



Memorandum

To: Tony Brindisi, P.E.
From: Josh Sender, P.E.
Date: June 13, 2019
Re: I-25 North Metro Managed Lanes RSA Report – 2019 Update

INTRODUCTION

The Road Safety Audit (RSA) report for the I-25 North Metro Managed Lanes was completed in December of 2017. This report included a crash data review for the I-25 mainline from milepost (MP) 217.04 (US 36 / I-270) to MP 222.18 (Community Center Dr) using crash data from January 1, 2012 through December 31, 2016. This memo intends to conduct a similar crash data review on the same project limits; however, this memo will also utilize crash data from January 1, 2017 through June 30, 2018.

This memo frequently references the following document:

- *I-25 North Metro Managed Lanes Road Safety Audit (RSA) Report, December 2017*

This memo contains the following sections and supporting attachments:

- Safety Enhancements
- Crash Data Review
- Next Steps

SAFETY ENHANCEMENTS

Since the completion and distribution of the RSA report, CDOT has continued to implement many of the safety enhancements mentioned in the report. These safety enhancements have included educational outreach efforts (Table 1), enhanced law enforcement visibility, and several roadway maintenance and engineering enhancements (Table 2).

Table 1 - Educational Outreach Efforts

- **Traditional Media**

Press release with resulting TV, radio, and print coverage

- **Variable Message Signs**

Safety messages on permanent and portable VMS, periodically changed

- **Social Media**

CDOT, State Patrol, Commuter Group, Corridor Government social media posts

- **CDOT Public Information Office and Partners**

Leverage partner social media, newsletters, websites, and billboard access to spread messages

- **E-470 / Express Toll**

Include information in billing statements and e-newsletters

Table 2 - Completed Safety Enhancements

Completed Safety Enhancement	Category
<ul style="list-style-type: none"> • "EXPRESS" word markings Reduce confusion approaching I-270 left exit 	Pavement Markings
<ul style="list-style-type: none"> • On-ramp striping improvements Merge traffic to one lane before entering mainline 	Pavement Markings
<ul style="list-style-type: none"> • "MOVE ACCIDENTS FROM TRAFFIC" signs Clear minor incidents from travel lanes quickly 	Signing
<ul style="list-style-type: none"> • Improve Express Lane dynamic sign messages Reduce confusion approaching I-270 left exit 	Signing
<ul style="list-style-type: none"> • Rumble Strips Improve compliance with managed lane entry point restrictions 	Roadway
<ul style="list-style-type: none"> • Evaluate and Implement Corridor Signing Improvements Improved signing for lane violation regulations, reduction of sign clutter, and improved guide signing 	Signing
<ul style="list-style-type: none"> • 88th Avenue Park-n-Ride Bus Operations Prevent unexpected bus maneuvers adjacent to freeway traffic. Communications with RTD appear to have resolved this issue. 	Operations / Incident Management
<ul style="list-style-type: none"> • Enhanced Law Enforcement Visibility Pilot program for rolling patrols during peak periods conducted Fall 2018. 	Enforcement
<ul style="list-style-type: none"> • Advanced Traffic Management Queue warning system implementation 	ITS

Furthermore, Table 3 shows the safety enhancements which are ongoing and currently underway.

Table 3 - Ongoing Safety Enhancements

Potential Safety Enhancement	Category	Schedule
<ul style="list-style-type: none"> • Traffic Incident Management Plan Multi-agency coordinated incident response and detour planning 	Operations / Incident Management	In progress: Estimated draft plan by end of August 2019
<ul style="list-style-type: none"> • Enhanced Law Enforcement Visibility Effort is continuing after aforementioned pilot program and is being funded by HPTE. Effort is continually evaluated for renewal every six months. 	Enforcement	In progress

Potential Safety Enhancement	Category	Schedule
<ul style="list-style-type: none"> • Advanced Traffic Management Investigate variable speed limits and speed harmonization 	ITS	Late 2020
<ul style="list-style-type: none"> • Managed Lane Ingress/Egress Zone Modifications Evaluate type, frequency, and delineation options (double dashed striping) of zones 	Signing and Pavement Markings	In progress
<ul style="list-style-type: none"> • Reconstruct Roadway to Full Template Provide standard shoulders, improve lane balance at I-270 / US 36 	Roadway	Post-2020
<ul style="list-style-type: none"> • Shoulder Widening (pull-out areas) Implement in select locations. Intended to be used by law enforcement 	Incident Management / Enforcement	July 2019
<ul style="list-style-type: none"> • Buffer Zone Delineation Enhancements Continue to explore various delineation strategies such as physical devices, seasonal applications, and selective location applications. 	Delineation	In progress

CRASH DATA REVIEW

The crash history for the period of January 1, 2012 through December 31, 2016 was examined in the RSA report. Within this study period, 2,739 crashes were reported along I-25 between MP 217.04 and MP 222.18. Of these, there were 525 injury collisions and 2 fatal collisions; 714 injured and 2 killed overall. Table 4 summarizes the crash totals for mainline I-25 over the five-year study period.

