Appendix 4 Existing Conditions Memorandum

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MEMORANDUM

Date: April 8, 2019 Project #: 23156
To: Tyler Deke, Bend MPO
Jovi Anderson, Bend MPO
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From: Alicia Hunter, Mike Alston, Ashleigh Ludwig, PE, and Brian L. Ray, PE

Project: Bend Area Transportation Safety Action Plan (TSAP)

Subject: Existing Conditions Summary

MEMORANDUM OVERVIEW

Kittelson & Associates, Inc. (Kittelson) is developing the Bend Area Transportation Safety Action Plan (TSAP). This memorandum summarizes existing crash data and patterns for the Bend Area TSAP. The evaluation findings will be used to identify emphasis areas for the Bend Area and inform the next step of the TSAP development, network screening. The Framework Memorandum, included as Attachment A, provides an overview of the entire TSAP development process for more background on the project. The Framework Memorandum also provides the City's vision and goals for this safety study and action plan.

01 | STUDY AREA

This section provides an overview of the study area for the Bend Area TSAP and discusses how coordination will occur with the Deschutes County TSAP, being conducted in parallel to this project.

BEND AREA TSAP

The study area for the Bend Area TSAP includes the Bend Urban Growth Boundary (UGB), as discussed in the Bend Area TSAP Framework memo (Attachment A). Figure 1 shows the number of crashes each year from 2007 through 2017. As shown on the figure, the number of crashes has generally been increasing over the past five years. Exposure, or number of miles traveled, is directly related to crash frequency. Higher VMT increases the risk for vehicles to be involved in a crash.

The annual Bend population estimates are presented in Figure 2, alongside the annual estimate for vehicle miles traveled (VMT) for the Bend Metropolitan Planning Organization (MPO) area. From 2007 to 2017, the Bend population grew by 11.5 percent, or 1.2 percent per year. VMT has grown by 6.6 percent (0.7 percent per year) over the same time period.

Figure 3 illustrates the crash rate (number of crashes per million vehicle miles traveled) for reported crashes as well as fatal and incapacitating crashes per year. Figure 3 shows that exposure has been increasing each year and that crash rates are also generally increasing. This pattern, along with Oregon's goal of eliminating fatal and severe crashes by 2035, emphasizes the need for developing a Transportation Safety Action Plan.

Figure 4 illustrates the area within the Bend UGB, the project study area. The area outside the Bend UGB boundary but within the Bend MPO boundary is a special case. For this subset of roadways, safety recommendations will be included in both the Bend Area TSAP and the Deschutes County TSAP.

Figure 1: Number of Fatal/Incapacitating Crashes per Year in Bend UGB

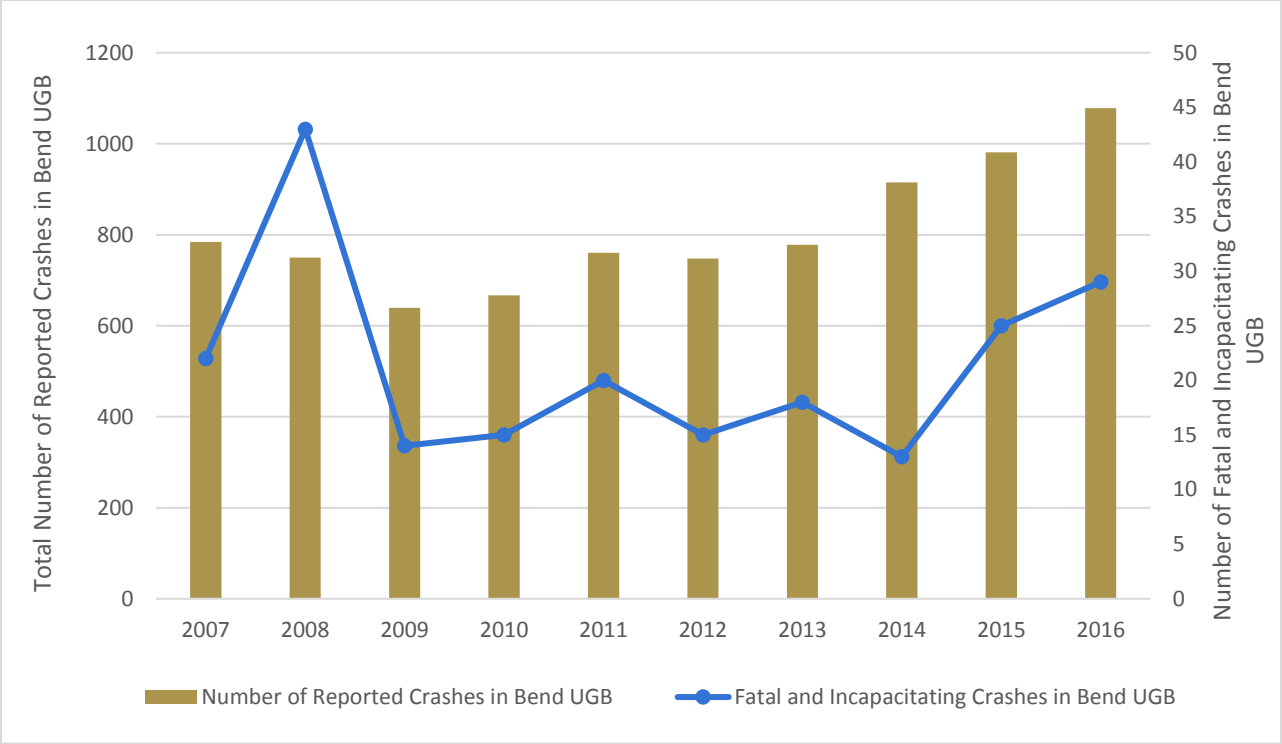
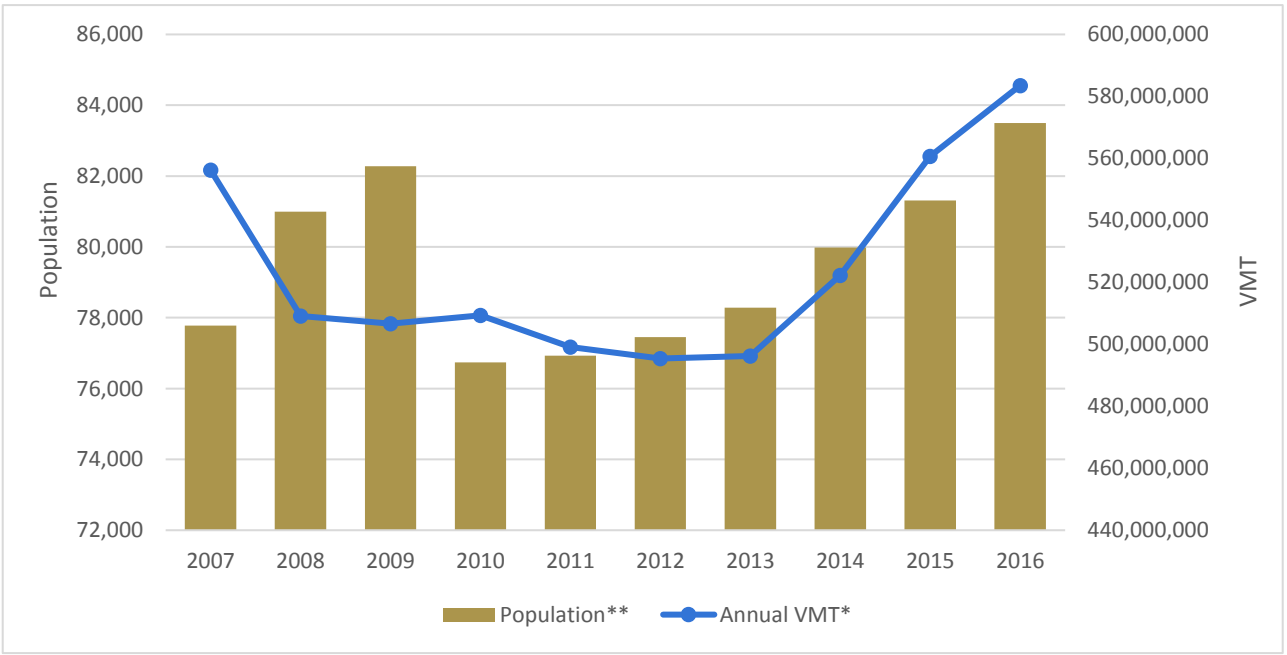
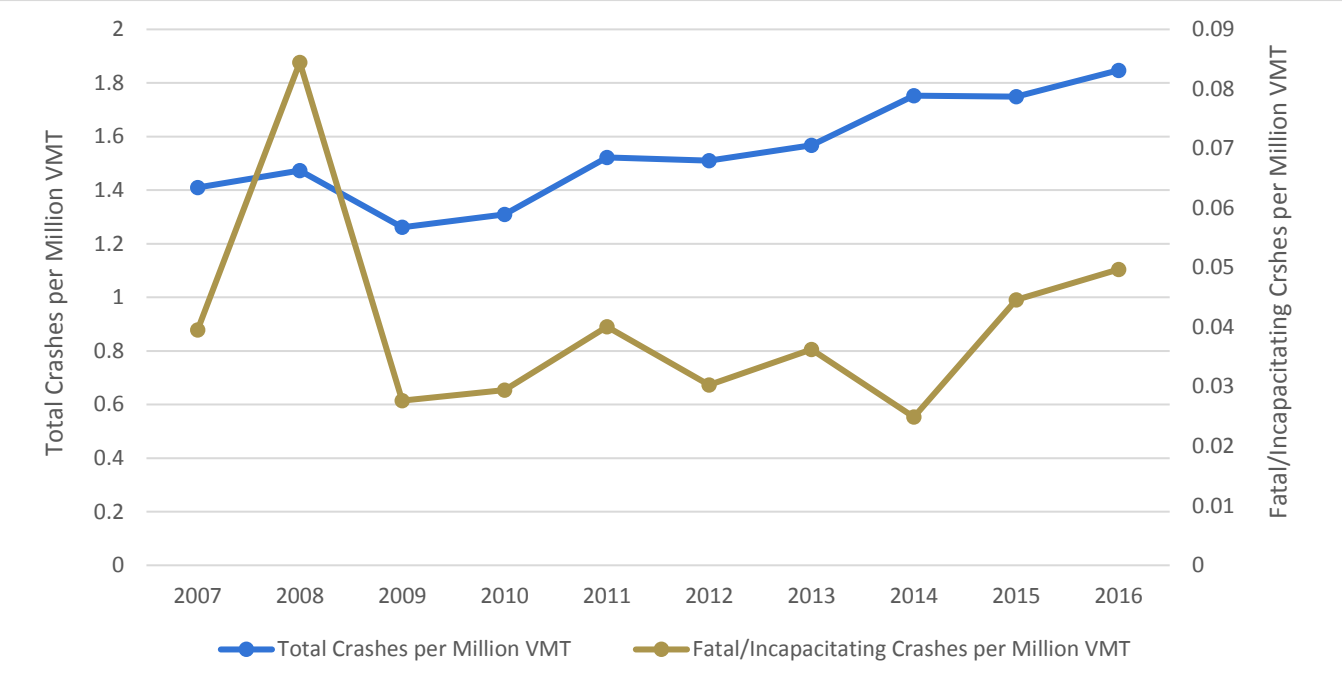


