Travel Time Reliability

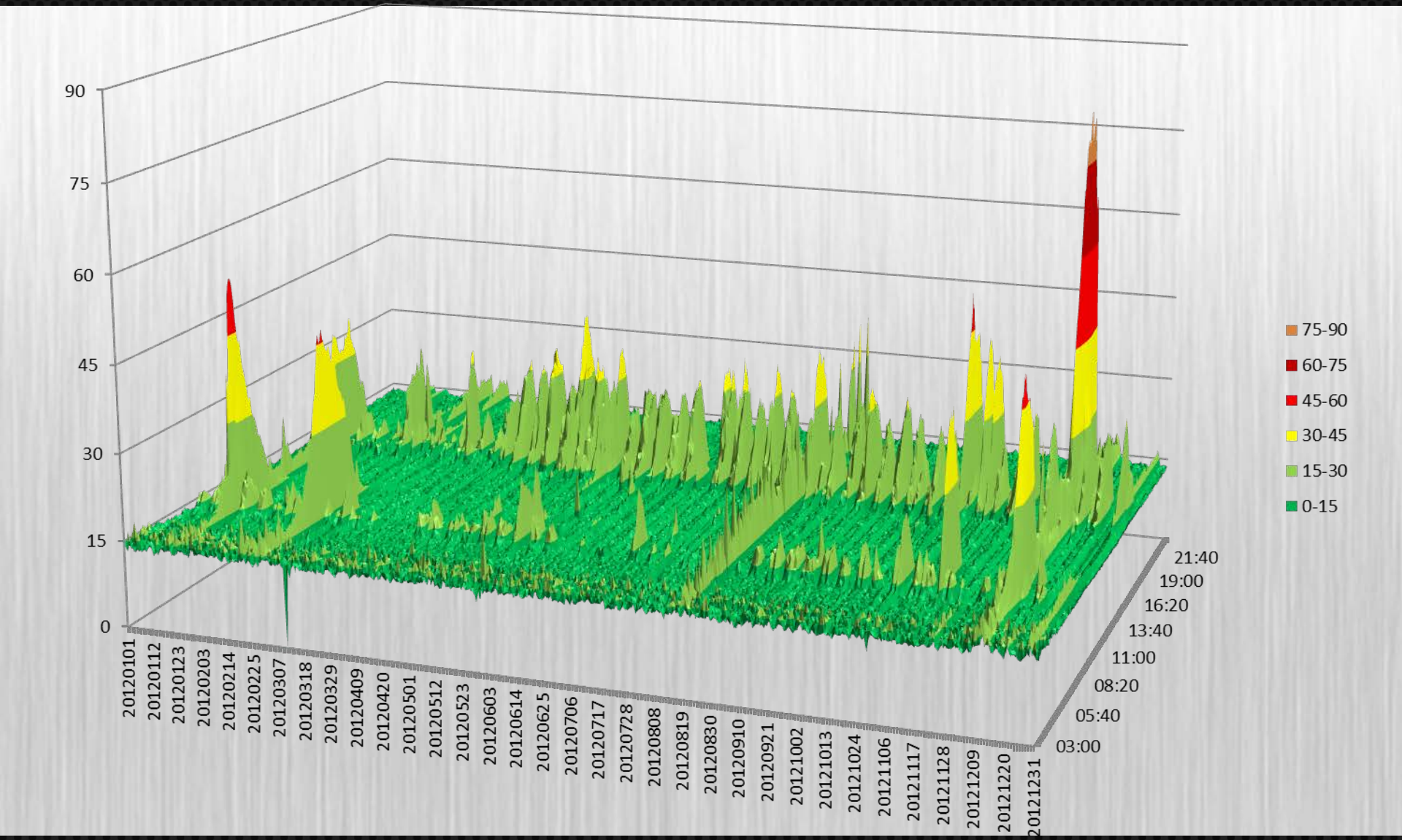
Evaluation of Recurring and Nonrecurring Congestion

Midwest Travel Model Users Group

July 19, 2016

SRF Consulting Group, Inc.

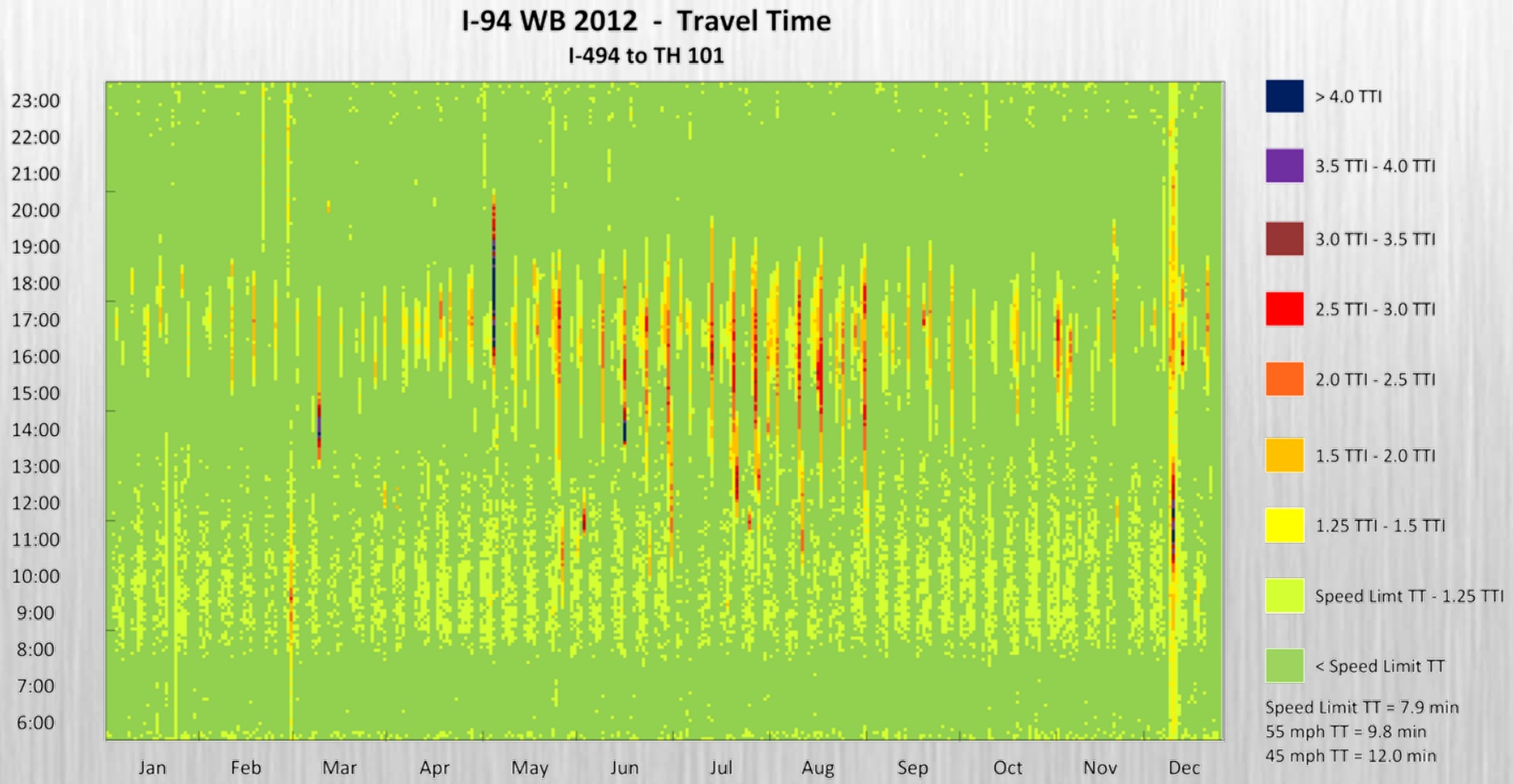
Reliability – Travel Times



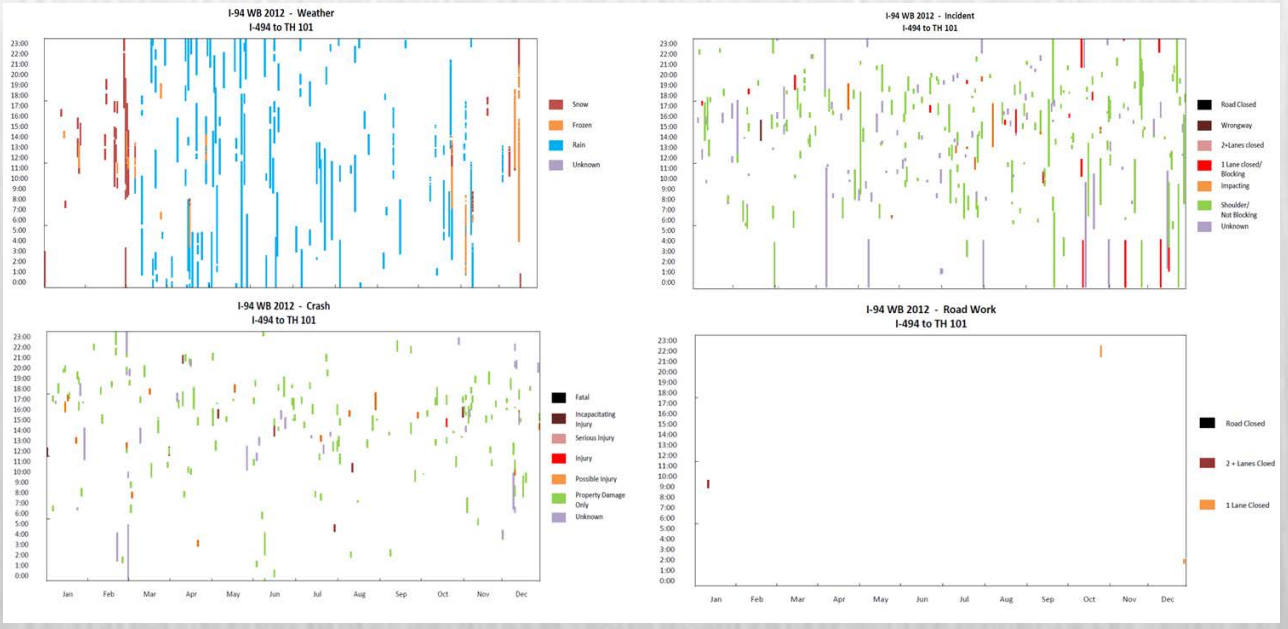
Measuring Reliability

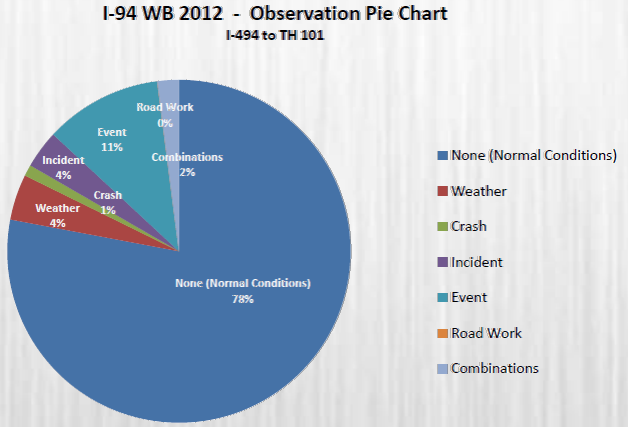
- Travel Time Data
  - INRIX, Bluetooth, TICAS, etc.
  - Not an average!
- Nonrecurring elements
  - Weather
  - Crashes
  - Roadwork
  - Events