Table 4 - Crash Totals from January 1, 2012 to December 31, 2016

Year	Property Damage Only (PDO) Crashes	Injury (INJ) Crashes	Injuries	Fatal (FAT) Crashes	Fatalities	Total Crashes
2012	253	67	95	0	0	320
2013	334	60	70	0	0	394
2014*	505	123	172	0	0	628
2015*	514	123	175	1	1	638
2016	606	152	202	1	1	759
Total	2,212	525	714	2	2	2,739
Average/Yr	442.4	105.0	142.8	0.4	0.4	547.8

*Primary construction period

The RSA report also examined cumulative crash totals for 2016 to determine if the managed lane tolling operation affected crash frequency. Figure 1 displays the cumulative crash total plot with the tolling timeline from the RSA report.

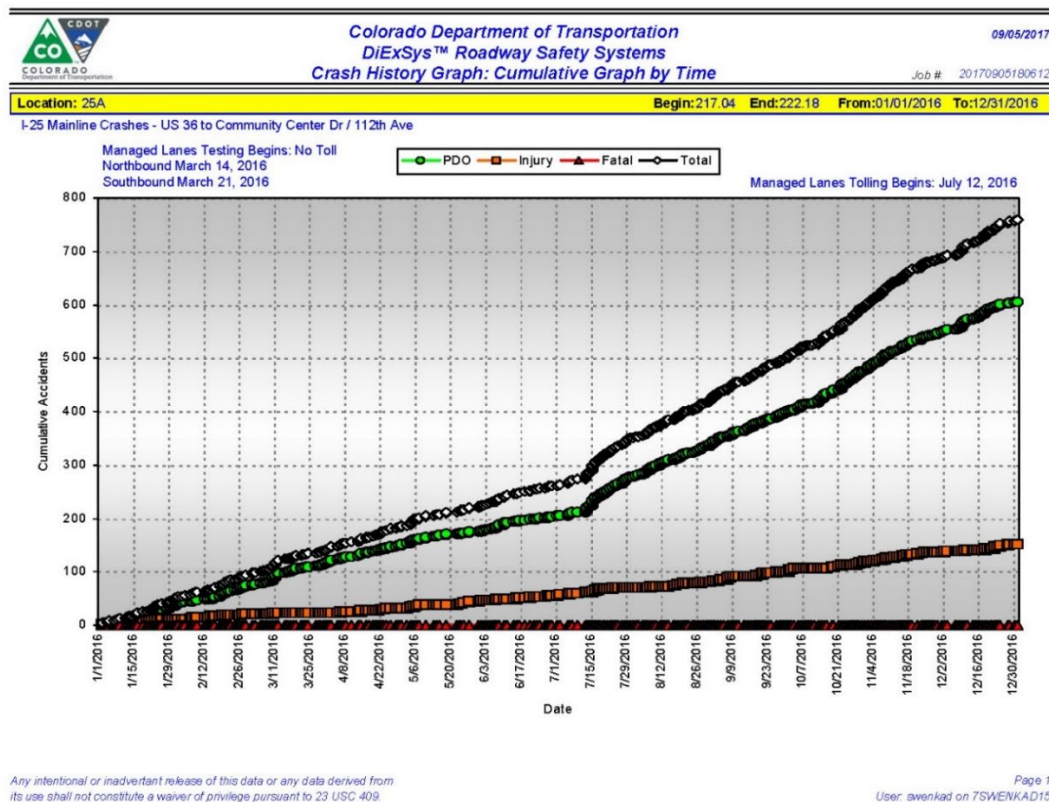


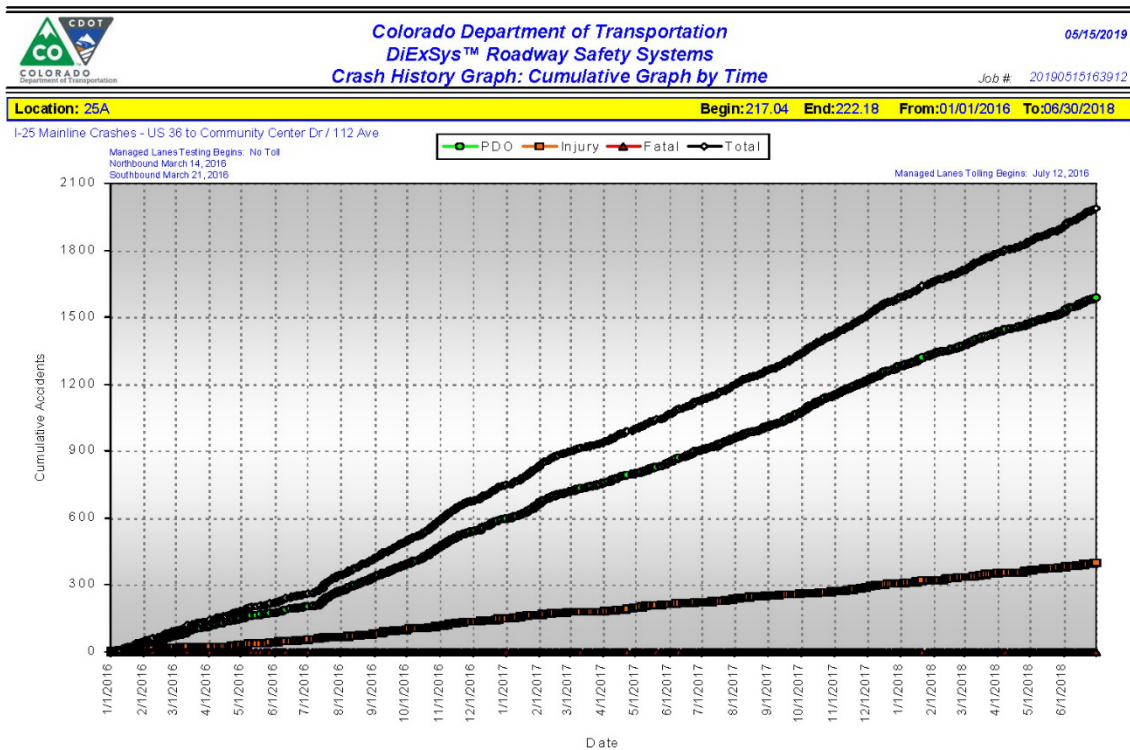
Figure 1 – January 1, 2016 to December 31, 2016 Crash Data with Tolling Timeline

