



Date: May 17, 2017
To: High Performance Transportation Enterprise Board
From: Kelly Brown, HPTE Tolling Operations Manager
Subject: Mountain Express Lane 2016-2017 Annual Operations Report

Purpose

The purpose of this memo is to summarize the content of the 2016-2017 Mountain Express Lane Annual Operations Report that will be presented at the May 2018 Board of Directors meeting.

Action

Informational only - no action requested.

Summary

Days and Hours of Operation

A memorandum of understanding (MOU) signed on September 22, 2017 between FHWA, CDOT, and HPTE allows for 100 days of operation and 1,168 hours of operation per operating year. The Mountain Express Lane operated for 782 hours on 88 days from November 2016 through October 2017.

Toll Rates

Toll rates were subject to adjustment, with the objective to balance between the respective toll rate, the Mountain Express Lane volume, and the overall corridor volume throughput.

Travel Time Reliability

The average hourly speeds for the Mountain Express Lane during the total 782 hours of operation for the 2016-2017 operation year were at least 45 mph for 95.2 percent of the time and the average hourly speeds were below 45 mph 4.8 percent of time.

The general purpose lanes also benefited by having the Mountain Express Lanes in operation. Average hourly speeds for the general-purpose lanes during the 782 hours of operation for the 2016-2017 operation year were above 45 mph for 76.5 percent of the time and travel in the general-purpose lanes was at or below 45 mph 23.5 % of the time.

Travel Volume

Overall, the average volume of the I-70 corridor traffic using the Mountain Express Lane was 7.9 percent. More vehicles used the Mountain Express Lane in the summer with 8.6 percent of the I-70 corridor traffic volume using the Mountain Express Lane. Whereas, winter saw 7.4 percent and autumn saw 7.9 percent of I-70 corridor traffic volume using the Mountain Express Lane. Average volume in the Mountain Express lane was higher on Sundays compared to Saturdays.

Summary

The first full year of the Mountain Express Lane operation benefited both the travelers in the general purpose lanes and those paying to use the Mountain Express lane.



I-70 Mountain Express Lane Annual Operations Report 2016-17

November 1, 2016 – October 31, 2017



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A. Introduction

The traffic demand on the Interstate 70 (I-70) corridor west of Denver is seasonal in nature due to the recreational opportunities in the mountains that are accessed from the corridor. To alleviate the heavy congestion, the Colorado Department of Transportation (CDOT) and the High-Performance Transportation Enterprise (HPTE) constructed a peak period shoulder lane on eastbound Interstate 70 (I-70), which began operating in December 2015. The shoulder lane is a tolled express lane, known as the I-70 Mountain Express Lane. The Mountain Express Lane operates during periods of high traffic volume on the eastbound inside shoulder of I-70 from Milepost (MP) 230 to MP 241.

The Federal Highway Administration (FHWA), CDOT and HPTE entered into a Memorandum of Understanding (MOU) which included a requirement to provide an annual report about the operations of the Mountain Express Lane. This report is prepared in response to the MOU.

B. Reporting and Performance Measures

Based on the seasonal nature of the Mountain Express Lane travel demand, the operating reporting period established for this report is from November 2016 through October 2017. The MOU set the following performance measures which are based on the Project's Concept of Operations:

- Travel Time Reliability
- Traffic Volumes and Traffic Type
- Safety and Crash Data (during operational and non-operational hours)
- Incident Clearance Times

Specific measures of performance are collected and derived from various data sources, including:

- COGNOS—A CDOT software system that uses ITS devices to compute prevailing speeds
- OTIS—CDOT's Online Transportation Information System is a set of applications and tools that integrates data and information, including traffic counts, roadway statistics, geographic data, and maps
- INRIX—INRIX is a global company that provides a variety of data relating to transportation analytics
- E-470 Public Highway Authority—E-470 provides back office services, such as toll collection, for the Mountain Express Lane
- I-70 W Situational Reports—CDOT creates daily reports of incidents and operations for the I-70 Mountain Corridor
- Di-Ex-Sys – A commercial database that analyzes police accident reports

C. Days and Hours of Operation

The current MOU (signed on September 22, 2017) between FHWA, CDOT, and HPTE allows for 100 days of operation (and 1,168 hours of operation) per operating year. **Figure 1** shows the number of hours of operation during each month of the current reporting period. The Mountain Express Lane operated for **782 hours** on **88 days**. **Figure 2** shows the 2016-2017 calendar of operation.

Hours of Operations per Month

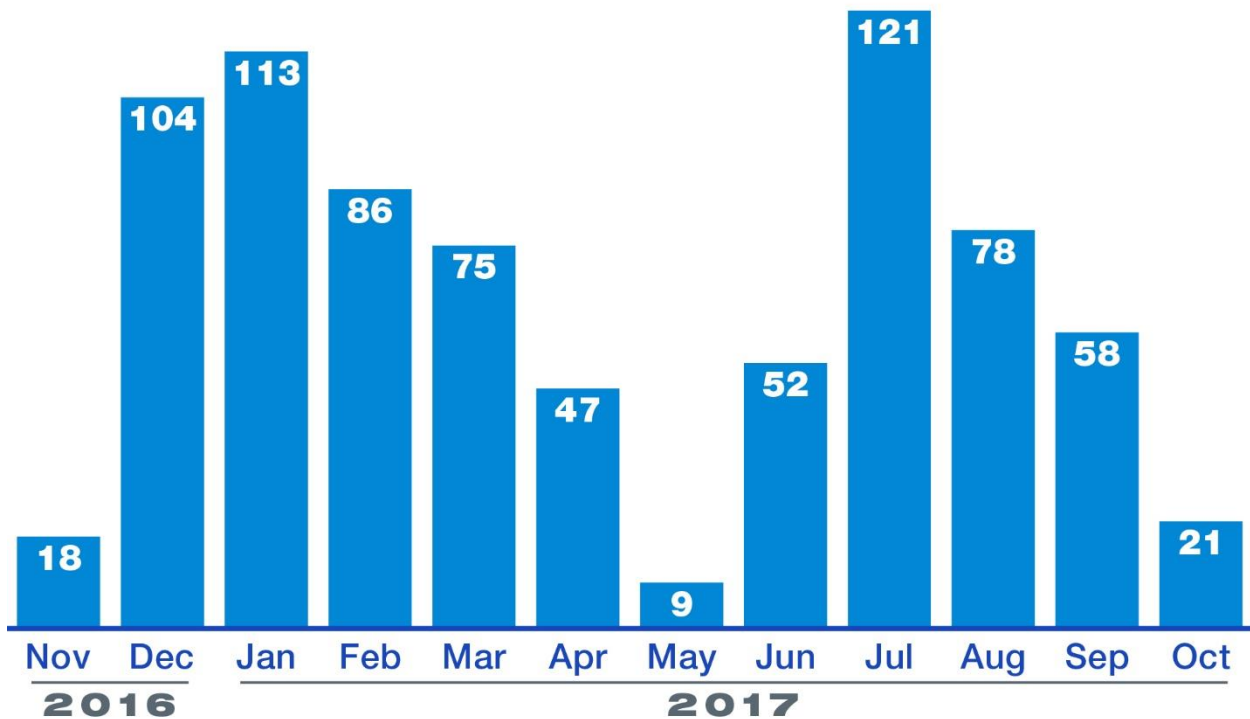


Figure 1. Mountain Express Lane Hours of Operation Per Month

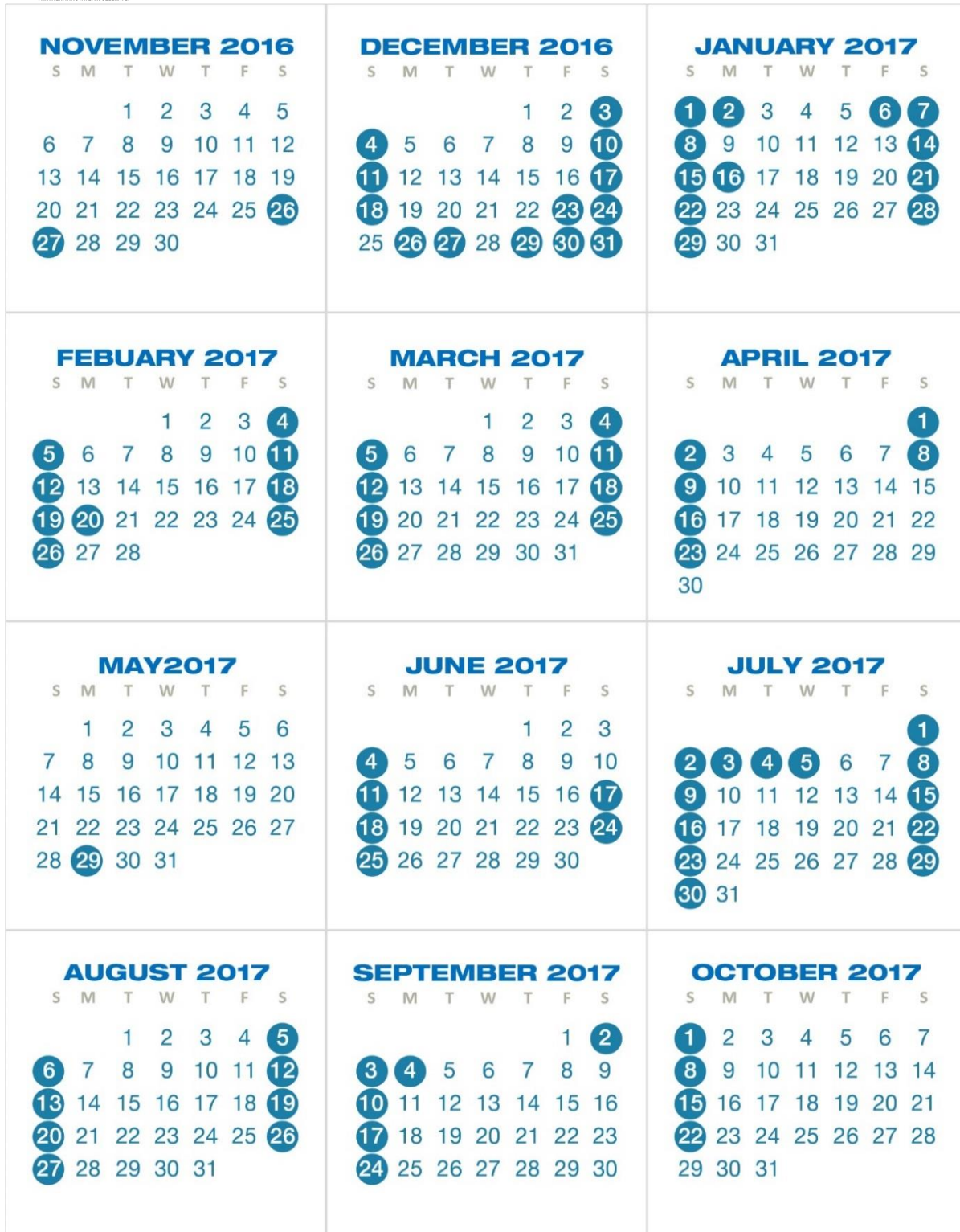


Figure 2. Mountain Express Lane Days of Operation



The high traffic volume periods are seasonal in nature because of the large number of recreational users who access the I-70 Mountain Corridor. Operations data are presented in three seasons, as follows:

Winter (ski season)

- Thanksgiving Holiday through the end of ski season
- November 26, 2016, through April 23, 2017
- Mountain Express Lane was open on Saturdays, Sundays, and Holidays

Summer (camping/hiking season)

- Memorial Day through Labor Day
- May 29, 2017, through September 4, 2017
- Mountain Express Lane was open on Saturdays, Sundays, and Holidays

Fall (hunting/leaf viewing season)

- September and October
- September 10, 2017, through October 22, 2017
- Mountain Express Lane was open based on traffic demand

During the winter and fall seasons, the typical opening time of the Mountain Express Lane was at 9:00 a.m.; typical closing time was at 6:00 p.m. on Saturdays and between 7:00 p.m. and 8:00 p.m. on Sundays (see **Table 1**).

Table 1. Mountain Express Lane Typical Opening and Closing Times

Season	Typical Opening	Typical Closing	
		Saturday	Sunday
Winter, 11/26/16 to 4/23/17	9:00 a.m.	6:00 p.m.	7:00 p.m. to 8:00 p.m.
Summer, 5/29/17 to 9/4/17	9:00 a.m.	6:00 p.m.	7:00 p.m. to 8:00 p.m.
Fall, 9/10/17 to 10/22/17	On Demand		

D. Toll Rates

Toll rates were subject to adjustment, with the objective to balance between the respective toll rate, the Mountain Express Lane volume, and the overall corridor volume throughput. For 74 percent of the hours of operation, toll rates were set at \$5.00; 9 percent of the hours were at \$4.00; 14 percent at \$6.00; 1 percent at \$3.00; and 1 percent at \$7.00 (see **Figure 3**). In August 2017, optimal toll rates of \$5.00 on Saturdays and \$6.00 on Sundays were selected to manage traffic demand in the Mountain Express Lane.

Percent of Hours of Toll Rate at \$X

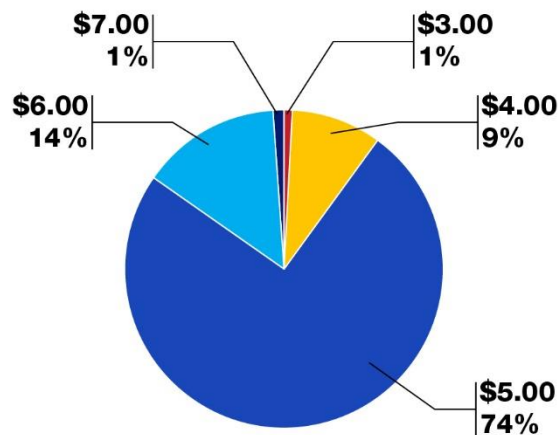


Figure 3. 2016-2017 Percent of Time at Variable Toll Rates

E. I-70 Travel Time Reliability

Travel time reliability is defined as the consistency or dependability of travel times, as measured from day to day and/or across different times of day. To assess the Mountain Express Lane travel time reliability, the following evaluations were completed:

- COGNOS data was used to evaluate if the average speed on the Mountain Express Lane reached the goal of 45 miles per hour (mph) or higher for 95 percent of the time
- INRIX data was used to compare the travel times in 2014 (before the construction of the Mountain Express Lane) to travel times for the operational year of 2016-2017.
- INRIX data was used to compare the planning and travel time indexes in 2014 to those for the operational year 2016-2017.

The year 2014 was used to evaluate the travel time reliability because it is the most recent full year of data prior to the construction of the Mountain Express Lane. During the Mountain Express Lane construction, ITS devices were added to the corridor to capture operational data. Therefore, more data are available now than were available prior to the opening of the Mountain Express Lane.

