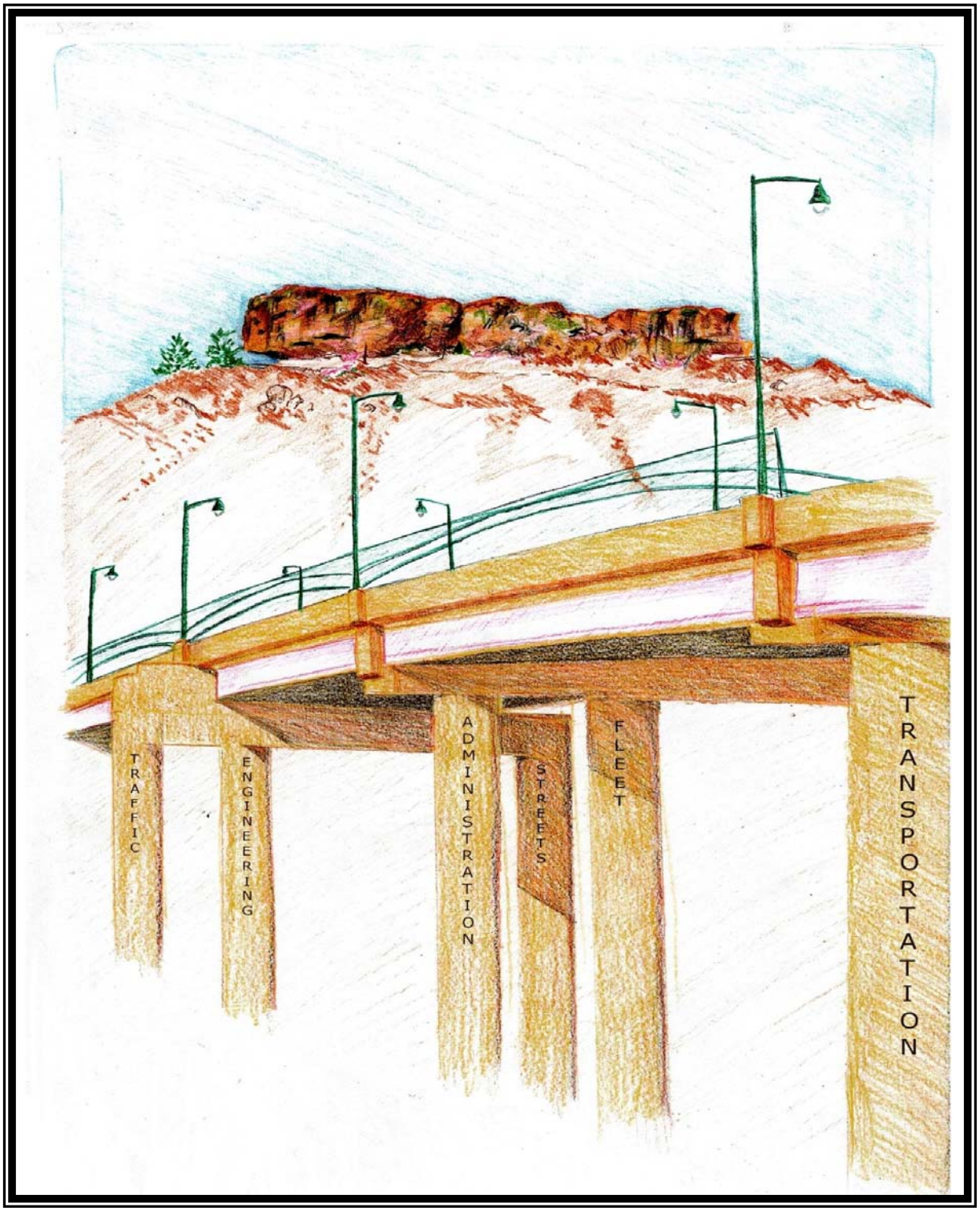
ATTACHMENT A

2015 TOWN OF CASTLE ROCK
MOTOR VEHICLE CRASH FACTS



PREPARED BY THE PUBLIC WORKS DEPARTMENT

ACKNOWLEDGEMENTS

This report was assembled from data provided by the Castle Rock Police Department crash report data from the year 2015. Each crash record, whether completed by a local police officer or a member of the Colorado State Patrol, was sent to Castle Rock and entered into a centralized database maintained by the Public Works Department.

The report itself was created by personnel in the Public Works Department.

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TOWN OF
CASTLE ROCK
COLORADO

Public Works Department

"Our mission is to provide outstanding service, safety and support for transportation infrastructure and maintenance."

June 30, 2016

It is our pleasure to provide you with the 12th Annual Castle Rock Motor Vehicle Crash Facts Report. The statistics provided will enable emergency services and design engineers alike gain a greater insight into the factors contributing to traffic crashes. This will then help both the Town and the Colorado Department of Transportation identify improvements that may help reduce crashes in a high-hazard areas or intersections.

We will continue to dedicate our time and efforts toward the improvement of safety on our street system.

Sincerely,

Robert Goebel, PE
Public Works Director

Ryan Germeroth, PE
Transportation Planning and Traffic Engineering Manager

EXECUTIVE SUMMARY

The mission of the Public Works Department is “To provide outstanding service, safety and support for transportation infrastructure and maintenance”. We believe that by analyzing our crash data on a regular basis we can help identify locations where the roadway environment may be a contributing factor to crashes. This information helps us to develop options for improvements and to schedule projects for correction. Since 2004, when Public Works first reported crash statistics, the numbers of fatalities, and persons injured have generally been declining. The Town’s focus on encouraging intersection treatments such as the use of roundabouts, which have demonstrated an ability to reduce personal injury type such as high speed “T-bone” crashes, are just one example of improvements that have assisted in this area. We also saw an increase in the number of crashes when compared to 2014 but this is not unexpected as traffic volumes in the Town have increased as well.

Crashes are the result of many factors. These factors can generally be classified into three main categories: 1) human factors, 2) vehicle factors, and 3) roadway environment. By far, the largest percentage of crashes can be attributed to human factors. These are the factors that drivers can control and are usually the simplest to correct. Basic driver awareness and respect for all users of the Town’s roadways will go the farthest towards reducing the number of crashes. Education, Enforcement and Engineering, the three “E’s”, all play an important role in improving safety. However it will take conscious decisions by drivers to change their behavior in order to make our roadway system safer.

Addressing vehicle factors is the responsibility of everyone who owns and operates a motor vehicle. Regular vehicle inspections along with preventative maintenance procedures will help reduce the chances of a crash occurring as a result of a vehicle malfunction.

The roadway environment is something that is out of the driver’s control, but it is within the control of the Town, and the Colorado Department of Transportation (CDOT) in the case of the State system. We work to identify locations where roadways themselves could be a contributing factor in a crash and implement treatments to correct these. Public Works uses statistical modeling to identify the locations where corrections to the roadway environment may improve safety. This helps direct limited resources to the locations where the most benefit can be obtained and avoids directing these resources toward locations where problems may not exist.

The information and crash trends that become evident during the preparation of the annual crash report help staff identify needed intersection improvements. For example, in order to help reduce the number of crashes involving left turning vehicles, the left turn signal operations have been changed in the past at locations with a higher than expected total of crashes. Similar changes have been made recently with the installations of flashing yellow arrows at Founders at Front and Blackfeather at Front.