Figure 2: Bend Population, VMT by Year

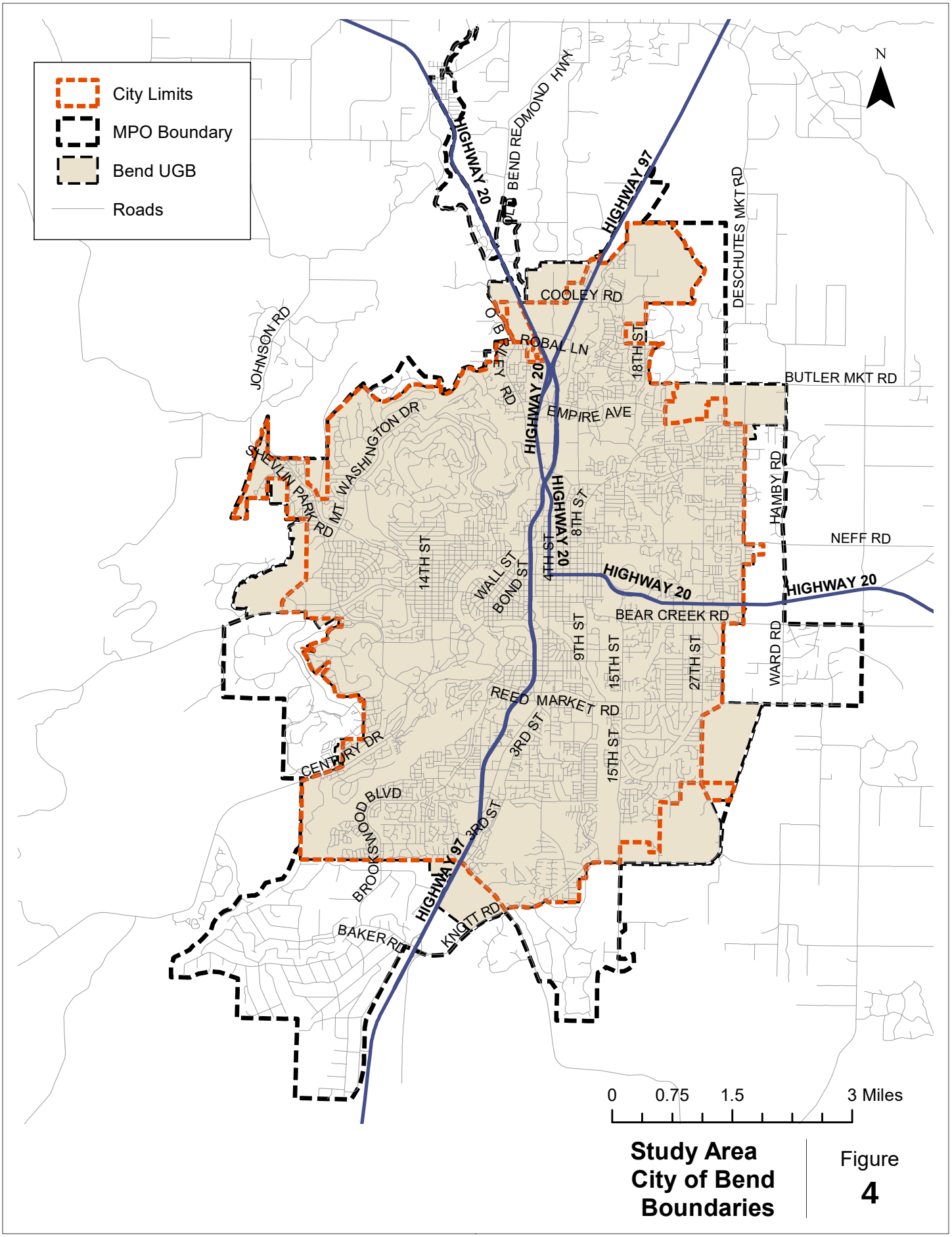


*VMT estimates are provided for the Bend MPO Area.
**2010 Population estimates provided by the US Census; others by PSU annual estimates.

Figure 3: Bend Area Crash Rates per Year



*VMT estimates are provided for the MPO Area. Number of reported crashes includes crashes within the Bend UGB.



Study Area City of Bend Boundaries

Figure **4**

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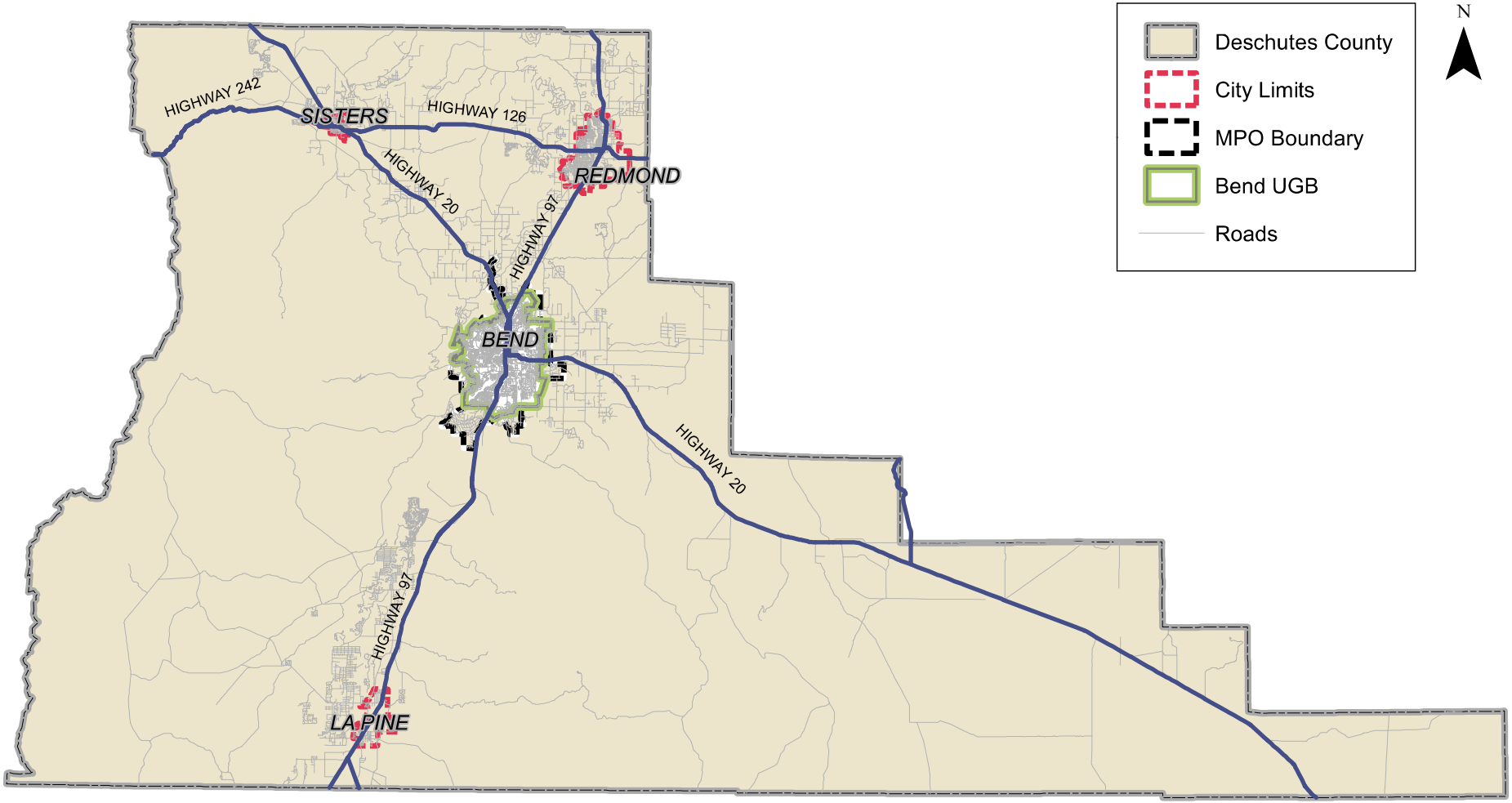
KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 StatePlane Oregon North FIPS 3601 Feet

DESCHUTES COUNTY TSAP

Deschutes County is completing a TSAP for the area outside of the Bend UGB. Kittelson & Associates, Inc. (Kittelson) is developing the County TSAP in parallel with the Bend Area TSAP. Figure 5 illustrates the study area for the County TSAP, including the unincorporated area outside the City UGB, as well as the cities of Sisters, Redmond, and La Pine. The two projects will be coordinated, with the analysis being conducted in parallel throughout the project. The Framework Memorandum (Attachment A) summarizes the steps of the analysis that will be completed jointly for both projects and how the recommendations will be split into both Plans. Many residents travel between communities within the County for work, shopping, recreation and educational opportunities; therefore, coordination between agencies is required for the sake of consistency and continuity between each of the TSAP's recommendations.



0 4.75 9.5 19 Miles

Study Area Deschutes County Boundaries

Figure **5**

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KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 StatePlane Oregon North FIPS 3601 Feet

02 | DATA OVERVIEW

Kittelson obtained roadway, traffic, and crash data from the Oregon Department of Transportation (ODOT), Deschutes County, and the Bend MPO. Crash data for Deschutes County was obtained from ODOT's database for January 1, 2012 through December 31, 2016, which includes all reported crashes. Reported crashes include those resulting in an injury or fatality, as well as those resulting in over $1,500 of property damage.[1] ODOT's crash database provides reported crash characteristics such as date, time, crash type, light conditions, roadway conditions, etc. that Kittelson used to analyze and document factors associated with crashes.

Crash severity, as reported in Oregon, is categorized into five categories: (1) fatal, (2) incapacitating (Injury A), (3) non-incapacitating (Injury B), (4) possible injury (Injury C - complaint of pain), and (5) no injury (PDO - property damage only). A crash's severity is defined by the most severe outcome among all parties involved; the fatal and incapacitating crashes are the focus of the TSAP. Crash data used in this memorandum discusses the number of crash events, not the number of personal injuries or fatalities. For example, one crash event may have resulted in multiple injuries or fatalities. This approach is taken so that results are not skewed to a smaller number of multi-injury events. However, this approach will not identify crash characteristics that are more likely to result in multiple injuries.

Combining crash data with roadway and traffic data can help analysts identify safety needs and identify appropriate countermeasures. Deschutes County and the Bend MPO provided roadway and traffic information in GIS format, including roadway functional classification, pedestrian and bicycle facilities, intersection traffic control, posted speed limits, traffic volumes, and bicycle level of traffic stress. Where possible, Kittelson joined the GIS information to the crash data to allow further exploration of characteristics associated with crashes. Table 1 summarizes the data requested and received from the County, MPO, City, and ODOT for this project. Some data will be used in later project tasks rather than in this memorandum.

Table 1: Data and Sources

Data	Source
Primary Data	
Roadway Functional Classification	County
Traffic Volumes	County and MPO (Countywide and MPO datasets will be merged)
Reported Crash Data	ODOT - Countywide dataset will be used
Jurisdiction	County and MPO
Traffic Control	County and MPO
Secondary Data	
Posted Speed Limit	County and MPO (Limited coverage available.)
Lane Widths	MPO
Sidewalk Presence	City
Bicycle Facilities	City
Trails	MPO (Parks Boundary)
Bicycle and Pedestrian Volumes	Not Yet Provided, may be available for select areas within MPO
Transit Routes and Stops	MPO

[1] ODOT increased the property damage threshold for reporting crashes from $1,500 to $2,500 as of January 1, 2018. However, the data reflected in this analysis corresponds to a reporting threshold of $1,500 of damage. (Source: https://content.govdelivery.com/accounts/ORDOT/bulletins/1cbed84)

03 | CRASH DATA ANALYSIS

Kittelson analyzed crash data for the City of Bend to identify crash characteristics, roadway characteristics, or behavioral characteristics associated with fatal and severe crashes.