1. Average Speeds

Mountain Express Lane

Average hourly speeds for the Mountain Express Lane during the total 782 hours of operation for the 2016-2017 operation year were extracted from COGNOS. **Figure 4** shows the average hourly speed distribution. According to the data, only 4.8 percent of the average hourly speeds were below 45 mph. Therefore, 95.2 percent of the average hourly speeds are at least 45 mph.

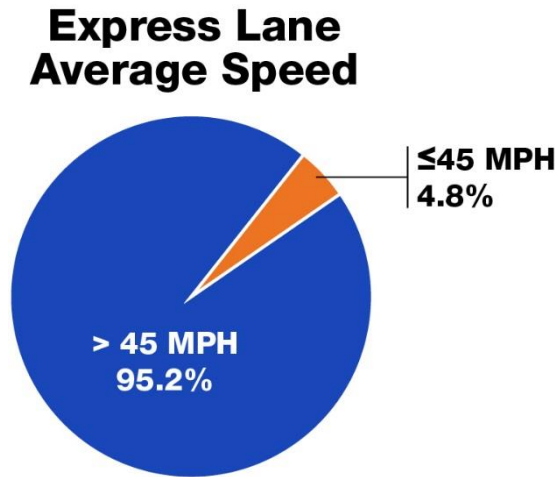


Figure 4. Mountain Express Lane Average Hourly Speed Distribution

General-Purpose Lanes

Average hourly speeds for the general-purpose Lanes during the 782 hours of operation for the 2016-2017 operation year were extracted from COGNOS. **Figure 5** shows the average hourly speed distribution. According to the data, 23.5 percent of the hourly speeds are at or below 45 mph and 76.5 percent of the hourly speeds are above 45 mph.

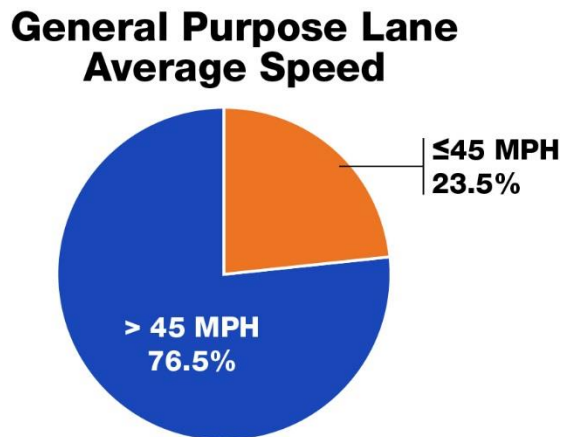
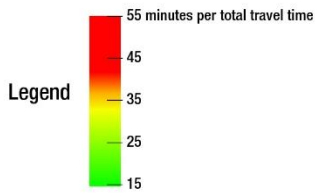


Figure 5. General-Purpose Lanes Average Hourly Speed Distribution

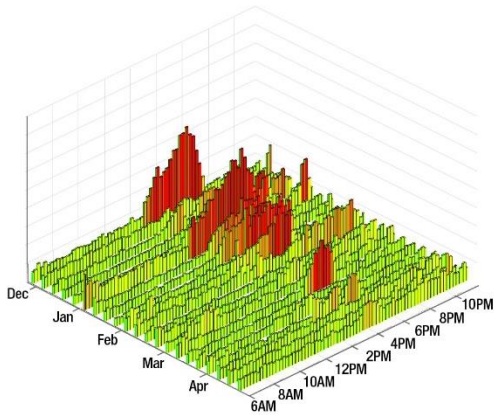
2. Before and After Express Lane Corridor-Level Travel Times

Travel time data were extracted from INRIX for before the Mountain Express Lane was constructed and open for operation and after the Mountain Express Lane opening (December 2015) for the seasonal operations period of the Mountain Express Lane. Saturday and Sunday travel times for year 2014 during the winter (December through April), summer (June through August), and fall (September through October) were compared to travel times for the same period for year 2017. Travel time in 2014 represents the average travel time eastbound across two general-purpose lanes. Travel time in 2017 represents the travel time eastbound across three lanes: two general-purpose lanes in addition to the Mountain Express Lane. **Figure 6, Figure 7, and Figure 8** depict that travel time comparison. As shown by the figures, the average travel times in 2017, when the Mountain Express Lane was operational, are substantially lower than travel times for the same period during 2014.

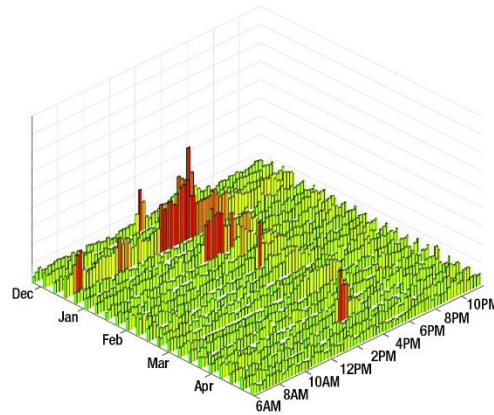
Winter Season Travel Summary



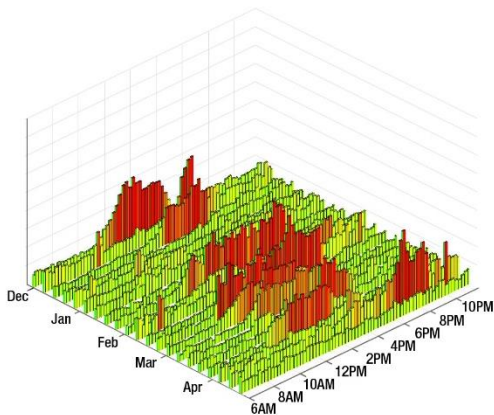
**2014 Saturday Travel Times
(Pre-Mountain Express Lane)**



**2017 Saturday Travel Times
(Mountain Express Lane Operational)**



**2014 Sunday Travel Times
(Pre-Mountain Express Lane)**



**2017 Sunday Travel Times
(Mountain Express Lane Operational)**

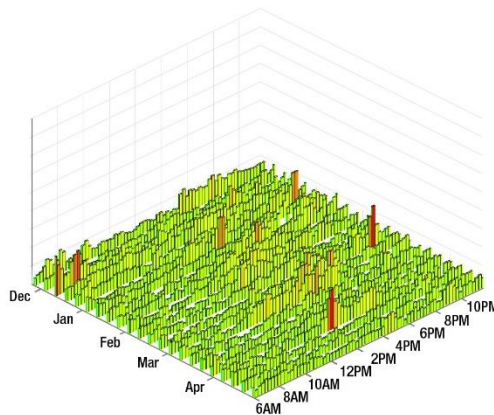
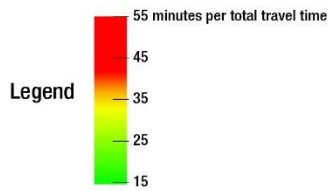
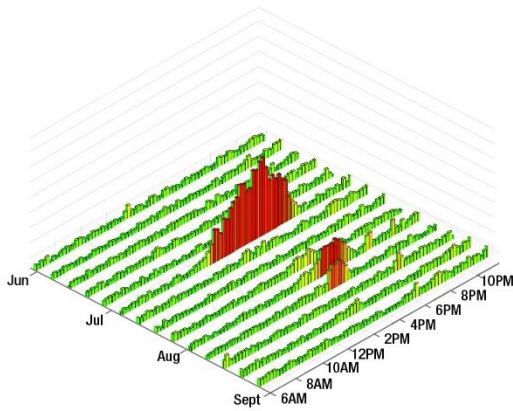


Figure 6. Winter Season Travel Time Comparison

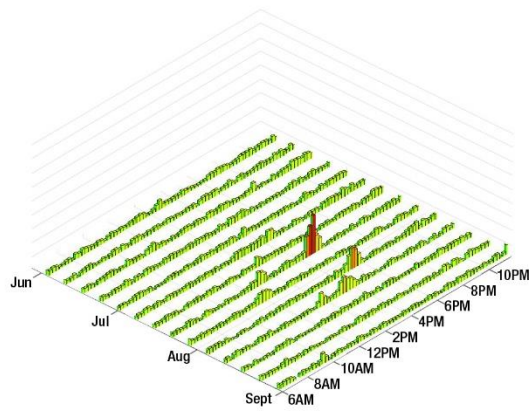
Summer Season Travel Summary



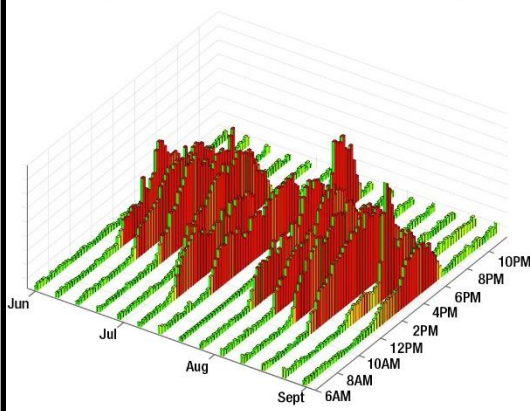
**2014 Saturday Travel Times
(Pre-Mountain Express Lane)**



**2017 Saturday Travel Times
(Mountain Express Lane Operational)**



**2014 Sunday Travel Times
(Pre-Mountain Express Lane)**



**2017 Sunday Travel Times
(Mountain Express Lane Operational)**

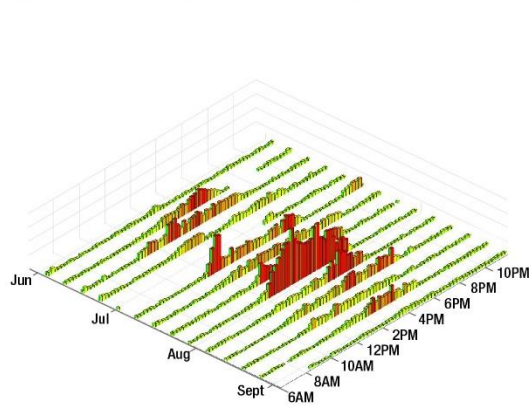
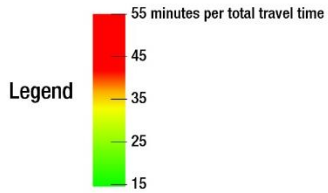
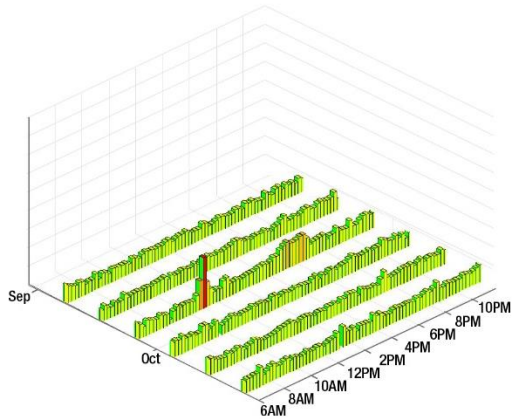


Figure 7. Summer Season Travel Time Comparison

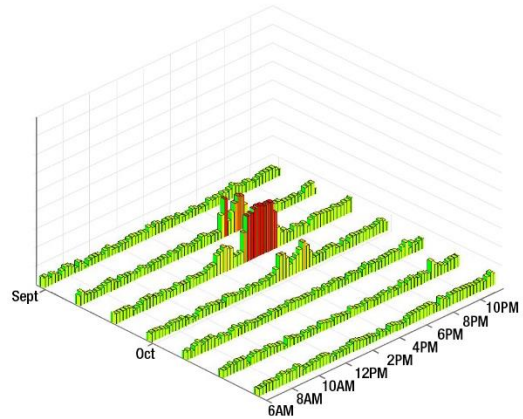
Fall Season Travel Summary



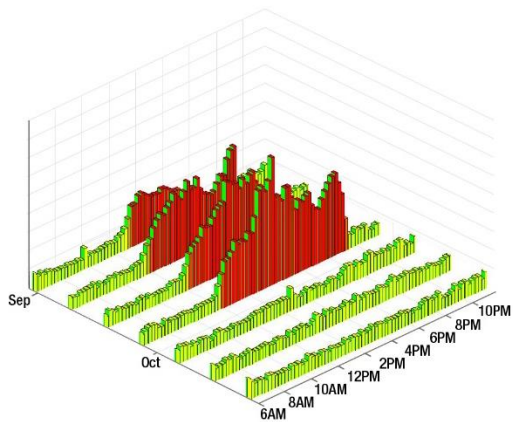
**2014 Saturday Travel Times
(Pre-Mountain Express Lane)**



**2017 Saturday Travel Times
(Mountain Express Lane Operational)**



**2014 Sunday Travel Times
(Pre-Mountain Express Lane)**



**2017 Sunday Travel Times
(Mountain Express Lane Operational)**

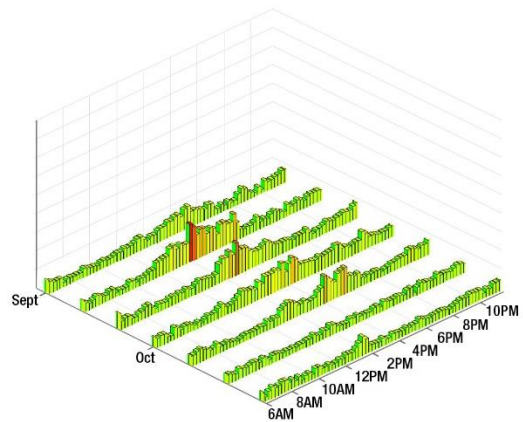


Figure 8. Fall Season Travel Time Comparison

3. Corridor-Level Planning Time Index and Travel Time Index

Planning time index (PTI) is a reliability measure that represents the ratio of the 95th percentile peak-period travel time to the free-flow travel time. For example, a value of 1.5 means that for a 30-minute trip in light traffic, 45 minutes should be planned. INRIX data were used to calculate the PTI. There are blank cells in these tables because some data were unavailable.

Table 2 shows the PTI for years November 2014 to October 2015 and November 2016 to October 2017. **Table 3** summarizes the PTI improvement by month and by day of week. For example, comparing November 2014 to November 2016, on a Sunday, PTI improved by 37 percent. This means that on a Sunday in November of 2016 compared to a Sunday in November of 2014, there would be a 37 percent savings of planning travel time. This improvement means that the total time users should allow to ensure on time arrival has decreased.