The 2015 data does show a few locations with higher numbers of crashes than could be expected to occur at intersections having similar characteristics. Several projects have been identified that have either already been completed or will be completed that are expected to help to reduce the number of collisions at the highest crash locations. All of the information gathered by staff will be forwarded along to CDOT for their use at intersections along the State Highway system in Castle Rock.

SECTION 1: 2015 Raw Data Summaries

This section summarizes the raw crash data for 2015 by various categories. The totals include all forms of transportation and include pedestrian, bicycle and motorcycle crashes. The purpose of this is for general public interest as well as for use by other staff departments that may use this information to assist with improving their operations.

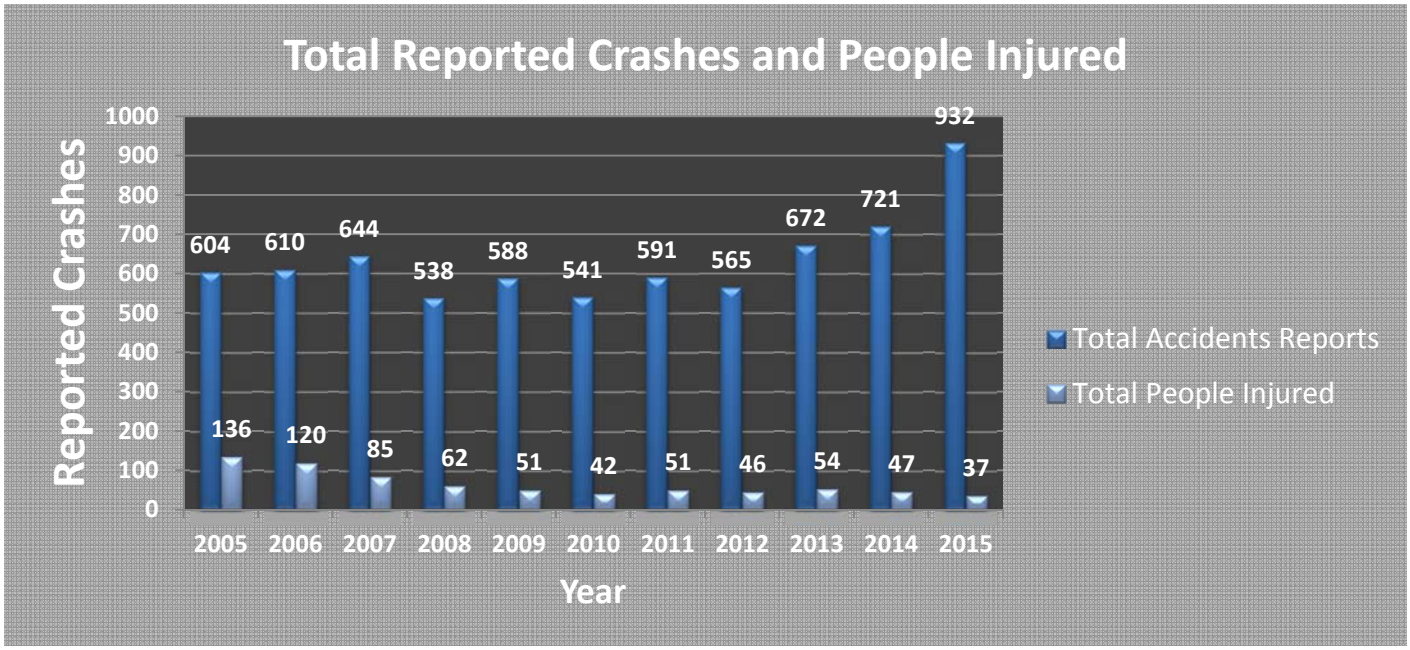
Quick Facts

	2015	2014	2013	2012
Total Reported Crashes	932	721	672	565
Fatalities	0	1	1	0
Total Persons Injured	37	47	54	46
Total Injury Incident Crashes	30	38	47	45

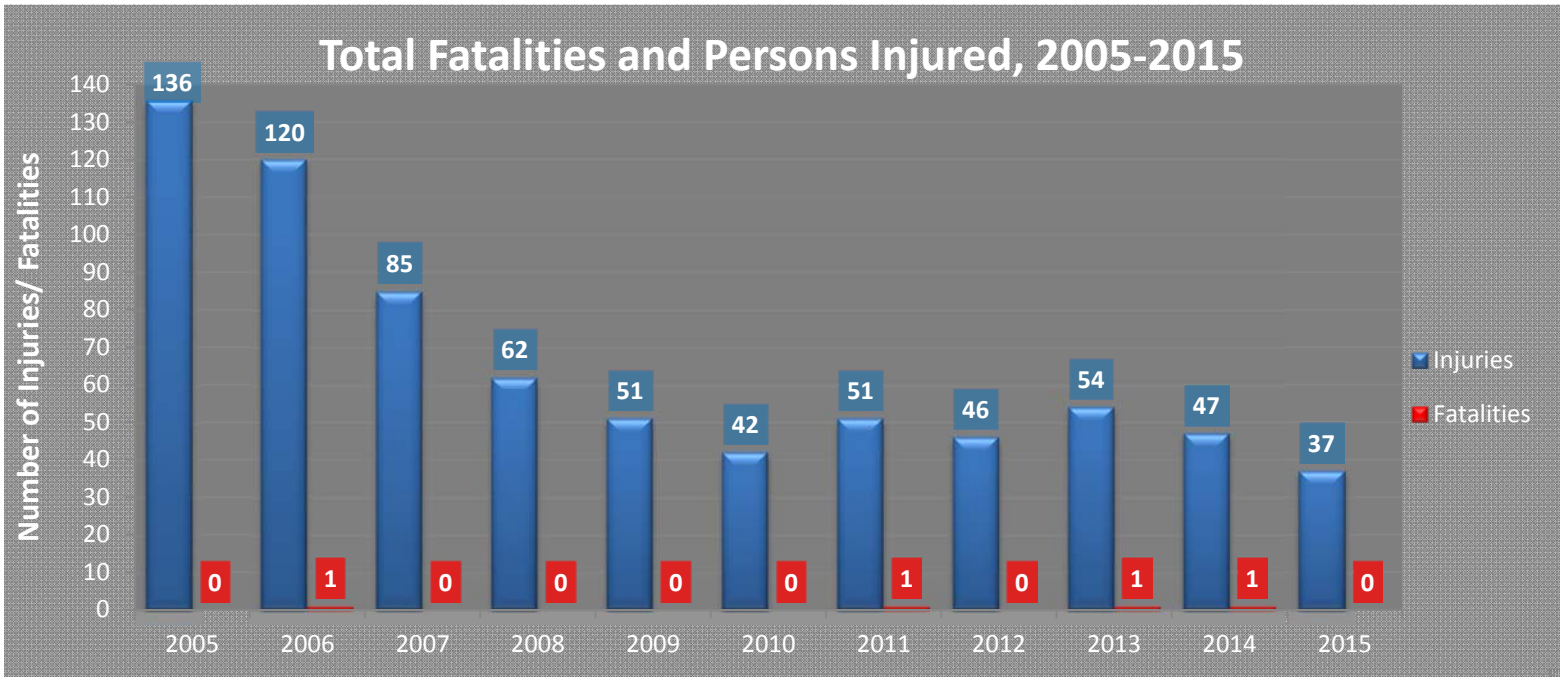
- On average, 1.1 traffic crash crashes were reported every 12 hours.
- Of all the crashes, the most frequent crash types were rear end collisions at 39% of the total, 13% were collisions with fixed objects and 13% were sideswipe collisions.

