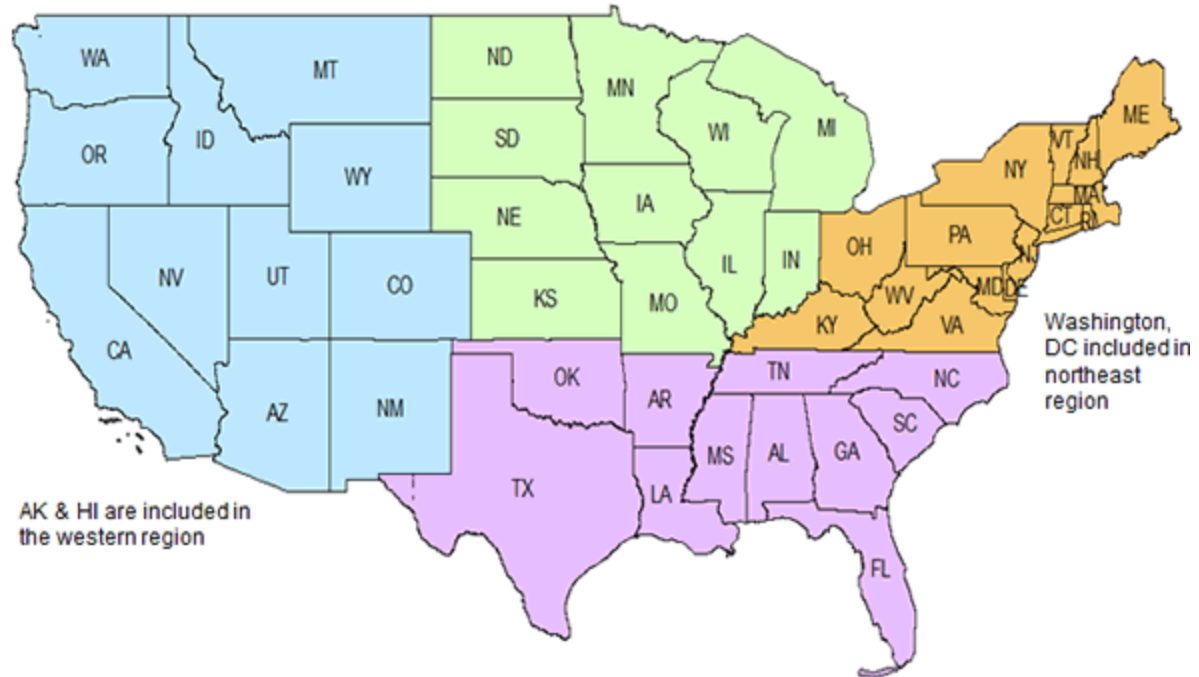
$$RI_{80} = \frac{80^{th} \text{ percentile Travel Time}}{\text{Travel Time at MnDOT Specified Threshold Speed}}$$

Truck Daily Delay

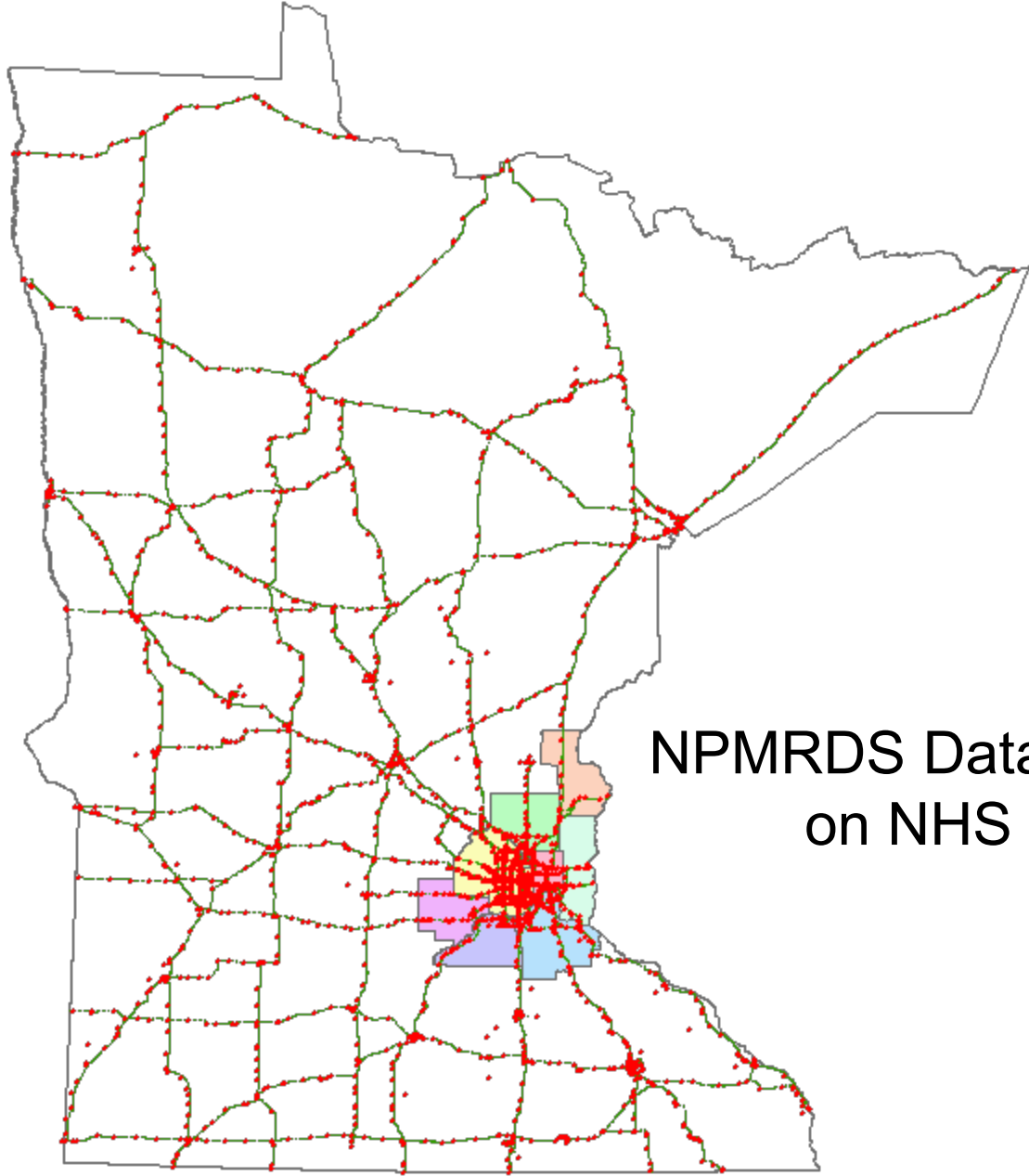
$$\sum_{\text{Segment}} \sum_{\text{Hour}} \left(\frac{\text{Segment Len.}}{\text{Travel Speed}} - \frac{\text{Segment Len.}}{\text{Threshold Speed}} \right) \times \text{Vol}\% \times \text{HCAADT}_{\text{Segment}}$$