Table 2. Planning Time Index

Eastbound I-70 from MP 230 to MP 241 Planning Time Index												
Day Of Week	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15
Sunday	1.87	–	2.36	2.35	2.09	1.32	1.29	2.11	2.38	2.27	2.54	1.22
Monday	1.49	1.62	1.98	2.40	1.93	1.52	1.37	2.29	1.44	1.41	2.47	2.47
Tuesday	1.44	1.69	1.33	1.23	1.47	–	1.33	3.83	-0.40	1.43	0.20	1.79
Wednesday	1.80	1.46	1.39	1.46	1.51	–	1.43	2.90	1.50	1.50	0.21	1.60
Thursday	1.53	1.60	1.57	1.92	1.74	–	1.76	1.96	1.57	1.56	0.50	2.83
Friday	1.39	1.38	2.06	1.39	1.82	–	1.32	1.48	1.33	1.32	1.63	2.70
Saturday	1.67	1.72	1.86	1.69	1.54	1.28	1.23	1.22	1.25	1.70	1.26	1.20
Day Of Week	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17
Sunday	1.18	1.29	1.3	1.36	1.25	1.18	1.13	1.85	2.43	1.75	1.38	1.24
Monday	1.16	1.19	1.34	1.19	1.16	1.13	1.15	1.09	1.09	1.09	1.19	1.14
Tuesday	1.15	1.26	1.3	1.14	1.16	1.34	1.16	1.1	1.09	1.08	1.09	1.1
Wednesday	1.14	1.34	1.56	1.14	1.15	1.27	1.14	1.1	1.11	1.08	1.09	1.07
Thursday	1.58	1.2	1.67	1.21	1.13	1.13	1.39	1.09	1.1	1.09	1.09	1.12
Friday	1.24	1.29	1.23	1.18	1.19	1.19	1.14	1.08	1.09	1.08	1.09	1.09
Saturday	1.15	1.27	1.36	1.17	1.16	1.31	1.12	1.1	1.11	1.1	1.27	1.08

Table 3. Planning Time Index Improvement

Eastbound I-70 from MP 230 to MP 241 Planning Time Index Improvement												
Day Of Week	November 2014-2016	December 2014-2016	January 2015-2017	February 2015-2017	March 2015-2017	April 2015-2017	May 2015-2017	June 2015-2017	July 2015-2017	August 2015-2017	September 2015-2017	October 2015-2017
Sunday	37%	–	45%	42%	40%	11%	12%	12%	-2%	23%	46%	-2%
Monday	22%	27%	32%	50%	40%	26%	16%	52%	24%	23%	52%	54%
Tuesday	20%	25%	2%	7%	21%	–	13%	71%	–	24%	–	39%
Wednesday	37%	8%	-12%	22%	24%	–	20%	62%	26%	28%	–	33%
Thursday	-3%	25%	-6%	37%	35%	–	21%	44%	30%	30%	–	60%
Friday	11%	7%	40%	15%	35%	–	14%	27%	18%	18%	33%	60%
Saturday	31%	26%	27%	31%	25%	-2%	9%	10%	11%	35%	-1%	10%



Mountain Express Lane Annual Operations Report November 2016–October 2017

Travel time index (TTI) is the ratio of the peak-period travel time to the free-flow travel time. **Table 4** shows the TTI for years November 2014 to October 2015 and November 2016 to October 2017. **Table 5** shows the improvement by month and by day of week for the operating year beginning in 2014 to the operating year beginning in 2016. For example, comparing Sundays during the month of November between years 2014 and 2016, the TTI improves by 17 percent. This improvement means that the time it takes to travel through the segment during the peak periods has decreased.

Table 4. Travel Time Index

Eastbound I-70 from MP 230 to MP 241 Travel Time Index												
Day Of Week	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15
Sunday	1.24	1.17	1.32	1.33	1.20	1.11	1.10	1.26	1.43	1.35	1.36	1.10
Monday	1.17	1.19	1.19	1.28	1.19	1.14	1.14	1.25	1.14	1.15	1.32	1.30
Tuesday	1.18	1.21	1.11	1.10	1.15	1.23	1.13	1.44	1.13	1.14	1.19	1.28
Wednesday	1.22	1.24	1.14	1.15	1.15	1.47	1.15	1.37	1.15	1.17	1.18	1.23
Thursday	1.19	1.20	1.15	1.24	1.18	1.18	1.20	1.23	1.16	1.18	1.25	1.41
Friday	1.16	1.15	1.22	1.15	1.17	1.25	1.13	1.14	1.10	1.11	1.21	1.33
Saturday	1.20	1.17	1.17	1.19	1.11	1.07	1.09	1.07	1.10	1.43	1.14	1.09
Day Of Week	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17
Sunday	1.03	1.09	1.07	1.06	1.03	1.03	1.01	1.13	1.23	1.12	1.04	1.01
Monday	1.03	1.05	1.09	1.02	1.03	1.01	1.04	1.01	0.99	1.00	1.01	1.02
Tuesday	1.03	1.06	1.08	1.02	1.02	1.07	1.02	1.03	0.99	1.00	1.00	1.00
Wednesday	1.03	1.10	1.15	1.01	1.02	1.06	1.03	1.03	1.01	1.01	1.00	0.99
Thursday	1.14	1.06	1.13	1.05	1.02	1.02	1.08	1.01	1.00	0.99	0.99	1.00
Friday	1.06	1.08	1.06	1.04	1.04	1.04	1.02	1.02	1.00	0.99	1.01	0.99
Saturday	1.04	1.07	1.07	1.03	1.02	1.08	1.00	1.00	1.01	1.00	1.02	0.98

Table 5. Travel Time Index Improvement

Eastbound I-70 from MP 230 to MP 241 Time Index Improvement												
Day Of Week	November 2014-2016	December 2014-2016	January 2015-2017	February 2015-2017	March 2015-2017	April 2015-2017	May 2015-2017	June 2015-2017	July 2015-2017	August 2015-2017	September 2015-2017	October 2015-2017
Sunday	17%	7%	19%	20%	14%	7%	8%	10%	14%	17%	24%	8%
Monday	12%	12%	8%	20%	13%	11%	9%	19%	13%	13%	23%	22%
Tuesday	13%	12%	3%	7%	11%	13%	10%	28%	12%	12%	16%	22%
Wednesday	16%	11%	-1%	12%	11%	28%	10%	25%	12%	14%	15%	20%
Thursday	4%	12%	2%	15%	14%	14%	10%	18%	14%	16%	21%	29%
Friday	9%	6%	13%	10%	11%	17%	10%	11%	9%	11%	17%	26%
Saturday	13%	9%	9%	13%	8%	-1%	8%	7%	8%	30%	11%	10%

F. I-70 Traffic Volume

Table 6, Table 7, and Table 8 show the 2016-2017 total traffic volumes for the Mountain Express Lane and the eastbound general-purpose lanes from MP 230 to MP 241 by season and day of week. The tables also show average daily traffic (ADT) by day of week when the Mountain Express Lane was open. The capture rate indicates the percentage of the total traffic that is using the Mountain Express Lane. The overall average capture rate of 2016-2017 is 7.9 percent. The summer capture rate (8.6 percent) is slightly higher than winter (7.4 percent) and fall (7.9 percent) capture rates. The ADT is higher on Sunday compared to Saturday. The highest ADT is on Sundays during the summer season (5/29/17 to 9/4/17) (5,190 vehicles). The highest volume day in the Mountain Express Lane in the winter season (11/26/16 to 4/23/17) was 6,800 vehicles and the highest volume day in the Mountain Express Lane during the summer season (5/29/17 to 9/4/17) was 9,000 vehicles.

Figure 9, Figure 10, and Figure 11 show the Mountain Express Lane and the I-70 Corridor volume, by season and by day, the ADT, and the express lane capture rate for the days that the Mountain Express Lane was open.

Table 6. I-70 Traffic Volumes and Capture Rate by Season

Season	Mountain Express Lane	I-70 Corridor (MP 230-241)	Mountain Express Lane Capture Rate Percent
Winter	115,200 2,300 ADT	1.56 million 31,000 ATD	7.4 percent
Summer	92,700 3,000 ADT	1.08 million 35,000 ATD	8.6 percent
Fall	19,100 2,700 ADT	243,200 34,700 ATD	7.9 percent
Total	227,100 2,600 ADT	2.89 million 32,800 ATD	7.9 percent

Table 7. I-70 Traffic Volumes by Season and Day of Week

	Mountain Express Lane			I-70 Corridor (MP 230-241)		
Season	Saturday	Sunday	Other	Saturday	Sunday	Other
Winter	25,200	64,000	26,000	546,500	721,900	291,400
Summer	6,700	72,700	13,300	356,700	548,000	179,700
Fall	Not Open	19,100	Not Open	N/A ¹	243,200	N/A ¹
Total	31,900	155,800	39,300	903,200	1,513,100	471,100

1 - Not applicable because Mountain Express Lane was not open

Table 8. I-70 Average Daily Traffic by Day of Week

	Mountain Express Lane			I-70 Corridor (MP 230-241)		
Season	Saturday	Sunday	Other	Saturday	Sunday	Other
Winter	1,260	3,080	2,550	27,300	34,400	31,700
Summer	560	5,190	1,940	29,700	39,100	35,400
Fall	Not Open	2,730	Not Open	N/A ¹	34,700	N/A ¹
Average²	1,000	3,670	2,240	28,200	36,000	33,550

1 - Not applicable because Mountain Express Lane was not open

2 - Average weighted by number of days per season

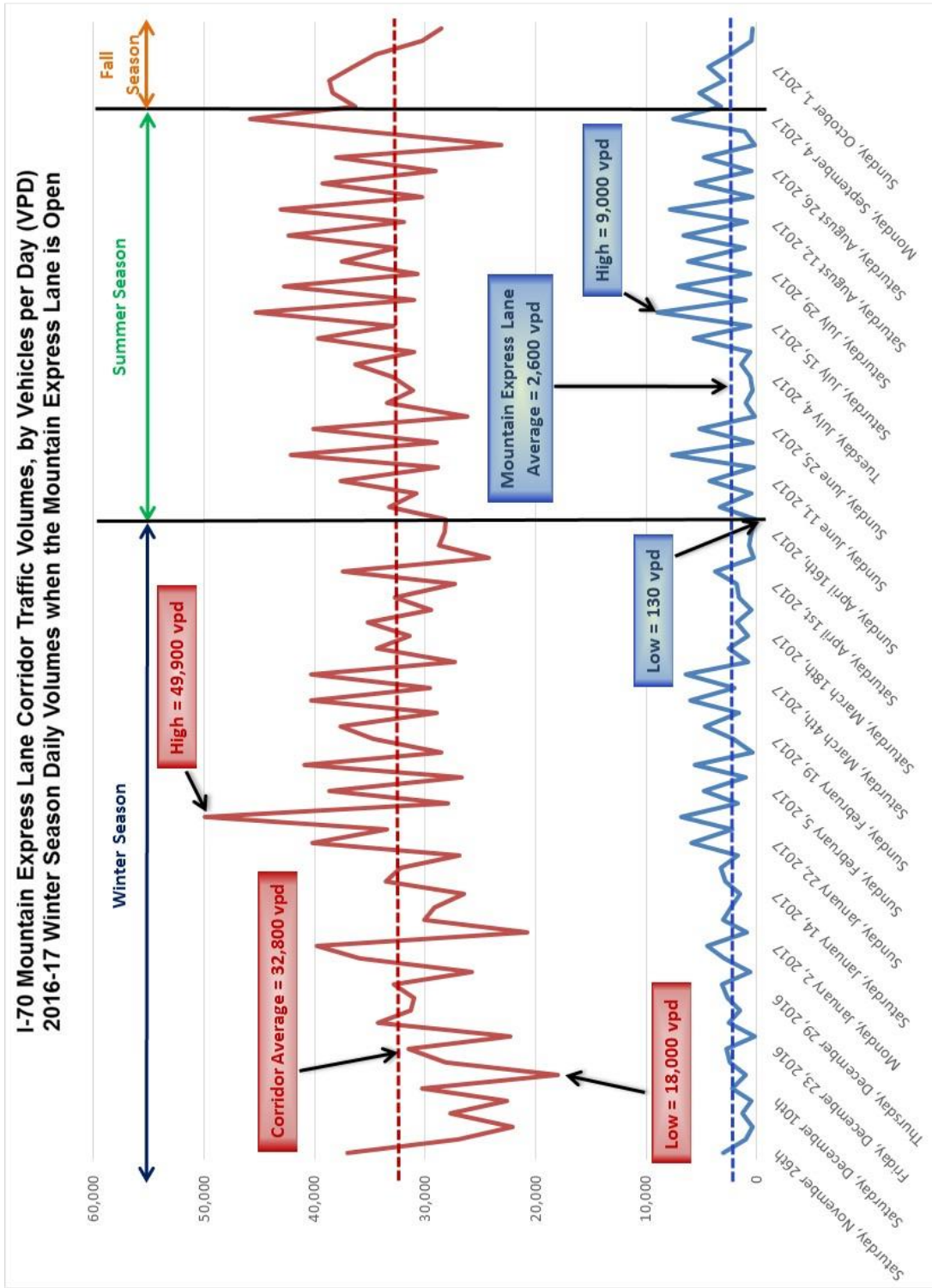


Figure 9. 2016-2017 Daily Volumes Mountain Express Lane and General-Purpose Lanes by Vehicles per Day (vpd)