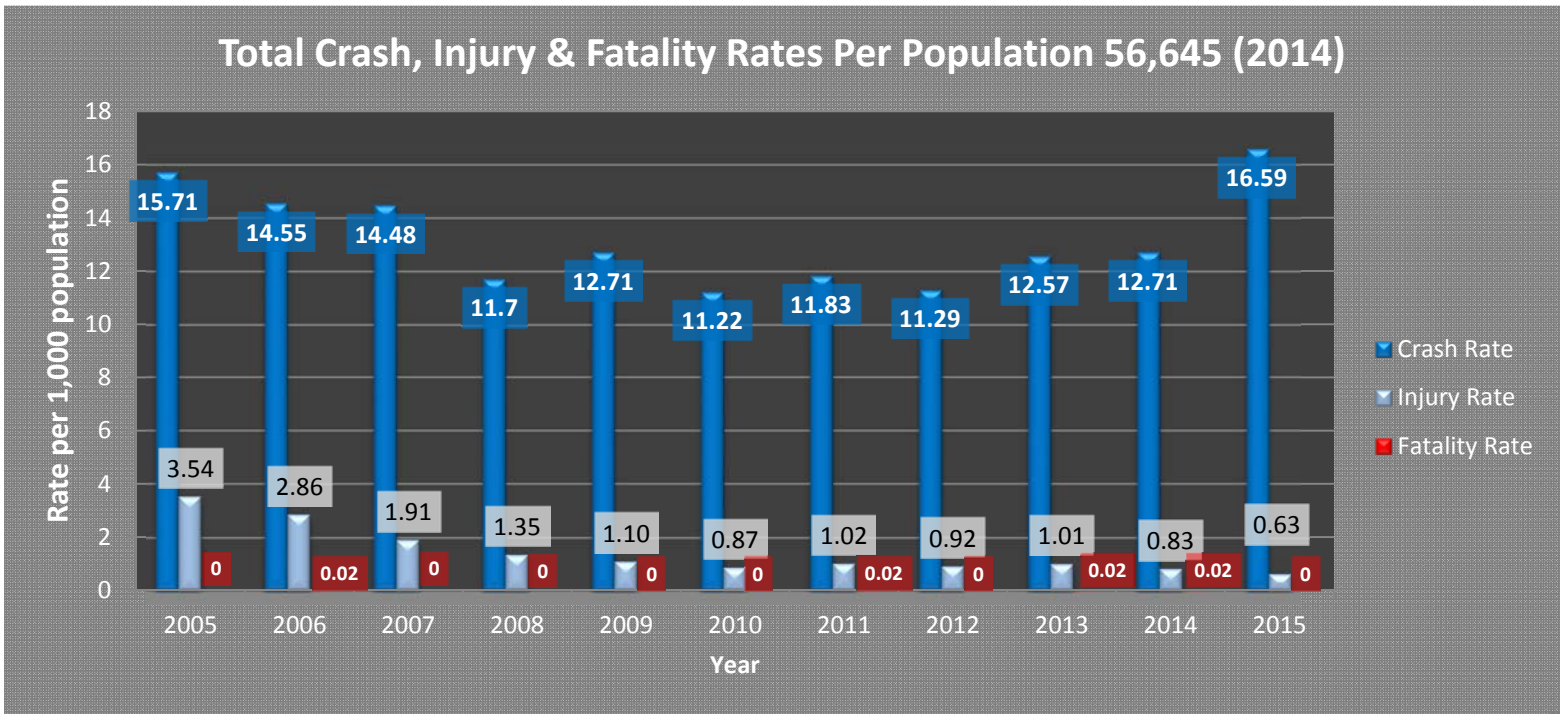
ANNUAL TRENDS

Over the past ten years the Town has averaged 701 reported crashes per year. In 2015 the number of crashes was 30% higher than in 2014. This is a much larger increase than what would be expected based on historical trends. The three crash types that account for this increase are rear end, angle and sideswipe collisions. These types of crashes are generally related to traffic congestion but it is likely that a fair portion of these additional crashes are associated with the work zone for the roadway reconstruction project that took place on Founders Parkway in 2015. The following charts provide a summary of the annual trends in recent years.