This section begins with a comparison of crash patterns within the City of Bend to three other similar cities: Corvallis, Medford, and Springfield. Comparing Bend's safety performance to these peer cities allows for a benchmark of the City's safety performance and an opportunity to establish emphasis areas for Bend. These three cities were selected based on their population, demographics, and similar characteristics to Bend. The comparison provides a helpful reference to other Oregon cities but does not reflect a comparative performance metric.

After the comparison to similar cities, this section focuses more specifically on Bend's crash patterns, including trends over time, roadway location and characteristics, behavioral patterns, and vulnerable road users (pedestrians, bicyclists, elderly drivers, and motorcyclists).

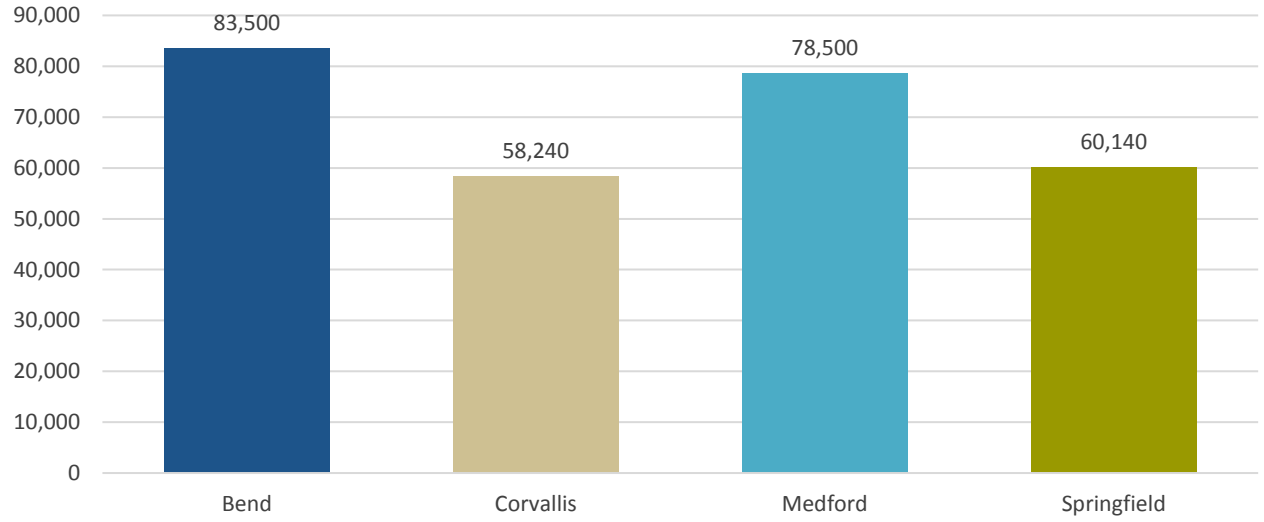
COMPARISON TO SIMILAR CITIES

This section compares Bend's crash performance for 2012 to 2016 to three comparison cities, with respect to the following categories:

- Trends over time (year over year, monthly);
- Roadway lighting conditions;
- Crash types;
- Behavioral characteristics (alcohol and drug use); and,
- Vulnerable road users (pedestrians and bicyclists).

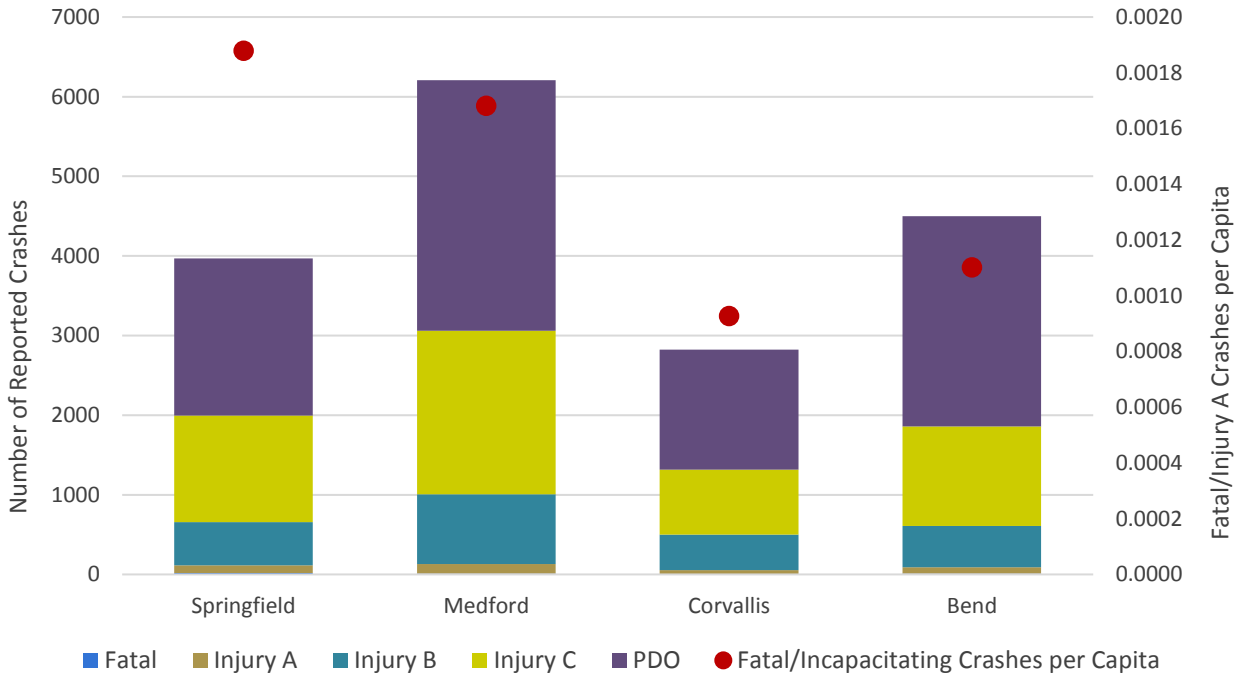
Figure 6 shows the 2017 estimated population for each city. Comparing each city's 2017 population (Figure 6) to its number of reported crashes between 2012 and 2016 (shown in Figure 7) reveals that Bend has a lower number of crashes per capita compared to Springfield and Medford, but slightly is higher compared to Corvallis. This comparison also holds true when comparing the number of fatal and incapacitating crashes per capita among the four cities, as shown by the points on Figure 7. Using population as an exposure measure provides a relative comparison between the four cities, absent of reliable VMT estimates for all four cities.

Figure 6: 2016 Population Estimates for Comparison Cities



Source: Portland State University (PSU); Kittelson, 2019.

Figure 7: Reported Crash Frequency: Bend, Corvallis, Medford, Springfield; 2012-2016



Source: ODOT; Portland State University (PSU); Kittelson, 2019.

CRASH SEVERITY

As previously discussed, crash severity is categorized into five categories: (1) fatal, incapacitating (Injury A), (2) non-incapacitating (Injury B), (3) possible injury (4) Injury C - complaint of pain), and (5) PDO, based on the most severe outcome among all parties involved. In the five years of data analyzed, two percent of reported crashes in Bend involved a fatality or incapacitating injury, similar to that of the comparison cities, as shown in Figure 8 through Figure 11.

The Bend UGB area had a fatal crash share below one percent. Bend showed the highest PDO share, with 59 percent of crashes reported as PDO crashes. This indicates when crashes occur in Bend, they result in injury less frequently than in the comparison cities.