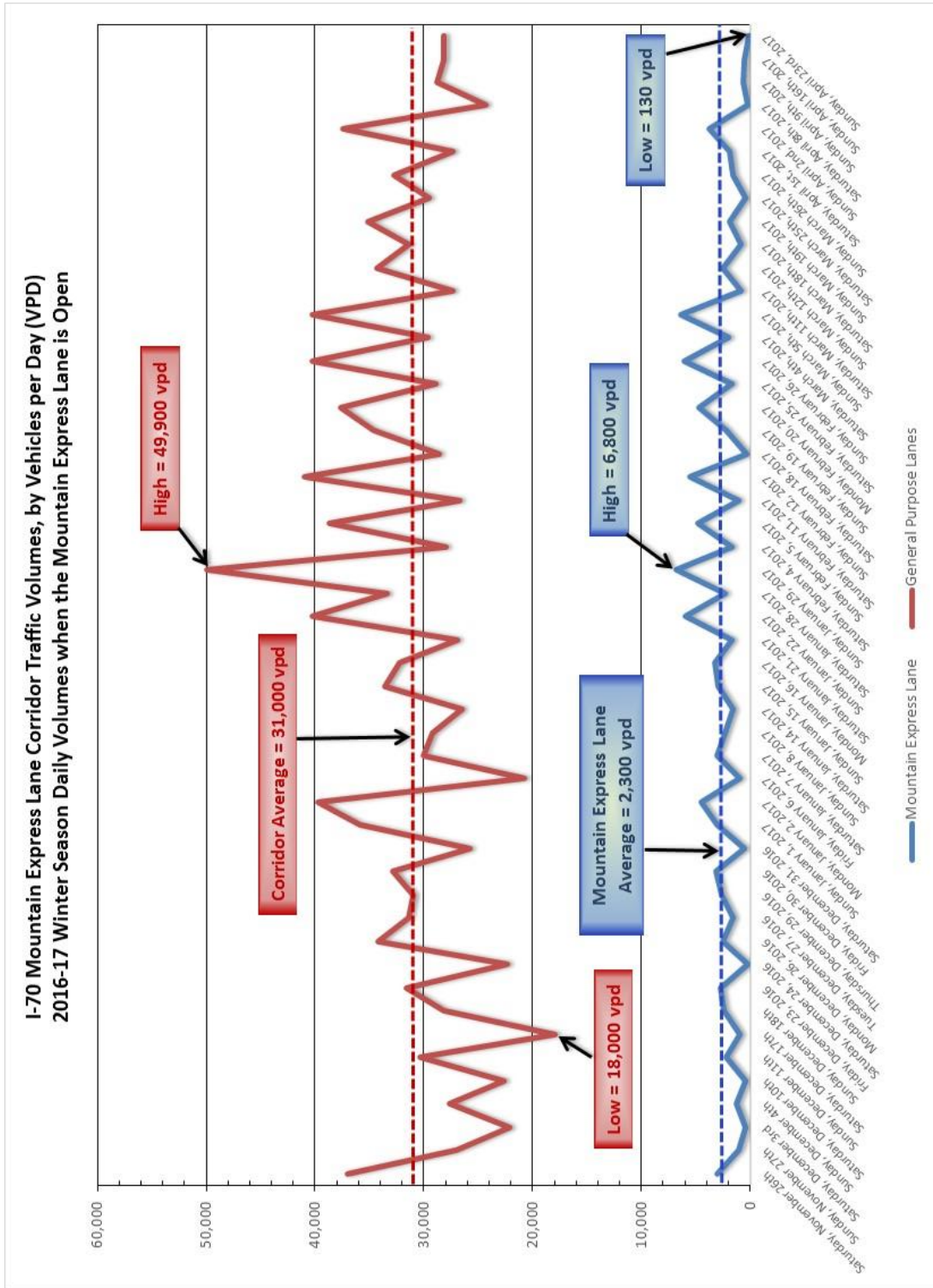


Figure 10. 2016-2017 Winter Daily Volumes Mountain Express Lane and General-Purpose Lanes by Vehicles per Day (vpd)

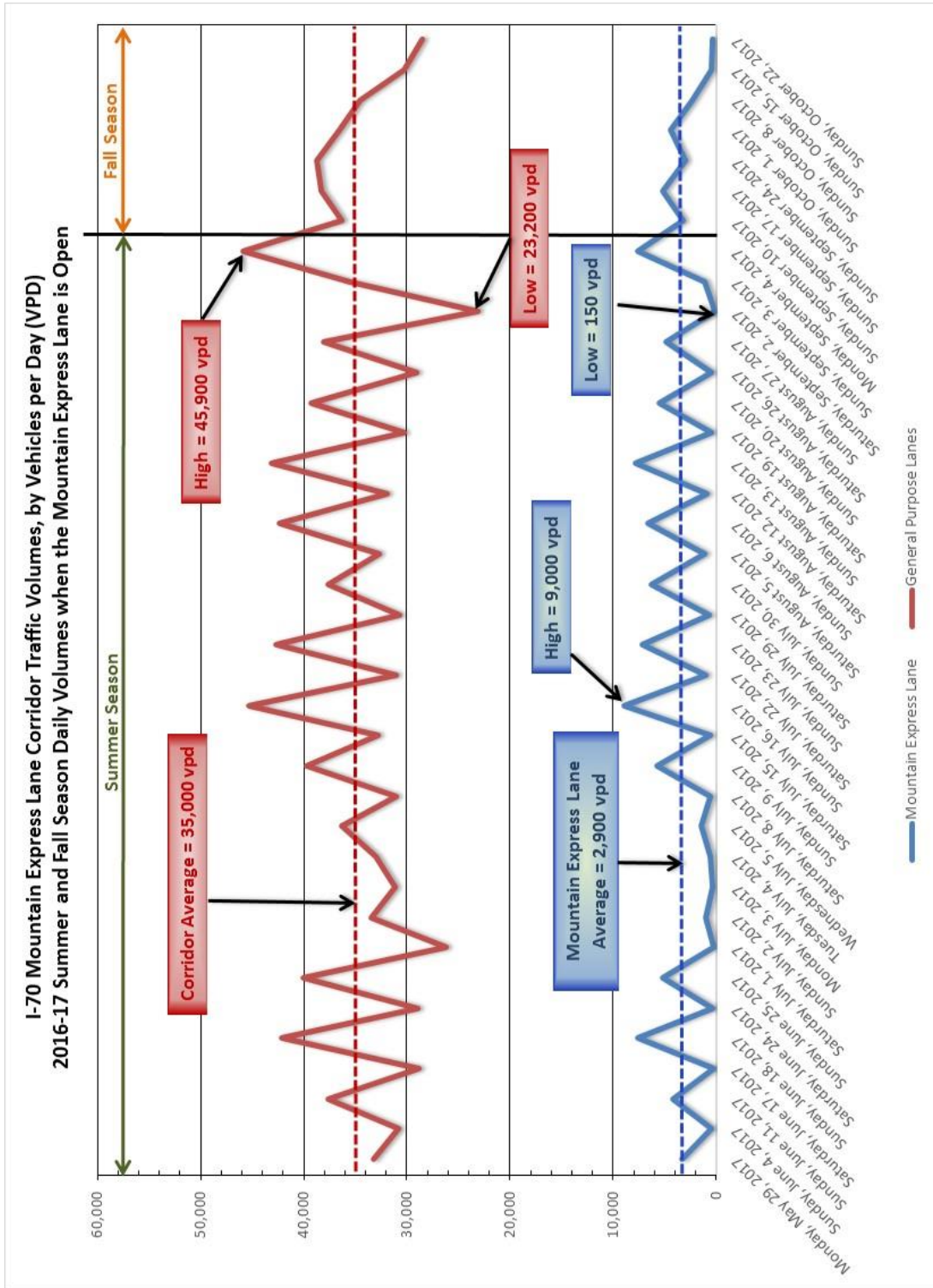


Figure 11. 2016-2017 Summer/Fall Daily Volumes Mountain Express Lane and General Purpose Lanes By Vehicles Per Day (vpd)

G.I-70 Crash Data and Incident Clearance Times

1. Crash Data and Crash Clearance Time during Mountain Express Lane Operations

The crash data for the 2016-2017 analysis is considered preliminary because there is a lag time between the time police crash reports are created and the time when crash data are available in DiExSys. DiExSys is the database which is created from police crash reports and provides the most detailed and accurate crash data available. Crash data for 2016-2017 will be updated when the DiExSys data are available.

For this report, crash data from COGNOS and the I-70 Daily Situation Reports were examined for the Mountain Express Lane operation year 2016-2017. When an incident occurs, CDOT personnel create an event in the Colorado Transportation Management System (CTMS) software, which then is integrated into COGNOS. Those same personnel create a daily Situation Report for the I-70 Corridor. **Figure 12** shows the spatial distribution of the crashes when the Mountain Express Lane was open.

As shown in **Table 9**, there were 44 total crashes on the days and during the times that the I-70 Corridor Mountain Express Lane was open. Of this total, 30 crashes occurred in the winter season, 11 crashes in the summer season, and three crashes in the fall season. The seasonal breakdown of the data reflects the days and hours within a season that the Express Lane was open.

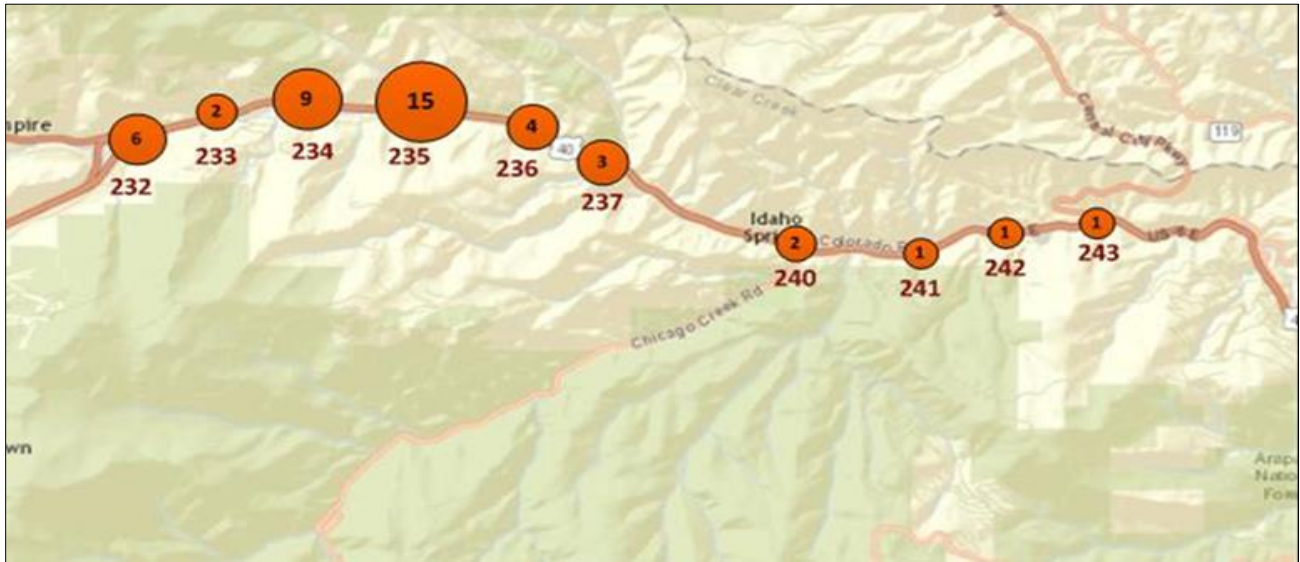
Table 9 also presents the average crash clearance time for operation year 2016-2017. The overall weighted average is 18 minutes. The average clearance time in the winter is 14 minutes, the average clearance time in the summer is 26 minutes, and the average clearance time in the fall is 31 minutes.

Table 9. Total Crashes while Mountain Express Lane was Open

Season	Location			Total	Average Clearance Time
	Express Lane	Express Lane/ GP Lane	GP Lane		
Winter 11/26/16- 04/23/17	5	4	21	30	14 minutes
Summer 05/29/17- 09/04/17	0	2	9	11	26 minutes
Fall 09/10/17- 10/22/17	2	0	1	3	31 minutes
Total	7	6	31	44	18 minutes¹

¹ – weighted average

Figure 12. Mountain Express Lane Crashes by Mile Marker



2. Crash Data for the I-70 Mountain Express Corridor during Full Year

Crash data for the I-70 Mountain Express Corridor for full operational years, which includes days when the Express Lane was open and when it was closed, is shown in **Table 10**. DiExSys data was analyzed for the crash data for the 2013-2016. The seasons have been determined using dates that can span calendar years and include the holidays that affect the travel on the corridor. The holidays of Thanksgiving, Memorial Day, and Labor Day occur on a different calendar dates from year to year. Crash data is generally considered over several years to account for variables such as weather. While the number of crashes in winter of 2015-2016 was high, as can be seen in 2016-2017, the number of crashes is trending downward.

Table 10 Total Crashes for Full Years

Season	Prior to Mountain Express Lane	After Mountain Express Lane	
	2013-2015 Average ¹	2015-2016 ¹	2016-2017 ²
Winter 11/1 – 05/20	49	89	51
Summer 05/21 – 09/07	21	20	16
Fall 09/0 -10/31	21	15	4
Total	91	124	71

1 - Source of data is DiExSys

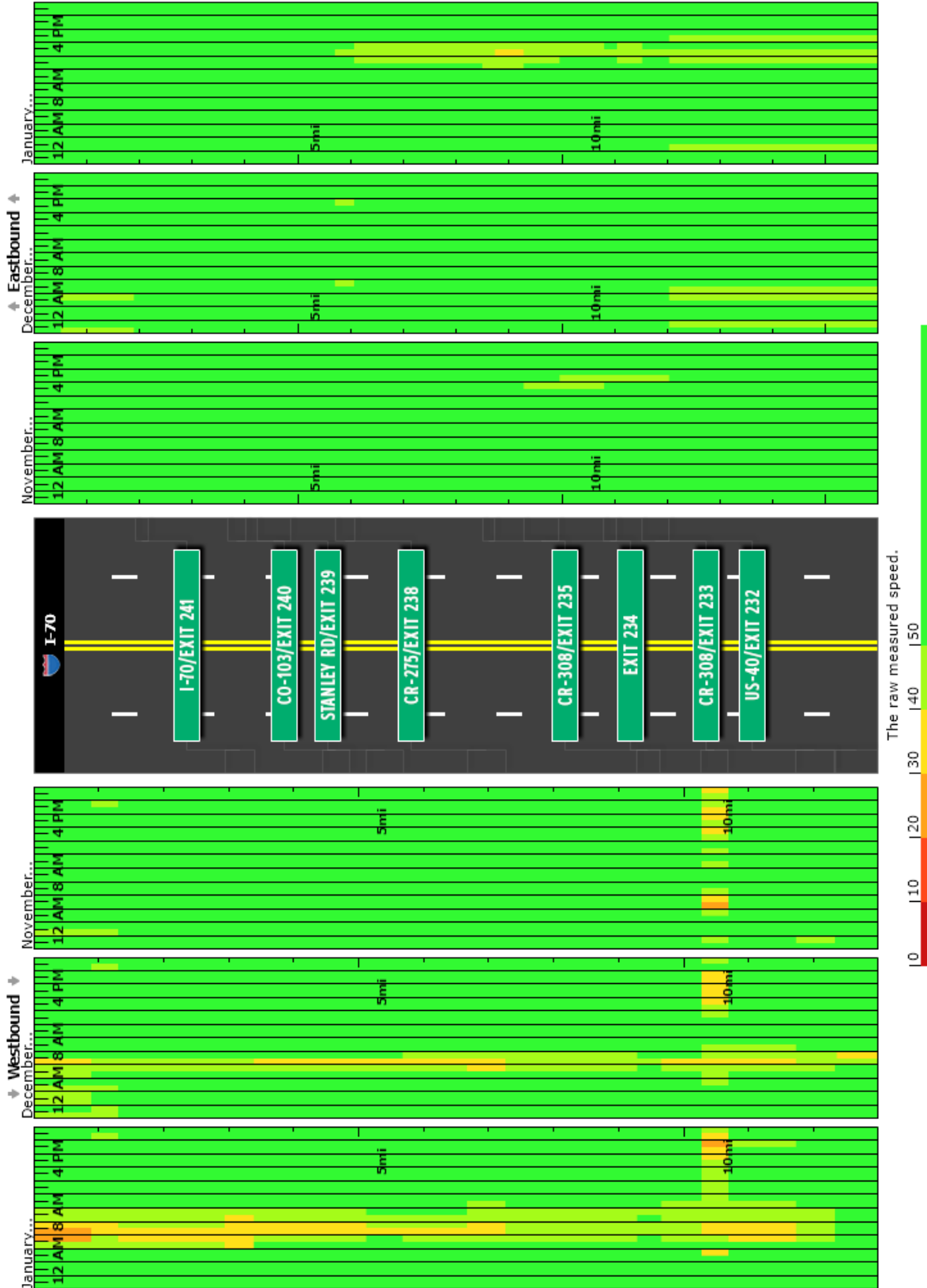
2 - Source of data is COGNOS and I-70 Situational Reports