Crash data from January 1, 2017 through June 30, 2018 is present in Table 5. During this time, 1,239 crashes were reported in the study area. Of these, there were 249 injury collisions with 330 injured overall and 0 fatal collisions.

Table 5 - Crash Totals from January 1, 2017 to June 30, 2018

Year	Property Damage Only (PDO) Crashes	Injury (INJ) Crashes	Injuries	Fatal (FAT) Crashes	Fatalities	Total Crashes
2017	686	157	207	0	0	843
Jan-Jun 2018	304	92	123	0	0	396
Total	990	249	330	0	0	1,239
Average/Yr	660.0	166.0	220.0	0.0	0.0	826.0

Figure 2 displays a similar cumulative crash total plot with the addition of the available 2017 and 2018 crash data.



Any intentional or inadvertent release of this data or any data derived from its use shall not constitute a waiver of privilege pursuant to 23 USC 409.

Figure 2 - January 1, 2016 to June 30, 2018 Crash Data with Tolling Timeline

A comparable five-year study period, July 1, 2013 through June 30, 2018, was examined using the additional crash data. During this time, 3,471 crashes were reported in the study area, seen in Table 6. Of these, there were 679 injury collisions with 920 injured overall and 0 fatal collisions.

Table 6 - Most Recent 5-Year Crash Totals (7/1/13 to 6/30/18)

Year	Property Damage Only (PDO) Crashes	Injury (INJ) Crashes	Injuries	Fatal (FAT) Crashes	Fatalities	Total Crashes
Jul-Dec 2013*	184	32	41	0	0	216
2014*	507	124	173	0	0	631
2015*	514	123	175	1	1	638
2016*	595	151	201	1	1	747
2017	686	157	207	0	0	843
Jan-Jun 2018	304	92	123	0	0	392
Total	2,790	679	920	2	2	3,471
Average/Yr	558.0	135.8	184.0	0.4	0.4	694.2

*Note: Crash totals for these time periods may not exactly match the crash totals seen in the RSA report. This is due to data cleaning and post processing occurring since the RSA report was published. Changes in crash totals are minor and do not affect overall conclusions.

Figure 3 shows the crash data broken down by severity comparing the RSA report five-year study period to the current five-year study period. The majority of the crashes along the corridor in each time frame are Property Damage Only (PDO) crashes.