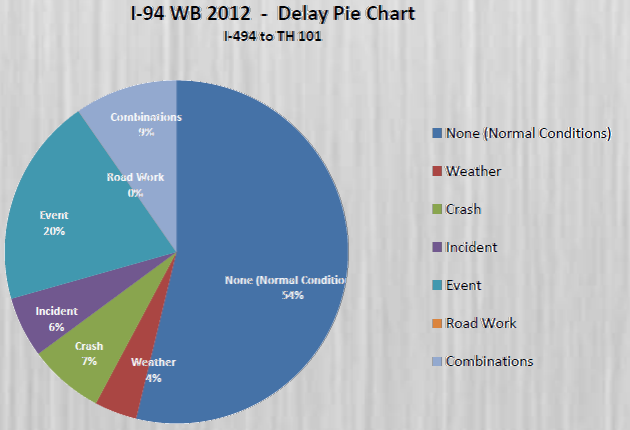
Reliability- Surface Plot



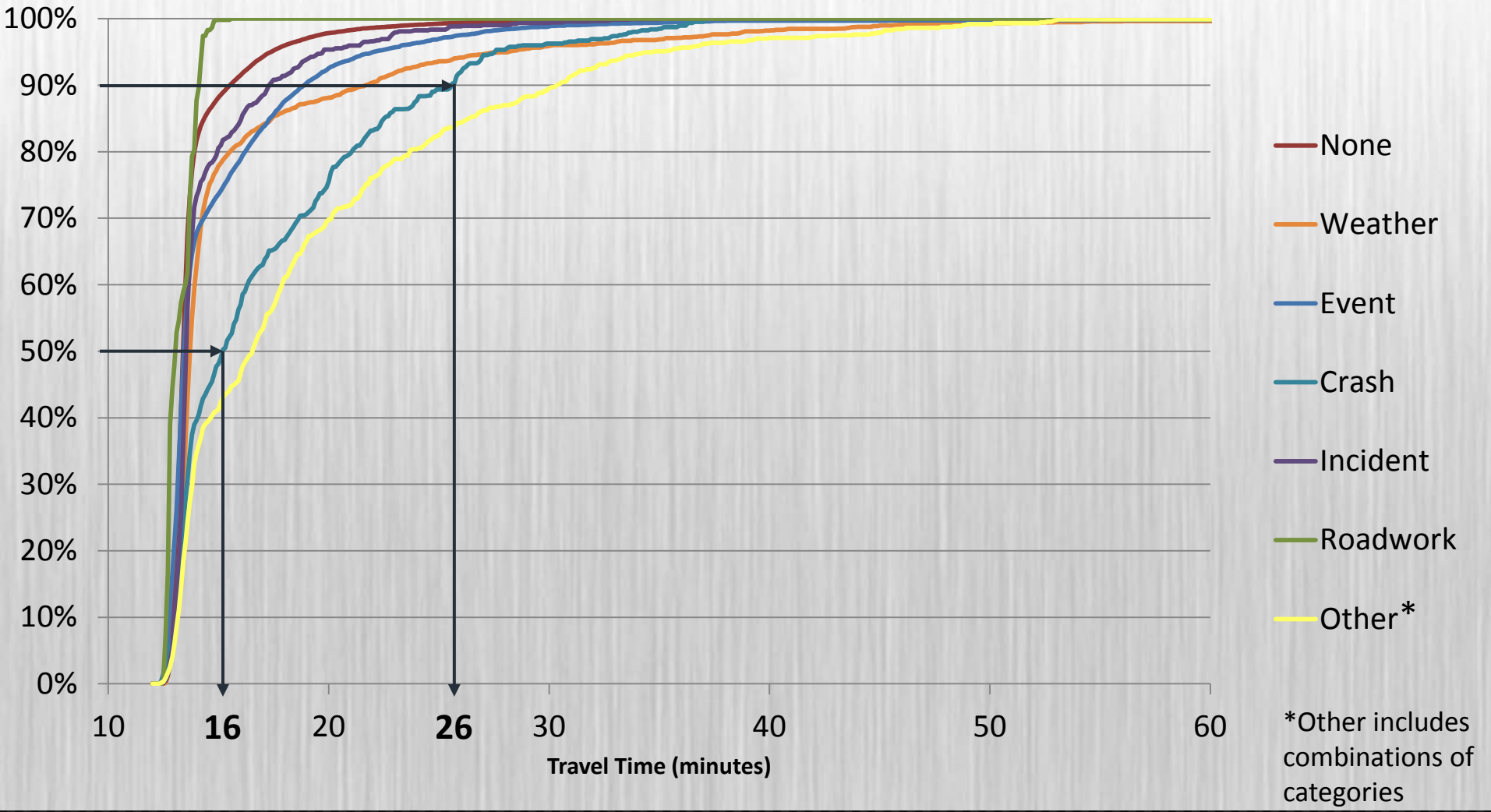
Previous SHRP 2 Work







Reliability – CDF Curves



*Other includes combinations of categories

Reliability Thermometers

Mon-Fri 06:00 to 09:00

Days/Month	Travel Time
1	14.6
2	14.9
3	15.1
4	15.4
5	15.6
6	15.9
7	16.2
8	16.5
9	16.8
10	17.2
11	17.7
12	18.4
13	19.3
14	20.3
15	21.6
16	23.5
17	25.3
18	27.6
19	31.6
20	37.9

Congestion Threshold

2x Free Flow Travel Time

Existing

Mon-Fri 06:00 to 09:00

Days/Month	Travel Time
1	14.7
2	15.4
3	16.0
4	16.6
5	17.4
6	18.6
7	20.3
8	22.4
9	24.2
10	25.2
11	26.9
12	29.3
13	32.3
14	34.4
15	35.3
16	35.5
17	35.7
18	35.9
19	36.4
20	40.5

Congestion Threshold

2x Free Flow Travel Time

Future

Travel Times

- 4.0 x Free Flow
- 3.5 x Free Flow
- 3.0 x Free Flow
- 2.5 x Free Flow
- 2.0 x Free Flow
- 1.5 x Free Flow
- Free Flow
- Managed Lane

Performance Measures

Travel Time Index

Travel Time Index is the ratio of the average observed travel time divided by the average free-flow travel time.

$$TTI = \frac{TT_{Observed}}{TT_{FreeFlow}}$$

Buffer Index

The buffer index is the proportion of extra time (or time cushion) that most travelers add to their average travel time when planning trips to ensure on-time arrival.

$$BI = \frac{TT_{95\%} - TT_{Mean}}{TT_{Mean}}$$

Planning Time Index

Planning Time Index is the factor applied to the free-flow time needed to ensure on-time arrival 95% of the time. It differs from the buffer index since it includes recurring delay as well as unexpected delay.

$$PTI = \frac{TT_{95\%}}{TT_{FreeFlow}}$$

Planning Time Failure / On-Time Measures

Planning Time Failure / On-Time Measures describe the percentage of trips with travel times within a certain factor of the median travel time. Common thresholds include 1.1* Median Travel Time or 1.25* Median Travel Time.

Other formulations of these measures denote the percentage of trips with average speeds below a specified threshold, for example 50 mph, **45 mph**, or 30 mph.

80th Percentile Travel Time Index

80th Percentile Travel Time Index is the 80th percentile travel time divided by the free flow travel time. It represents another threshold of impacted traffic flow condition.