APPENDIX A—RAW SPEEDS GRAPHICS FROM INRIX

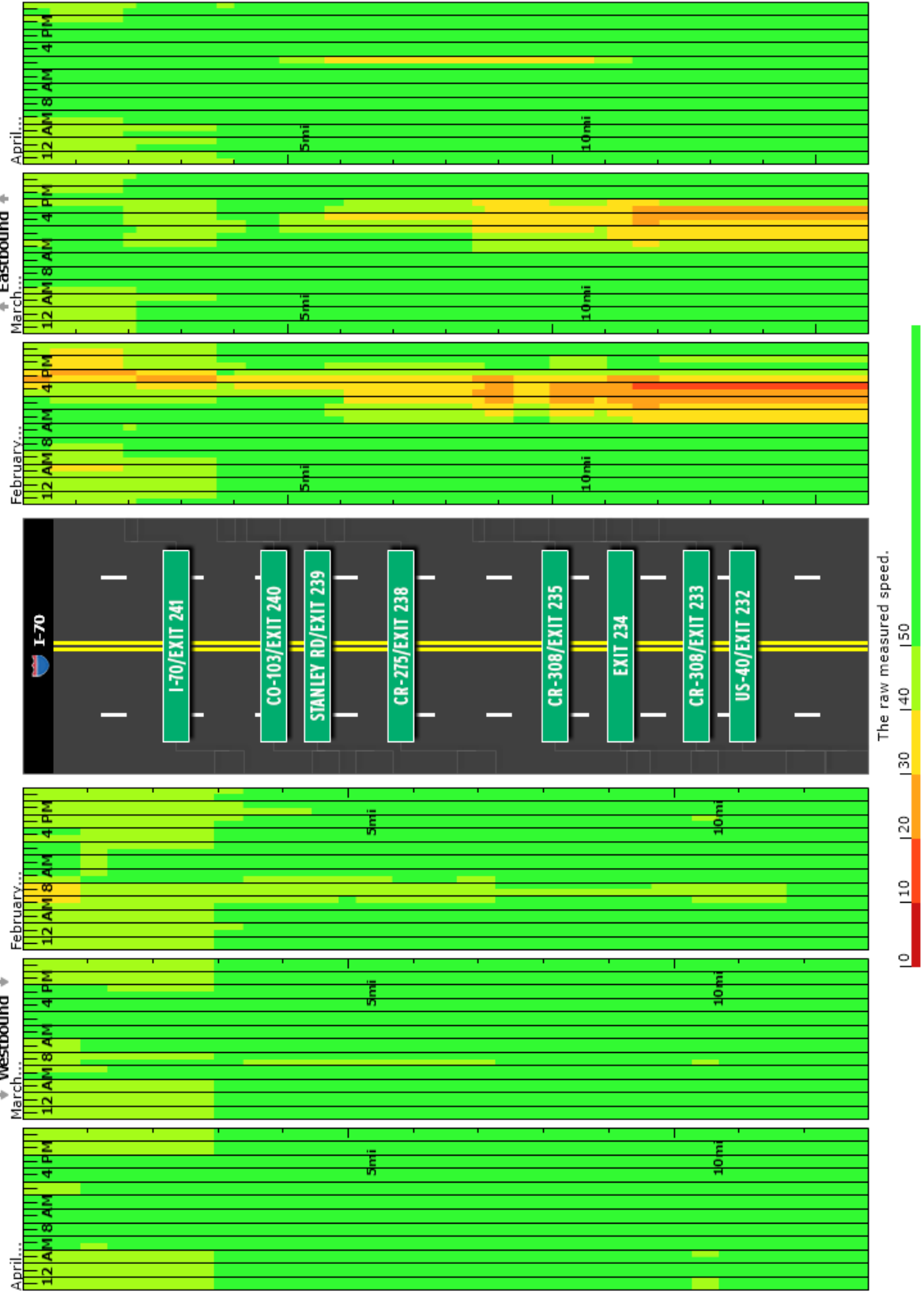
Speed on I-70 between US-40/Exit 232 and CR-314/Exit 243 using INRIX data

Averaged by 1 hour for November 2016 (every weekend), for December 2016 (every weekend), and for January 2017 (every weekend)



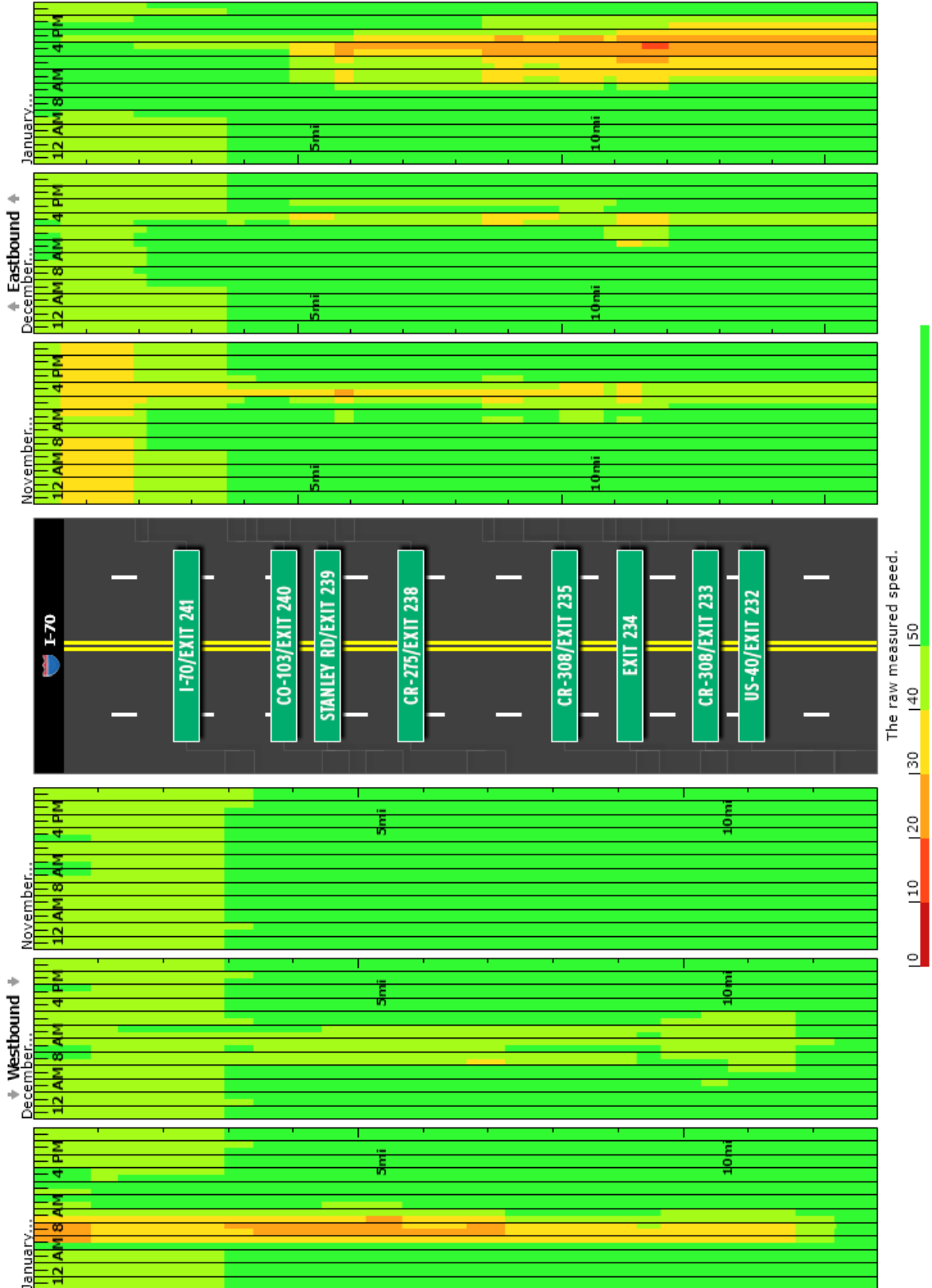
Speed on I-70 between US-40/Exit 232 and CR-314/Exit 243 using INRIX data

Averaged by 1 hour for February 2015 (every weekend), for March 2015 (every weekend), and for April 2015 (every weekend)



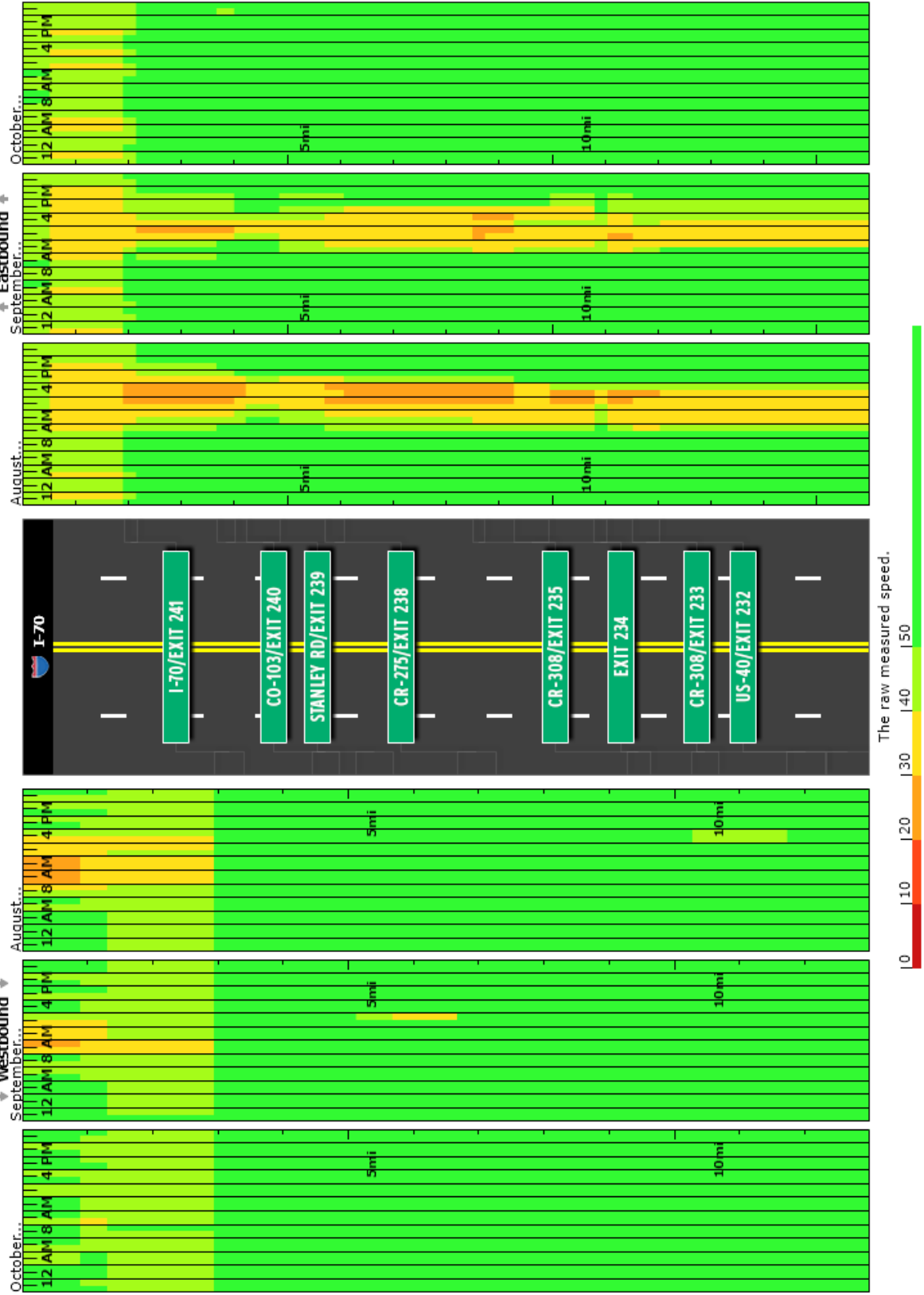
Speed on I-70 between US-40/Exit 232 and CR-314/Exit 243 using INRIX data

Averaged by 1 hour for November 2014 (every weekend), for December 2014 (every weekend), and for January 2015 (every weekend)



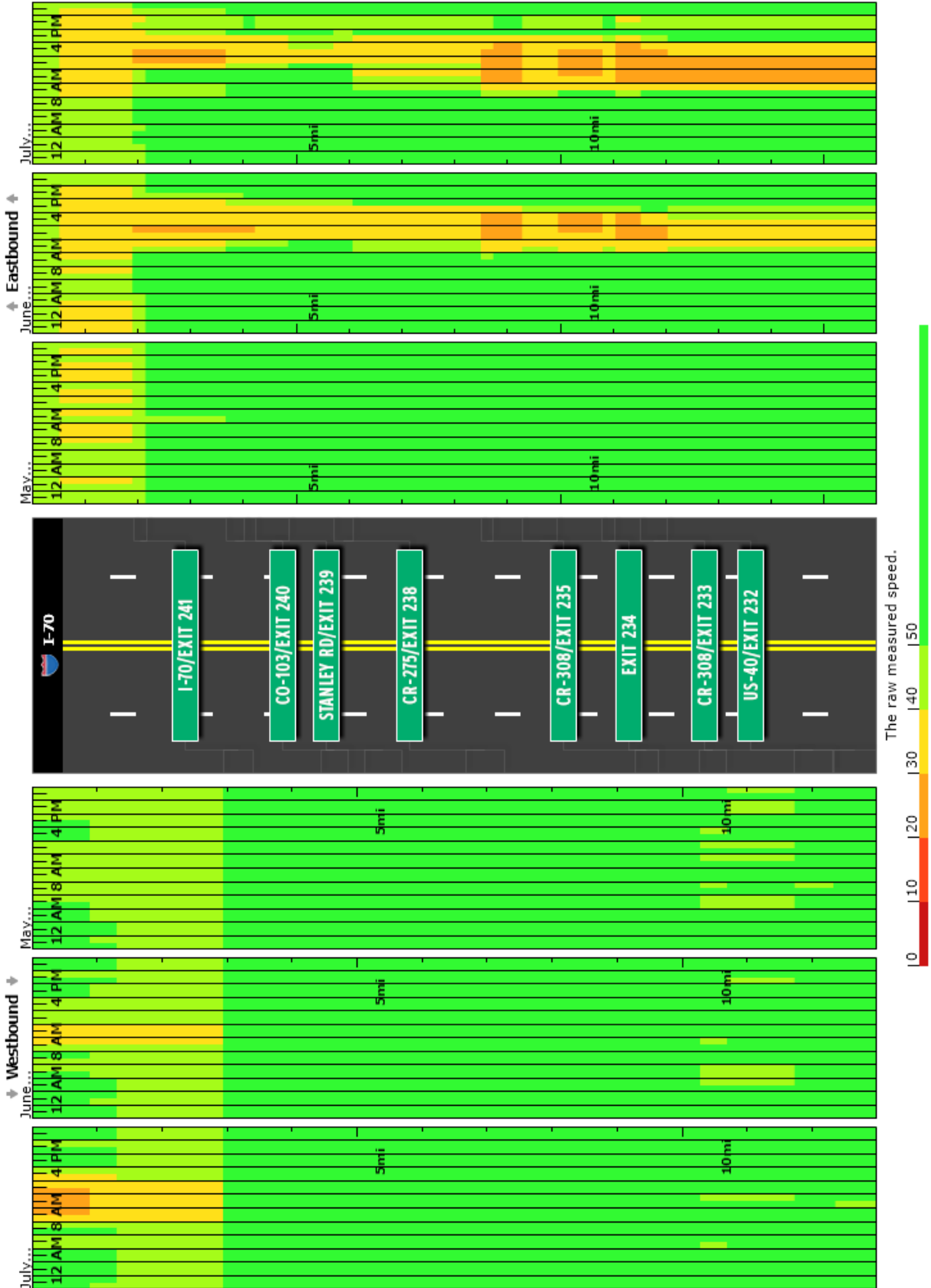
Speed on I-70 between US-40/Exit 232 and CR-314/Exit 243 using INRIX data