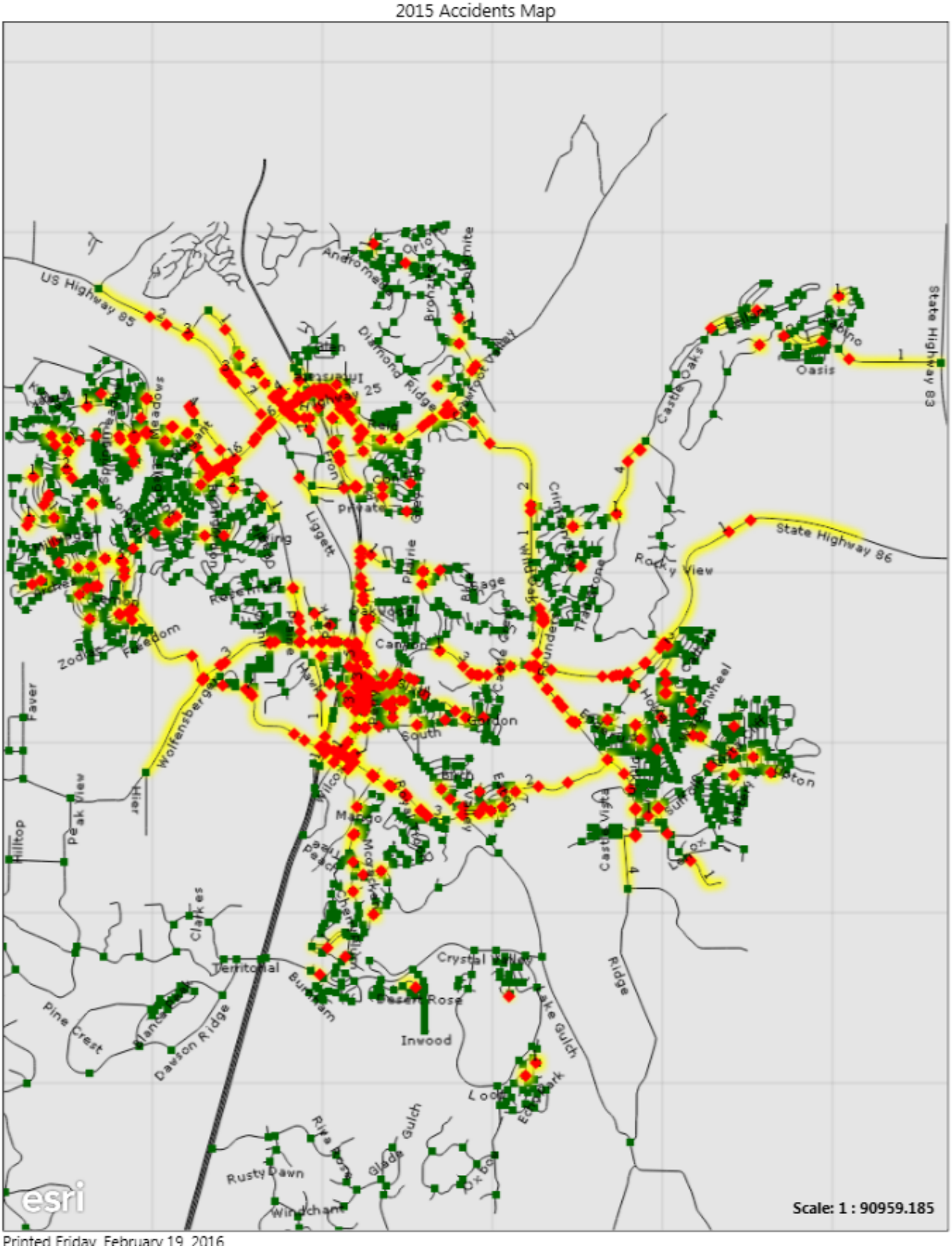


The number of people injured in 2015 crashes decreased by 21% from 2014's total of people injured. (*the method of reporting injured persons changed statewide in July 2007). In 2015 there were 25 crashes where one person was injured, 4 crashes where 2 people were injured and 1 crash where four people were injured. For the year 2015 no Fatalities were recorded.





2015 Accidents Map



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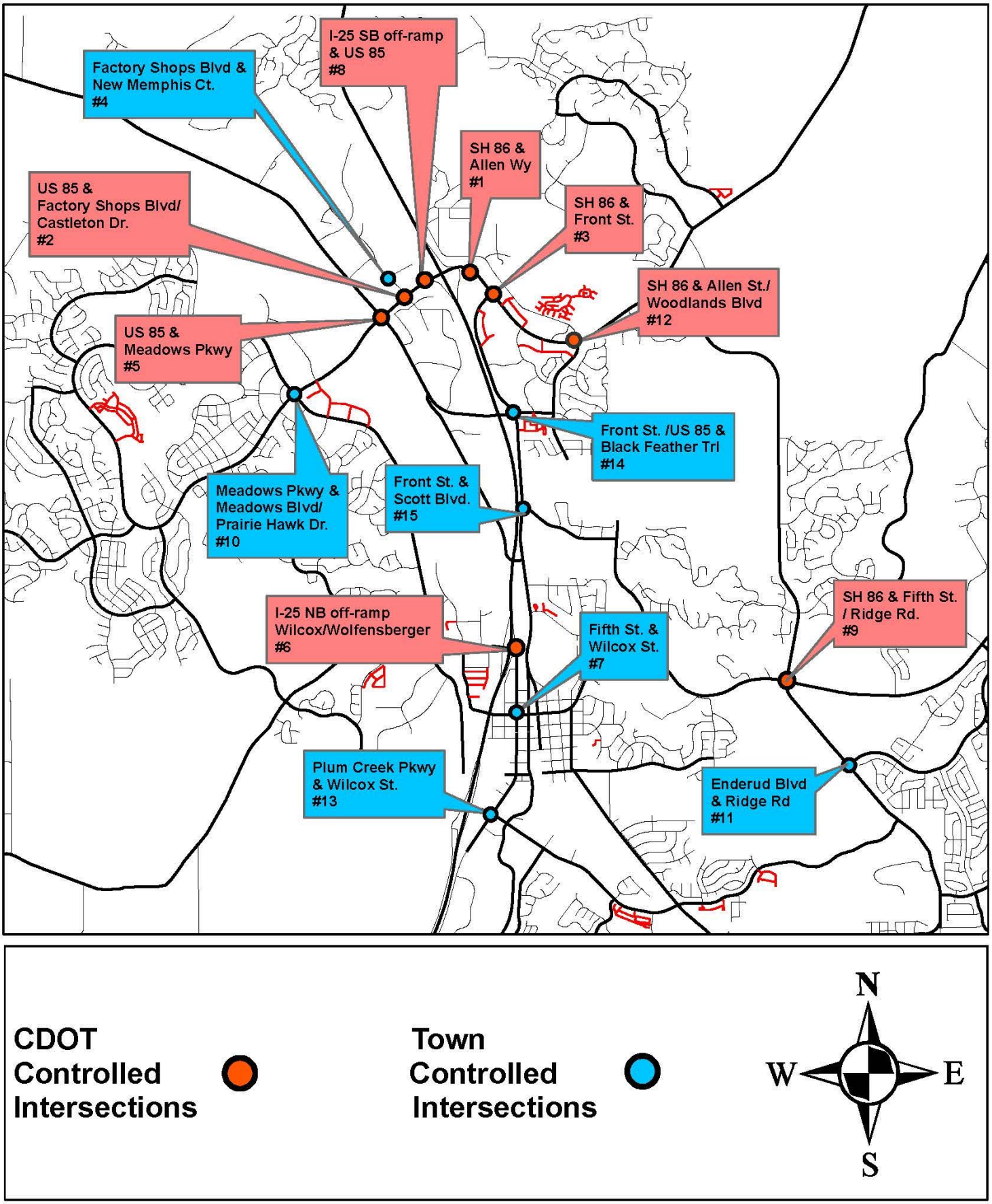
This map shows the crash locations throughout the town, crashes are identified by the red dots intersections are identified by green dots. Many of these locations had several crashes reported. The arterial and collector streets have the highest incident of crashes, which is expected considering that they also have the highest traffic volumes.

HIGHEST CRASH RATES BY LOCATION

Intersections	Number of Crashes (2012-2015)	Average Volume through Intersection	Crash Rate (MEV)	Rank (2015)/(2014)
SH 86 @ Allen Way	148	49,780	2.04	1/1
US 85 @ Factory Shops / Castleton Dr.	145	62,177	1.60	2/2
SH 86 @ Front St.	84	43,377	1.33	3/3
Factory Shops Blvd @ New Memphis	31	16,020	1.33	4/6
US 85 @ Meadows Pkwy	84	44,520	1.29	5/5
NB I-25 @ Wilcox St.	42	23,400	1.23	6/4
Fifth @ Wilcox St.	31	22,365	0.95	7/13
SB I-25 @ US 85	87	65,005	0.92	8/8
SH 86 @ Fifth / Ridge	42	31,919	0.90	9/12
Meadows Pkwy @ Meadows Blvd/ Prairie Hawk Dr.	49	38,298	0.88	10/10
Enderud Blvd. @ Ridge Road	20	17,150	0.80	11/-
SH 86 @ Allen St./ Woodlands Blvd.	32	27,785	0.79	12/7
Plum Creek Pkwy @ Wilcox St.	40	36,175	0.76	13/-
Front St. @ Black Feather / Hwy 85	28	26,099	0.73	14/11
Front St. @ Scott Blvd	23	22,195	0.71	15/15

15 Highest Accident Rate Locations



SECTION 2: Public Works Statistical Analysis

This section of the report summarizes the statistical review of the 2015 raw data. The purpose of this is to provide an initial "screen" to identify the signalized intersections that are producing crash numbers that exceed the number that may be expected to occur when compared to similar intersections sharing similar characteristics in Colorado. The reason signalized intersections are the primary focus is related to the ability to produce an accurate statistical model. As more data becomes available, the Town will work toward establishing models for all intersection types: roundabouts, four-way stops, two-way stops, and non-intersection segments. Since crashes are "expected" to occur, it's important to determine which locations are experiencing crashes at a higher rate than should be expected.