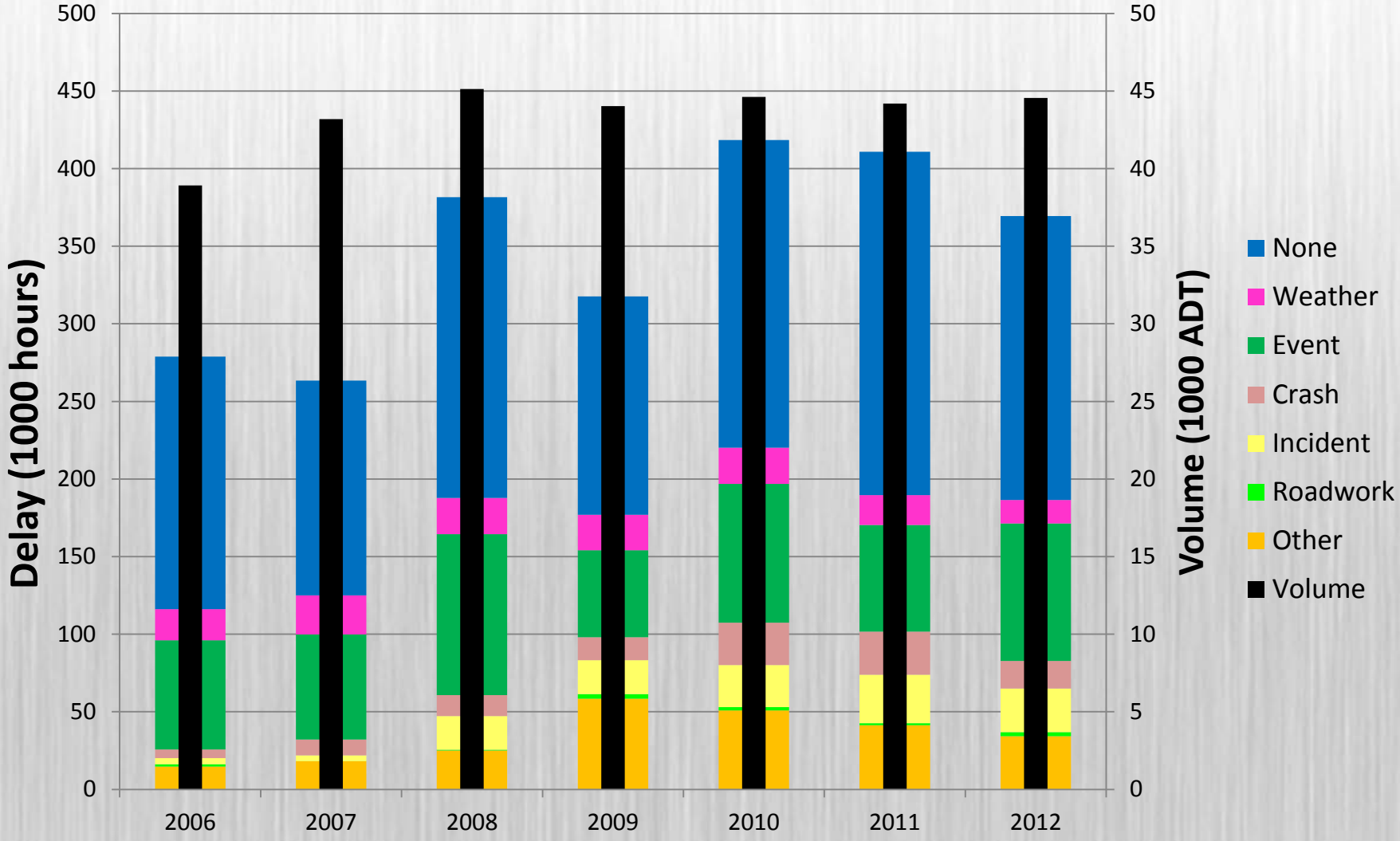
$$TTI_{80\%} = \frac{TT_{80\%}}{TT_{FreeFlow}}$$

Misery Index

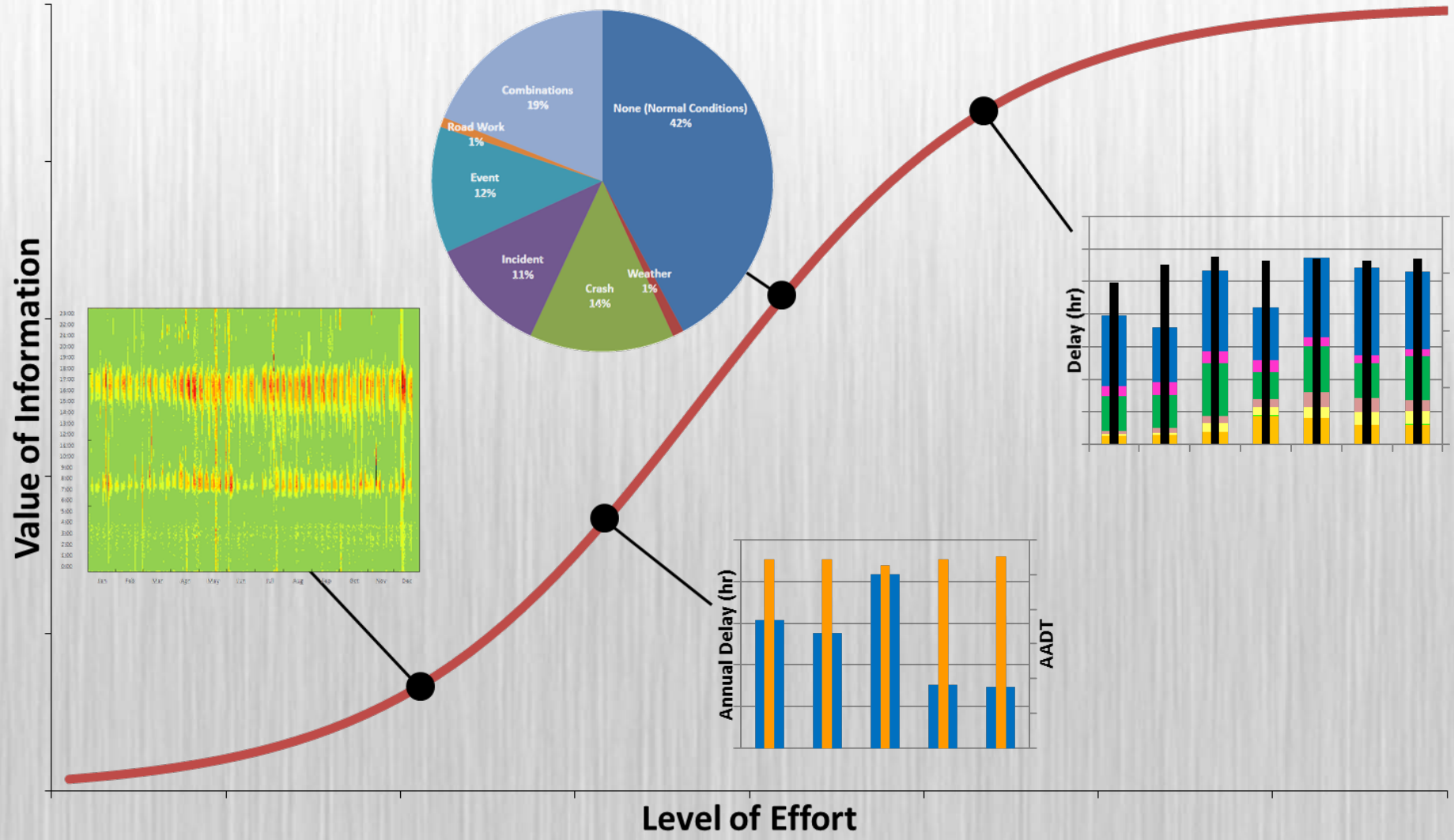
Misery Index is the average of the highest five percent of travel times divided by the free flow travel time. Often referred as the 97.5% travel time index.