Threshold Speed = 45 MPH, Max Throughput Speed





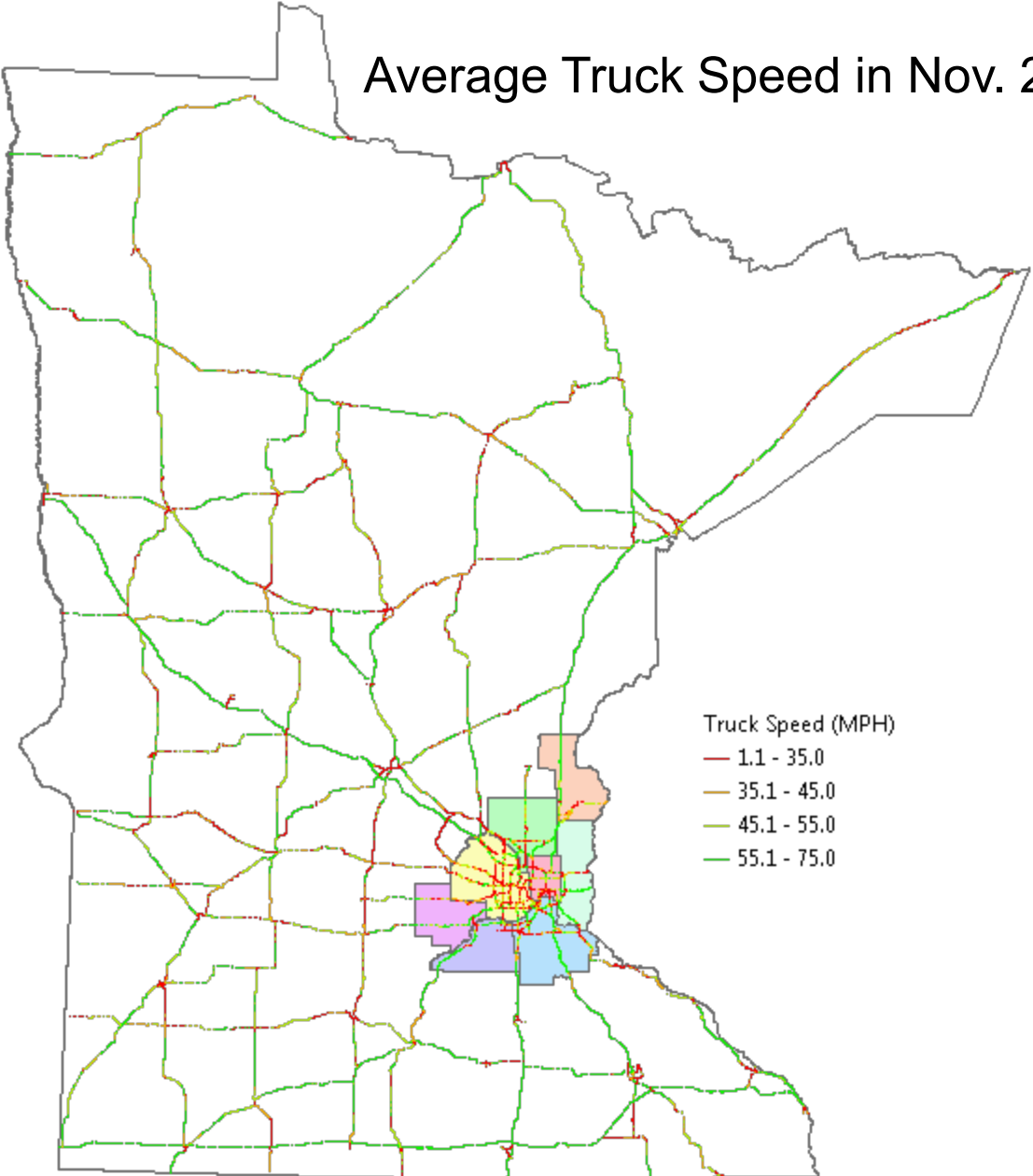
NPMRDS Analysis Example



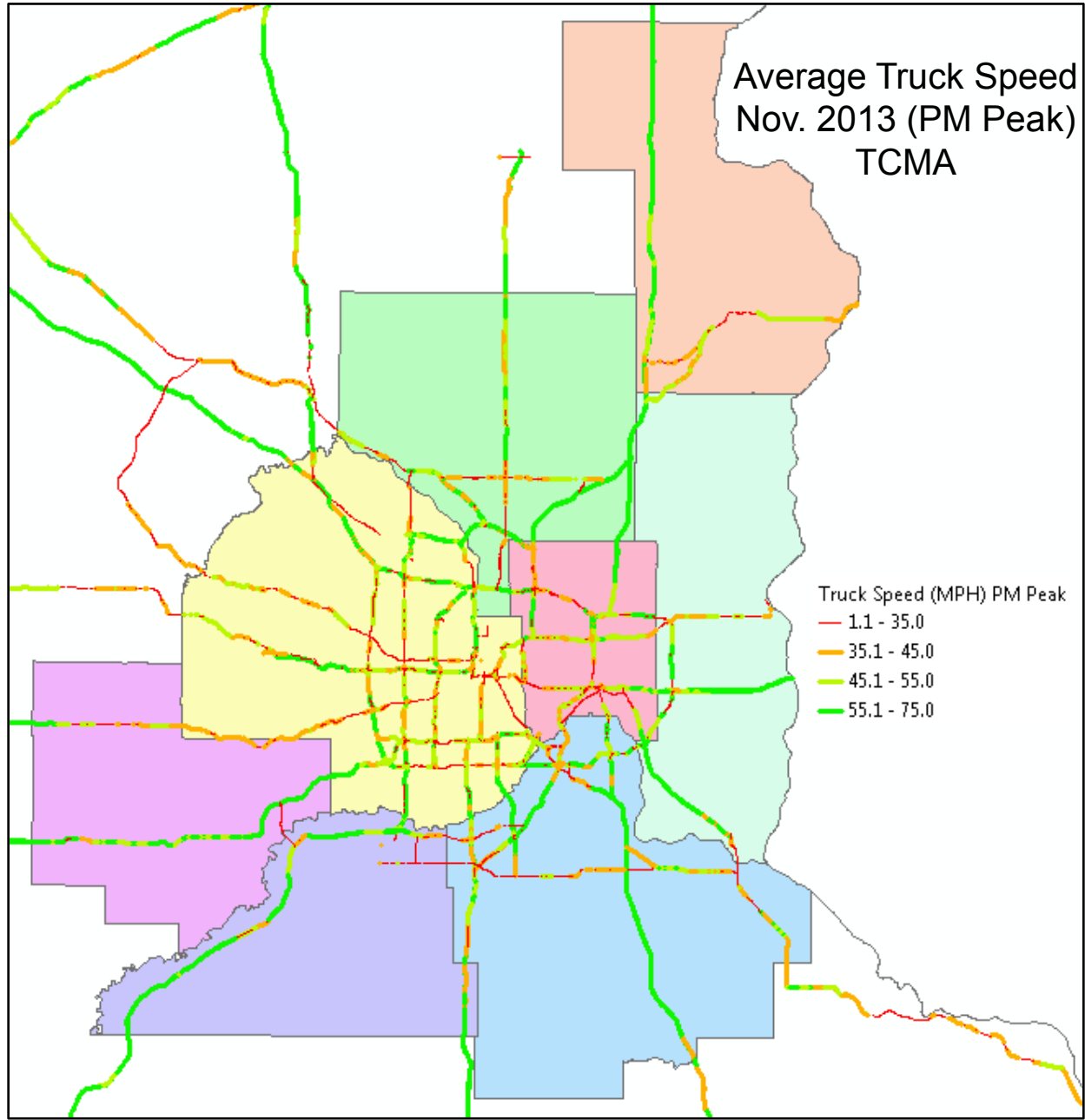
NPMRDS Data Coverage
on NHS in MN



Average Truck Speed in Nov. 2013 (PM Peak)



Average Truck Speed
Nov. 2013 (PM Peak)
TCMA



NPMRDS vs. Raw GPS Data

- NPMRDS contains processed travel time data
- Mobility measures
- Reliability measures
- NPMRDS cannot be used to compute delay due to no probe vehicle count information
- GPS raw data requires additional data processing