ROAD & INTERSECTION SAFETY

One important goal from this crash data is to identify locations where the road environment may be a contributing factor to crashes. This is possible through statistical analysis. The goal in this regard is to identify locations where roadways or traffic control devices could be a contributing factor and implement treatments to correct these.

The definition of the safety of a road section or intersection used by the Transportation Planning and Traffic Engineering Division is the number of crashes expected to occur at these locations during a specified period as compared to what actually has occurred. Because there are factors that are not related to the physical roadway environment that contribute to crashes, road sections and intersections are expected to have crashes occur. Since what is 'expected' cannot be known, safety can only be estimated, and estimation is in degrees of precision. The precision of an estimate is usually expressed by its standard deviation.

For practical reasons Traffic Engineering is interested in the safety of a road section or intersection that seems to have too many crashes. If the estimation of safety is based only on crash counts or crash rates, the estimate would be biased. The existence of this 'regression-to-mean' bias has been long recognized given that crash rates at a given location tend to fluctuate from one year to the next due to multiple variables. If not accounted for, regression-to-mean bias is known to produce inflated estimates of countermeasure effectiveness so it is important to review several years' worth of data to account for statistical anomalies.

In light of this, the magnitude of safety problems at intersections can be assessed through the use of Safety Performance Functions (SPF). The SPF reflects the complex relationship between exposure (measured in daily traffic) and the crash count for an intersection measured in crashes per year. The SPF models provide an estimate of the normal or expected crash frequency and severity for a range of ADT among similar facilities. The Colorado Department of Transportation (CDOT) has calibrated several different Safety Performance Functions based on actual crash data collected at intersections throughout the State.

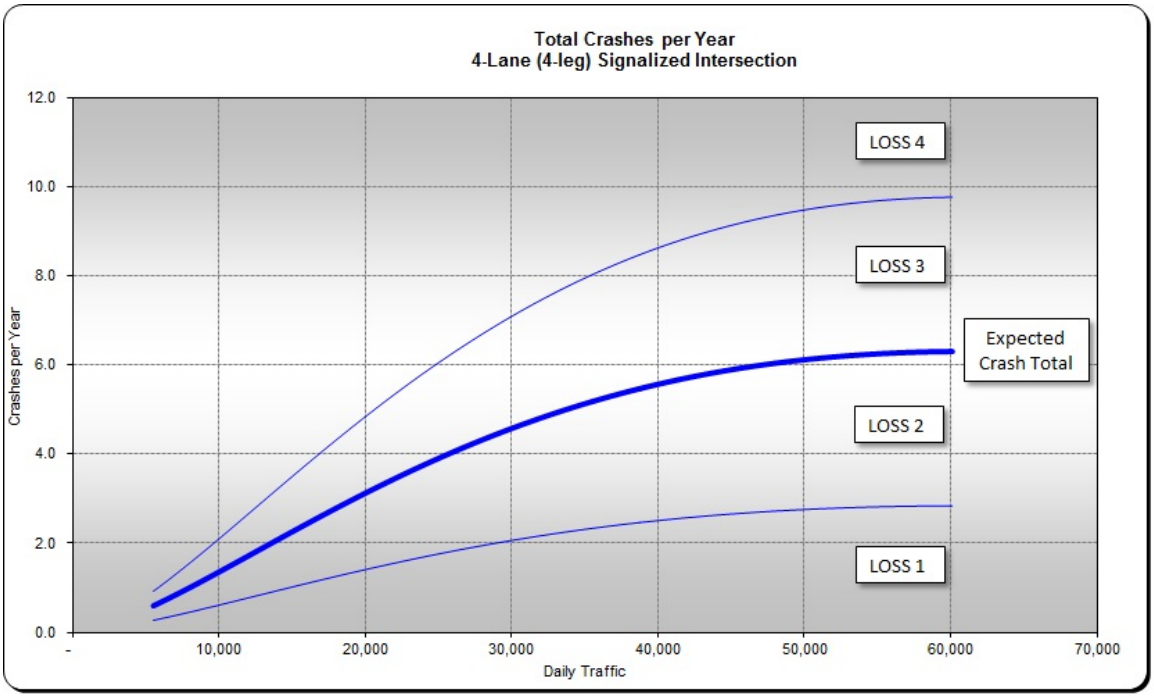
All of the dataset preparation was performed using the Town's crash databases. Crash history for each intersection was prepared using the most recent three years of available crash data. Average Daily Traffic (ADT) for each intersection approach (major street and minor street) over the three years was entered into the same dataset.

Development of the SPF lends itself well to the conceptual formulation of the Levels of Service of Safety (LOSS). The concept of level of service uses quantitative measures that characterize safety of an intersection in reference to its expected performance. If the level of safety predicted

by the SPF will represent a normal or expected number of crashes at a specific level of ADT, then the degree of deviation from the norm can be stratified to represent specific levels of safety.

LOSS-I – Indicates low potential for crash reduction
LOSS-II – Indicates better than expected safety performance
LOSS-III – Indicates less than expected safety performance
LOSS-IV – Indicates high potential for crash reduction

Gradual change in the degree of deviation of the LOSS boundary line from the fitted model mean reflects the observed increase of variability in crashes as ADT increases. LOSS reflects how the intersection is performing in regard to its expected crash frequency at a specific level of ADT (major street and minor street). It only provides a crash frequency comparison with the expected norm. It does not, however, provide any information related to the nature of the safety problem itself. If a safety problem is present, LOSS will only describe its magnitude from the frequency standpoint. The nature of the problem is determined through diagnostic analysis using direct diagnostics and pattern recognition techniques and will be discussed later in this report. The following provides an example of a SPF for a 4-lane signalized intersection as well as the corresponding LOSS categories.



INTERSECTIONS WITH THE HIGHEST CRASH RATES

The following tables summarize the 2015 highest crash rate locations. This table provides the actual crash total, the statistically expected crash total as well as the Level of Service of Safety and corresponding safety performance.

Intersections	Expected Crash History (Crashes / Year)	Observed Crash History (Crashes / Year)	Level of Service of Safety	Safety Performance
SH 86 @ Allen Way	18.4	37.0	4	High potential for reduction
US 85 @ Factory Shops / Castleton Dr.	24.4	36.3	4	High potential for reduction
SH 86 @ Front St.	14.9	21.0	4	High potential for reduction
US 85 @ Meadows Pkwy	17.3	21.0	4	High potential for reduction
NB I-25 @ Wilcox St.	5.3	10.5	4	High potential for reduction
Factory Shops Blvd @ New Memphis	3.1	7.8	4	High potential for reduction
SH 86 @ Allen St./ Woodlands Blvd.	7.5	8.0	3	Worse than expected
Fifth @ Wilcox St.	5.1	7.8	3	Worse than expected
Front St. @ Scott Blvd	5.4	5.8	3	Worse than expected
SH 86 @ Fifth / Ridge	10.3	10.5	2	Average performance
Front St. @ Black Feather / Hwy 85	7.9	7.0	2	Average performance
SB I-25 @ US 85	26.4	21.8	2	Better than expected
Meadows Pkwy @ Meadows Blvd/ Prairie Hawk Dr.	14.2	12.3	2	Better than expected
Plum Creek Pkwy @ Wilcox St.	13.0	10.0	2	Better than expected
Enderud Blvd @ Ridge Rd	N/A	5.0	N/A	Better than expected

As can be seen in this table there are a total of nine intersections that have an observed crash total that is higher than what would be expected at other similar intersections in Colorado. The next section provides a summary of the crash types to focus on potential areas for improvement to the roadway environment.