$$MI = \frac{TT_{97.5\%}}{TT_{FreeFlow}}$$

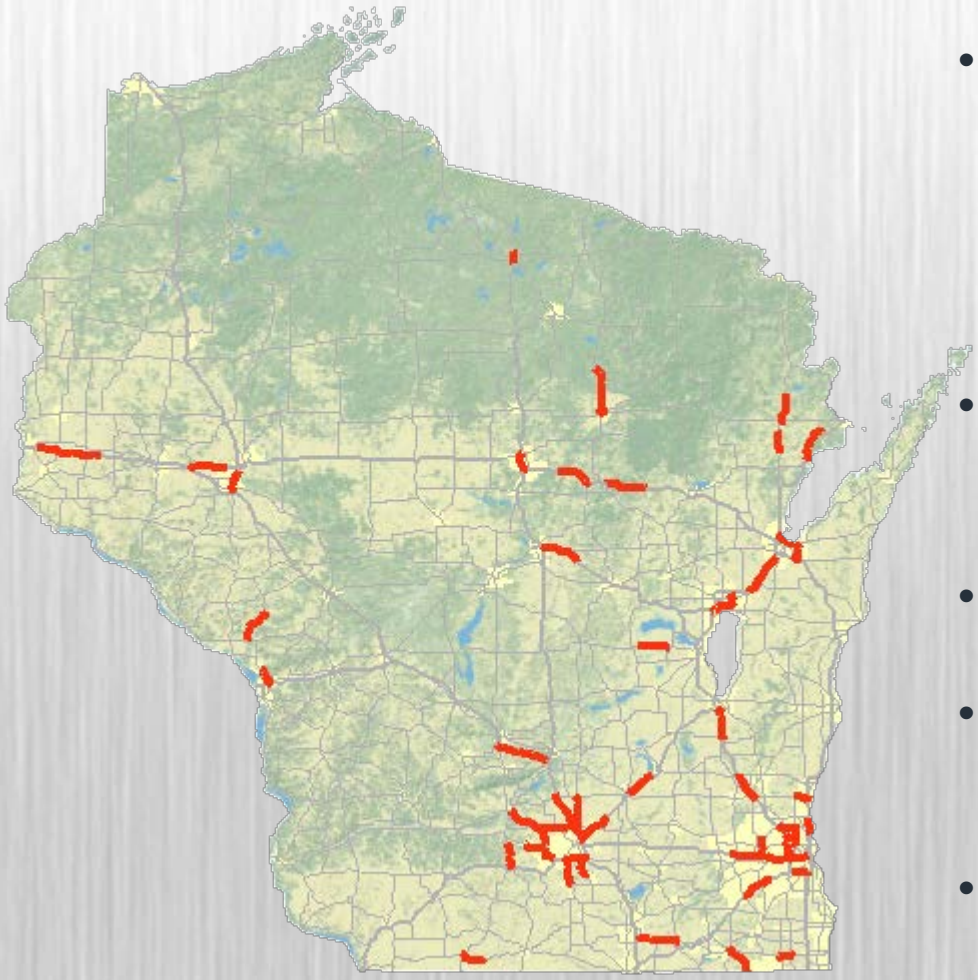
Previous SHRP 2 Work



Previous SHRP 2 Work

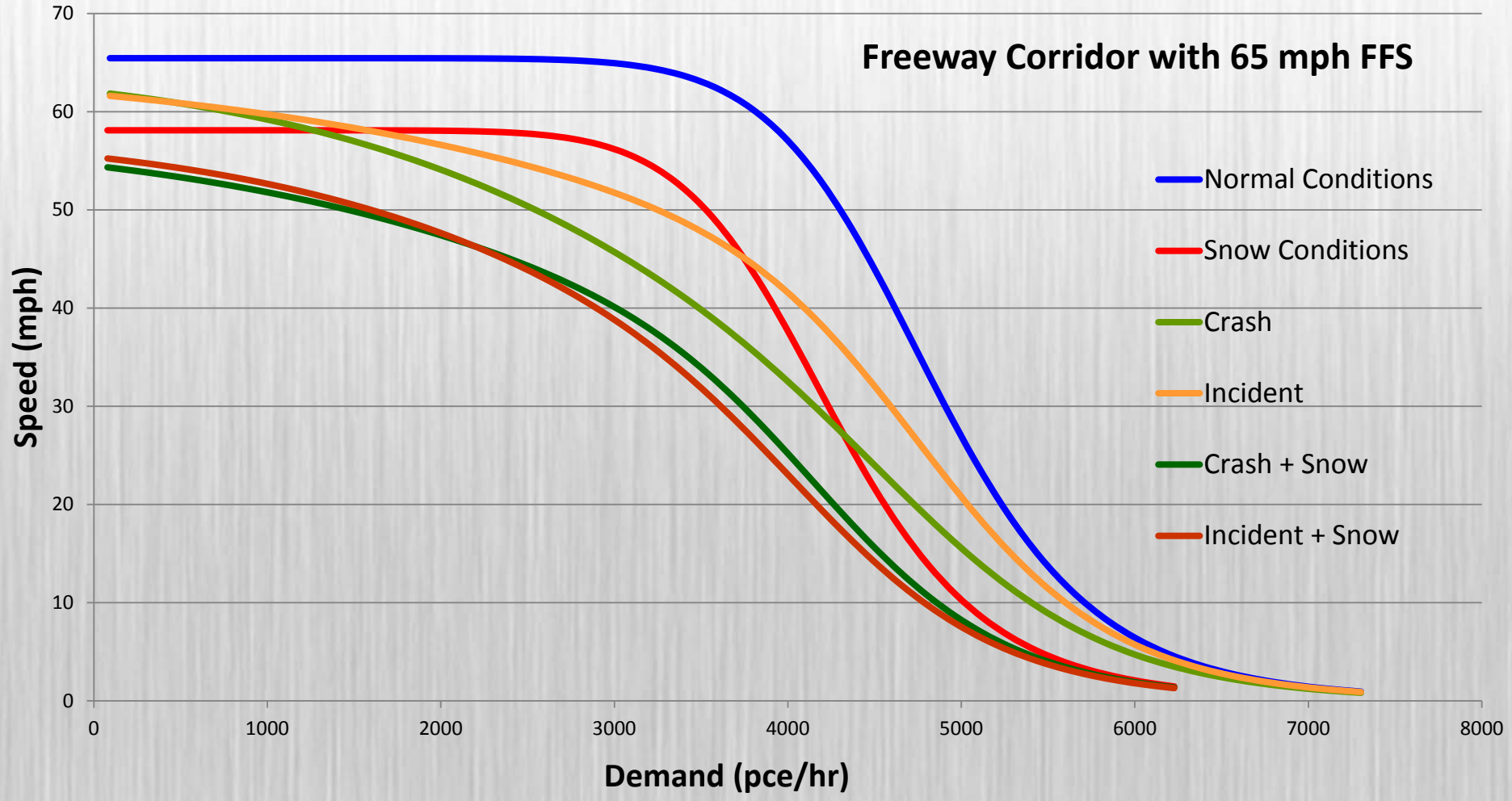


WisDOT Reliability



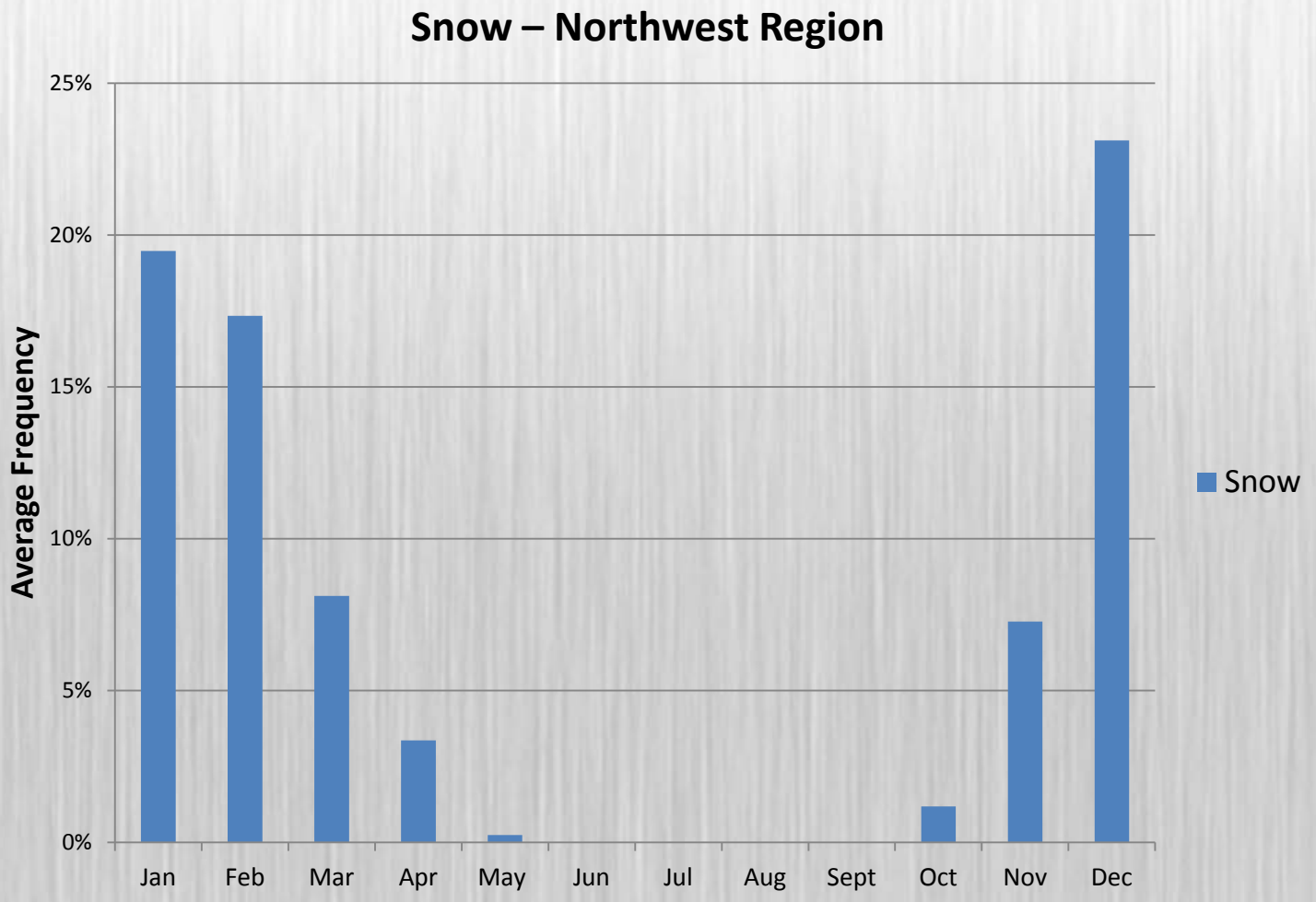
- Approximately 800 directional miles
  - Freeways -- 4 and 6 lanes
  - Rural two-lane highways
  - Urban arterials
- 3 years of Travel Time Data
  - 1 to 5 min. intervals
- ATR Continuous Volume Data
- Sites with highest combined volumes and crashes received priority
- 90% used for model development
  10% used to verify and calibrate