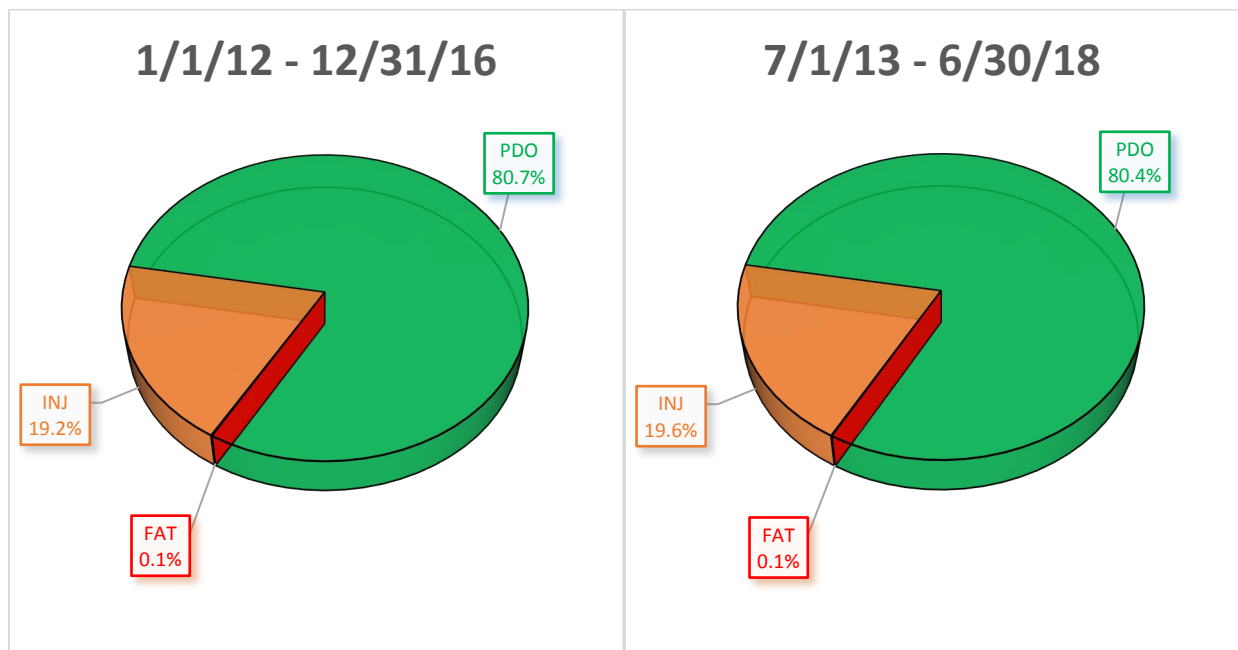


Figure 3 – Crash Distribution by Severity

Crash data was also analyzed by type with a similar five-year study period comparison seen in Figure 4. The majority of the crashes along the corridor in each time frame are rear-end crashes. Sideswipe same direction and concrete barrier crash percentages decreased slightly while rear-end crash percentages increased slightly when comparing the two time frames.

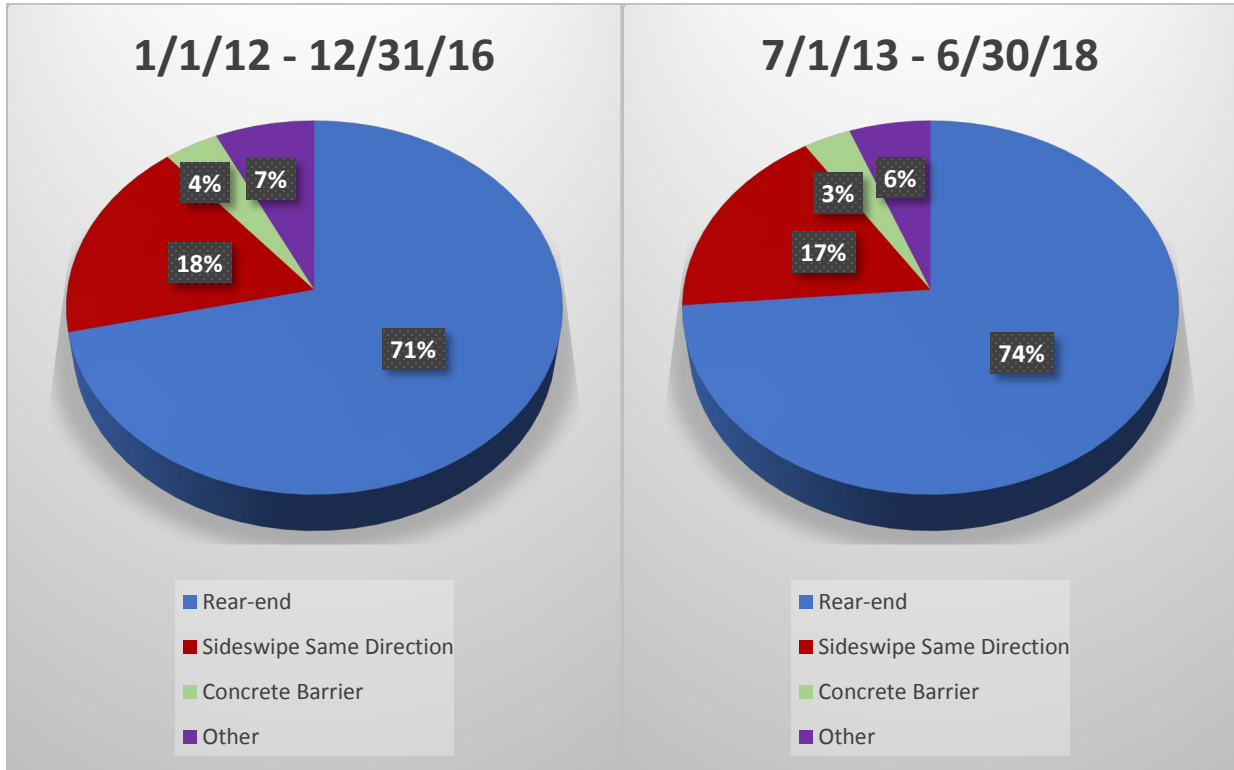


Figure 4 – Crash Distribution by Type

The RSA report also analyzed crash data by specific sections of the I-25 corridor as seen in Table 7.