Averaged by 1 hour for August 2014 (every weekend), for September 2014 (every weekend), and for October 2014 (every weekend)



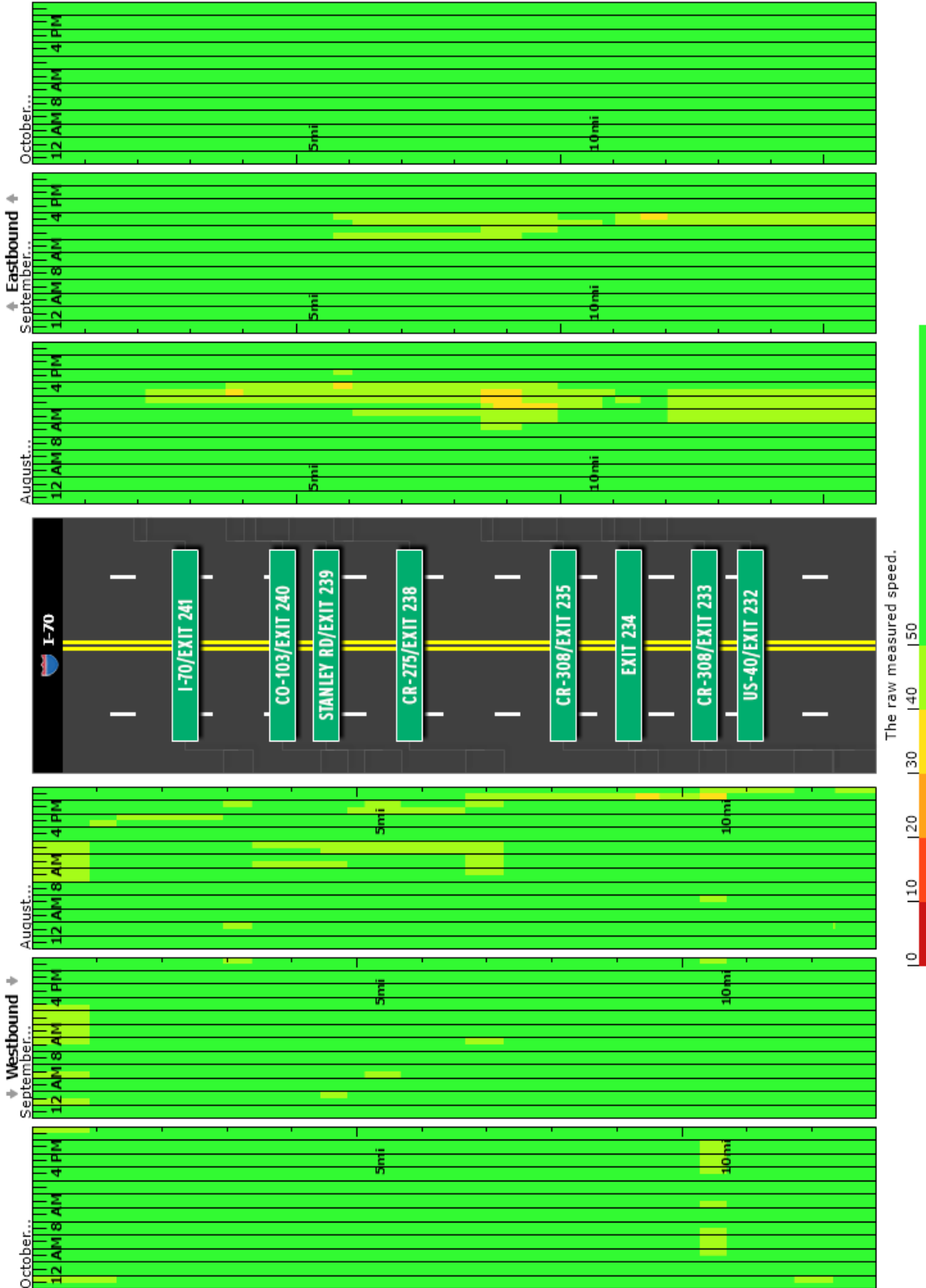
Speed on I-70 between US-40/Exit 232 and CR-314/Exit 243 using INRIX data

Averaged by 1 hour for May 2014 (every weekend), for June 2014 (every weekend), and for July 2014 (every weekend)



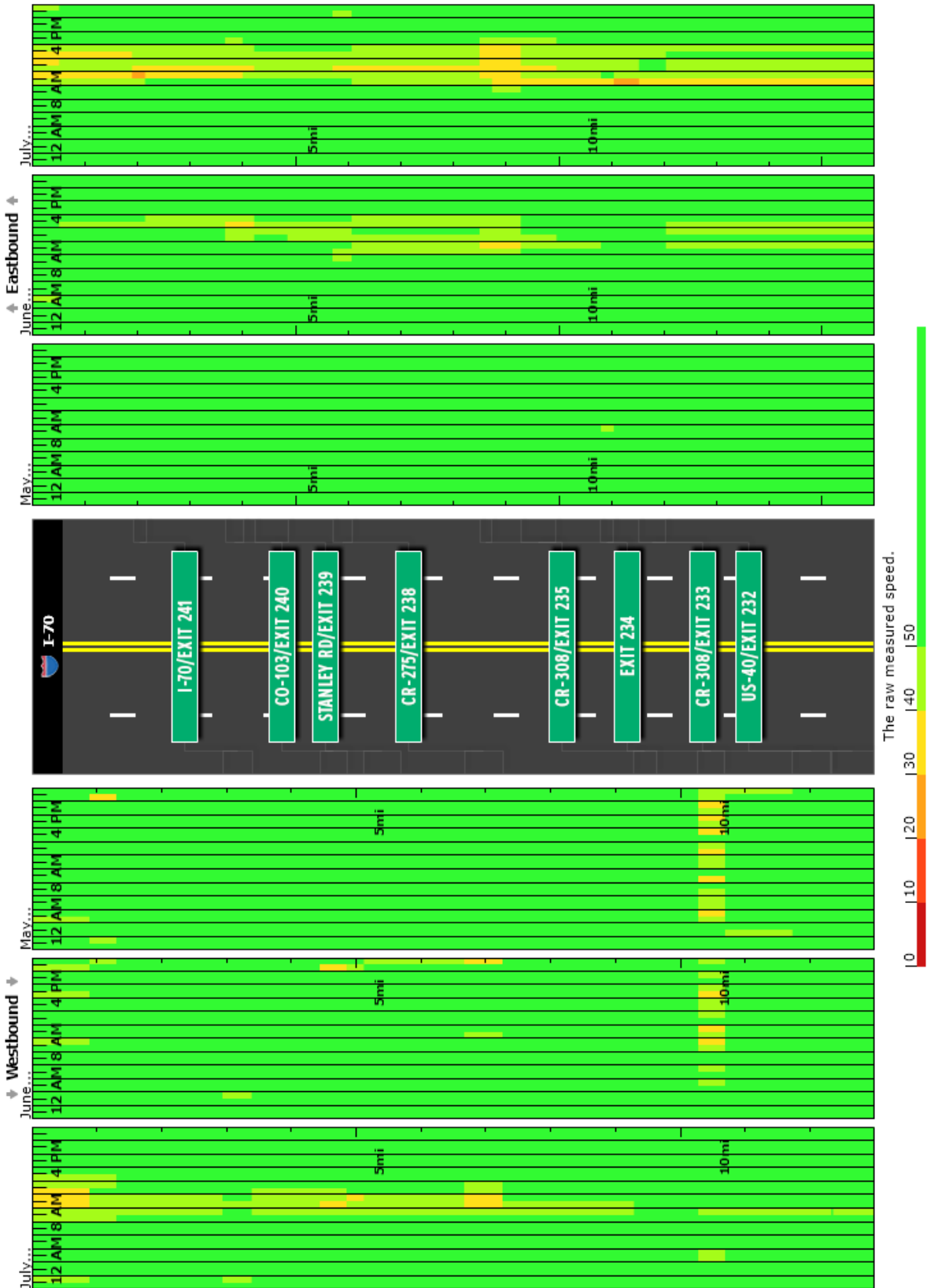
Speed on I-70 between US-40/Exit 232 and CR-314/Exit 243 using INRIX data

Averaged by 1 hour for August 2017 (every weekend), for September 2017 (every weekend), and for October 2017 (every weekend)



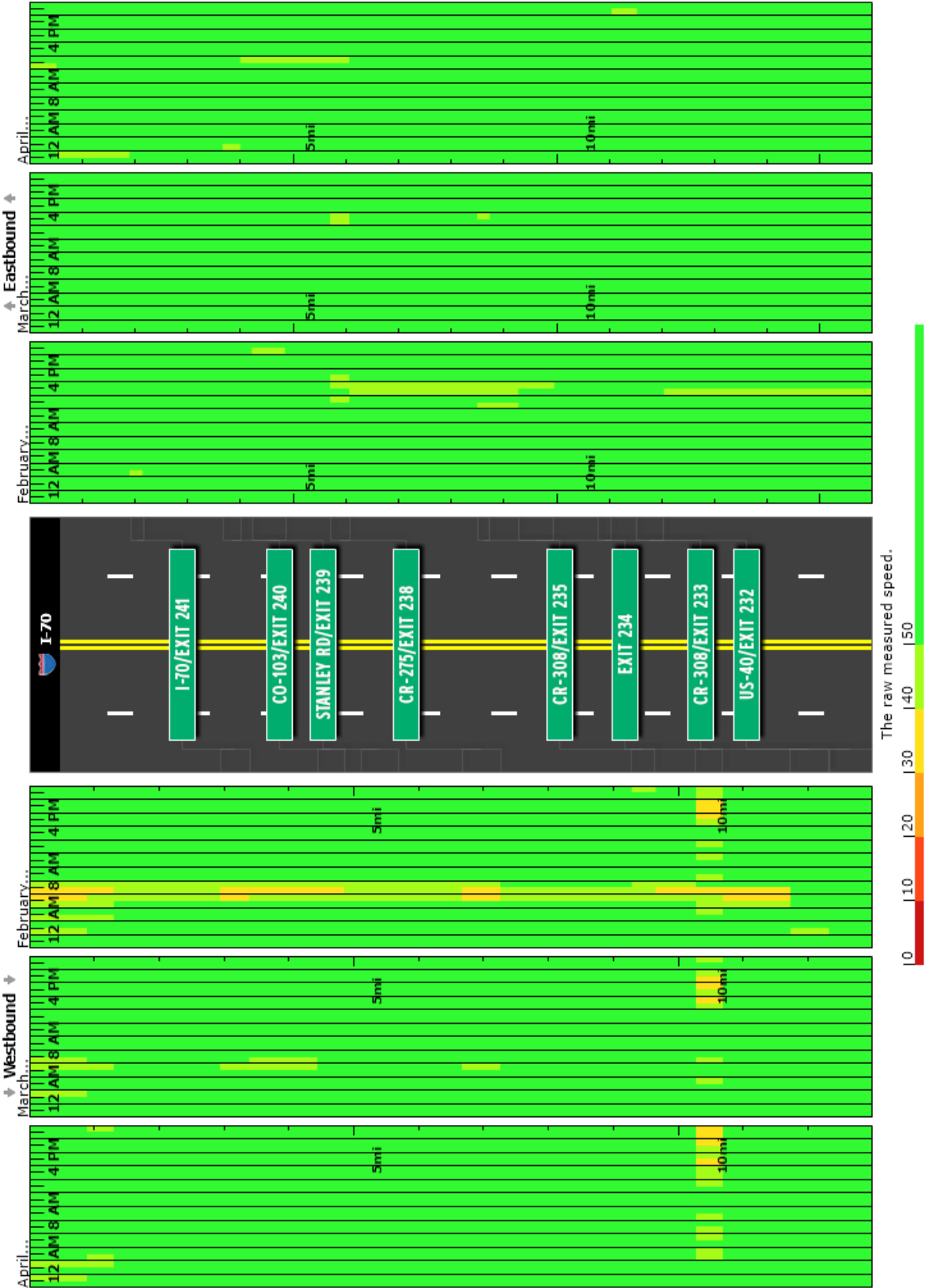
Speed on I-70 between US-40/Exit 232 and CR-314/Exit 243 using INRIX data

Averaged by 1 hour for May 2017 (every weekend), for June 2017 (every weekend), and for July 2017 (every weekend)



Speed on I-70 between US-40/Exit 232 and CR-314/Exit 243 using INRIX data

Averaged by 1 hour for February 2017 (every weekend), for March 2017 (every weekend), and for April 2017 (every weekend)





APPENDIX B—MEMORANDUM OF UNDERSTANDING

CDOT Contract Number: 351001403
Contract Routing Number: 18-HAA-XE-00005

**AMENDED
MEMORANDUM OF UNDERSTANDING (MOU)
By and between the
FEDERAL HIGHWAY ADMINISTRATION,
UNITED STATES DEPARTMENT OF TRANSPORTATION (Division)
AND
COLORADO DEPARTMENT OF TRANSPORTATION (CDOT)
AND
COLORADO HIGH PERFORMANCE TRANSPORTATION ENTERPRISE (HPTE)**

WHEREAS, CDOT has constructed the *I-70 Eastbound Peak Period Shoulder Lane Project* (hereinafter referred to as the "Project"); and

WHEREAS, the Division, CDOT and HPTE previously entered into an MOU for the Project, which contemplated changes as a second step to allow for added operation flexibility following the commencement of operations; and

WHEREAS, this Amended MOU is intended to supersede and replace the original MOU dated April 22, 2014; and

WHEREAS, CDOT and HPTE desire to continue tolling during periods of high traffic volumes on the eastbound inside shoulder from MP 230 to MP 241 (hereinafter referred to as the "Toll Facility"); and

WHEREAS, the Division, CDOT and HPTE recognize the seasonality of the traffic demand experienced by the Toll Facility and therefore agree that for purposes of data collection, operational assessments, performance measures and reviews, the Toll Facility reporting period shall be the twelve month operating year from November 1st to October 31st, inclusive; and

WHEREAS, the following are conditions of the design variance required for the Project:

- a. CDOT and HPTE agree to collect sufficient Toll Facility data and adjacent GP Lanes data to provide a complete view of the total corridor performance.
- b. The following data on the Toll Facility and adjacent GP Lanes are to be collected during each operating year to assemble the following performance measures that are based upon the Project's Concept of Operations. The Project's Concept of Operations, recommended performance measures are as follows:
 1. Interstate 70 Travel Time Reliability;
 2. Interstate 70 Traffic Volume and Traffic Type;
 3. Interstate 70 Safety and Crash Data, during operational and non-operational periods including the location of the incident;
 - a. Included as a performance measure will be an evaluation of incidents that occur in the Toll Facility when the Toll Facility is in the closed state; and
 4. Incident clearance times (as measured from the time of dispatch of Courtesy Patrol to when all emergency responders have left the scene).