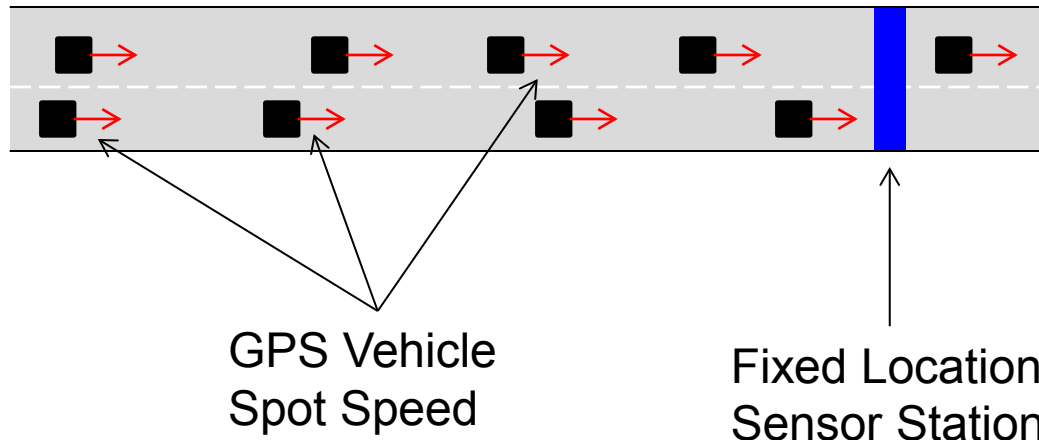




Truck Speed Analysis



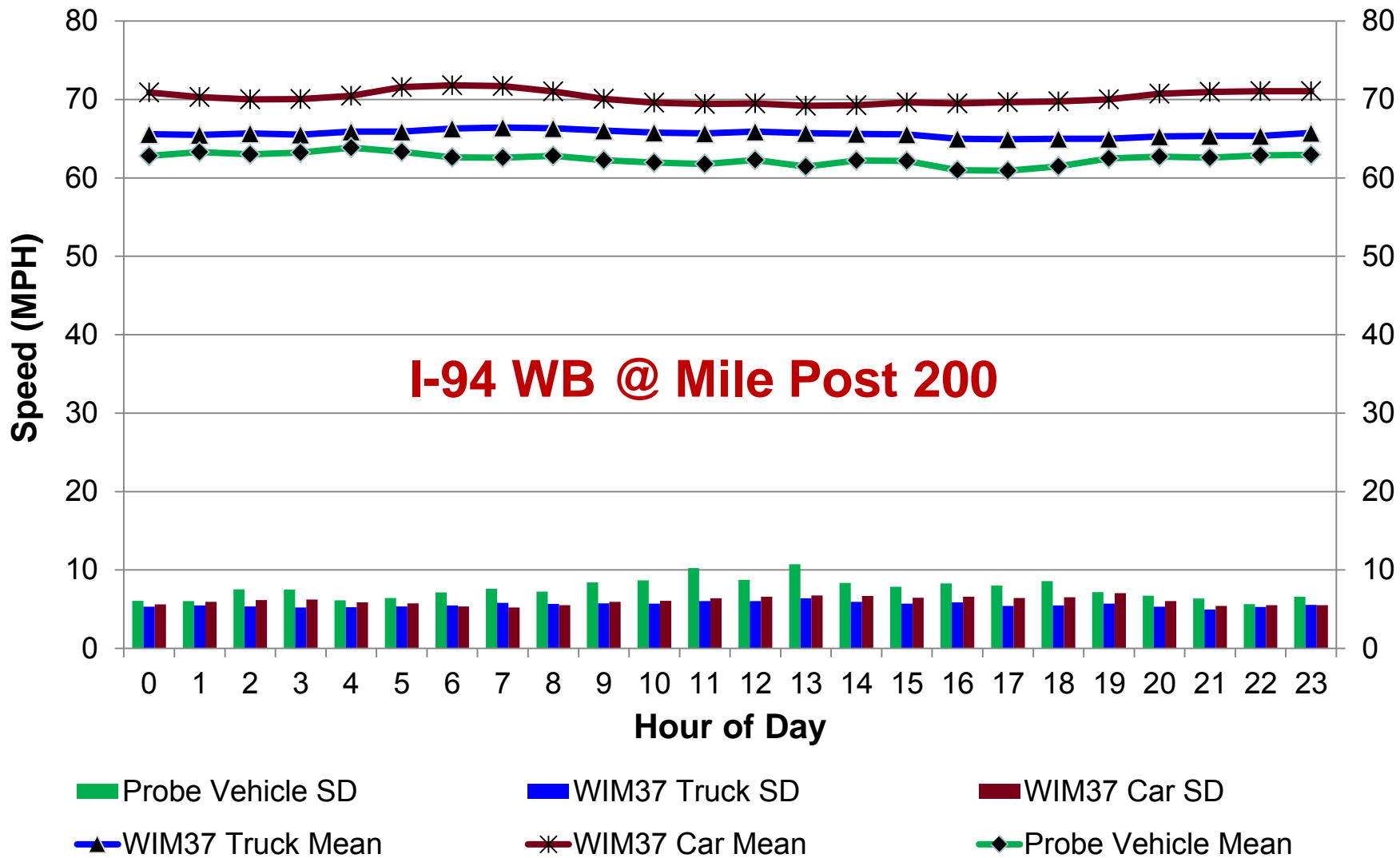
GPS vs Sensor Speed



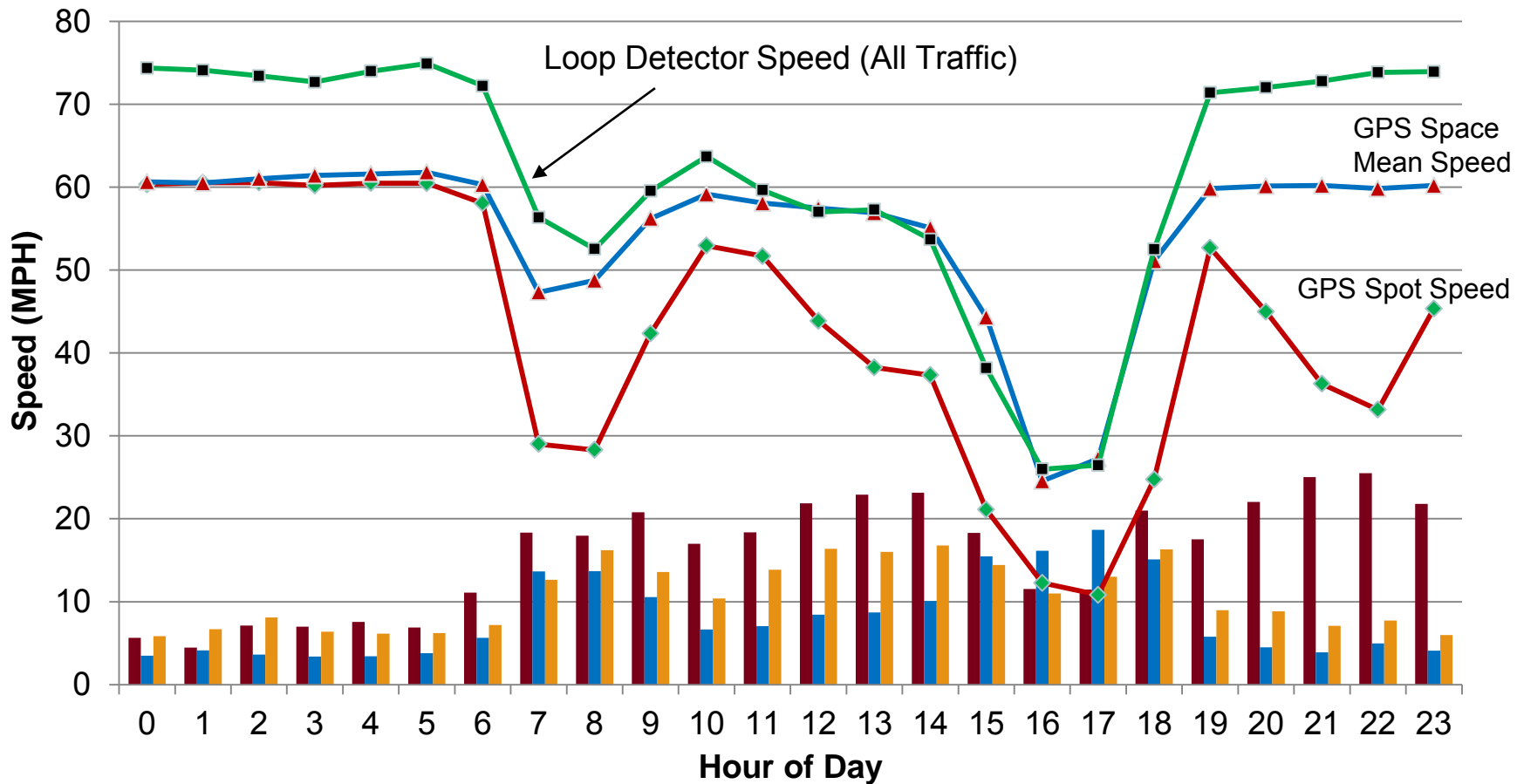
- Fixed station speed (sample in space)
- Instantaneous probe speeds in a roadway segment (sample in traffic flow)