Table 7 - I-25 Sections

Section	Begin Mile Post	Begin Reference	End Mile Post	End Reference	Length (miles)
1	217.036	I-270 and US-36 Junction	218.463	84 th Avenue	1.451
2	218.463	84 th Avenue	219.859	Thornton Parkway	1.318
3	219.859	Thornton Parkway	221.027	104 th Avenue	1.182
4	221.027	104 th Avenue	222.177	Community Center Drive	1.135

Figure 5 shows the distribution of the at fault vehicle (Vehicle 1) direction while comparing the two five-year study period. In both study periods, a greater proportion of crashes occur in the southbound direction in Sections 2, 3, and 4 while the reverse is true in Section 1. In comparing the most recent five-year period with the five-year period presented in the RSA Report, there is an increase in the proportion of southbound crashes in Section 1 and 2, Section 3 proportions remain relatively unchanged, and there is an increase in the proportion of northbound crashes in Section 4. In each case, however, the directional prevailing majority remains unchanged.

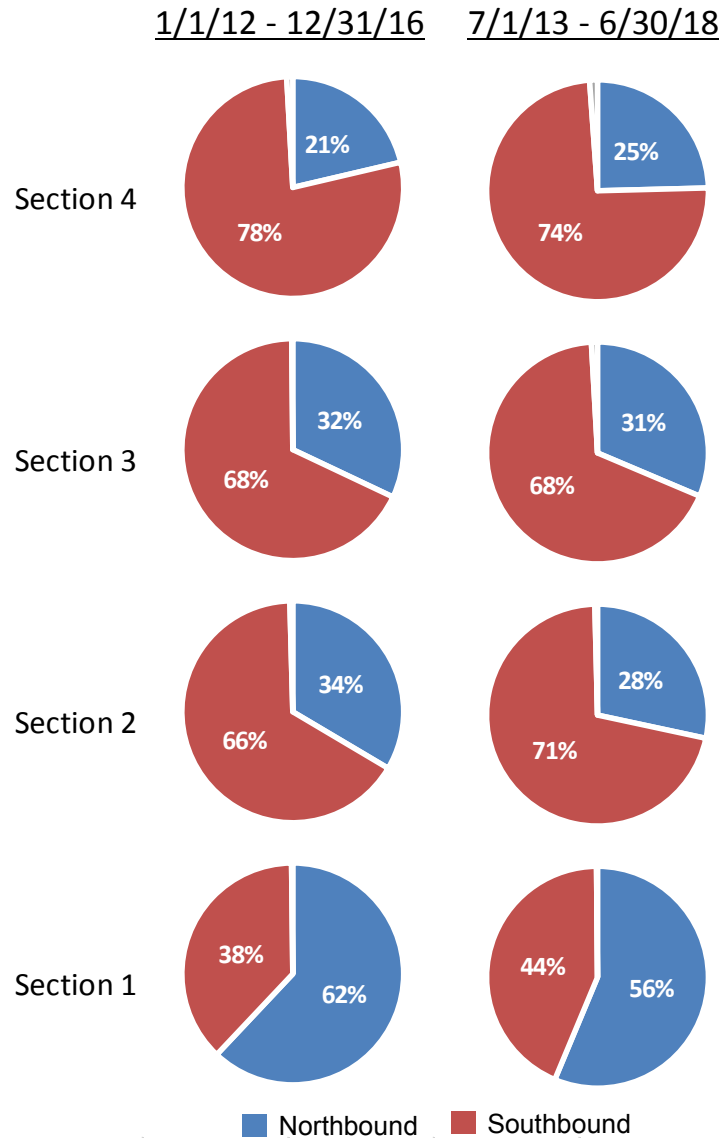


Figure 5 - Crash Distribution by Section and Direction

Figure 6 compares the crash totals in each section of I-25 using the two aforementioned five-year study periods. Consistent with the findings in the RSA report, Section 2 still appears to stand out as the largest contributor to total crashes in this corridor of I-25.