Travel Time Equations

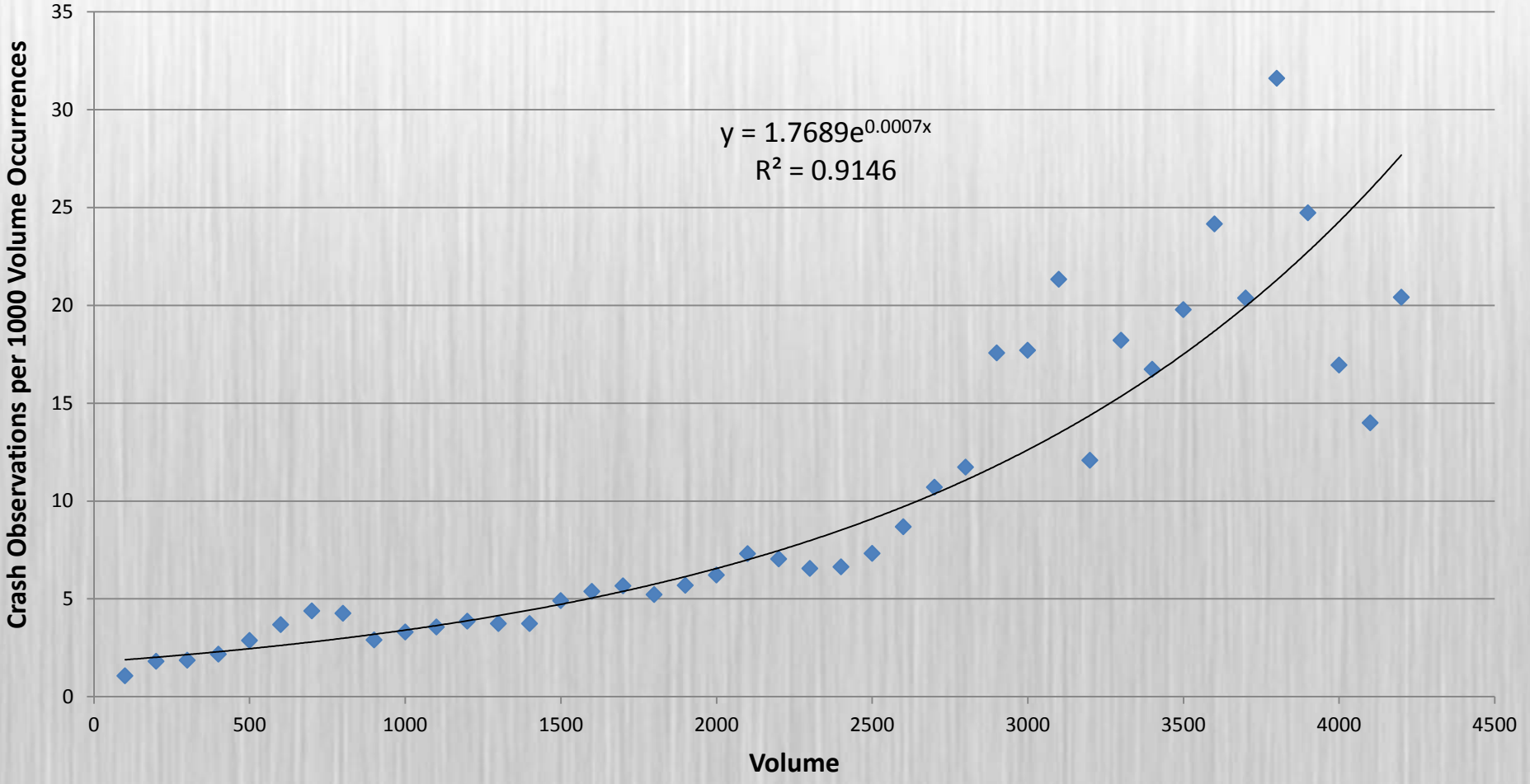


Snow Frequencies

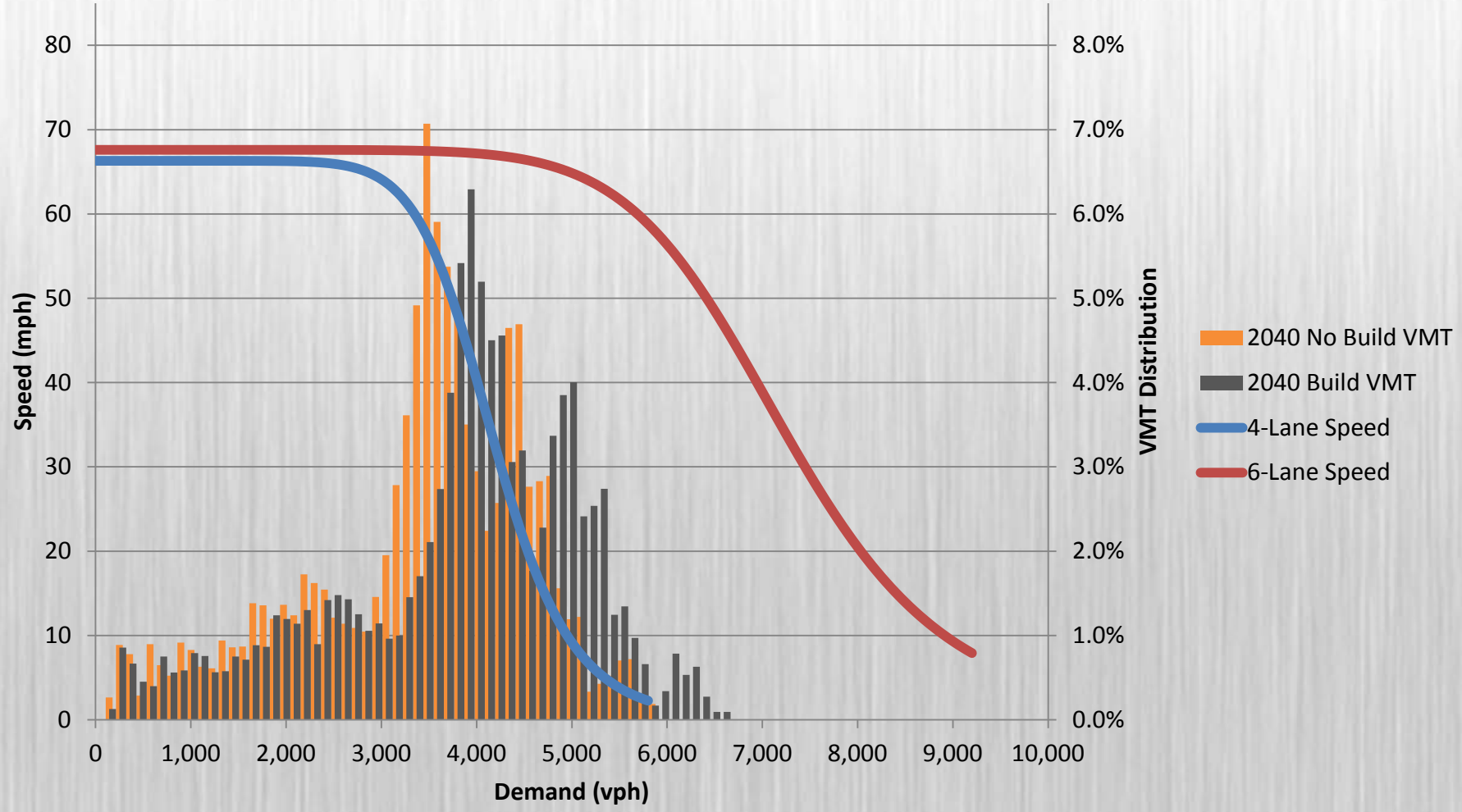
- Average Frequencies developed for each month by weather region