GPS vs. WIM37 Vehicle Speed Comparison

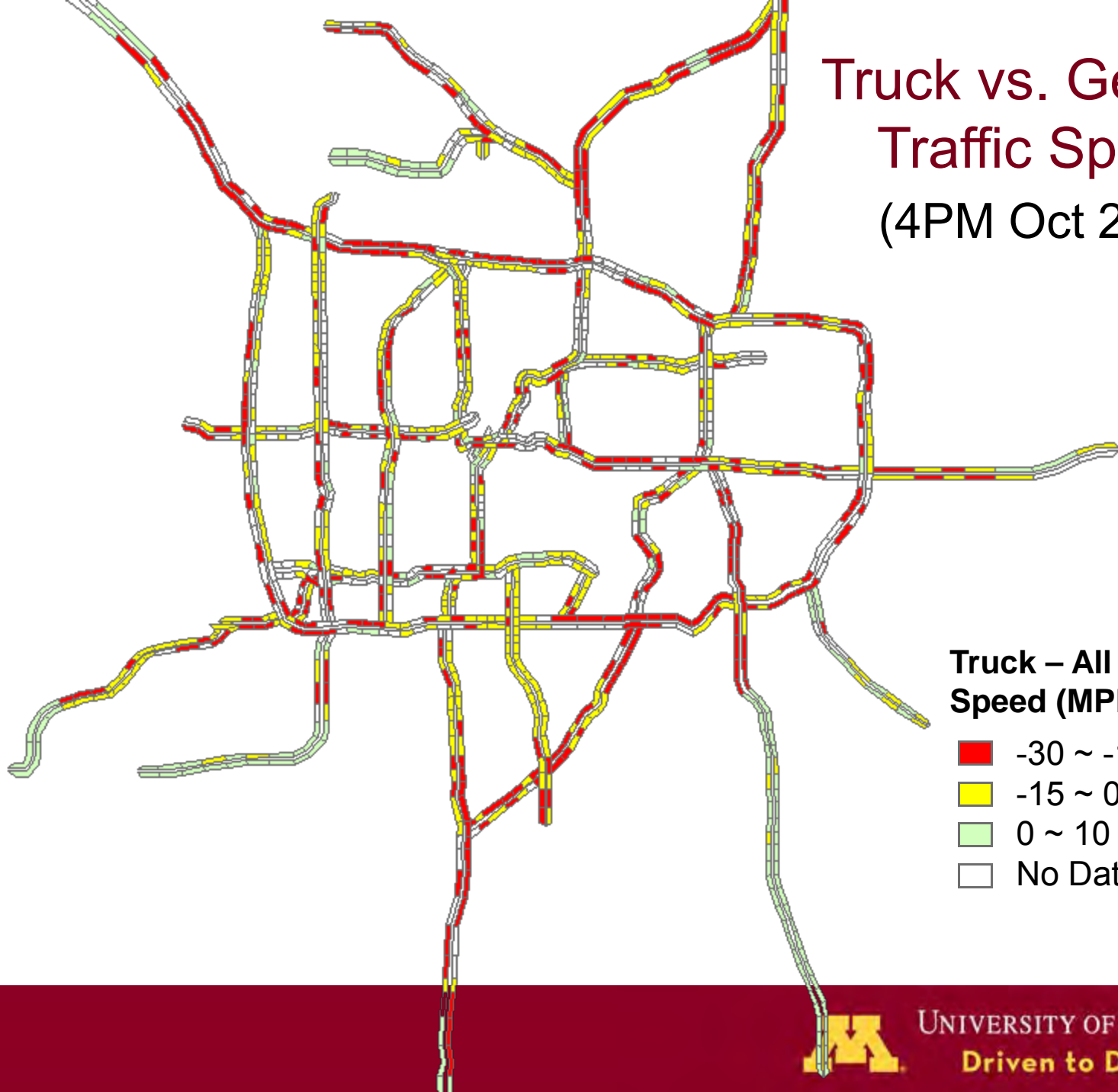


Speed Comparison - Truck GPS vs. Loop Detector (I-494 EB @ France Avenue)



- GPS Point Speed SD
- Loop Detector Speed SD
- GPS Space Mean Speed SD
- GPS Spot Speed
- Loop Detectors (All Traffic) Speed Average

Truck vs. General Traffic Speed (4PM Oct 2013)