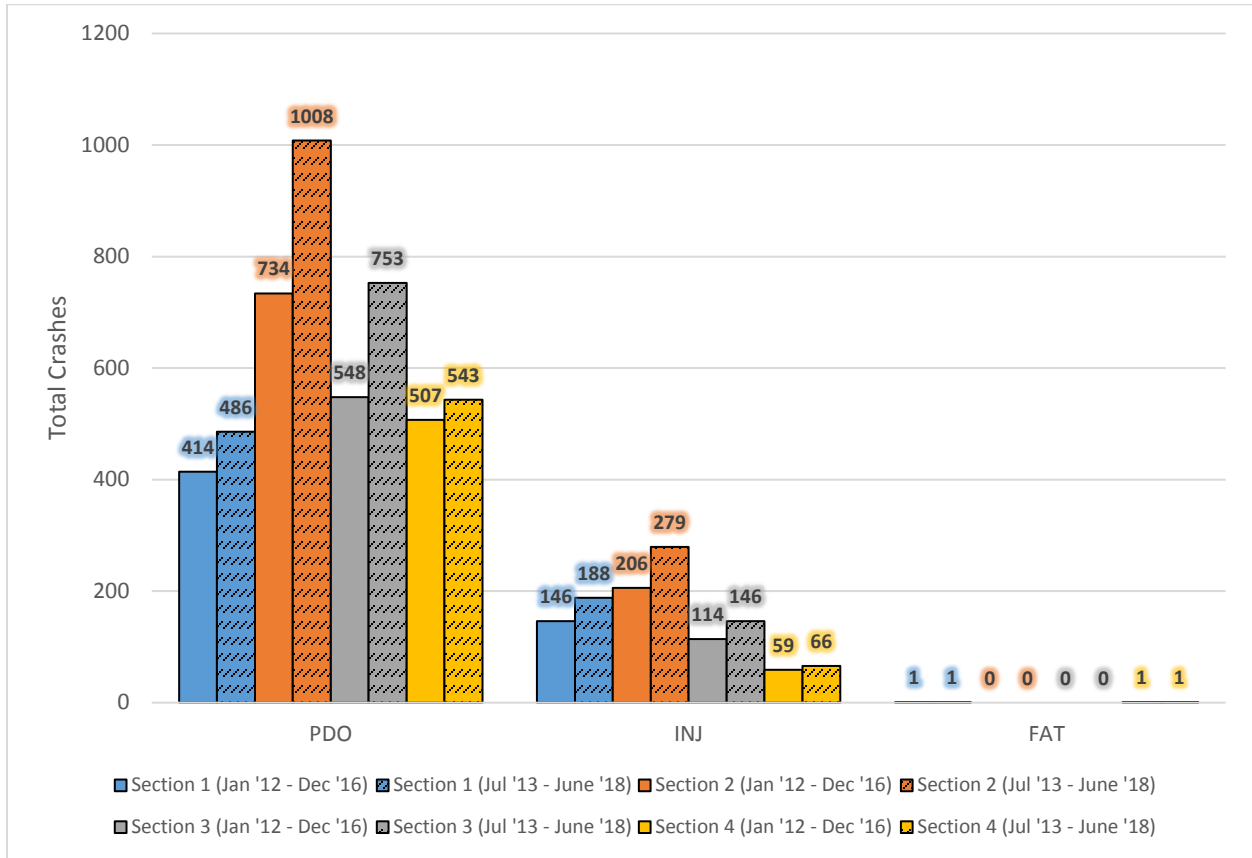


Figure 6 - Total Crashes by Section and Severity

The RSA report noted that there was a distinct increase in annual crash rate from 2012 to 2016. This observation was examined by plotting the cumulative number of each crash type for each year. As mentioned in the RSA report, the plot line for each year generally trends on a linear path, indicating a consistent trend in monthly crash totals within that year. However, the RSA report notes that March to April of 2015 and June to July of 2016 both indicate a sharp increase in slope. Figure 7 displays this plot along with additional lines reflecting the new July 1, 2017 through June 30, 2018 cumulative crash totals (new lines highlighted with a yellow glow).