The information provided by the performance measures shall be assembled into a report that provides an assessment of the operating year's performance with recommendations as needed for the upcoming operating year. If needed, as a part of the operating year

CDOT Contract Number: 351001403
Contract Routing Number: 18-HAA-XE-00005

assessment, CDOT or HPTE will conduct a review of the functionality of the Toll Facility or components of the Toll Facility. The accuracy and findings of the report shall be certified by CDOT and HPTE and submitted to the Division, within two months of the end of the operating year. One certified report shall be sufficient to satisfy the requirements of this paragraph so long as both parties are bound by such certification. If requested, CDOT and HPTE agree to provide Clear Creek County (CCC) results of the Project's ongoing assessment as a part of CDOT/CCC Quarterly Coordination Meetings.

- c. In addition to paragraph b. above, CDOT will conduct an annual multidisciplinary review of the Toll Facility that includes a safety analysis and focuses on signing, striping, and operations during both the peak and non-peak operations. The results of the review shall be shared with FHWA.
- d. CDOT will maintain the striping to ensure the striping remains of high quality for the facility
- e. CDOT and the HPTE agree to reassess the Toll Facility in the year 2020 in conjunction with the I-70 Programmatic Environmental Impact Statement (PEIS) Record of Decision (ROD) reassessment.

At that time, the full range of improvements evaluated at Tier 1 may be reconsidered. In addition, the I-70 Collaborative Effort stakeholder committee (including the lead agencies) may reconsider the full range of improvements evaluated in the Final PEIS, or pursue a new process because the context in which this Tier 1 decision was made is so changed that none of the alternatives evaluated in the Final PEIS meets future transportation needs. Global, regional, and local trends such as peak oil, climate change, technological advances, and changing demographics could affect these future transportation needs.

The reassessments can proceed in parallel with Tier 2 NEPA processes for individual projects. Preparation of a reassessment does not require ongoing Tier 2 NEPA processes to be halted, nor does it preclude the initiation or conclusion of other Tier 2 NEPA processes.

- f. CDOT and HPTE agree to limit the use of the Toll Facility according to the following operational limitations:
 - 1. The Toll Facility operations shall be limited to peak periods of congestion, which based on modeling and historic data, are projected to be on Saturdays and Sundays from December through March, and July through September.
 - 2. The Toll Facility shall operate during holiday associated traffic and planned special events throughout the year, both which are anticipated to generate a large, concentrated number of return trips from the I-70 Mountain Corridor to the Denver Metropolitan Area.
 - 3. In order to balance the semi-predictable nature of the I-70 Mountain Corridor traffic peaks with the uncertainties that come from adverse weather and tight geometry, HPTE and the CDOT Transportation Management Center (CTMC) operations center will have the flexibility to determine when congestion levels have risen to a level that warrants opening the Toll Facility. It is anticipated that the Toll Facility will normally be operated between the hours of 9:00am and 8:00pm.
 - 4. When necessary, the Toll Facility shall be allowed to operate during emergency closures of the general purpose lanes. A toll may not be charged for use of the Toll Facility during emergency closures. If a toll is not charged, these hours of

CDOT Contract Number: 351001403
Contract Routing Number: 18-HAA-XE-00005

- emergency use will not be counted when calculating whether the Toll Facility's annual operational limits set forth in Paragraph 6 below apply.
5. The Toll Facility operations are weather dependent.
 6. The Toll Facility shall not operate on more than 100 days per year (including holidays), or operate in excess of 1,168 hours per year.
 7. The Toll Facility shall cease operation by the year 2035 unless modified by a different project, which may or may not be a part of the Corridor's long term solution.

The CDOT and the HPTE agree that if the above operational limitations are not met, the Division has the right to revoke the design variances allowed for the Project from MP 230 to MP 241 and require all Federal funds be repaid in full. If the above mentioned limitations are not met, the Division has the right to require CDOT to restore the cross section and right side break down shoulder to a pre-Project condition.

IN WITNESS THEREOF, the parties hereto have caused this Amended MOU to be duly executed, on the date of the last signature below.

COLORADO DEPARTMENT OF TRANSPORTATION

BY:  _____
Shailen P. Bhatt, Executive Director

DATE: 9/1/17

COLORADO HIGH PERFORMANCE TRANSPORTATION ENTERPRISE

BY:  _____
David L. Spector, Director

DATE: 8/29/17

**FEDERAL HIGHWAY ADMINISTRATION
COLORADO DIVISION**

BY:  _____
John M. Cater, Division Administrator

DATE: 9/22/17



Mountain Express Lane Annual Operations Report

November 2016–October 2017

Prepared by:

ATKINS



COLORADO

Department of
Transportation



2016-2017 Mountain Express Lane Annual Operations Report



I-70 Mtn. Express Lanes – Agenda



- **Agenda**

- **❖ November 1, 2016, through October 31, 2017
Operations Report**

- Hours of operations
- Calendar
- Seasons
- Toll rates

- **❖ Findings**

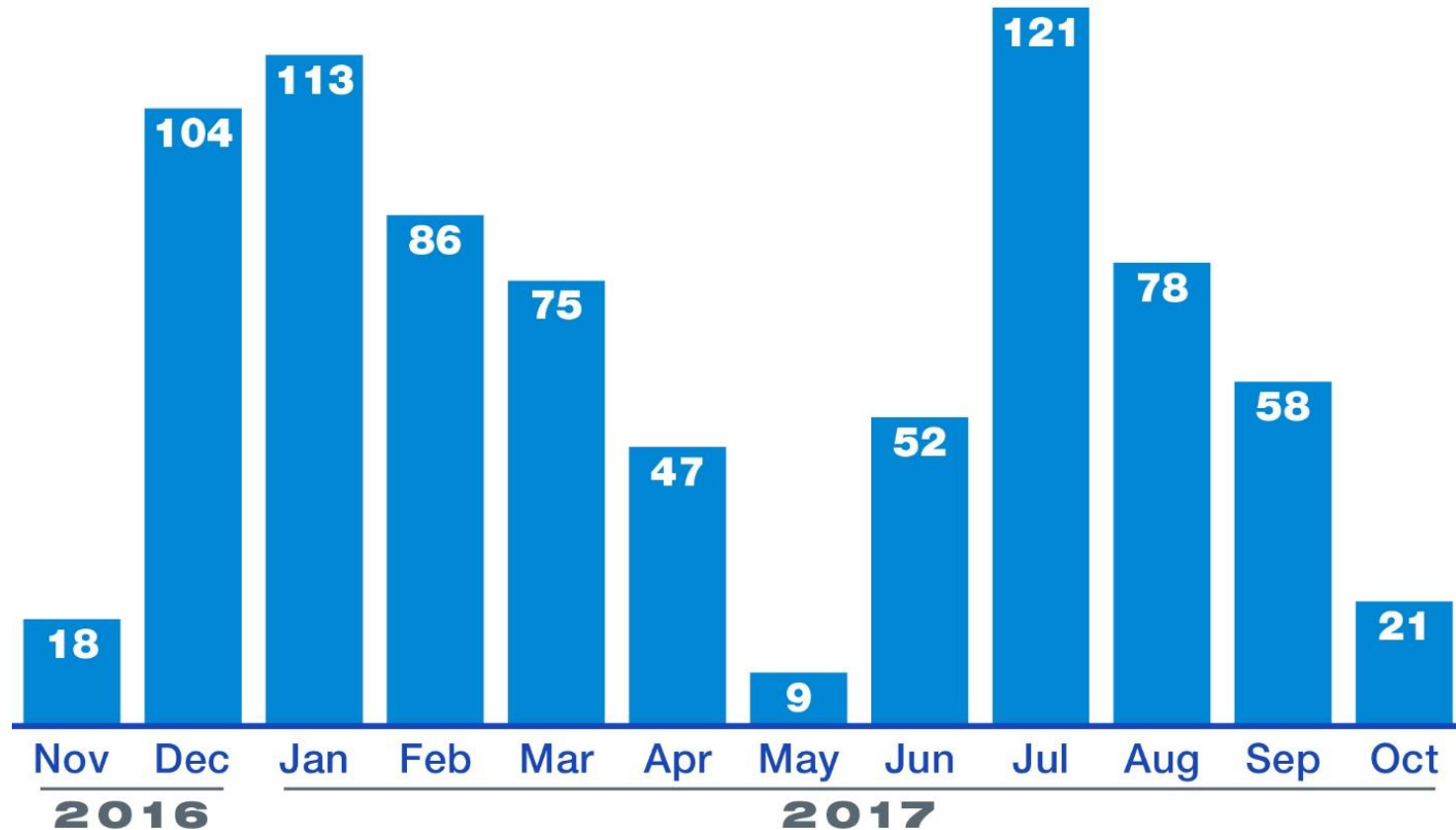
- Speeds
- Travel Time Reliability
- Volumes
- Safety



I-70 Mtn. Express Lanes – Hours of Operations



Hours of Operations per Month





I-70 Mtn. Express Lanes – Calendar



<p>NOVEMBER 2016</p> <p>S M T W T F S</p> <p>1 2 3 4 5</p> <p>6 7 8 9 10 11 12</p> <p>13 14 15 16 17 18 19</p> <p>20 21 22 23 24 25 26</p> <p>27 28 29 30</p>	<p>DECEMBER 2016</p> <p>S M T W T F S</p> <p>1 2 3</p> <p>4 5 6 7 8 9 10</p> <p>11 12 13 14 15 16 17</p> <p>18 19 20 21 22 23 24</p> <p>25 26 27 28 29 30 31</p>	<p>JANUARY 2017</p> <p>S M T W T F S</p> <p>1 2 3 4 5 6 7</p> <p>8 9 10 11 12 13 14</p> <p>15 16 17 18 19 20 21</p> <p>22 23 24 25 26 27 28</p> <p>29 30 31</p>
<p>FEBRUARY 2017</p> <p>S M T W T F S</p> <p>1 2 3 4</p> <p>5 6 7 8 9 10 11</p> <p>12 13 14 15 16 17 18</p> <p>19 20 21 22 23 24 25</p> <p>26 27 28</p>	<p>MARCH 2017</p> <p>S M T W T F S</p> <p>1 2 3 4</p> <p>5 6 7 8 9 10 11</p> <p>12 13 14 15 16 17 18</p> <p>19 20 21 22 23 24 25</p> <p>26 27 28 29 30 31</p>	<p>APRIL 2017</p> <p>S M T W T F S</p> <p>1</p> <p>2 3 4 5 6 7 8</p> <p>9 10 11 12 13 14 15</p> <p>16 17 18 19 20 21 22</p> <p>23 24 25 26 27 28 29</p> <p>30</p>
<p>MAY 2017</p> <p>S M T W T F S</p> <p>1 2 3 4 5 6</p> <p>7 8 9 10 11 12 13</p> <p>14 15 16 17 18 19 20</p> <p>21 22 23 24 25 26 27</p> <p>28 29 30 31</p>	<p>JUNE 2017</p> <p>S M T W T F S</p> <p>1 2 3</p> <p>4 5 6 7 8 9 10</p> <p>11 12 13 14 15 16 17</p> <p>18 19 20 21 22 23 24</p> <p>25 26 27 28 29 30</p>	<p>JULY 2017</p> <p>S M T W T F S</p> <p>1</p> <p>2 3 4 5 6 7 8</p> <p>9 10 11 12 13 14 15</p> <p>16 17 18 19 20 21 22</p> <p>23 24 25 26 27 28 29</p> <p>30 31</p>
<p>AUGUST 2017</p> <p>S M T W T F S</p> <p>1 2 3 4 5</p> <p>6 7 8 9 10 11 12</p> <p>13 14 15 16 17 18 19</p> <p>20 21 22 23 24 25 26</p> <p>27 28 29 30 31</p>	<p>SEPTEMBER 2017</p> <p>S M T W T F S</p> <p>1 2</p> <p>3 4 5 6 7 8 9</p> <p>10 11 12 13 14 15 16</p> <p>17 18 19 20 21 22 23</p> <p>24 25 26 27 28 29 30</p>	<p>OCTOBER 2017</p> <p>S M T W T F S</p> <p>1 2 3 4 5 6 7</p> <p>8 9 10 11 12 13 14</p> <p>15 16 17 18 19 20 21</p> <p>22 23 24 25 26 27 28</p> <p>29 30 31</p>





I-70 Mtn. Express Lanes – Seasons



Season	Typical Opening	Typical Closing	
		Saturday	Sunday
Winter 11/26/16 to 4/23/17	9:00 a.m.	6:00 p.m.	7:00 - 8:00 p.m.
Summer 5/29/17 to 9/4/17	9:00 a.m.	6:00 p.m.	7:00 - 8:00 p.m.
Fall 9/10/17 to 10/22/17	On Demand		