**Truck – All Vehicle
Speed (MPH)**

- -30 ~ -15
- -15 ~ 0
- 0 ~ 10
- No Data



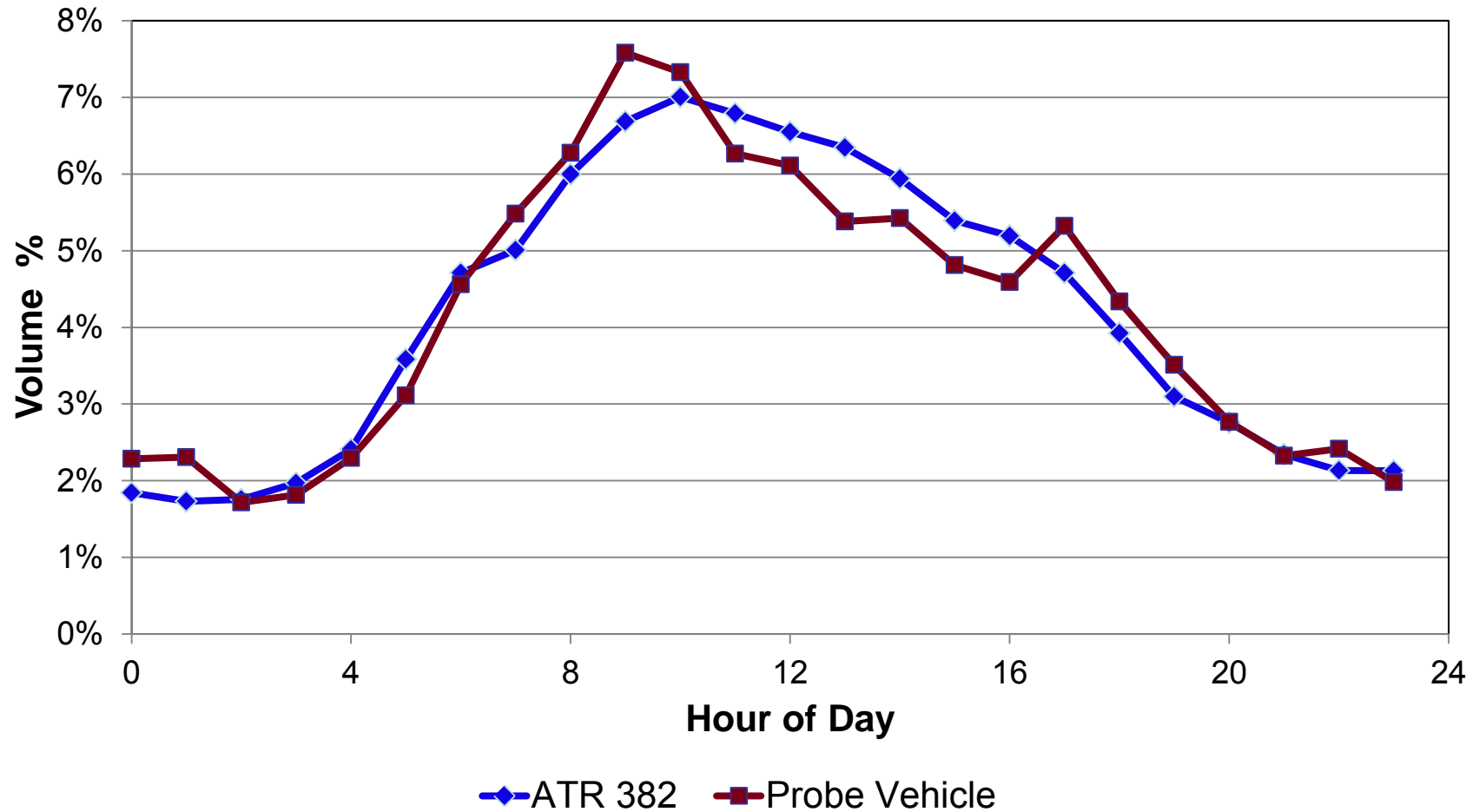


Truck Volume Percentage



ATR 382 vs. Probe Vehicle

Compariosn of Volume Percentage by Hour



Correlation of GPS vs. ATR Hourly Volume %

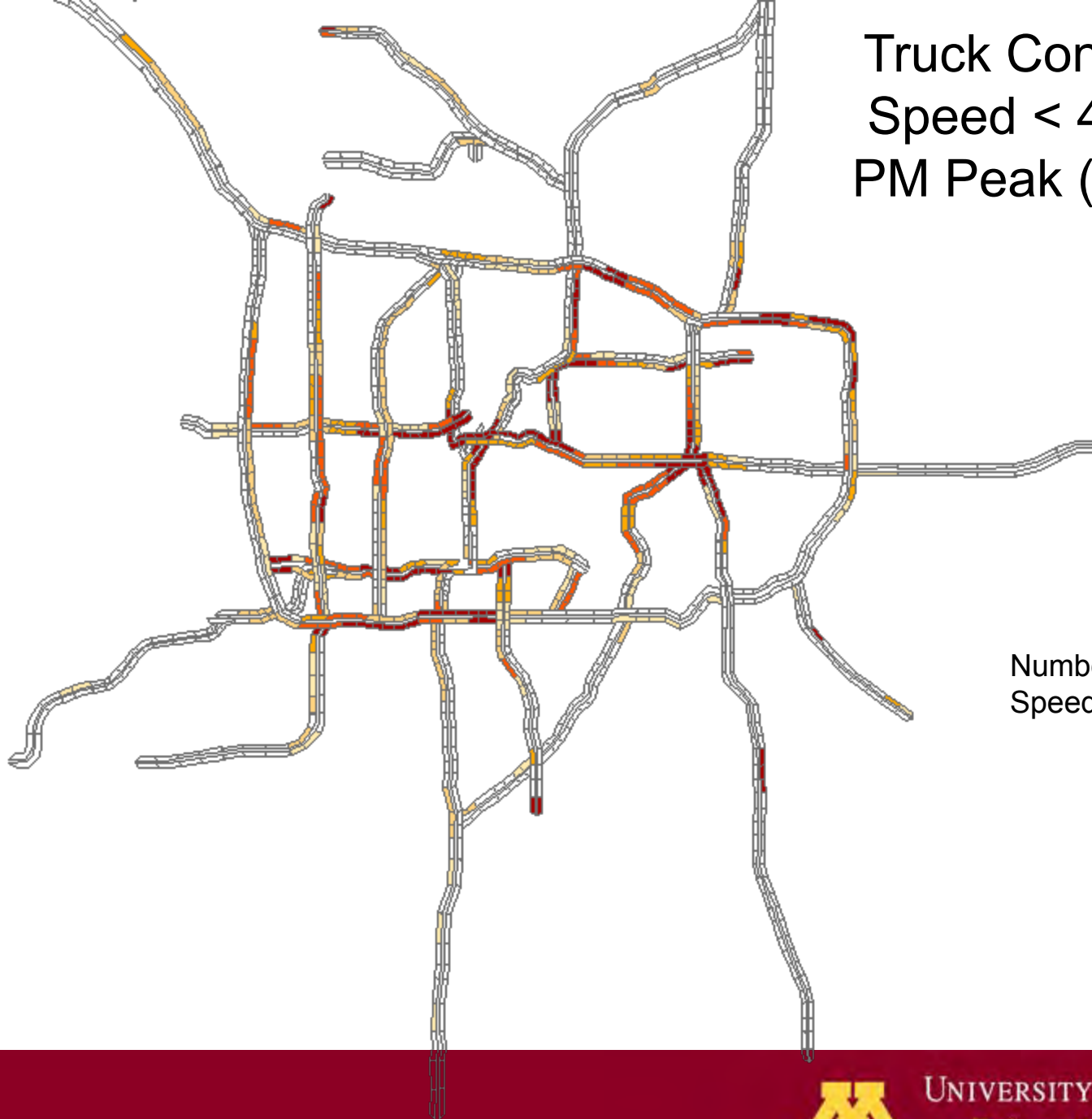
ATR Data		Probe Vehicle Data			Correlation Coefficient
ID	HCAADT	Route ID	Segment ID	Count	
188	2,600	29	19	43,199	0.83
191	2,150	33	88	11,961	0.94
200	7,900	24	77	129,595	0.87
335	3,450	34	74	19,741	0.93
341*	5,100	4	18	70,873	0.61
351	1,600	9	15	4,107	0.93
352	1,600	31	55	11,686	0.86
353	1,750	37	49	26,821	0.96
365**	1,700	26	31	4,933	0.51
381	1,350	14	7	22,530	0.99
382	2,700	29	67	42,469	0.97
388	830	25	3	2,576	0.84
400	1,600	9	15	2,841	0.81
422	NA	1	8	433	0.96

* ATR341 - S OF CSAH35 (50TH ST N) IN OAKDALE (I-694)

** ATR365 - S OF CSAH116 (BUNKER LAKE BLVD NE) IN HAM LAKE (State Highway 65)



Truck Congestion Speed < 45 MPH PM Peak (2-7 PM)



Number of Hours
Speed < 45 MPH



Truck Mobility Measure

Time Period (2012 Weekdays TCMA)	AM Peak 5-10 AM	PM Peak 2-7 PM
# of Miles with Average Speed < 45 MPH	96	147
Total Miles of RTMC Stations in TCMA	774	774
Percentage of Miles < 45 MPH	12.4%	19.0%