Figure 8: Crash Frequency and Severity, Bend 2012-2016

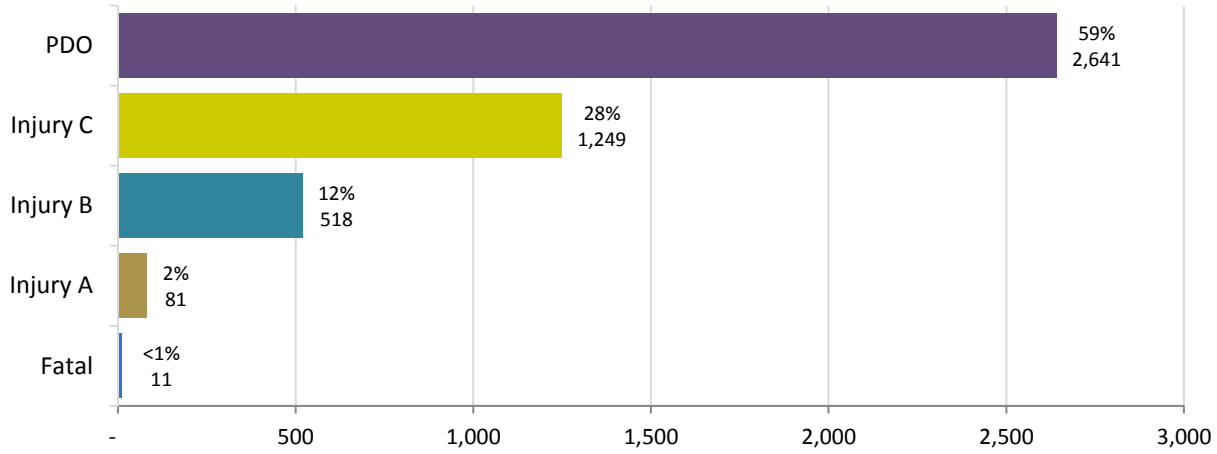


Figure 9: Crash Frequency and Severity - Corvallis, 2012-

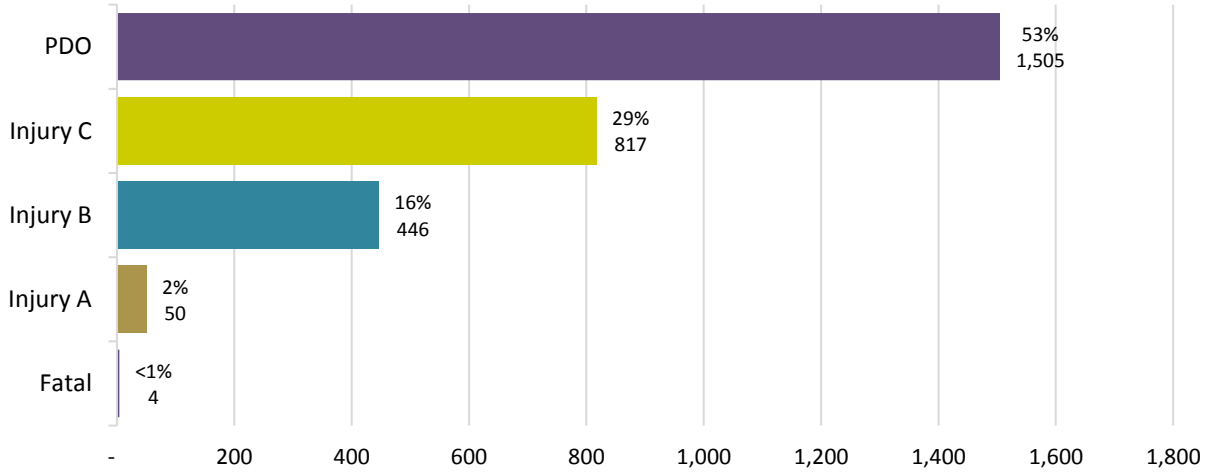


Figure 10: Crash Frequency and Severity, Medford 2012-2016

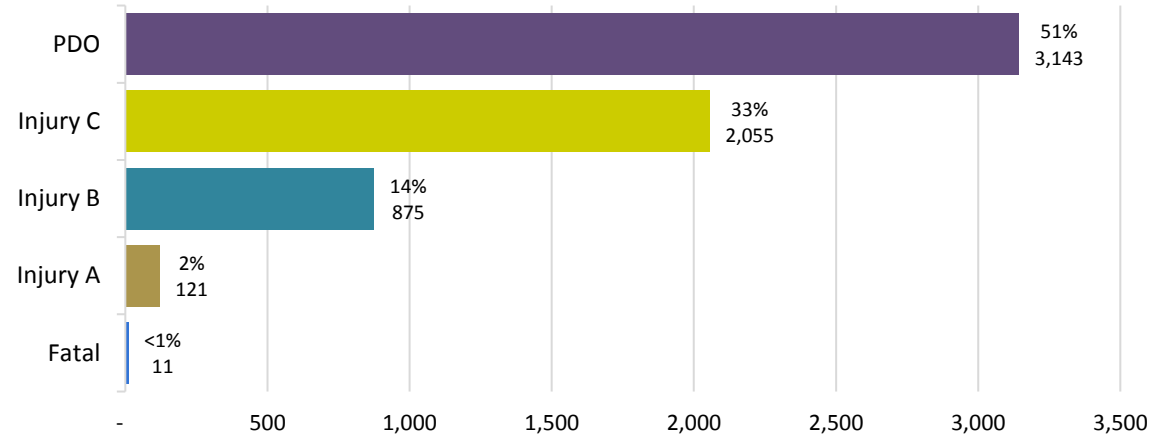
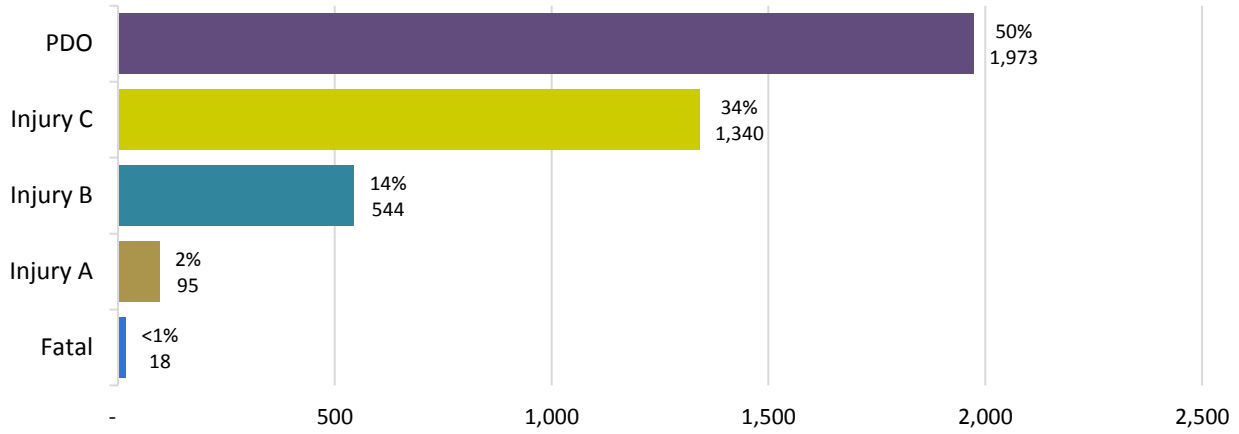


Figure 11: Crash Frequency and Severity, Springfield 2012-2016



TRENDS OVER TIME CRASH SUMMARY

Crashes by Year

As shown in Table 2 and Figure 12, the annual number of reported crashes has been increasing in Bend since 2012. As shown in Table 2, the average annual increase in crash frequency in Bend was 11 percent, and the average annual increase in fatal and incapacitating crashes in Bend is 16.7 percent.

Figure 13 through Figure 15 shows the annual crash frequency in the three comparison cities, which have also shown general increasing trends since 2012. Bend's average annual increase in crash frequency (11 percent) was higher than that of the three comparison cities. The average annual increase in fatal and incapacitating crashes in Bend is tied with Corvallis with the highest rate of 16.7 percent per year. However, the number of fatal and incapacitating crashes per year is relatively low, compared to the total number of crashes, and therefore susceptible to higher percentage fluctuations.

Table 2. Average Annual Increase in Crash Frequency by City

Average Annual Increase in Crash Frequency*	Bend	Corvallis	Medford	Springfield
Total Crash Frequency	11.0%	3.3%	7.8%	4.9%
Fatal and Incapacitating Crash Frequency	16.7%	16.7%	7.7%	*(3.8%)*

*Average annual increase in crash frequency is calculated by comparing the crash count of 2012 to 2016.