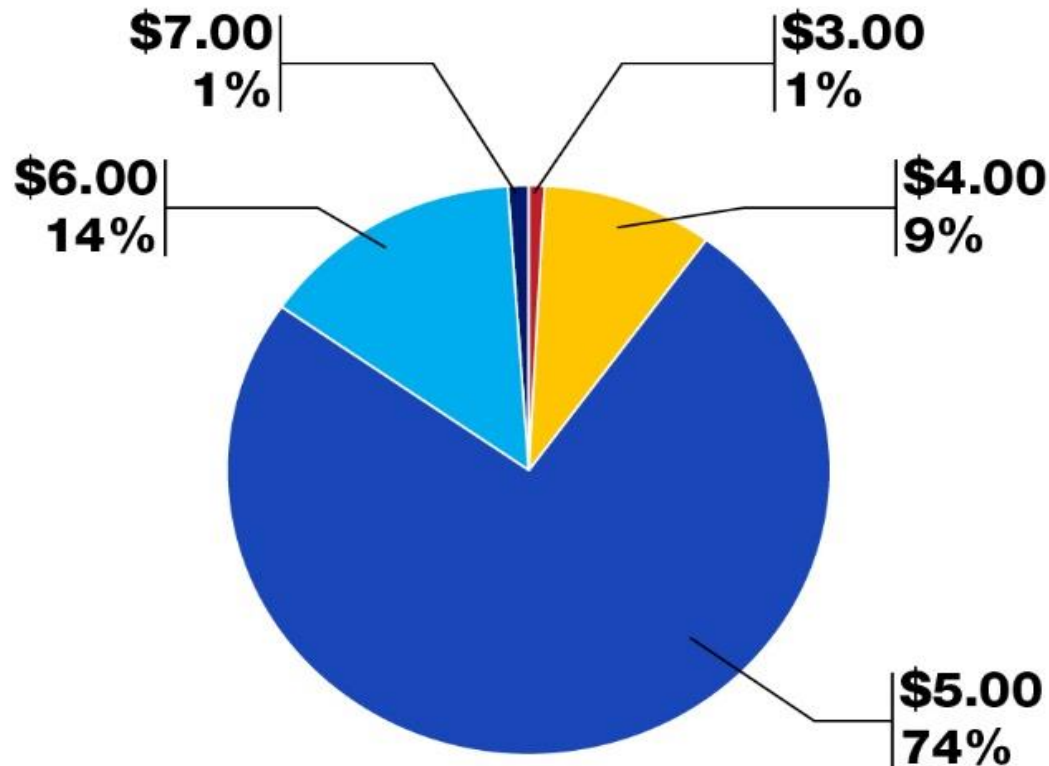




I-70 Mtn. Express Lanes – Toll Rates



Percent of Hours of Toll Rate at \$X

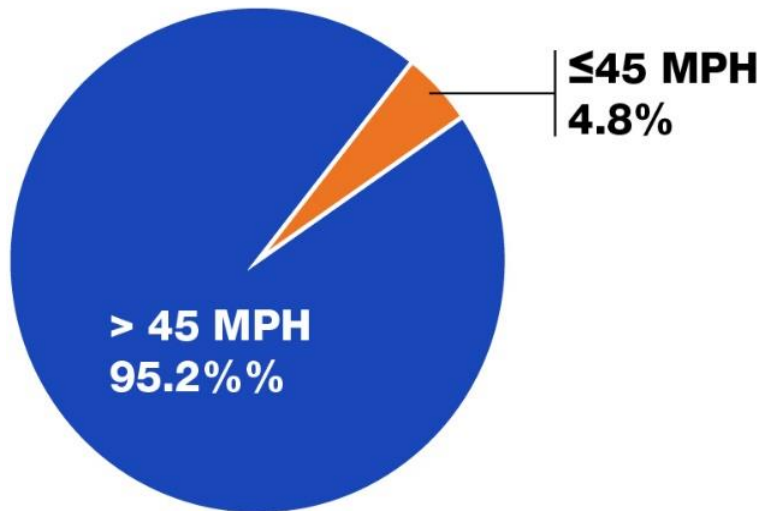




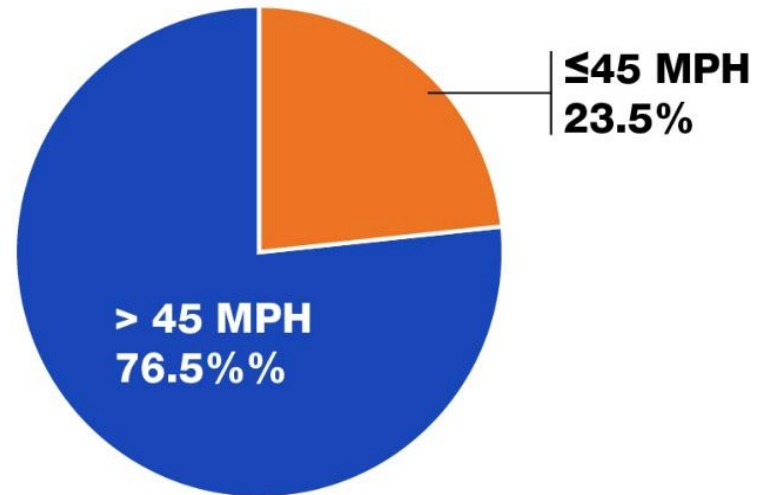
I-70 Mtn. Express Lanes – Speeds



Express Lane Average Speed



General Purpose Lane Average Speed

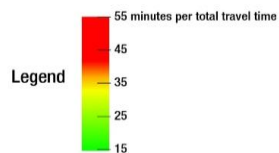




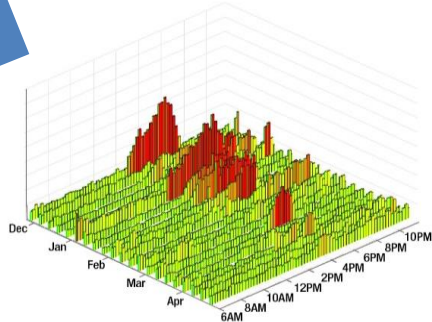
I-70 Mtn. Express Lanes – Travel Time Reliability



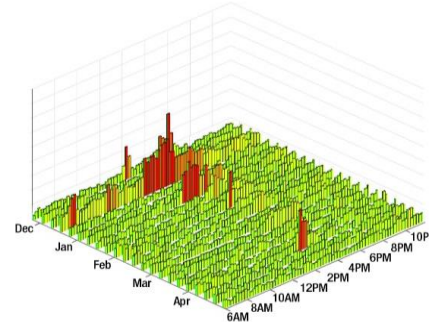
Winter Season Travel Summary



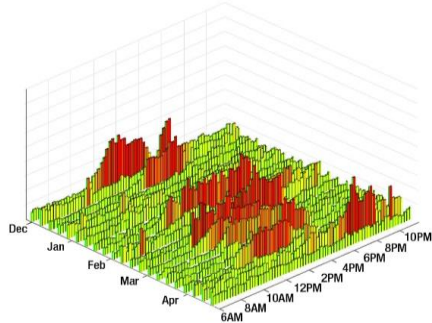
**2014 Saturday Travel Times
(Pre-Mountain Express Lane)**



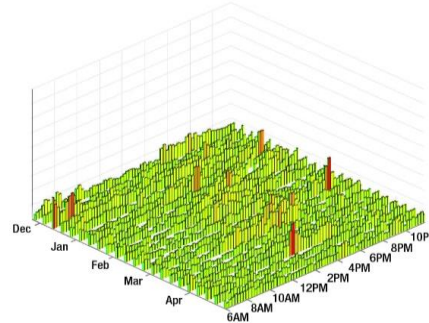
**2017 Saturday Travel Times
(Mountain Express Lane Operational)**



**2014 Sunday Travel Times
(Pre-Mountain Express Lane)**



**2017 Sunday Travel Times
(Mountain Express Lane Operational)**



Winter Season



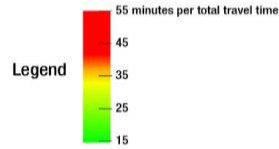


I-70 Mtn. Express Lanes – Travel Time Reliability

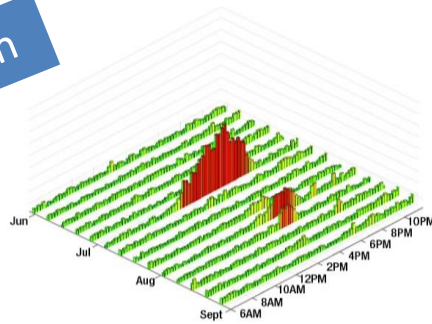


Summer Season

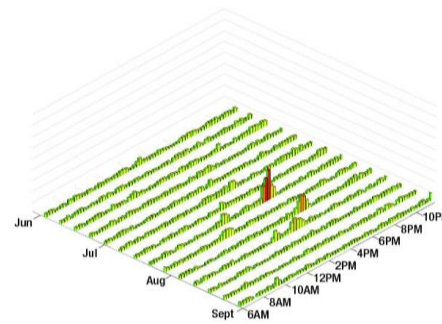
Summer Season Travel Summary



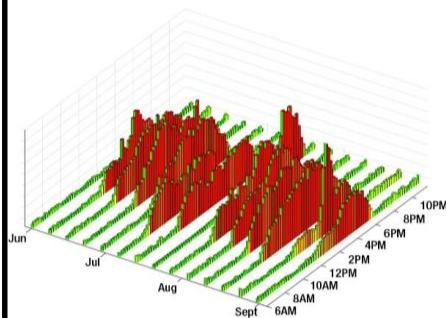
2014 Saturday Travel Times
(Pre-Mountain Express Lane)



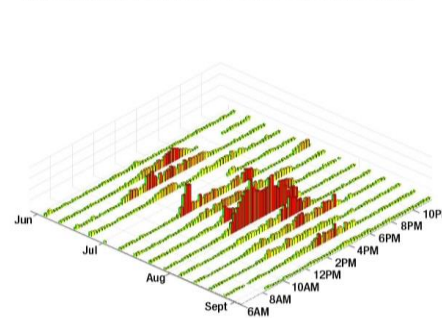
2017 Saturday Travel Times
(Mountain Express Lane Operational)



2014 Sunday Travel Times
(Pre-Mountain Express Lane)



2017 Sunday Travel Times
(Mountain Express Lane Operational)





I-70 Mtn. Express Lanes – Volumes

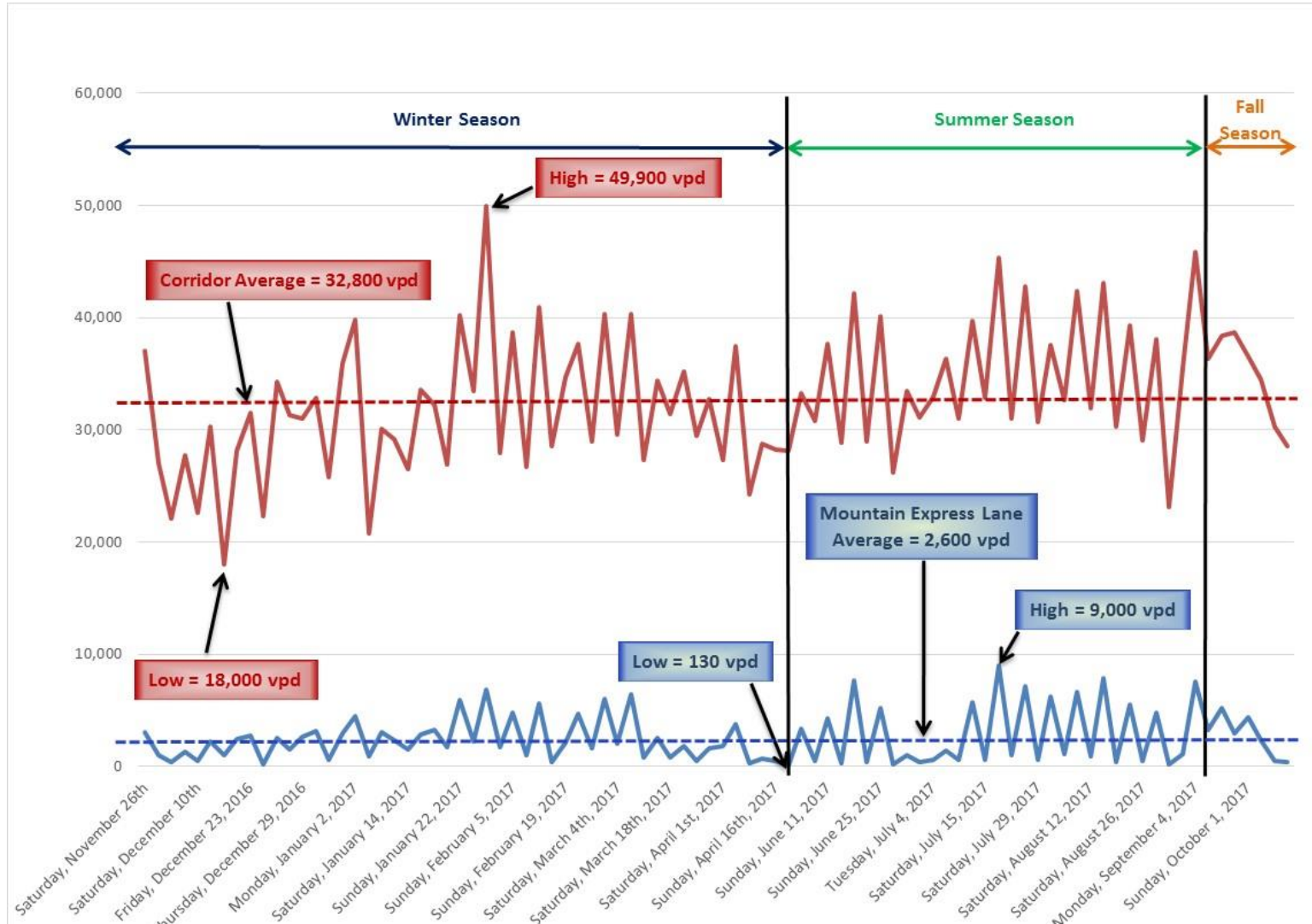


Season	Mountain Express Lane	I-70 Corridor (MP 230-241)	Mountain Express Lane Capture Rate Percent
Winter	115,200 2,300 ADT	1.56 million 31,200 ATD	7.4 percent
Summer	92,700 3,000 ADT	1.08 million 35,000 ATD	8.6 percent
Fall	19,100 2,700 ADT	243,200 34,700 ATD	7.9 percent
Total	227,100 2,600 ADT	2.89 million 32,800 ATD	7.9 percent





I-70 Mtn. Express Lanes – Volumes





I-70 Mtn. Express Lanes – Safety



Season	Location			Total	Average Clearance Time
	Express Lane	Express Lane/ GP Lane	GP Lane		
Winter 11/26/16-04/23/17	5	4	21	30	14 minutes
Summer 05/29/17-09/04/17	0	2	9	11	26 minutes
Fall 09/10/17- 10/22/17	2	0	1	3	31 minutes
Total	7	6	31	44	18 minutes





I-70 Mtn. Express Lanes



**Thank You
Questions?**