Truck Delay

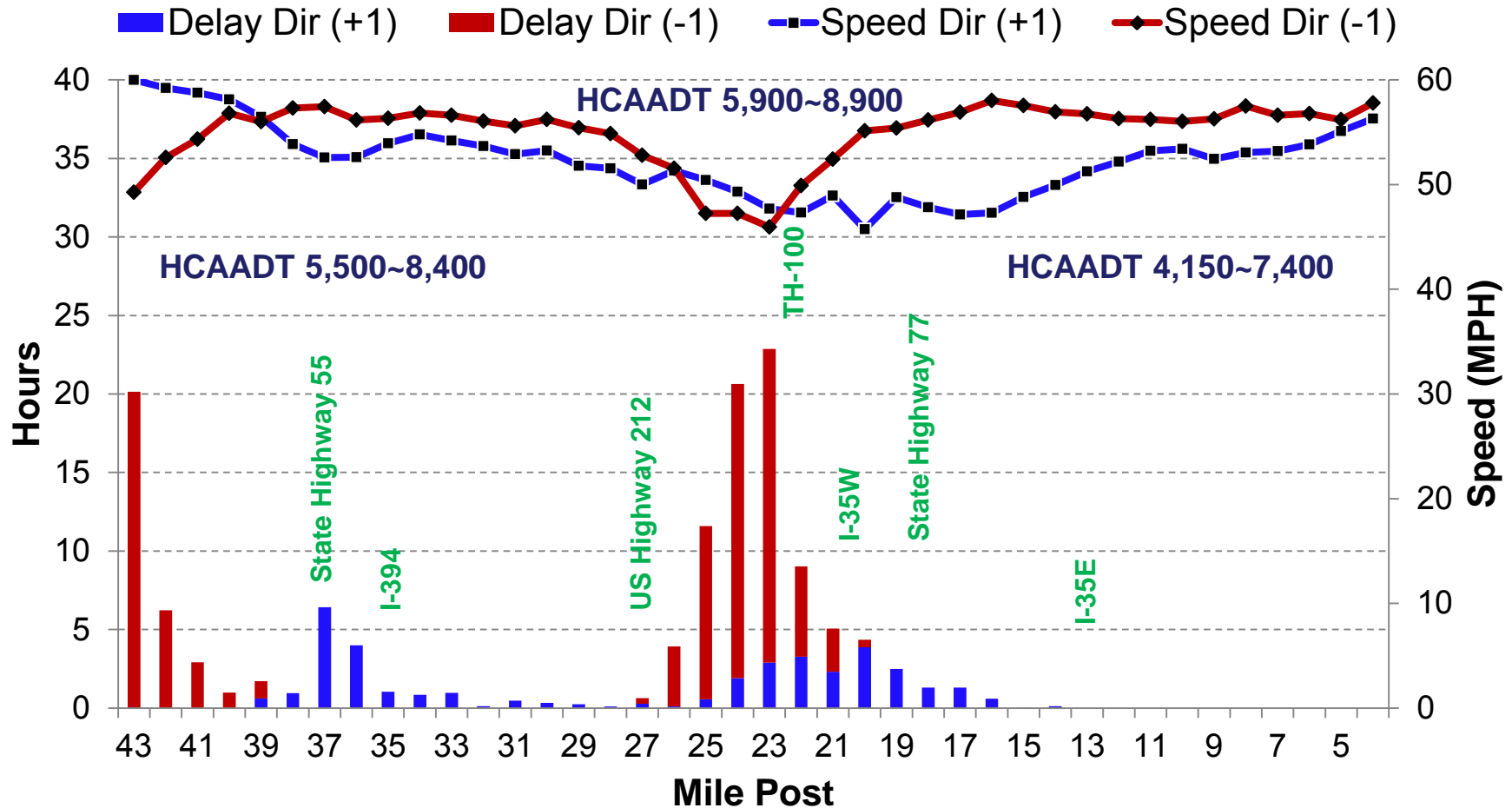
$$\sum_{\text{Segment Hour}} \sum \left(\frac{\text{Segment Len.}}{\text{Travel Speed}} - \frac{\text{Segment Len.}}{\text{Threshold Speed}} \right) \times \text{Vol\%} \times \text{HCAADT}_{\text{Segment}}$$

Threshold Speed = 45 MPH, Max Throughput Speed



I-494

Average Daily Delay and Speed



Threshold Speed 45 MPH

Total Truck Delay = 37 (+1) + 95 (-1) = 132 Hours / Day



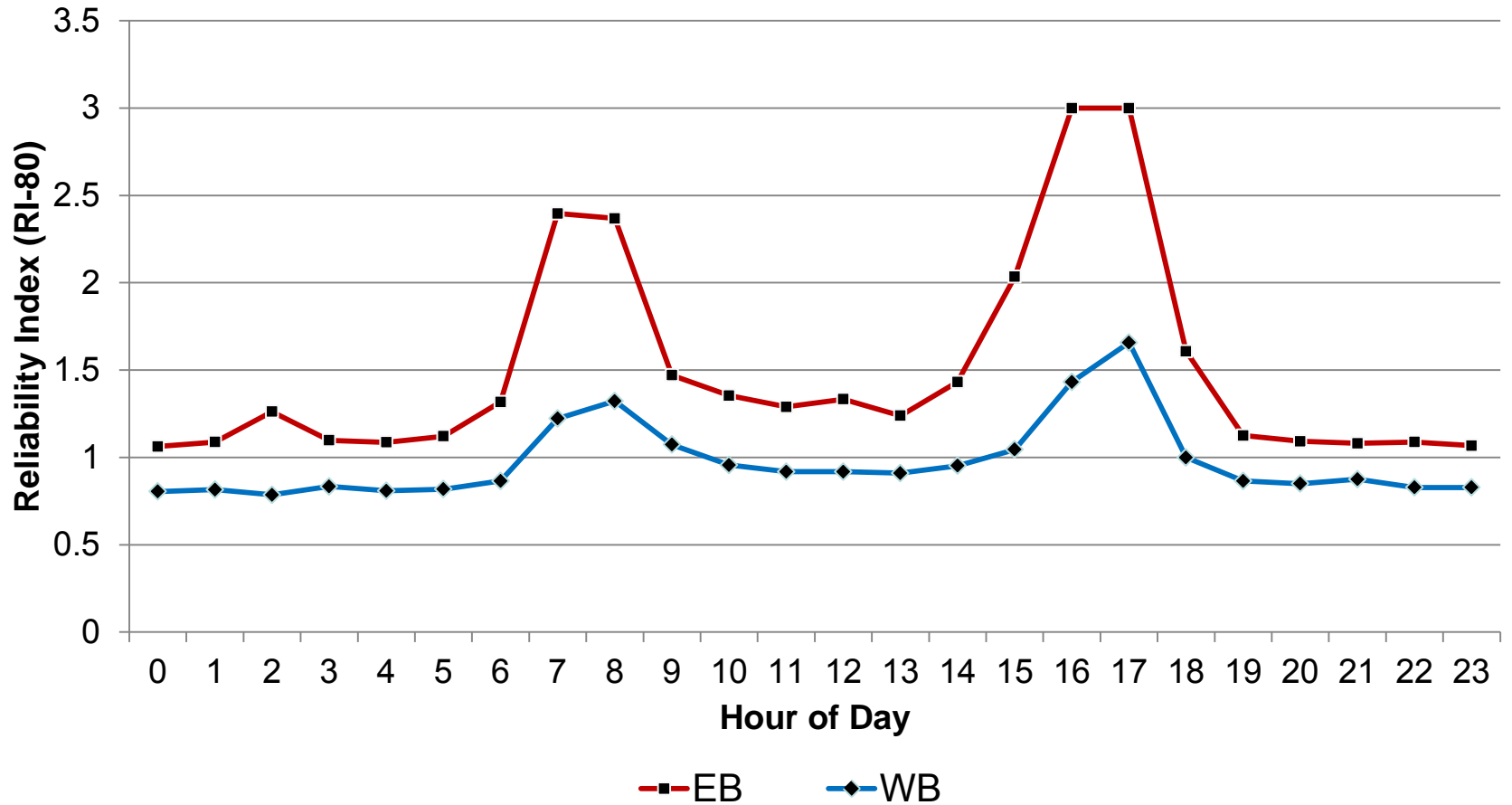
Travel Time Reliability

$$RI_{80} = \frac{80^{\text{th}} \text{ percentile Travel Time}}{\text{Travel Time at MnDOT Specified Threshold Speed}}$$