Figure 12: Crashes by Year, Bend 2012-2016

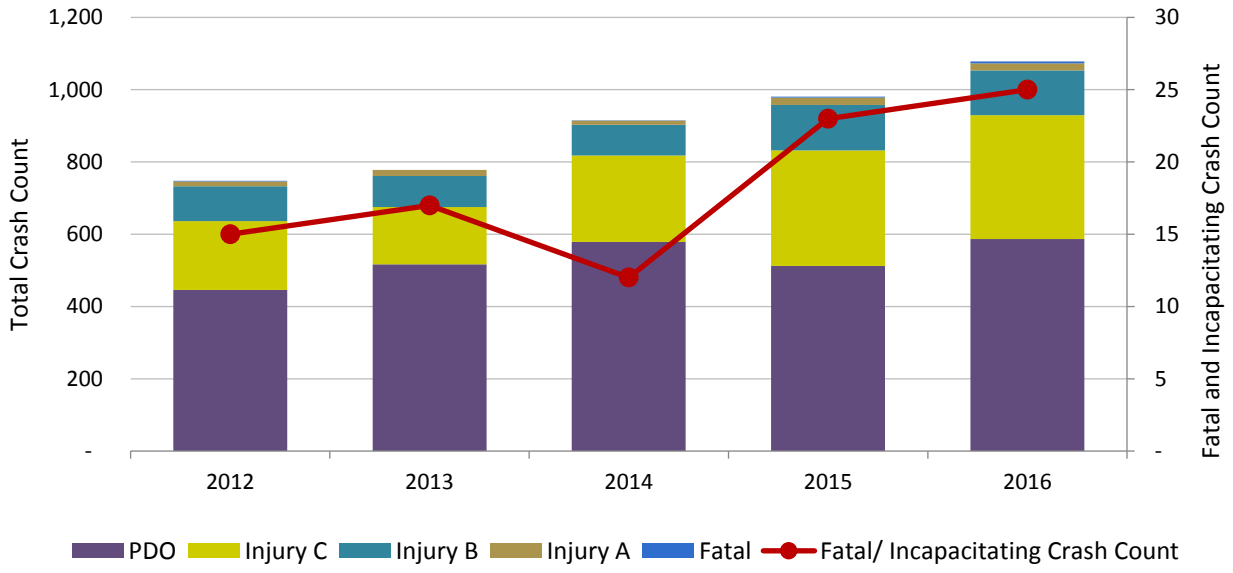


Figure 13: Crashes by Year, Corvallis 2012-2016

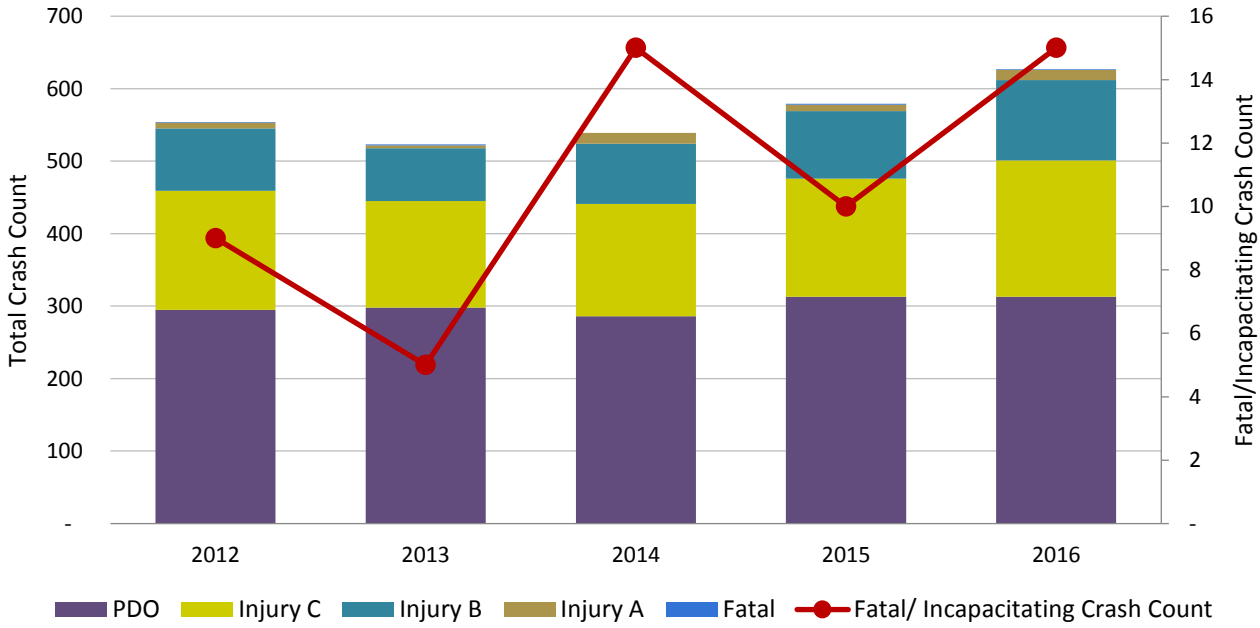


Figure 14: Crashes by Year, Medford 2012-2016

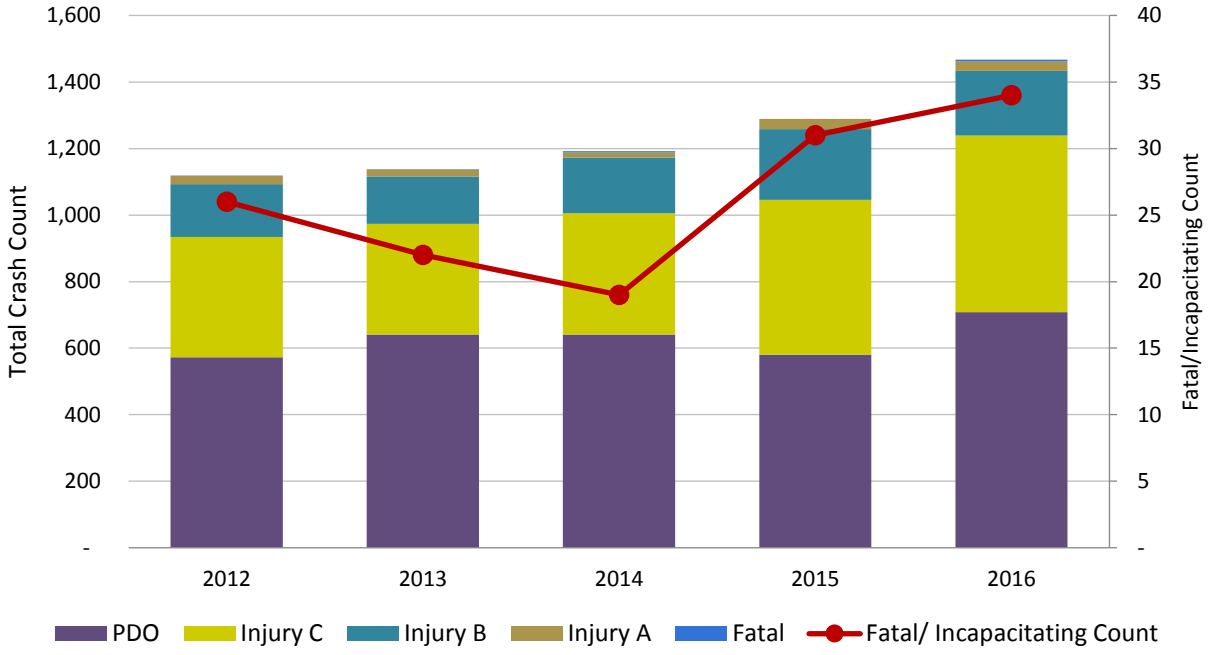
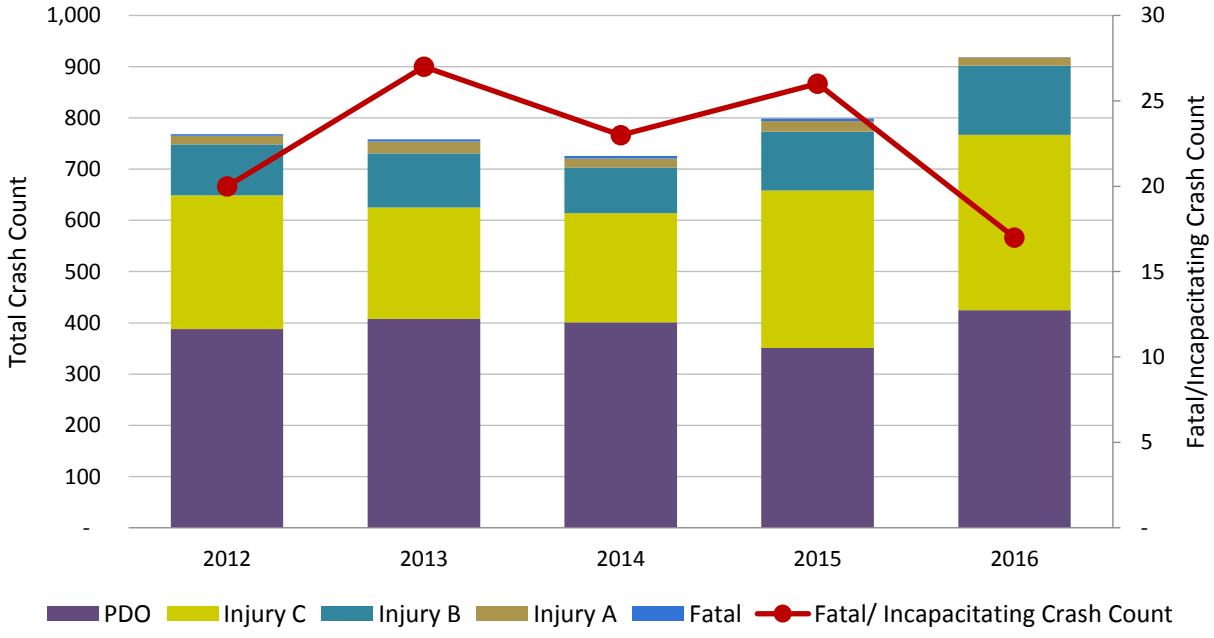


Figure 15: Crashes by Year, Springfield 2012-2016



Crashes by Month

As shown in Figure 16 the highest crash frequency for Bend occurred in the month of December. In Bend, 17 fatal and incapacitating crashes were reported during August. This number is more than double the six to eight fatal/incapacitating crashes reported during most months of the year.

Figure 17 through Figure 19 show the number of crashes per month is relatively consistent throughout the year in all four cities, with a slight increase in the fall and winter months. This trend may be associated with shorter daylight hours or an increase in rain, snow, and ice during the fall and winter months. Even though traffic volumes are typically highest during summer months, more crashes are reported during fall/winter months. Although the total number of crashes generally increases in the fall or winter months, the number of fatal and severe crashes, shown by the line on the graphs, spikes between July and September for Bend, Medford, and Springfield.