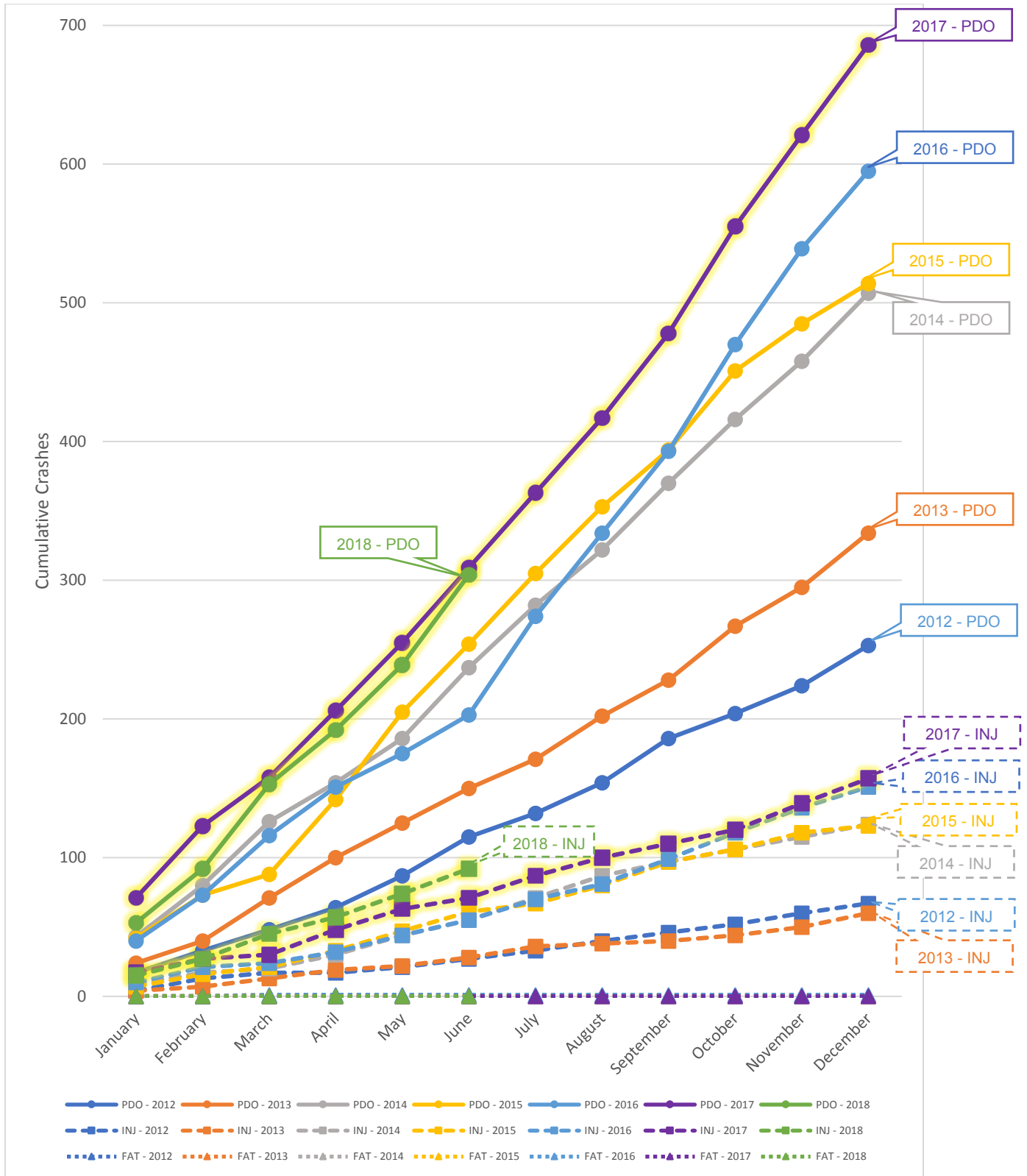


Figure 7 - Cumulative Crash Totals

A more detailed examination of the slope of each plot line displayed in Figure 7 is shown in Table 8. These slopes correspond to the trend in the cumulative monthly crash totals for each crash type during each year. These data indicate that the yearly total number of crashes seen on this corridor of I-25 is indeed rising. In 2017, the PDO slope for the full year increased by approximately 10% from the previous year. The 2017 INJ slope, however, slightly declined from the previous year. Meanwhile, the PDO and INJ slopes for the first half of the year 2018 both increased from the year 2017.

Table 8 - Cumulative Crash Total Plot Line Slopes

	2012	2013	2014	2015	2016	2017	Jan-Jun 2018
PDO Slope	21.8	27.9	42.2	46.1	50.8	55.7	49.6
INJ Slope	5.5	4.8	11.3	11.2	13.0	12.6	15.4
FAT Slope	0.0	0.0	0.0	0.1	0.1	0.0	0.0

The RSA report further investigated these trends by examining the total crash rate per million vehicle miles traveled (MVMT) for this I-25 corridor for each year. Figure 8 displays these crash rates and is appended with the most recent crash data, highlighted in yellow.