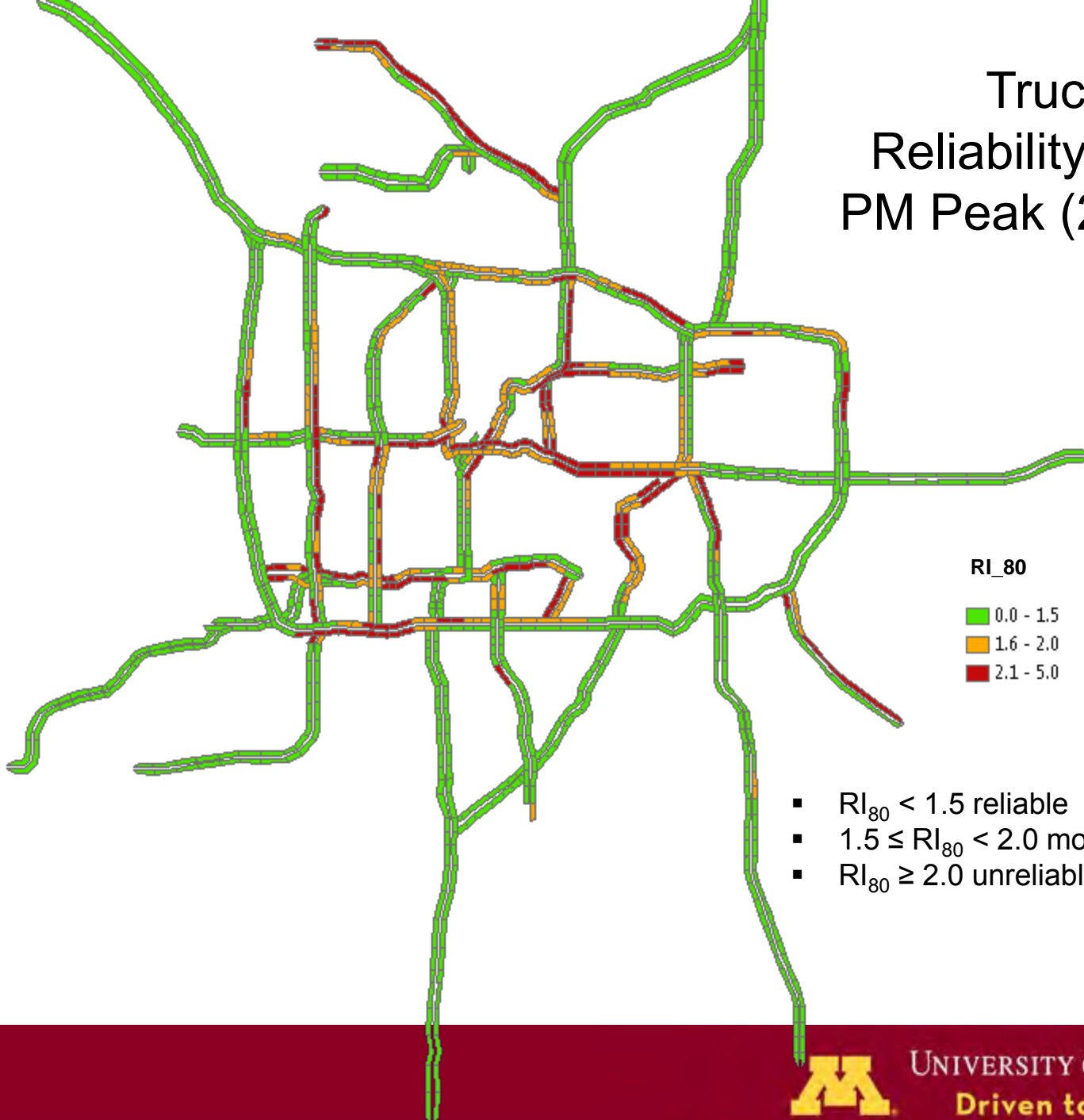
Threshold Speed = 45 MPH, Max Throughput Speed



I-694 Travel Time Reliability at I-35W



Truck Reliability Index PM Peak (2-7 PM)





Truck Bottlenecks



Truck Bottleneck in PM Peak

(Based on Delay)

Rank	Location	Dir.	PM Peak Delay (hours) / Mile	PM Peak Reliability R180	HCAADT	Number of Lanes	Length (miles)
1	I-35W at I-694	NB	14.08	1.94 - 3.75	7700 - 8500	3	3.30
2	I-35W at I-94	SB	12.94	5.00	3250 - 8300	3	1.01
3	I-494 between I-35W & 169	EB	11.31	2.05 - 4.09	6900 - 9100	2	4.88
4	I-394 between TH 100 & I-94	EB	7.14	2.59 - 3.75	400	3	2.61
5	I-694 between I-35E & I-35W	WB	6.85	2.37 - 3.04	6700 - 7800	2	3.02
6	I-694 at I-35W	EB	6.81	1.58 - 2.18	9000 - 12300	2	2.25
7	TH 62 at TH 169	WB	6.41	2.81 - 5	2450	2	2.26
8	US52 at I-94	NB	6.40	4.33	4800 - 5200	3	0.75
9	I-94 at I-35W	WB	5.95	2.6 - 3.25	6600 - 6800	3	3.27
10	I-94 at I-35E	EB	5.88	2.84 - 3.21	6600 - 7100	4	2.67