Figure 16: Crashes by Month, Bend 2012-2016

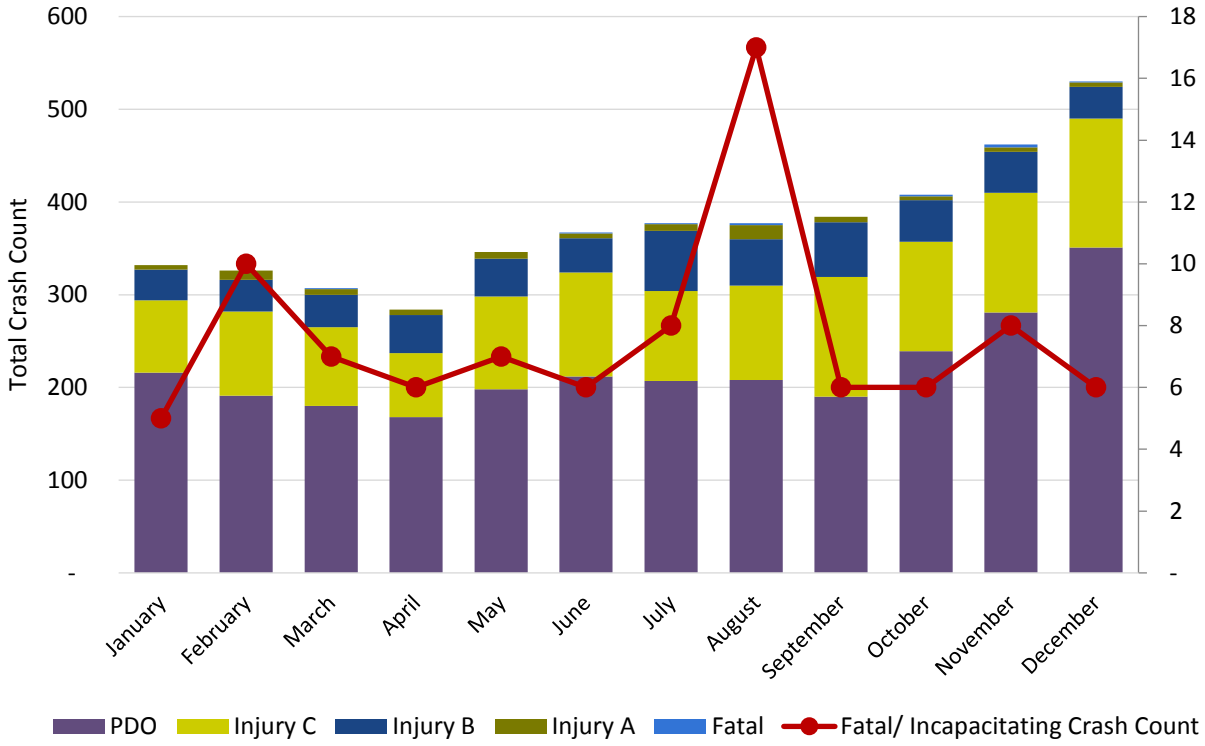


Figure 17: Crashes by Month, Corvallis 2012-2016

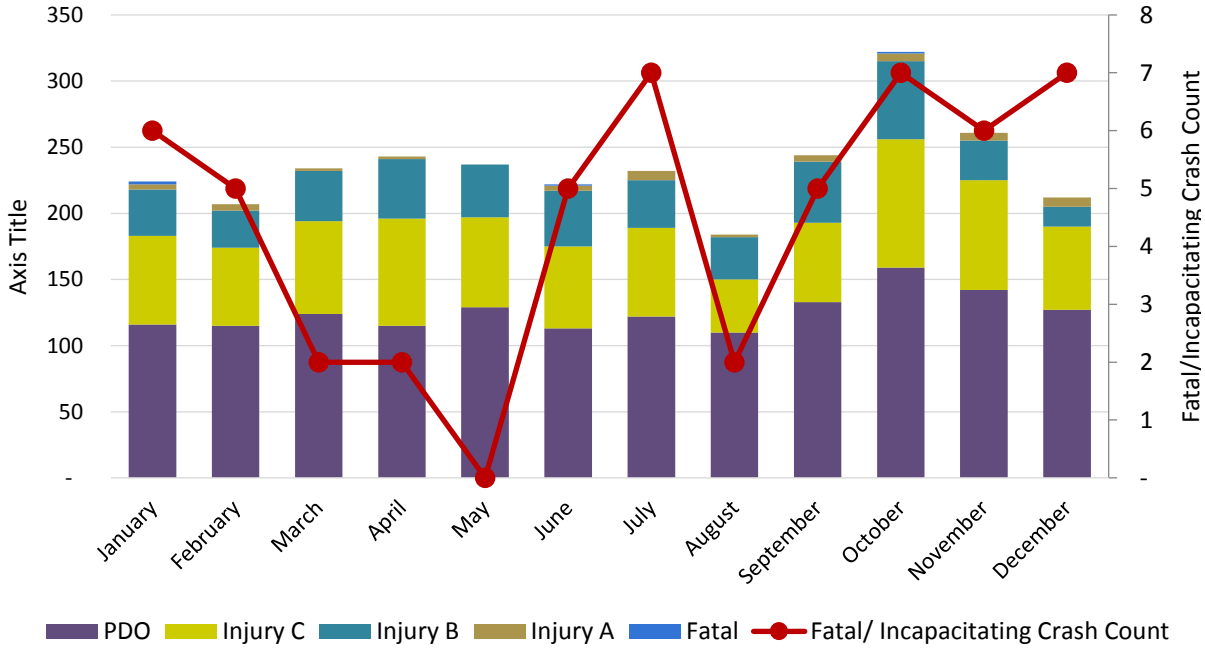


Figure 18: Crashes by Month, Medford 2012-2016

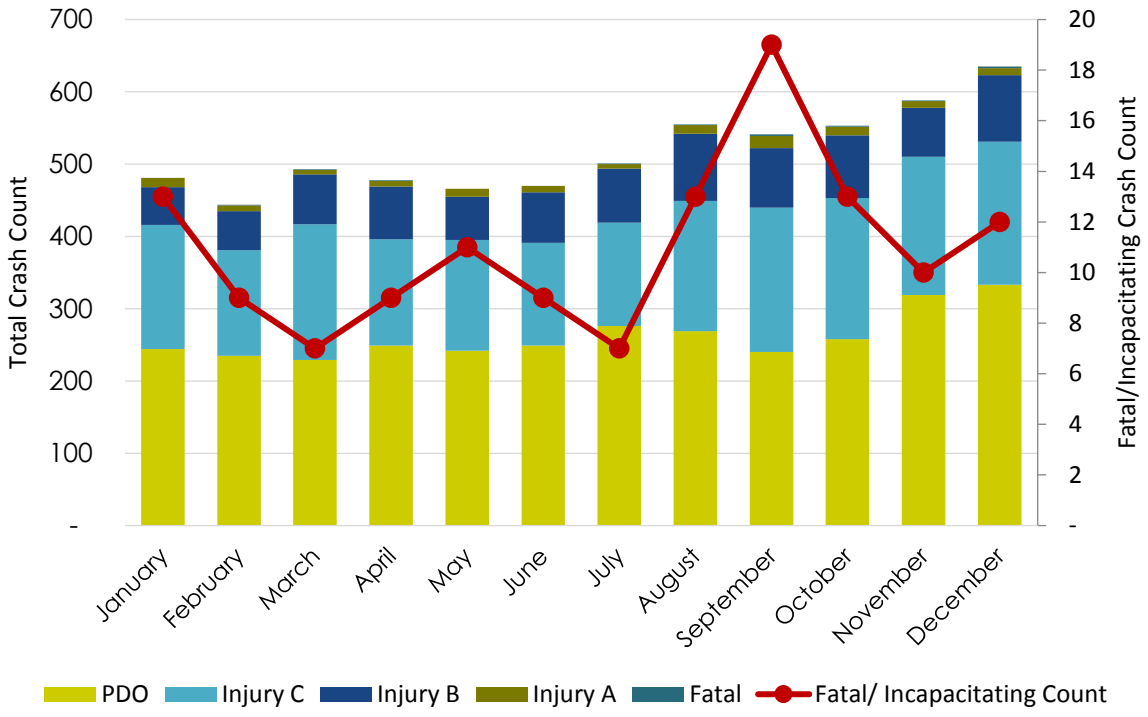
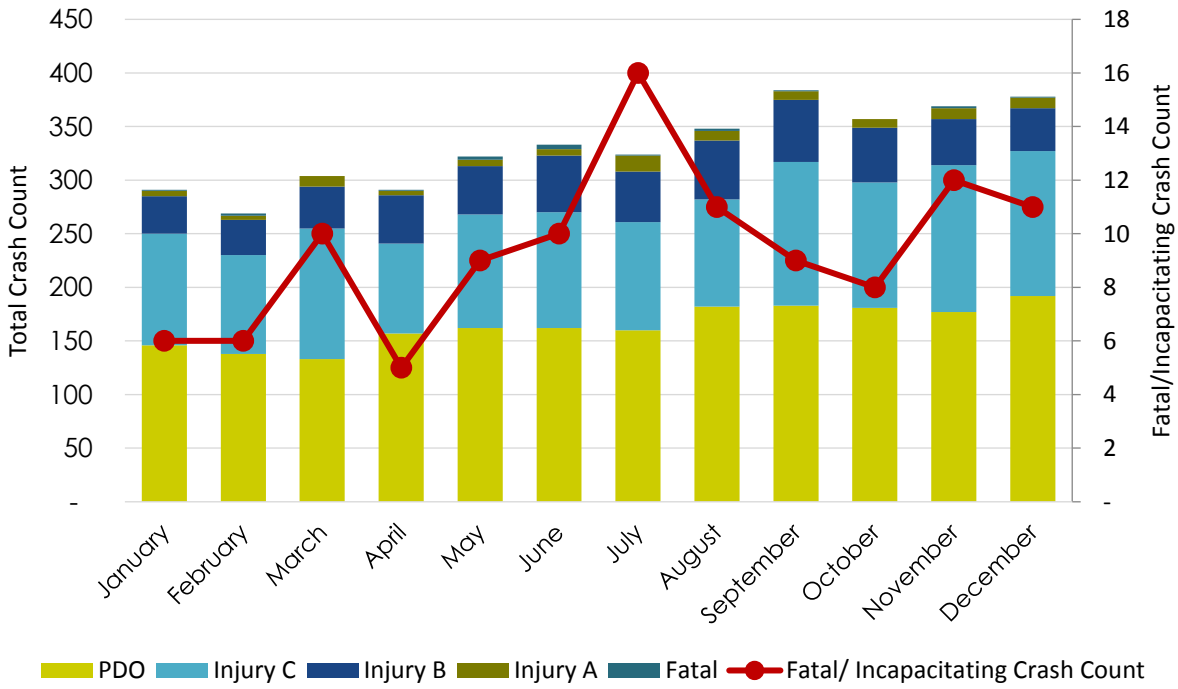


Figure 19: Crashes by Month, Springfield 2012-2016



ROADWAY CHARACTERISTICS

Light Conditions

Figure 20 through Figure 23 summarize the light conditions associated with reported crashes in each of the cities. When considering the fatal and incapacitating crashes, shown by symbols on the charts, 33 percent of fatal/incapacitating crashes in Bend occurred during dark, dawn, or dusk.

Between 72 and 78 percent of crashes occurred in daylight conditions in the four cities analyzed. Compared to the similar cities, Bend had the lowest percentage of fatal/incapacitating crashes that occurred during dark, dawn, or dusk, indicating that Bend does not have a disproportionately higher share of fatal/incapacitating crashes occurring during dark conditions, relative to the comparison cities. However, Bend had the highest share (20 percent) of fatal/incapacitating crashes occurring in dark conditions without streetlights, relative to the comparison cities. This could be related to the varying coverage of streetlights in each city. Some cities may have more streetlights than Bend, but this information is not readily available for comparison.

Figure 20: Crashes by Lighting Condition, Bend 2012-2016

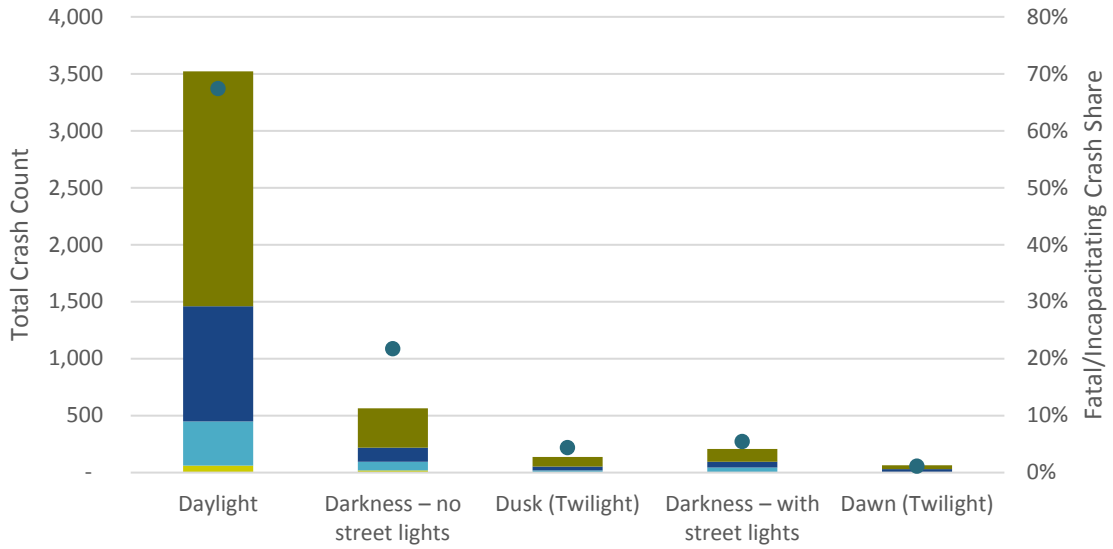


Figure 21: Crashes by Lighting Condition, Corvallis 2012-2016

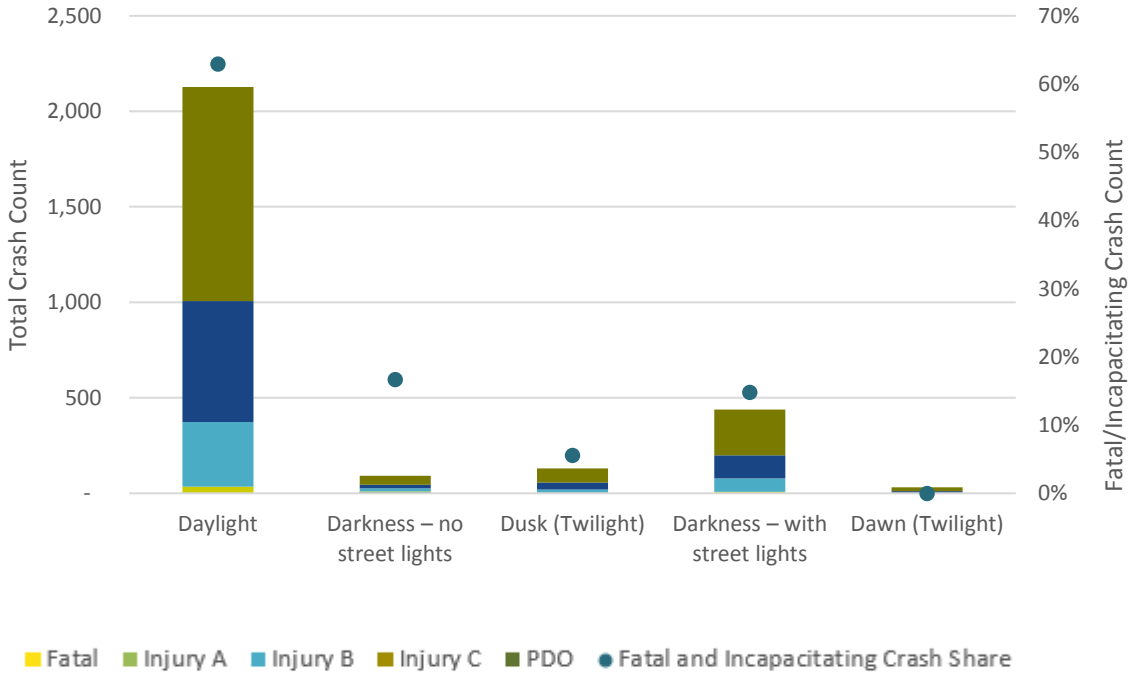


Figure 22: Crashes by Lighting Condition, Medford 2012-2016

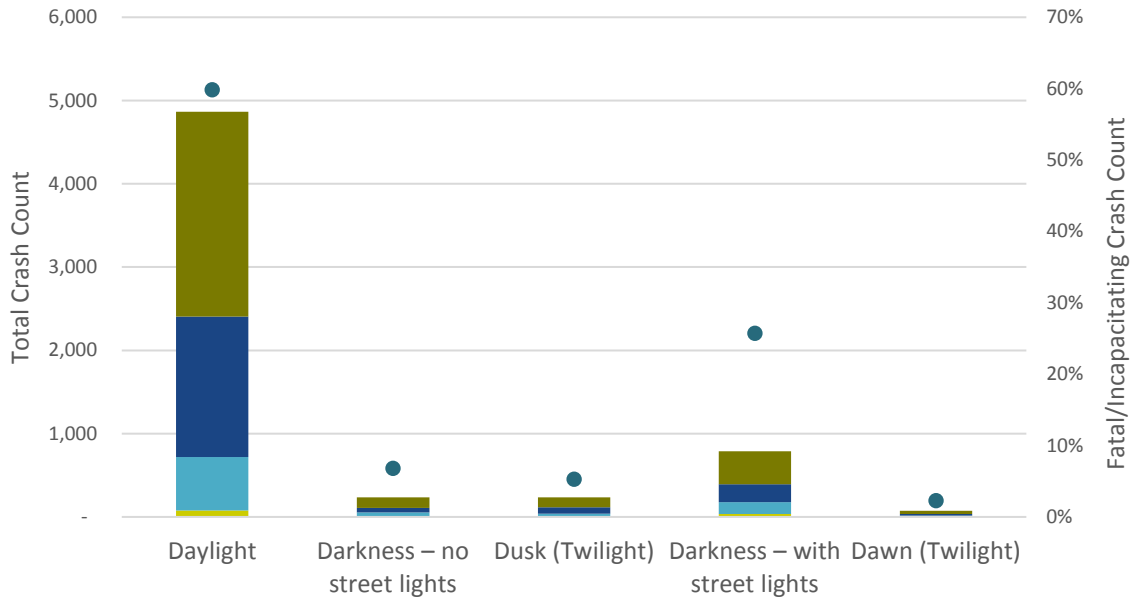
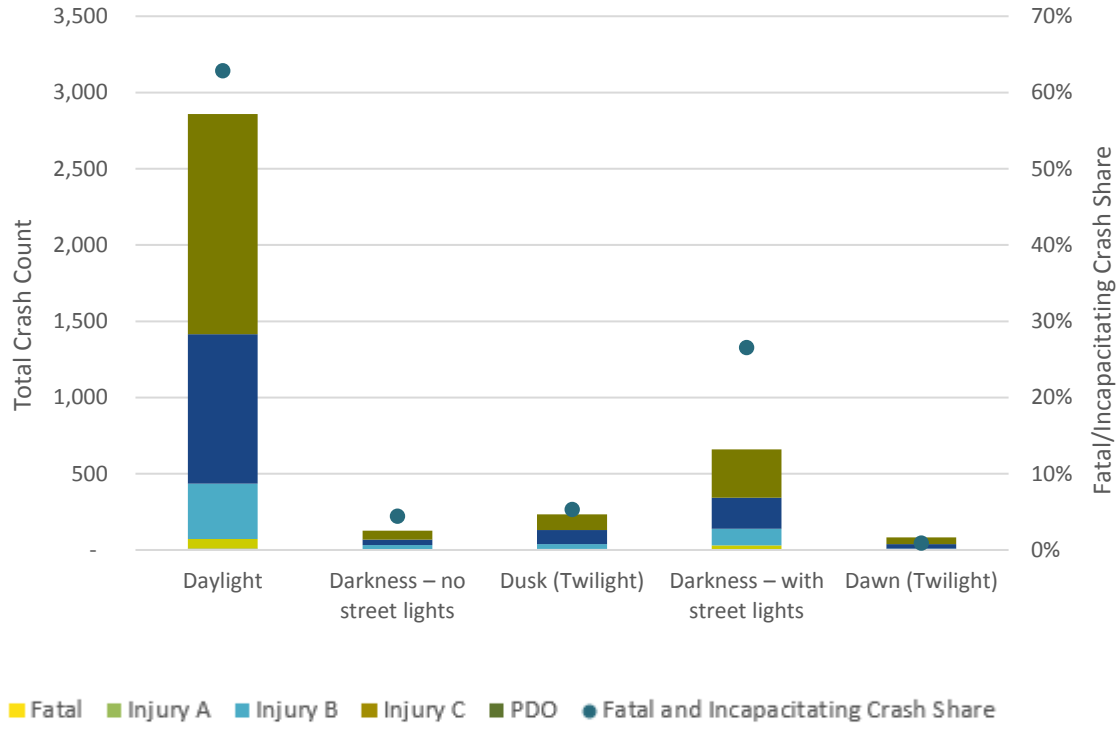