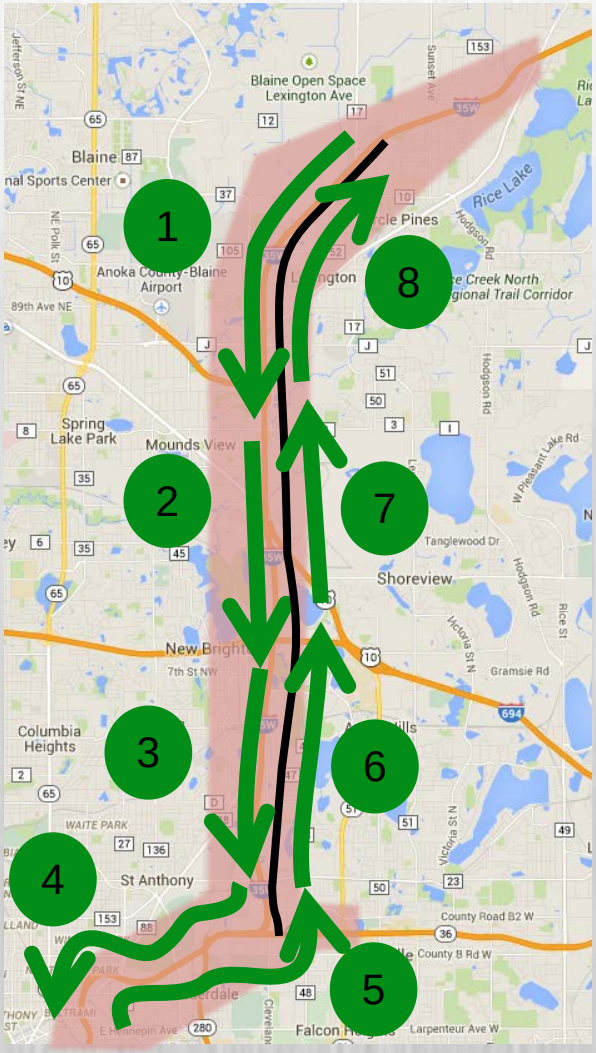
Crash Risk Distribution



Predictive Reliability Example

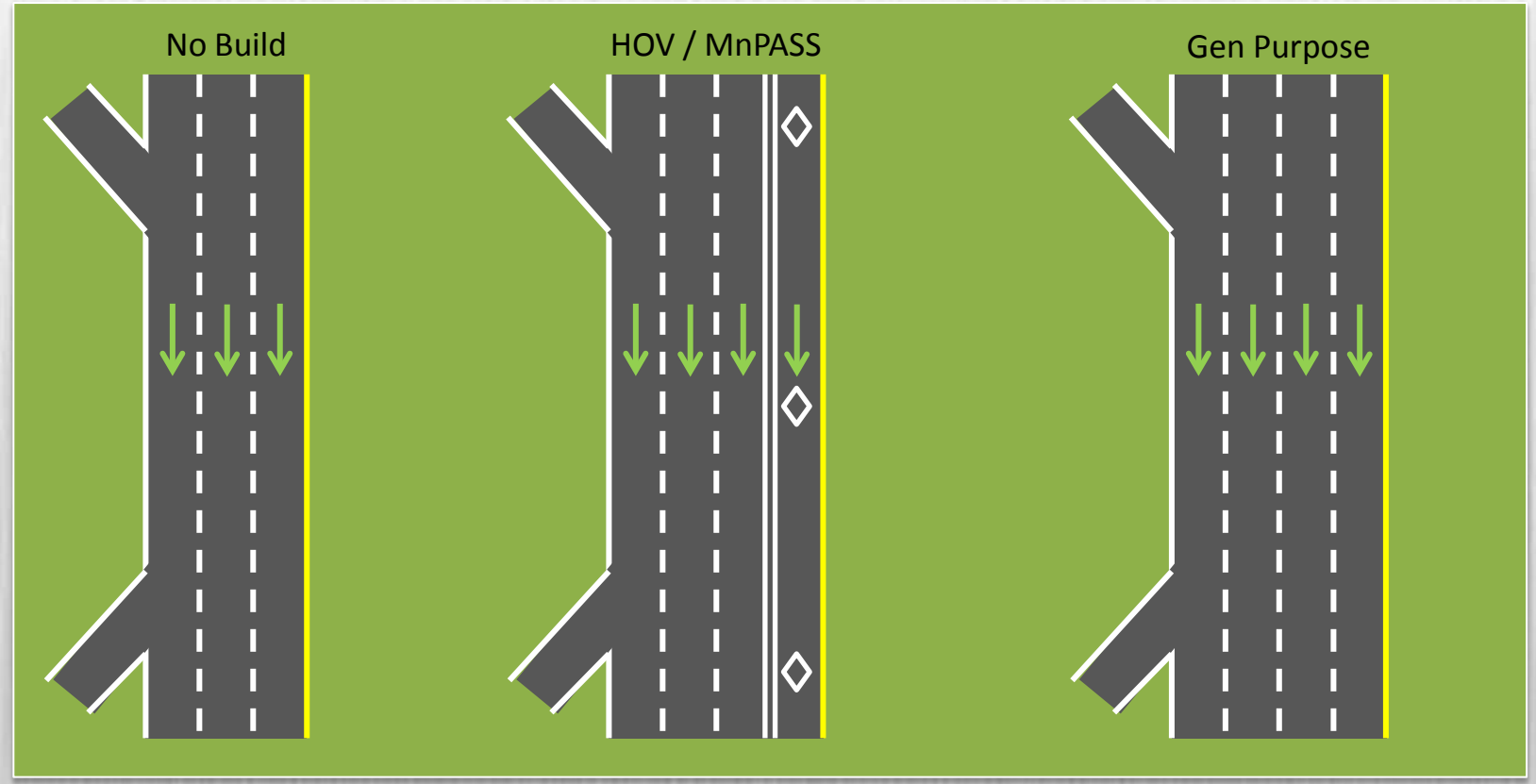


I-35W Managed Lane

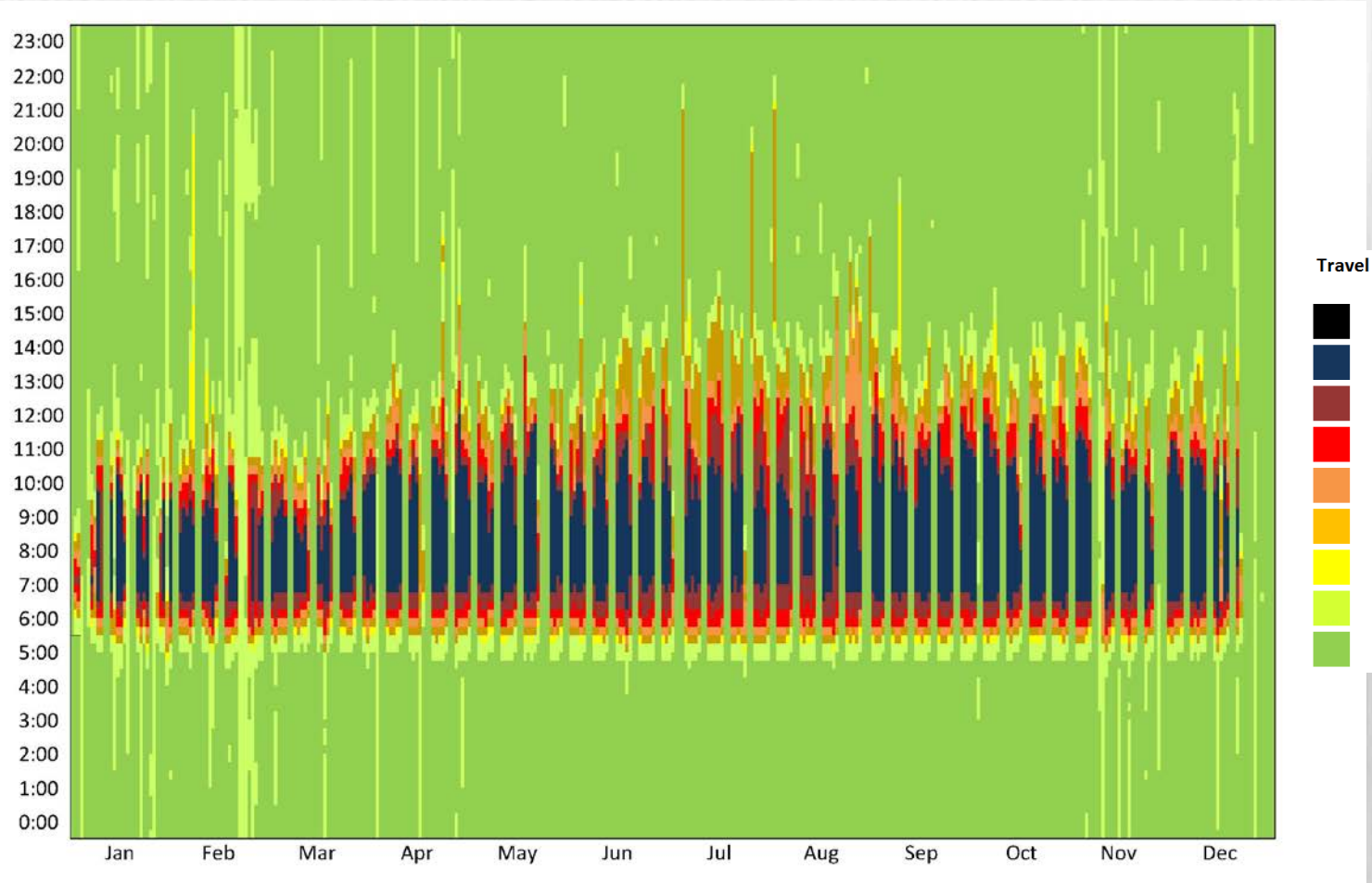


- 8 segments in study area
- Travel time and volume data
  - Year 2014 (every day)
  - 15-minute intervals
- Non-recurring conditions data
  - MnCMAT crash data
  - NOAA weather data