PLANNED MITIGATION MEASURES

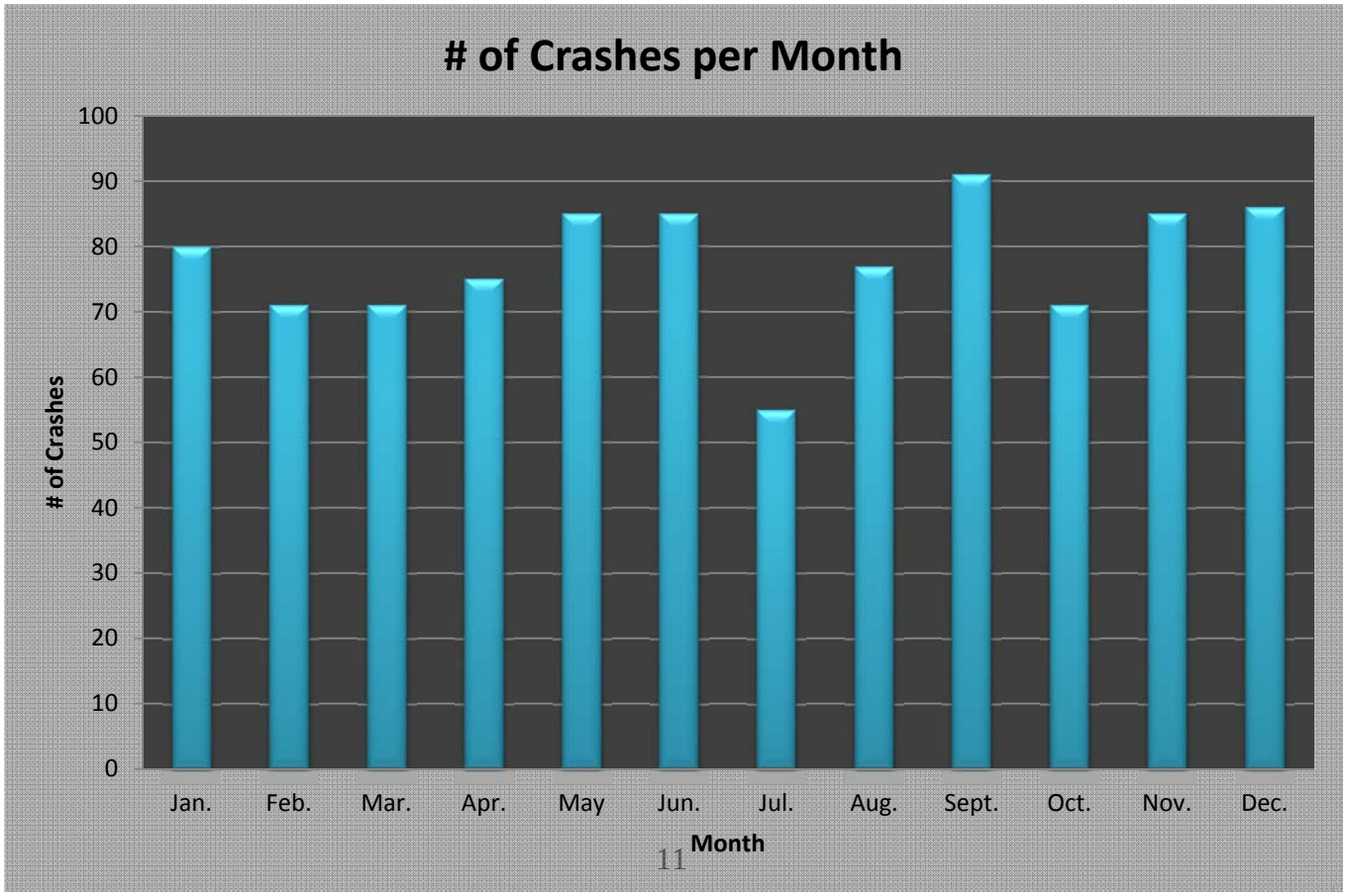
The crash history from January 2012 to December 2015 was reviewed for each of the nine intersections with a LOSS rating of 3 or higher. The following tables summarize the crash type(s) at each intersection that was higher than would be expected for a similar four or six lane signalized intersection in Colorado.

Intersections	Crash Type(s) in Need of Correction	Mitigation Measures
SH 86 @ Allen Way	Rear end, Angle (left turns & broadside)	Review the red / yellow clearance intervals as part of 2016 Meadows / Founders signal timing project. Evaluate for flashing yellow arrow turn phase.
US 85 @ Factory Shops / Castleton Dr.	Rear end	Review the red / yellow clearance intervals as part of 2016 Meadows / Founders signal timing project.
SH 86 @ Front St.	Rear end, Angle (left turns)*	Review the red / yellow clearance intervals as part of 2016 Meadows / Founders signal timing project. Flashing yellow arrow was installed for north / south lefts in 2014. Since then left turn crashes have decreased from 13 in 2013 to 3 in 2015.
Factory Shops Blvd @ New Memphis	Broadside (WB thrus & SB thrus)*	Signal timing was modified early in 2016. Impact is yet to be determined.
US 85 @ Meadows Pkwy	Rear end	Review the red / yellow clearance intervals as part of 2016 Meadows / Founders signal timing project.
NB I-25 @ Wilcox St.	Approach Turn (EB lefts & WB thrus)	Evaluate for flashing yellow arrow left turn phase
Fifth @ Wilcox St.	Rear end	No recommendation
Front St. @ Scott Blvd.	Approach Turn (SB lefts & NB thrus)	Evaluate for flashing yellow arrow left turn phase
SH 86 @ Allen St./ Woodlands Blvd.	Rear end	Review the red / yellow clearance intervals as part of 2016 Meadows / Founders signal timing project.