Figure 23: Crashes by Lighting Condition, Springfield 2012-2016



COLLISION TYPE

Collision type is summarized for the four comparison cities in Figure 24 through Figure 27. The *collision type* field includes broad categories like *rear-end* or *angle*.[3] The *non-collision* crash type refers to crashes involving a single vehicle, which includes overturn crashes. Crashes involving pedestrians are listed as a *pedestrian*-specific collision type, but those involving bicycles are distributed among all collision types and not specifically identified in this attribute. Bicycle crashes are discussed separately in the bicycle section of the memorandum.

In Bend, *rear-end, turning movement, angle, fixed-object,* and *sideswipe-overtaking* crashes are the five most common collision types among reported crashes. When considering only fatal and incapacitating crashes, *turning movement, rear-end, angle, pedestrian,* and *fixed-object* are the most common collision types. Although the number of pedestrian crashes was lower in comparison to other collision types in the City, the likelihood of a pedestrian crash resulting in a fatal or incapacitating injury is higher than other collision types.

Crash data for the comparison cities showed similar trends, with the most common collision types among reported crashes including *rear-end, turning movement, angle,* and *fixed-object* crashes. *Pedestrian* crashes were among the top five *collision types* for fatal/incapacitating crashes in the three comparison cities.

[3] Another data field, *crash type*, presents similar information with more specific format. For the purposes of comparing data among similar cities, the summarized category is used. The more detailed data (*crash type*) is referenced for additional details when needed.

Figure 24: Crashes by Type and Severity, Bend 2012-2016

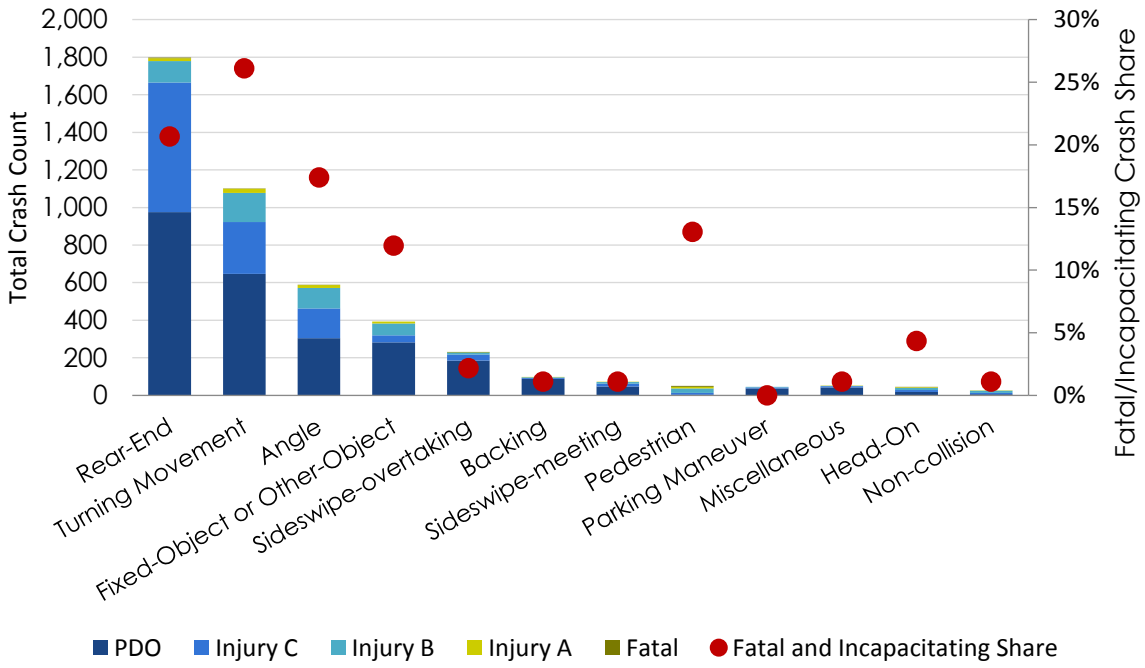


Figure 25: Crashes by Type and Severity, Medford 2012-2016

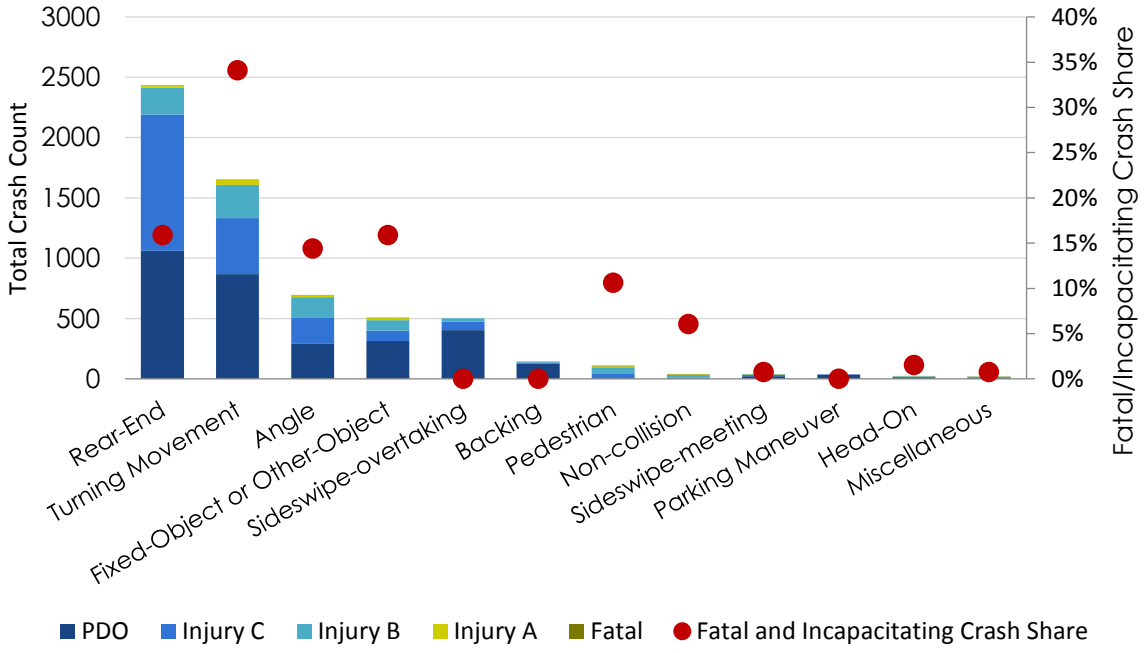


Figure 26: Crashes by Type and Severity, Springfield 2012-2016

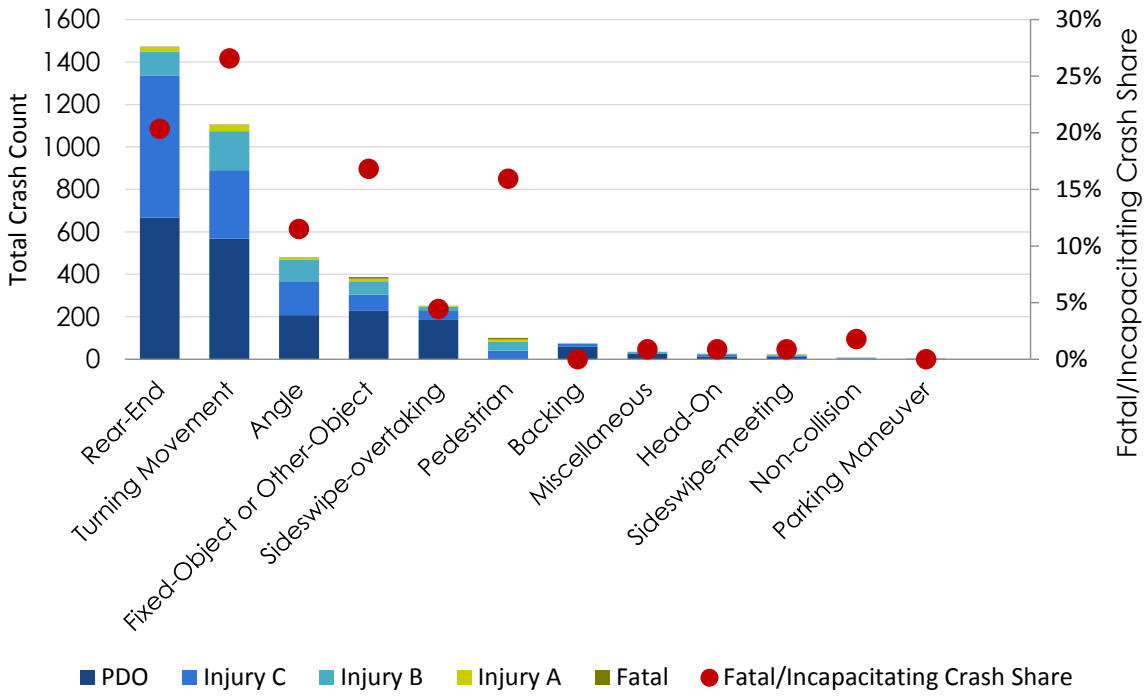
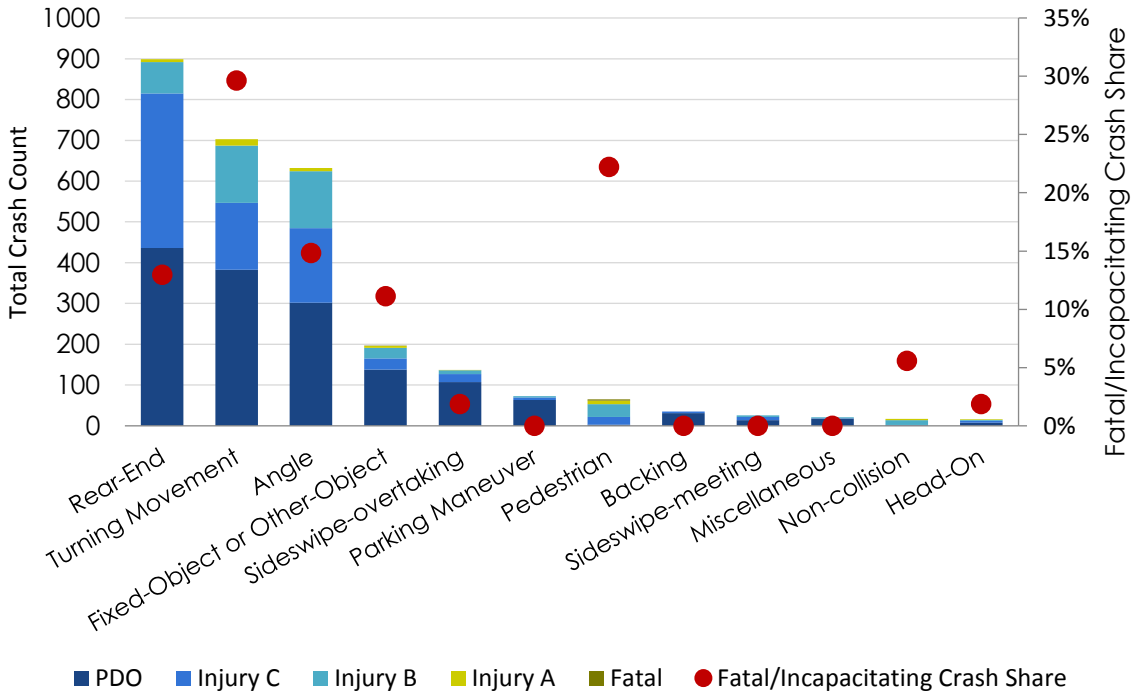