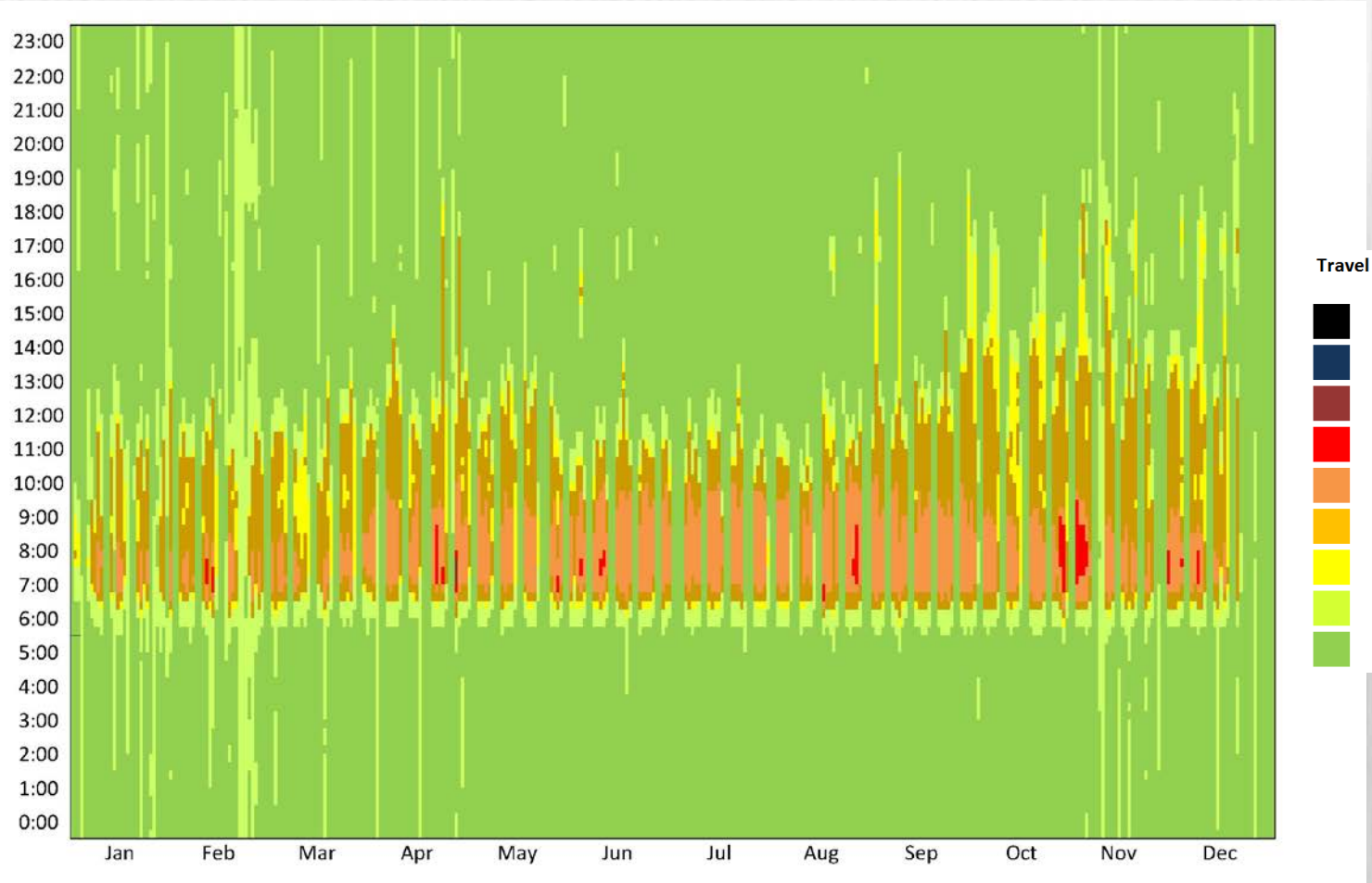
Project Alternatives



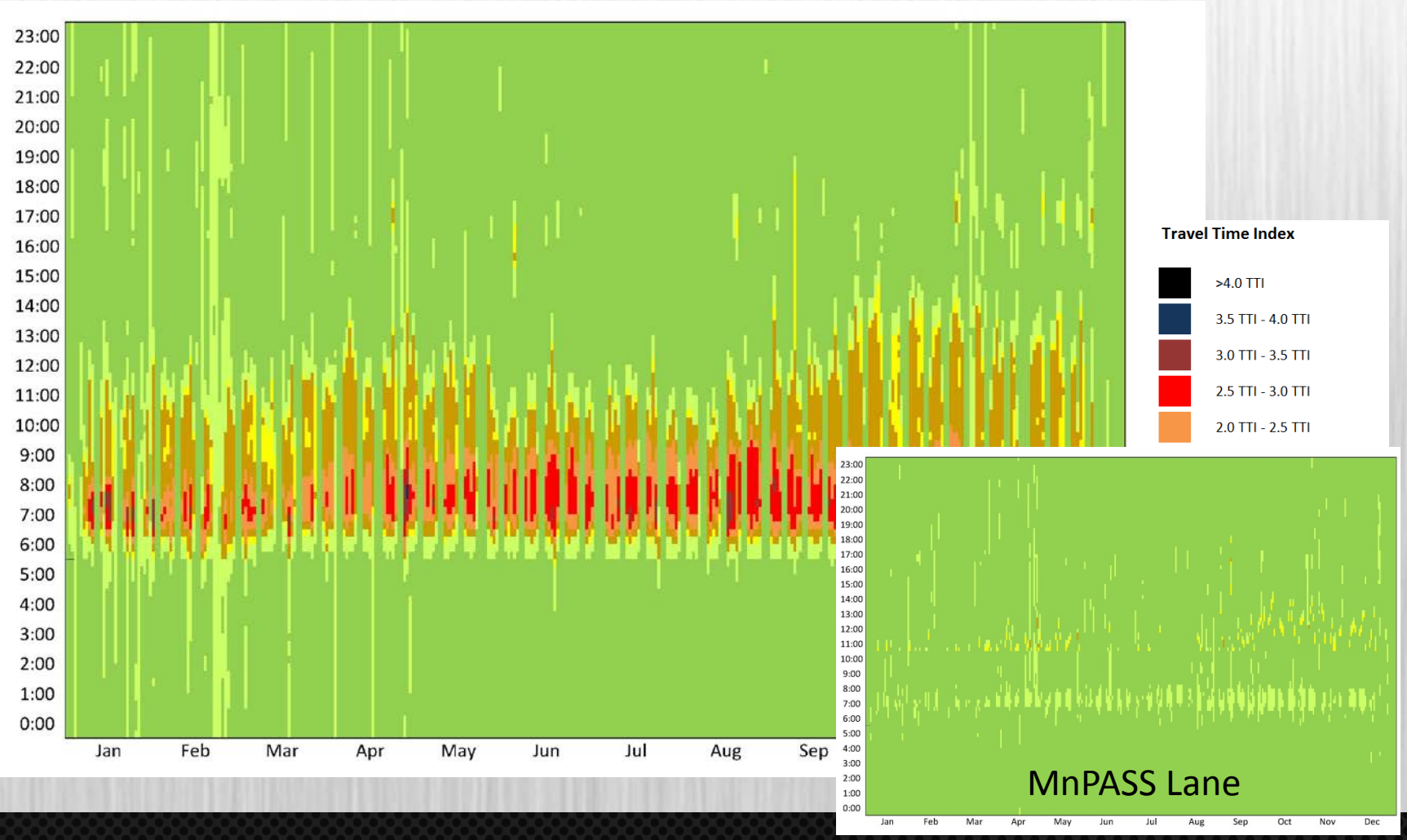
Southbound – 2040 No Build



Southbound – 2040 GP



Southbound – 2040 MnPASS



Southbound Reliability – AM Peak

North of Lexington Ave to Mississippi River

Mon-Fri 06:00 to 09:00

Days/Month	Travel Time
1	14.7
2	15.4
3	16.0
4	16.6
5	17.4
6	18.6
7	20.3
8	22.4
9	24.2
10	25.2
11	26.9
12	29.3
13	32.3
14	34.4
15	35.3
16	35.5
17	35.7
18	35.9
19	36.4
20	40.5

2040 GP

Mon-Fri 06:00 to 09:00

Days/Month	Travel Time
1	14.7
2	15.9
3	16.7
4	17.8
5	19.3
6	21.3
7	23.5
8	25.6
9	27.5
10	29.6
11	32.2
12	34.6
13	36.6
14	38.2
15	39.7
16	41.4
17	43.0
18	43.9
19	45.0
20	48.3

2040 MnPASS (GP Lanes)

Mon-Fri 06:00 to 09:00

Days/Month	Travel Time
1	14.5
2	15.0
3	15.3
4	15.5
5	15.6
6	15.7
7	15.7
8	15.8
9	15.9
10	15.9
11	16.0
12	16.1
13	16.2
14	16.2
15	16.2
16	16.3
17	16.3
18	16.4
19	16.7
20	17.6

2040 MnPASS (MnPASS Lane)

Mon-Fri 06:00 to 09:00

Days/Month	Travel Time
1	14.7
2	16.5
3	18.5
4	21.0
5	23.9
6	27.3
7	32.2
8	36.6
9	40.7
10	43.0
11	43.5
12	44.4
13	46.2
14	48.3
15	50.8
16	54.1
17	56.7
18	58.6
19	58.8
20	58.8

2040 HOV (GP Lanes)

Mon-Fri 06:00 to 09:00

Days/Month	Travel Time
1	14.5
2	15.0
3	15.3
4	15.4
5	15.4
6	15.4
7	15.5
8	15.5
9	15.5
10	15.5
11	15.6
12	15.6
13	15.7
14	15.7
15	15.7
16	15.7
17	15.7
18	15.7
19	16.1
20	16.9

2040 HOV (HOV Lane)

Northbound Reliability – PM Peak

Mississippi River to North of Lexington Ave

Mon-Fri 15:00 to 18:00

Days/Month	Travel Time
1	16.2
2	18.4
3	21.6
4	24.3
5	24.8
6	25.6
7	26.8
8	28.2
9	29.6
10	31.9
11	32.8
12	33.2
13	33.9
14	34.9
15	36.3
16	38.3
17	40.9
18	42.2
19	42.4
20	43.0

2040 GP

Mon-Fri 15:00 to 18:00

Days/Month	Travel Time
1	16.3
2	19.4
3	25.3
4	29.9
5	32.8
6	33.5
7	34.7
8	35.8
9	36.8
10	37.9
11	39.0
12	40.0
13	41.3
14	42.2
15	42.2
16	42.3
17	42.4
18	42.5
19	42.8
20	44.3

2040 MnPASS (GP Lane)

Mon-Fri 15:00 to 18:00

Days/Month	Travel Time
1	16.1
2	16.7
3	17.0
4	17.2
5	17.3
6	17.4
7	17.5
8	17.5
9	17.6
10	17.6
11	17.6
12	17.7
13	17.8
14	18.0
15	18.1
16	18.2
17	18.3
18	18.4
19	18.4
20	18.9

2040 MnPASS (MnPASS Lane)

Mon-Fri 15:00 to 18:00

Days/Month	Travel Time
1	16.3
2	22.1
3	34.8
4	36.4
5	38.3
6	40.1
7	41.6
8	42.2
9	42.2
10	42.3
11	42.4
12	42.5
13	42.7
14	42.8
15	43.2
16	43.5
17	43.8
18	44.4
19	45.5
20	47.5

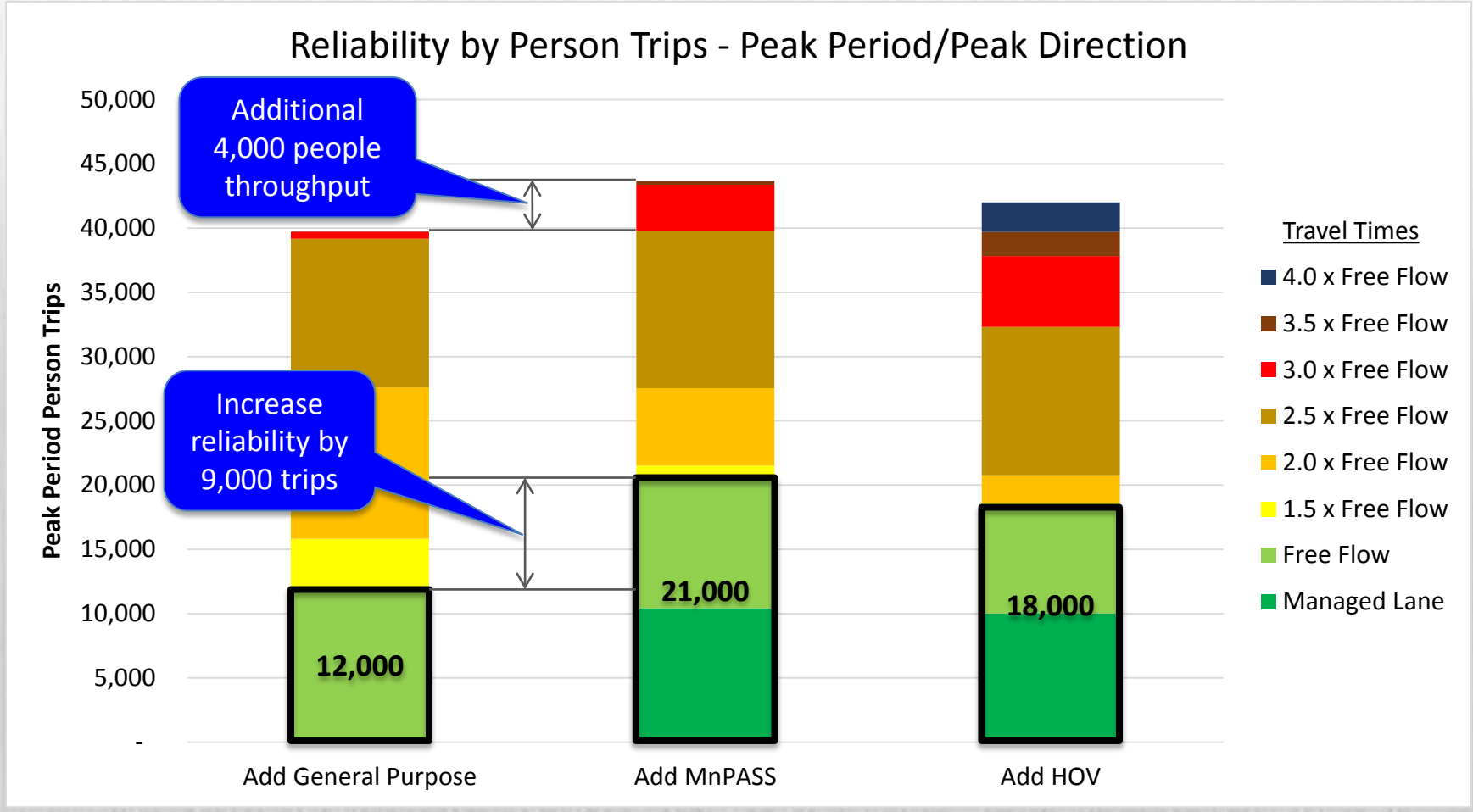
2040 HOV (GP Lanes)