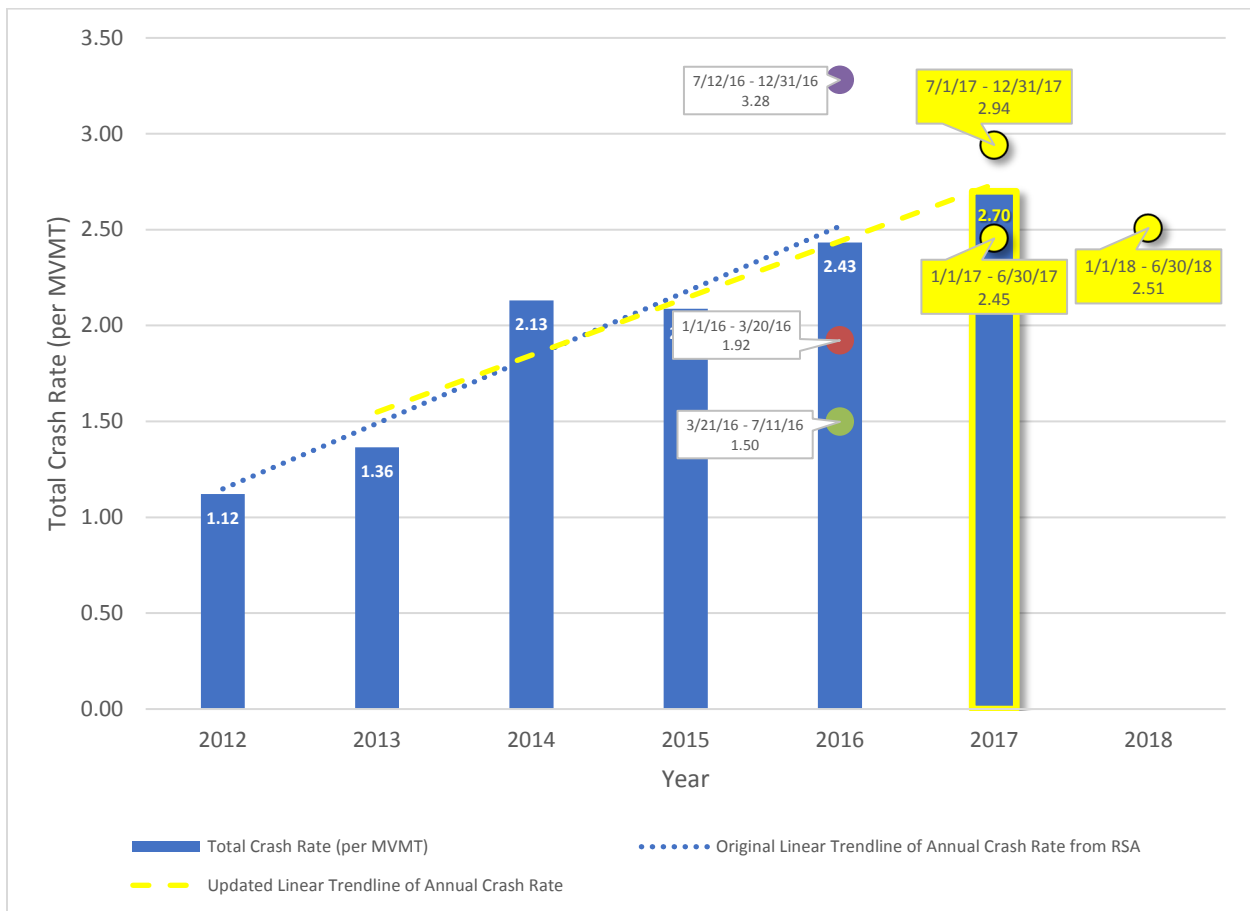


Figure 8 - Total Crash Rates by Year

The total crash rate for 2017 was 2.70 crashes per MVMT, an increase of approximately 11% from the previous year. The total crash rate for the first half of 2018 decreased approximately 7% from the year

2017. Figure 8 also displays two linear trendlines. The blue dotted linear trendline was the previous trendline drawn in the RSA report which used crash data from 2012 to 2016. The yellow dashed linear trendline represents the trend seen in total annual crash rate from 2013 to 2017. Notably, the trendlines both have a positive slope, however the slope of the yellow trendline is less than the slope of the blue trendline. In practical terms, this means that on this corridor of I-25, the total crash rate is continuing to rise from year to year, but the rate at which this crash rate grows has slowed.

Meanwhile, the average annual daily traffic (AADT) on this corridor of I-25 has continued to show a modest increase from 2012 to 2017. Crash frequency has continued to outpace volume as displayed in Figure 9 and Table 9.

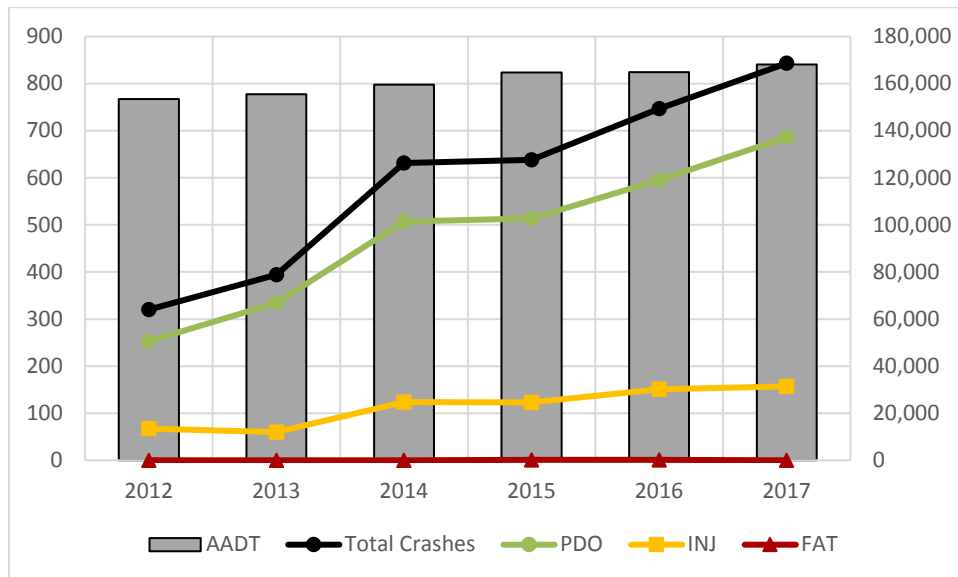


Figure 9 - Total Crash Distribution Compared to AADT

Table 9 - 2012 to 2016 and 2013 to 2017 Comparison

	2012 Data	2016 Data	Percent Increase from 2012 to 2016	2013 Data	2017 Data	Percent Increase from 2013 to 2017
Total Crashes	320	747	133.4%	394	843	114.0%
AADT	153,388	164,923	7.5%	155,489	168,182	8.2%

NEXT STEPS

The safety enhancements on this corridor of I-25 which are either completed, in progress, or planned may affect the trend in crash totals. The level of effectiveness of these safety enhancements will be seen by continuing to monitor and summarize the crash data on a regular basis.