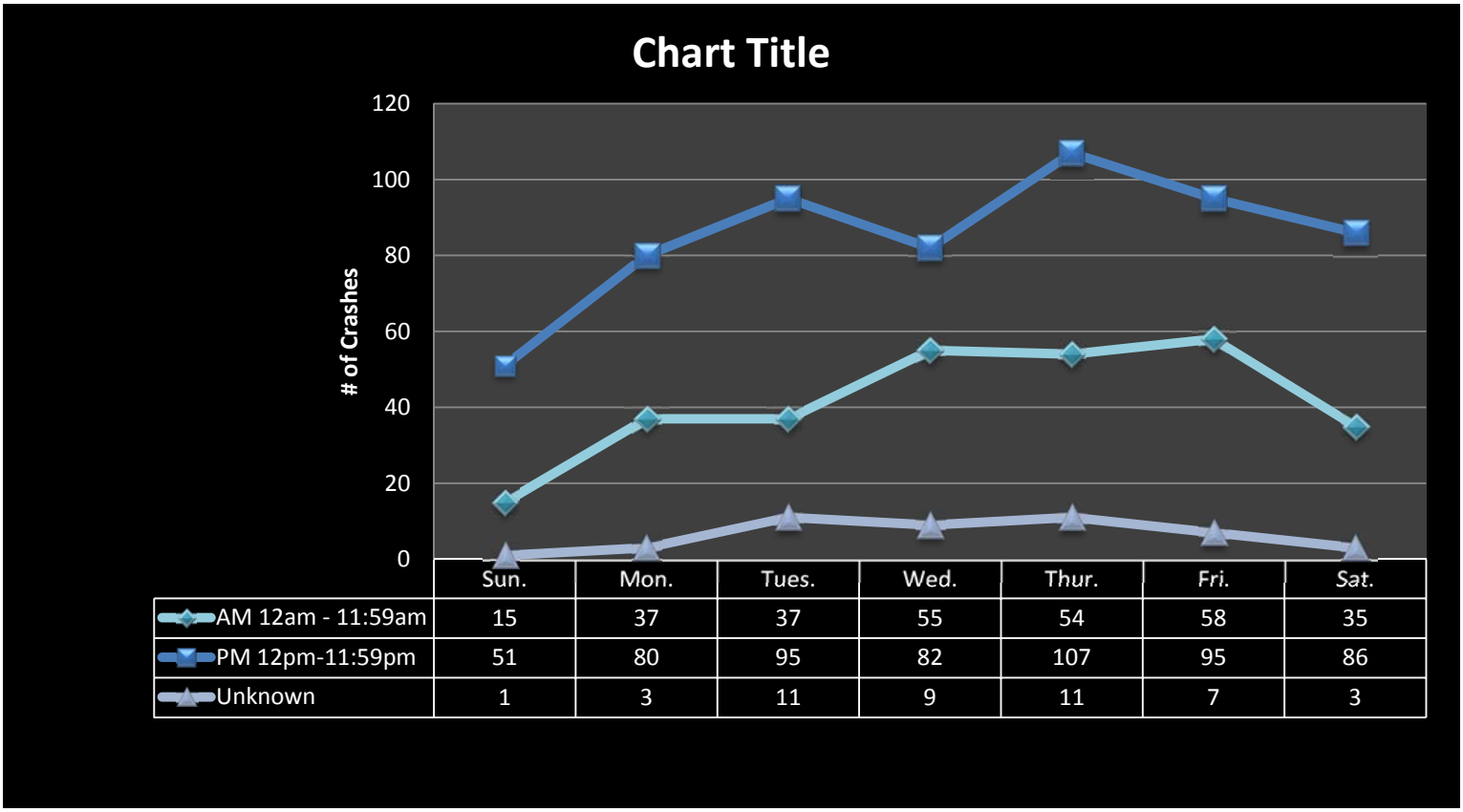
As can be seen in this table, primarily rear end collisions and approach turn collisions (a crash where a left turning vehicle turns out in front of an opposing through vehicle) are the crash types that are occurring at a rate that is more frequent than expected. By nature, traffic signals tend to cause an increase in rear end collisions so they cannot be eliminated entirely. However, certain measures such as improved signal timing can help to reduce the number of rear end collisions by reducing congestion. Town staff will work to implement the other measures not yet complete in the table above over the remainder of 2016 and early 2017.

2015 CRASH DATA TRENDS & METRICS

Months	Crashes	%	Fatalities	%
January	80	9%	0	0%
February	71	8%	0	0%
March	71	8%	0	0%
April	75	8%	0	0%
May	85	9%	0	0%
June	85	9%	0	0%
July	55	5%	0	0%
August	77	8%	0	0%
September	91	10%	0	0%
October	71	8%	0	0%
November	85	9%	0	0%
December	86	9%	0	0%
Total	**932**	**100.00%**	**0**	**0%**



CRASH BREAKDOWN BY WEEKDAY & TIME IN 2015

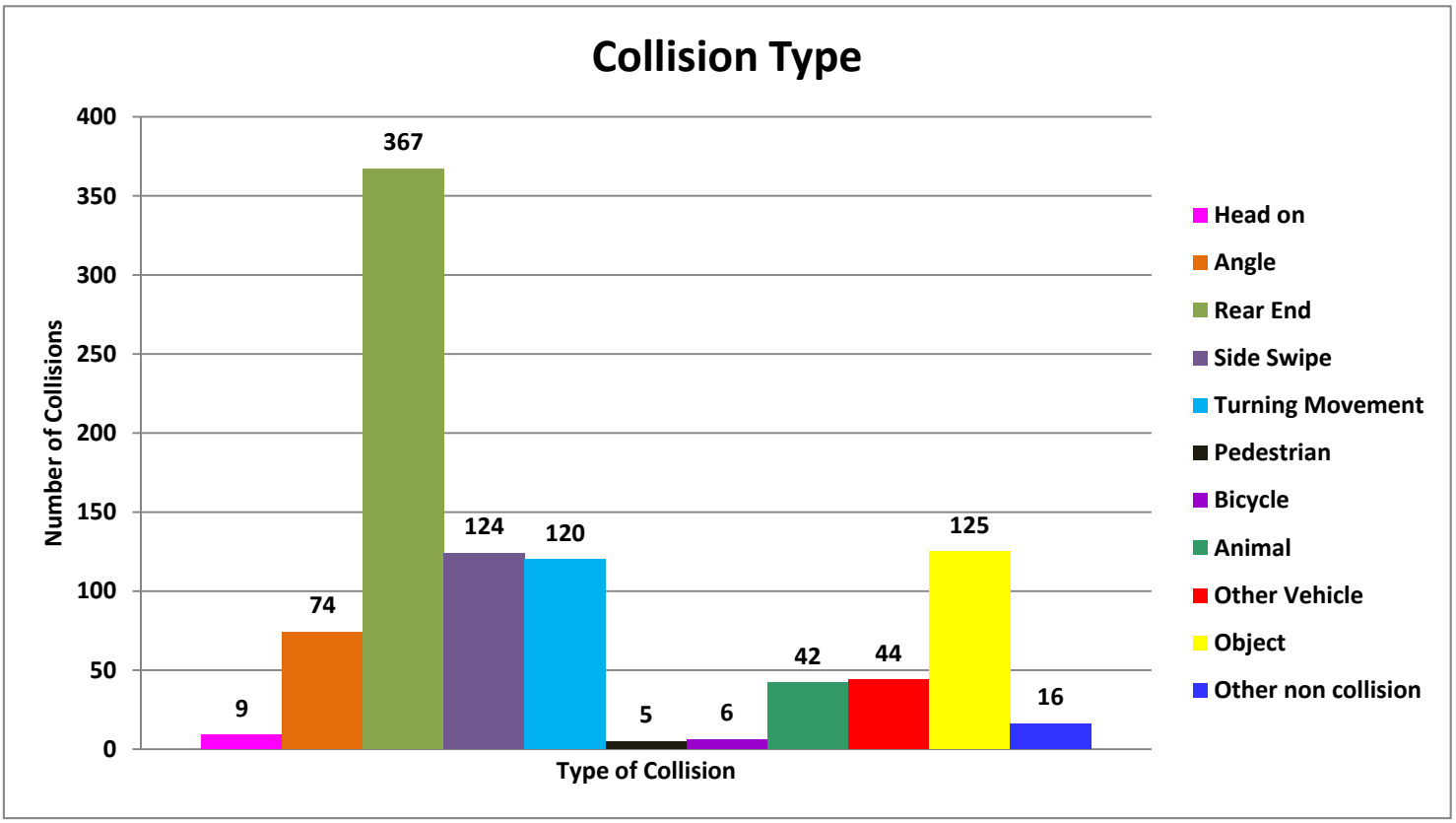


Days of the Week	# of Crashes	%	Fatalities	%
Sun.	67	7%	0	0%
Mon.	120	13%	0	0%
Tues.	143	15%	0	0%
Wed.	146	16%	0	0%
Thur.	172	19%	0	0%
Fri.	160	17%	0	0%
Sat.	124	13%	0	0%
Total	**932**	**100.00%**	**0**	**100%**