Mon-Fri 15:00 to 18:00

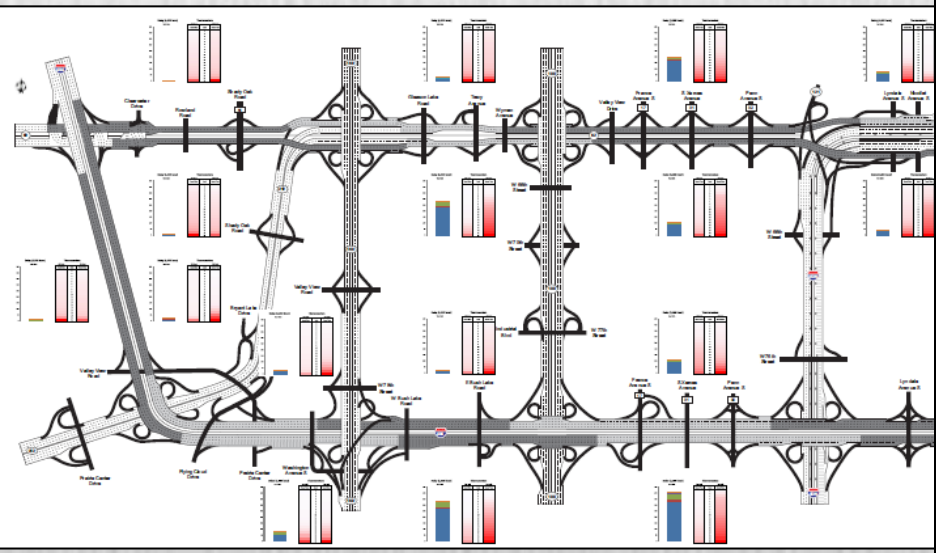
Days/Month	Travel Time
1	16.1
2	16.7
3	16.8
4	16.9
5	16.9
6	16.9
7	16.9
8	16.9
9	17.0
10	17.1
11	17.2
12	17.2
13	17.3
14	17.3
15	17.3
16	17.3
17	17.3
18	17.3
19	17.5
20	17.9

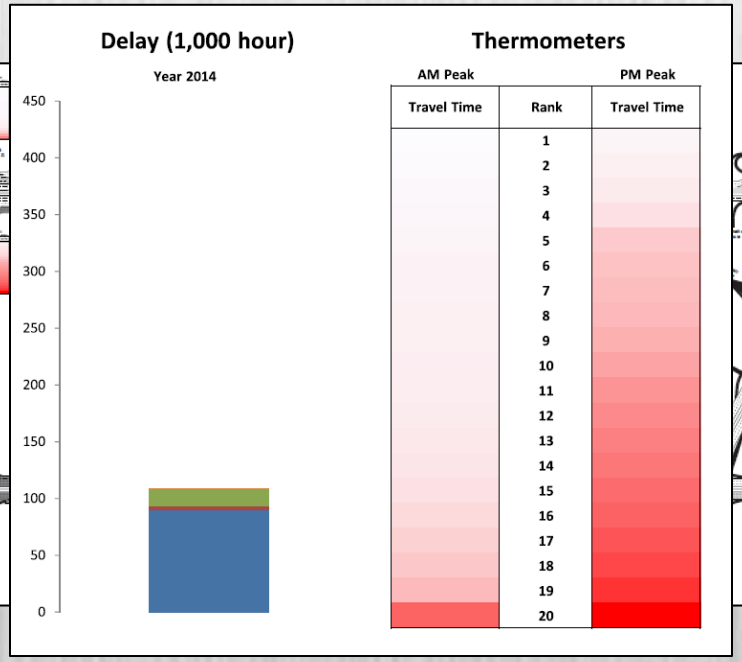
2040 HOV (HOV Lane)

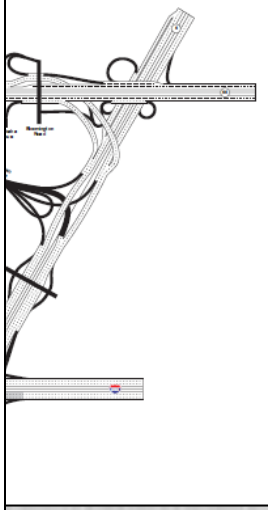
Reliability Comparison



I-494/TH 62 Congestion Relief







TH 169 Mobility Study

PTI	Delay (hr)	RR	Weather RR	Crash RR		PTI	Delay (hr)	RR	Weather RR	Crash RR
1.33	44	92%	77%	33%		3.42	446	41%	19%	16%
2.30	78	89%	75%	67%	Excelsior	2.20	136	76%	51%	8%
2.06	162	66%	51%	50%		0.97	2	100%	99%	N/A
1.40	60	91%	81%	70%	Old Shakopee	1.30	39	95%	87%	50%
					CR 69					

Notes:

Tuesday – Thursday only

Planning Time Index (PTI) = $\frac{TT_{95\%}}{TT_{FreeFlow}}$

Delay is the average total delay (for all vehicles) for the peak period in hours

Reliability Rating (RR) = $\frac{Trips_{TT<1.25*FFTT}}{Trips_{total}}$

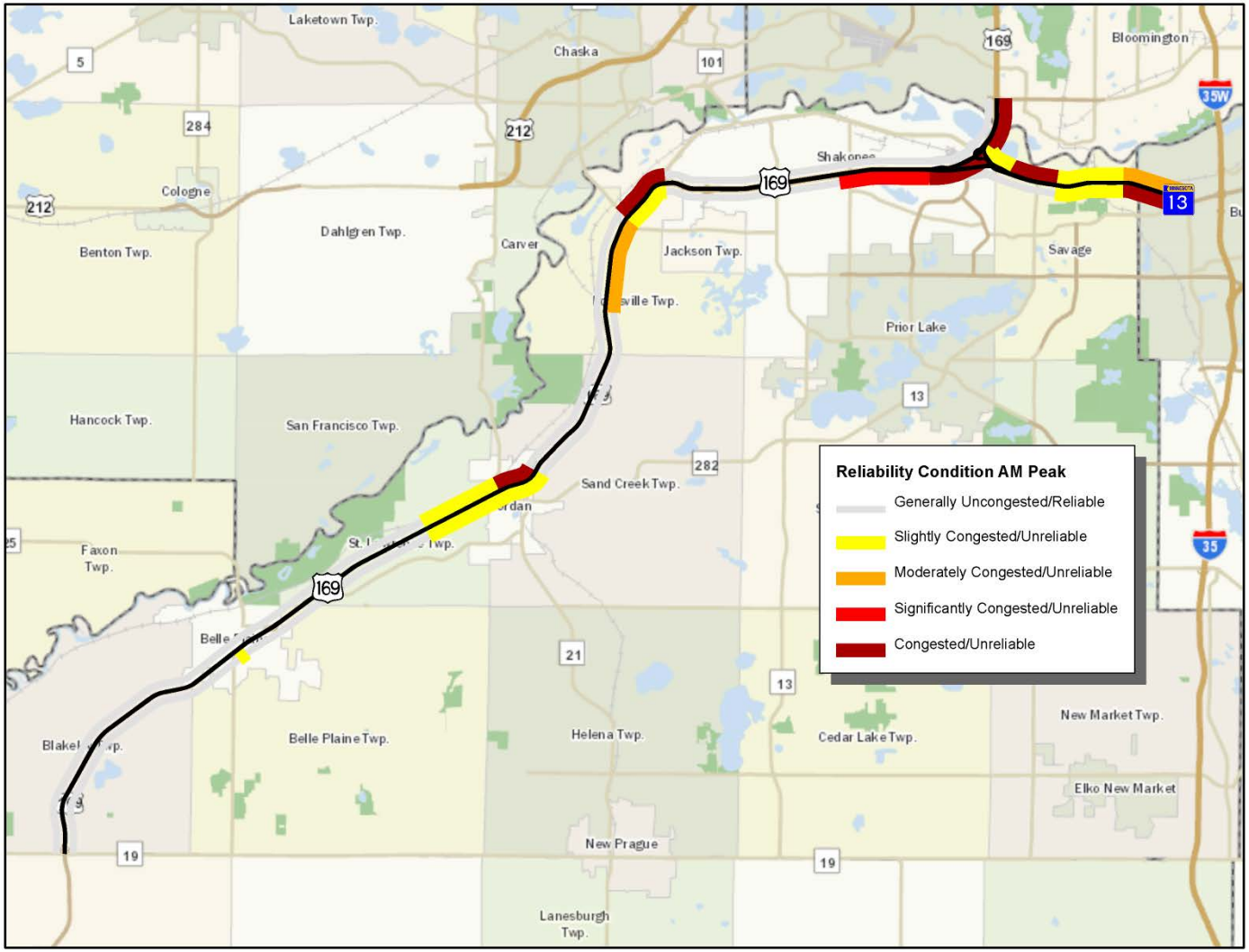
N/A = Insufficient Data

Previous Applications

Scott County Congestion Performance Measures

AM Peak Reliability/ Congestion Map

Data Source: NPMRDS



Reliability Resources

Upcoming Activities

- Minnesota Reliability Outreach (Fall 2015)

Online Resources

- SHRP 2 Website
  - Publications, Tools, and Webinars
- Travel Time Reliability Reference Manual
  - Online Wikibook by Michael Janson

Questions?
Thank you!

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