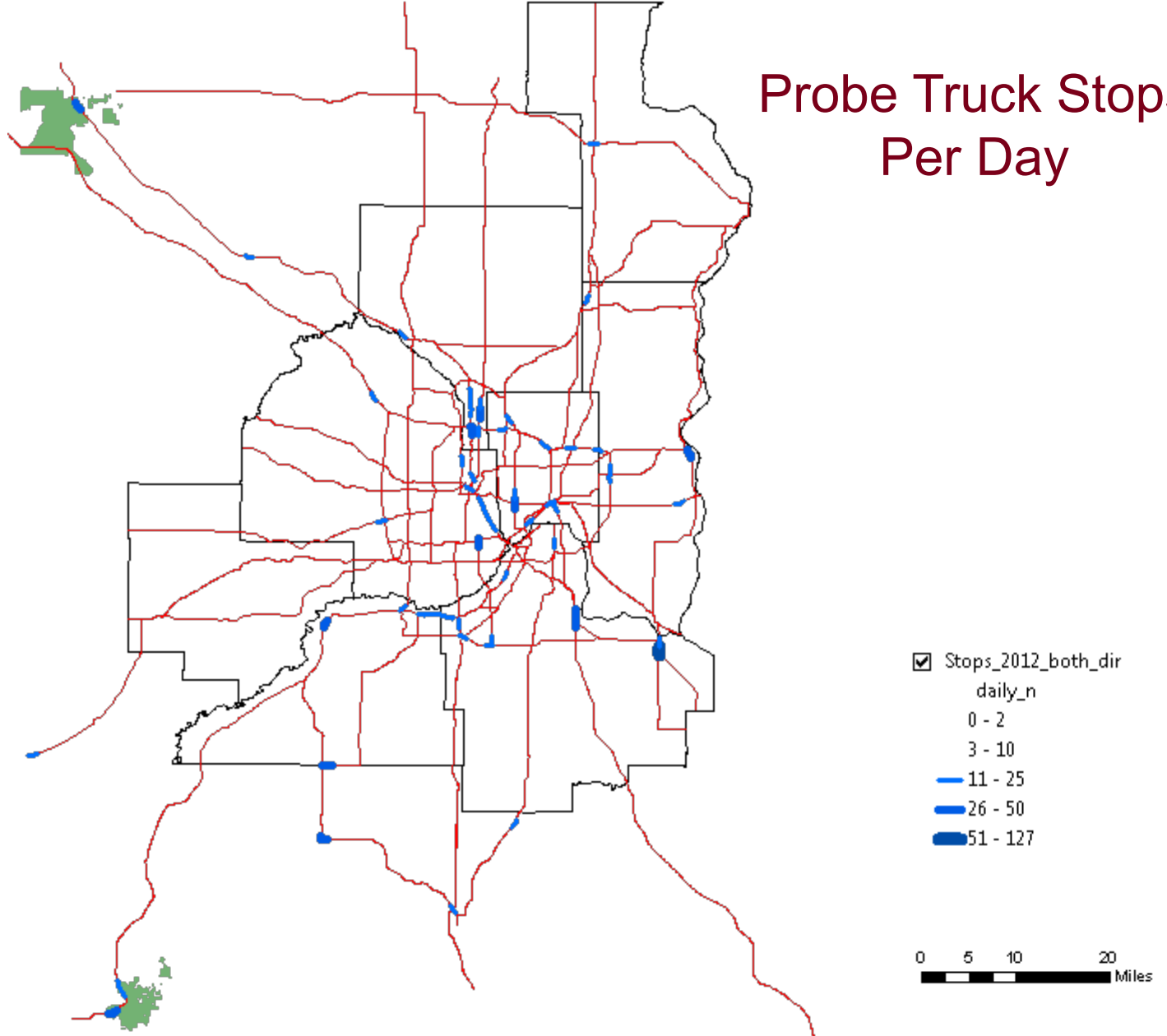




Truck Stop and Parking

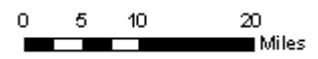
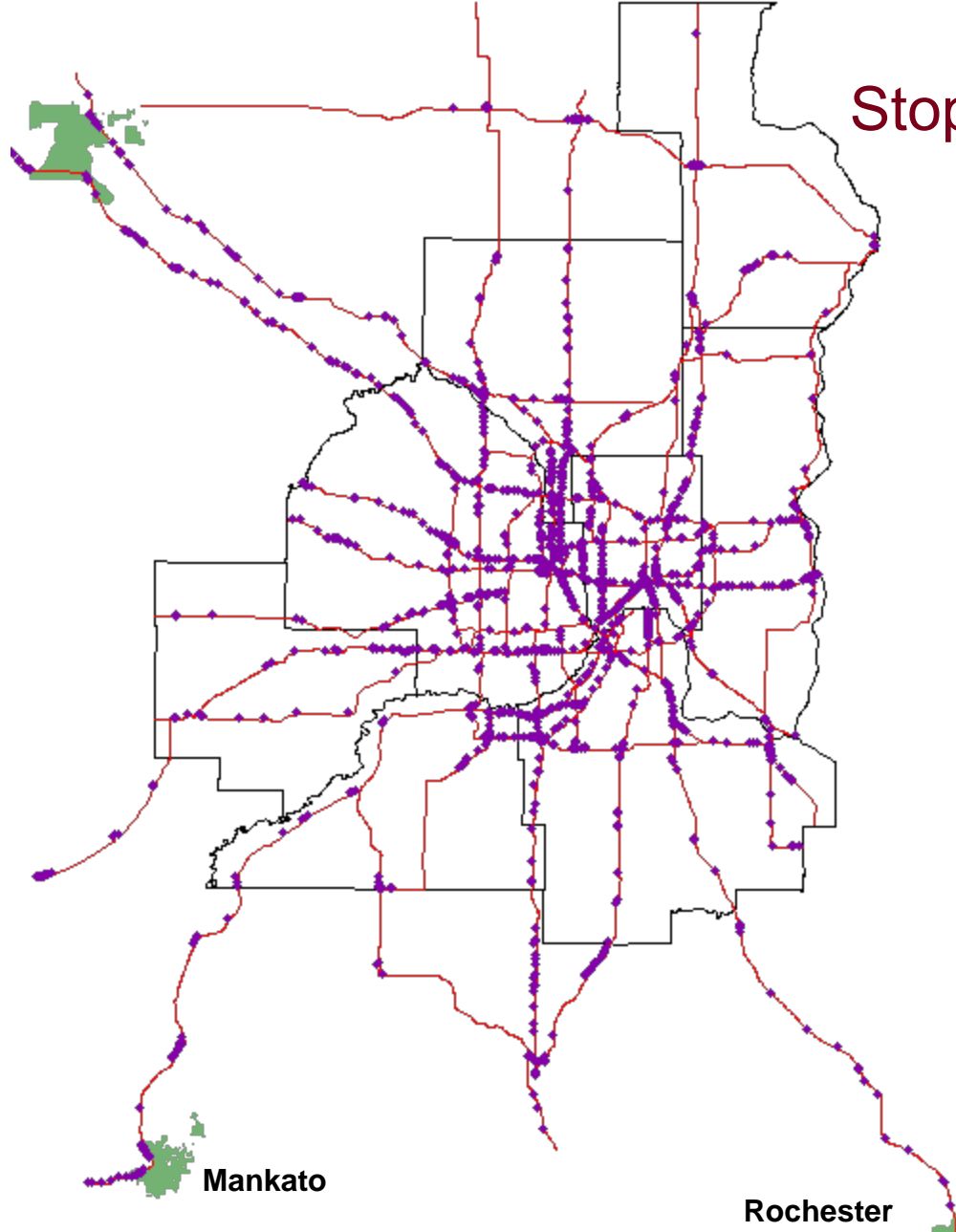


Probe Truck Stops Per Day



St. Cloud

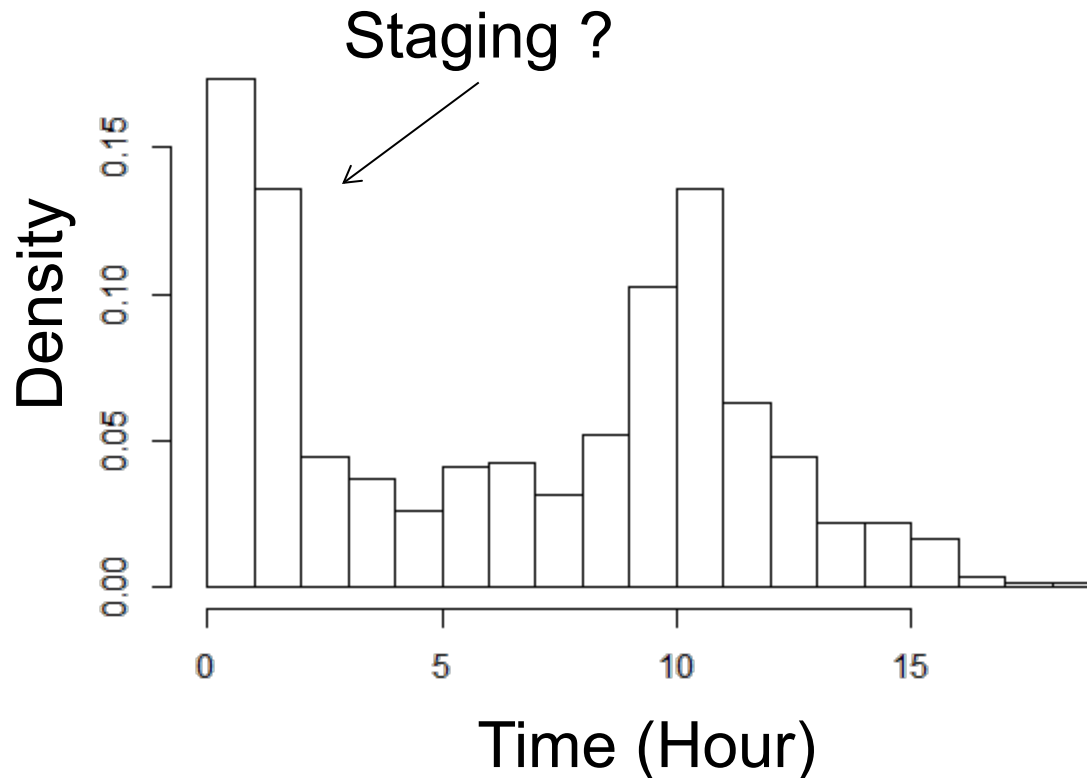
Stop Duration > 0.5 hr



Truck Parking at I-94 Rest Area in Maple Grove



Histogram of Parking Duration at the Rest Area on I-94 in Maple Grove



DS-A&C



Concluding Remarks

- Probe vehicle data is a reliable data source to generate performance measures on roadways without loop detectors
- NPMRDS supports mobility and reliability measures
- Delay cannot be computed from NPMRDS due to lack of probe vehicle count information



Future Opportunities

- Generate reliable performance measures from probe vehicle data or NPMRDS
- Analyze and monitor performance measures in TCMA or statewide regularly
- Incorporate PM into forecasting & planning model (*Transportation Policy Plan 2040*)
- Take advantage of NPMRDS (NHS only)
- Truck bottlenecks
- Truck parking duration and facility needs





Acknowledgements

- MnDOT – OFCVO & TDA
- Project TL John Tompkins & other TAP Members
- ATRI – Dan Murray & other staff
- HERE Traffic
- CTS, UMN
- MTO, Civil Engineering, UMN
- FHWA



THANK YOU !

QUESTIONS ?