TIMES OF CRASHES

Time	# of Crashes	% of Crashes	# of Fatalities	% of Fatalities
12:00 am	10	1%	0	0%
1:00 am	5	1%	0	0%
2:00 am	6	1%	0	0%
3:00 am	4	0%	0	0%
4:00 am	2	0%	0	0%
5:00 am	3	0%	0	0%
6:00 am	21	2%	0	0%
7:00 am	56	6%	0	0%
8:00 am	46	5%	0	0%
9:00 am	37	4%	0	0%
10:00 am	38	4%	0	0%
11:00 am	63	7%	0	0%
12:00 pm	69	7%	0	0%
1:00 pm	58	6%	0	0%
2:00 pm	48	5%	0	0%
3:00 pm	82	9%	0	0%
4:00 pm	94	11%	0	0%
5:00 pm	67	7%	0	0%
6:00 pm	43	5%	0	0%
7:00 pm	38	4%	0	0%
8:00 pm	31	3%	0	0%
9:00 pm	32	3%	0	0%
10:00 pm	18	2%	0	0%
11:00 pm	16	2%	0	0%
Unknown	45	5%	0	0%
TOTAL	**932**	**100.00%**	**0**	**0%**

TYPES OF CRASHES



Vehicle Type	Vehicles Involved in Crashes	% of Vehicles
Auto	750	44%
SUV	578	34%
Pick-up	229	14%
Auto/SUV/ Truck w/ Trailer	24	1%
Truck (over 10,000 lbs.)	36	2%
Motorcycle/Moped	11	1%
Bicycle	4	0%
School Bus/ Bus	4	0%
Hit & Run	50	3%
Other	9	1%
Total	**1695**	**100.00%**

CRASH LOCATION

Intersections By Classification	Number of Crashes	Number of Fatalities	Number of Injuries
Arterial/Arterial	246	0	5
Arterial/Collector	138	0	3
Arterial/Local	75	0	9
Collector/Collector	48	0	1
Collector/Local	32	0	2
Local/Local	22	0	2
Total	**561**	**0**	**22**

Segments	Number of Crashes	Number of Fatalities	Number of Injuries
Multi-lane Arterial or Collector	191	0	3
Two-lane Arterial or Collector	124	0	8
Local	56	0	4
Total	**371**	**0**	**15**

CRASH ENVIRONMENT

Traffic Control Device	Crashes	Crashes related to Traffic Control Device	%
Railroad Device	0	0	0%
Roundabout	9	0	1%
Yield Sign	3	0	0%
Stop Sign	180	8	19%
Traffic Signal	361	25	39%
None	379	0	41%
Total	**932**	**33**	**100.00%**

Weather	Crashes	%
Clear	781	84%
Rain	50	5%
Snow/Sleet	91	10%
Other	10	1%
Total	**932**	**100.00%**

Road Conditions	Crashes	%
Dry	707	76%
Wet	89	10%
Icy/Slushy/Snowy	135	14%
Other	1	0%
Total	**932**	**100.00%**

Lighting Conditions	Crashes	%
Day	746	80%
Night	186	20%
Total	**932**	**100.00%**

THE DRIVER

Primary Causes of Crashes *	Driver 1	Driver 2	% of Primary Causes D.1 & D.2 (1,566)
Failed to Yield Right of Way	117	6	8%
Careless/Reckless Driving	373	14	25%
Violation of Red Signal	24	2	2%
Violation of Stop Sign	8	0	0%
Unsafe Backing	26	1	2%
Speeding too fast for conditions	32	2	2%
Following too closely	61	7	4%
All Other/Unknown	218	675	57%
Total	**859**	**707**	**100.00%**

Condition of Drivers *	Driver 1	Driver 2	% of Condition of Drivers D.1 & D.2 (1,566)
No Defect or Unknown	257	680	60%
Other* (includes: aggressive driving, fatigue, distractions, illness)	437	22	29%
Inexperienced Drivers	129	5	9%
Cell Phone	12	0	0%
Drugs or Alcohol Related	24	0	2%
Total	859	**707**	**100.00%**

ALCOHOL & DRUG INVOLVEMENT

*Number of Crashes Involving Drivers Influenced by Alcohol or Drugs

Age	All Drivers	Male	Female
<14	0	0	0
15-19	0	0	0
20-24	2	2	0
25-29	7	6	1
30-34	4	2	2
35-39	2	0	2
40-44	1	1	0
45-49	1	1	0
50-54	5	3	2
55-59	0	0	0
60-64	0	0	0
65-69	2	2	0
>70	0	0	0
Total	**24**	**17**	**7**

2% of the total crashes reported in 2015 involved alcohol or drugs. This was a slight decrease from 2014's 3% and is slightly below the national average.

AGES OF DRIVERS/PEDESTRIANS INVOLVED IN CRASHES OVERALL

- 158 unknown drivers/pedestrians (gender & age)

Age	% of Total Drivers/Pedestrians			
	Male	Female	Total	Percent
<14	3	0	3	0%
15-19	112	124	236	14%
20-24	100	52	152	9%
25-29	76	49	125	8%
30-34	70	74	144	9%
35-39	75	80	155	9%
40-44	82	75	157	10%
45-49	67	101	168	10%
50-54	61	93	154	9%
55-59	52	70	122	8%
60-64	39	58	97	6%
65-69	31	41	72	4%
>70	40	31	71	4%
Total	**808**	**848**	**1656**	**100.00%**

DEFINITIONS

The following special terms are used throughout this report, and are provided to clarify the meaning of the data.

1. **Crash (or traffic crash):** An unintended event involving a motor vehicle that causes death, injury, or property damage.

2. **Alcohol Involvement Crash:** Any motor vehicle crash in which a driver, pedestrian, or bicyclist had consumed alcohol.

3. **Fatal Crash:** A traffic crash which involving the death of one or more persons.

4. **Hit-Other-Vehicle:** A type of collision in which the first harmful event involves a collision between two or more vehicles.

5. **Injury Crash:** An crash involving injuries to one or more persons which may or may not require transportation to a medical facility.

6. **Motor Vehicle:** Any motorized (mechanically or electrically powered) vehicle not operated on rails.

7. **Other Non-collision:** An event during an crash sequence which does not involve a collision with another vehicle or object.

8. **Property Damage Crash:** An crash not involving either a fatality of an injury to any party but which does include damage to one or more vehicles.

9. **Rollover:** An crash in which the overturning of a vehicle was the first harmful event.

10. **Type of Crash:** The category which best describes the general type of collision which was the first event.