Figure 27: Crashes by Type and Severity, Corvallis 2012-2016



BEHAVIORAL CHARACTERISTICS

Alcohol and Drug Involved Crashes

The influence of alcohol and drug use is coded in the crash data from the police officer's assessment. In the case of drug use, a crash would be flagged if drug use is reported by the police, by test results, or if the suspect admits use. A flag in the data for alcohol use would occur from observations at the scene, breath or field sobriety tests, or conclusions in the reporting officer's narrative. The two flags are combined for city-level comparison here. In general, alcohol and drug involved crashes tend to be underreported in official crash reports.

As shown in Figure 28, alcohol or drugs were involved in six percent of reported crashes and 20 percent of fatal/incapacitating crashes in the Bend UGB. Compared with the three comparison cities, shown in Figure 29 through Figure 31, Bend has the highest percentage of fatal/incapacitating crashes involving alcohol or drugs.

Figure 28: Alcohol and Drug Crashes, Bend 2012-2016

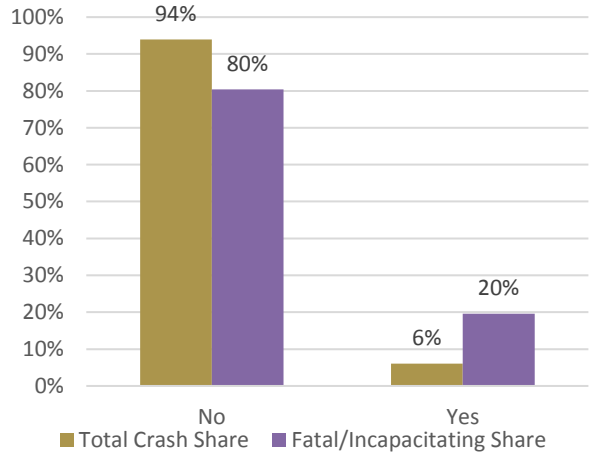


Figure 29: Alcohol and Drug Use, Corvallis 2012-2016

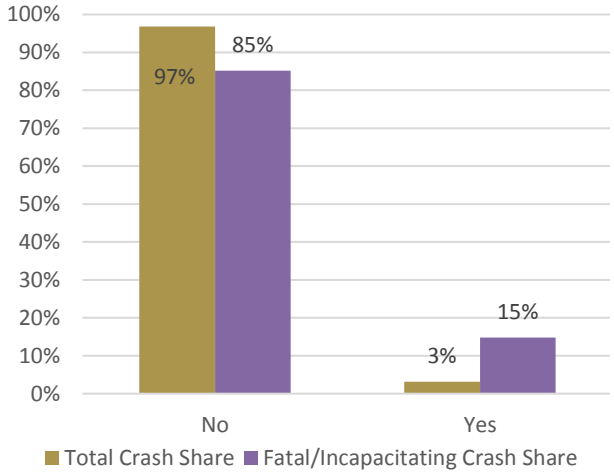


Figure 30: Alcohol and Drug Crashes, Medford 2012-2016

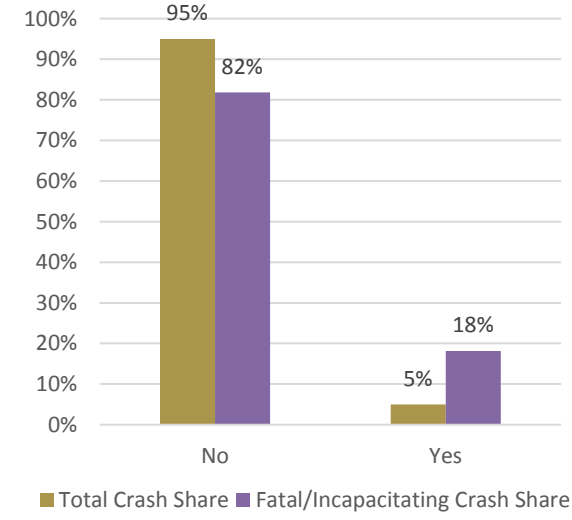
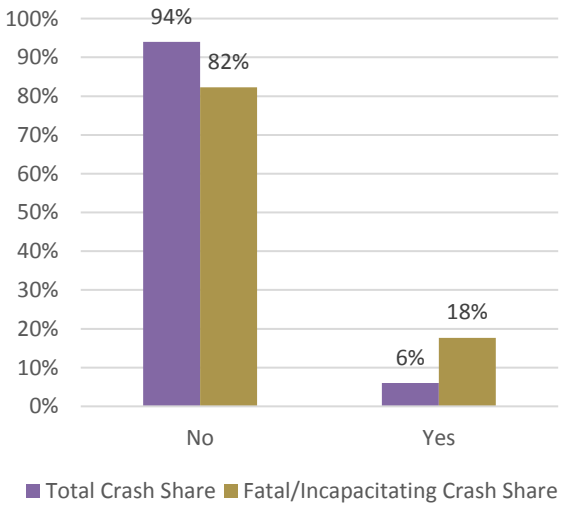


Figure 31: Alcohol and Drug Crashes, Springfield 2012-2016



VULNERABLE ROAD USERS

Vulnerable users refer to road users who are more likely to suffer an injury or fatality as a result of a crash and may include pedestrians, bicyclists, motorcyclists, and elderly drivers. Although the definition of vulnerable users is broad, this section discusses specifically pedestrian crashes and bicyclist crashes in the three comparison cities. Additional vulnerable users are discussed specific to Bend later in the memorandum.

Pedestrian Crashes

As noted in the crash type discussion, pedestrian crashes constitute a relatively low share of overall crashes in each of the comparison cities. However, when pedestrians are involved in crashes, the results are more likely to result in injury than with crashes involving only vehicles. Preventing pedestrian crashes is important to reducing severe or fatal crashes. More detail on pedestrian crashes in Bend is provided in a subsequent section of this memorandum.

As shown in Figure 32, pedestrian crashes account for one percent of all reported crashes but 13 percent of all fatal/ incapacitating crashes in Bend. Ninety-four percent of pedestrian crashes in Bend resulted in some level of injury or fatality, and 24 percent of pedestrian crashes resulted in fatal or incapacitating injury.

As shown in Figure 33 through Figure 35, the majority of pedestrian crashes in the three comparison cities resulted in injury or fatality. Compared to the three comparison cities, Bend had the highest percentage of pedestrian crashes resulting in fatal or incapacitating injury (24 percent in Bend; 19 percent in Corvallis; 18 percent in Springfield; and 13 percent in Medford).

Figure 32: Pedestrian Crashes by Severity, Bend 2012-2016

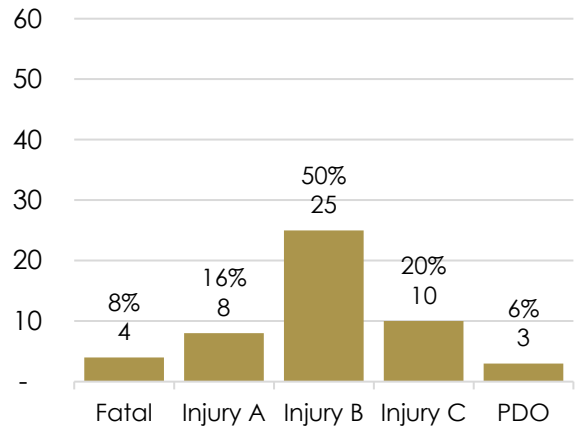


Figure 33: Pedestrian Crashes by Severity, Corvallis 2012-2016

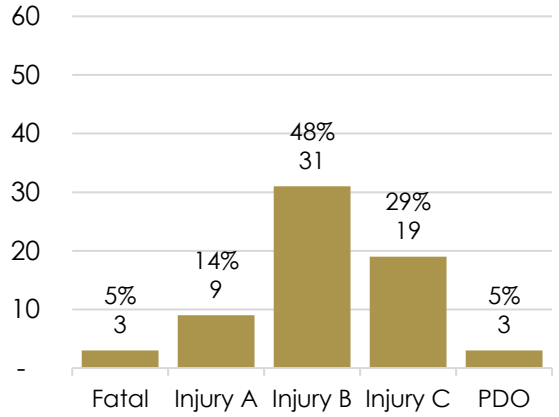


Figure 34: Pedestrian Crashes, Medford 2012-2016

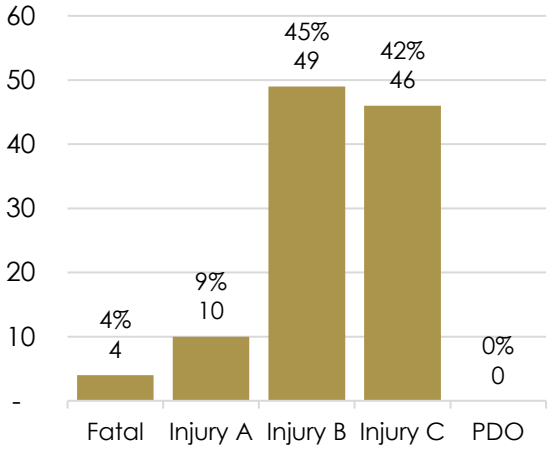
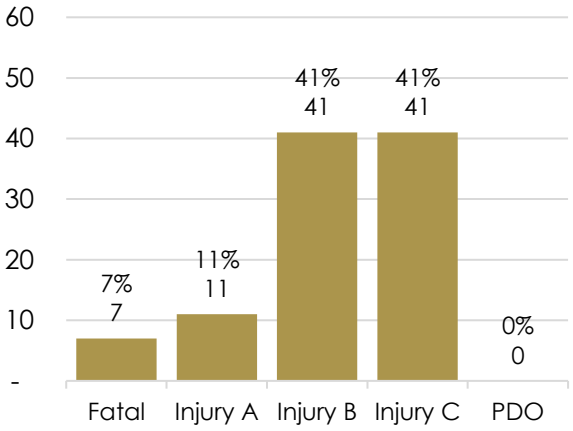


Figure 35: Pedestrian Crashes, Springfield 2012-2016



Bicycle Crashes

Bicyclists represent a vulnerable segment of the road user population, with the majority of bicycle crashes resulting in some level of injury or fatality. As with pedestrians, reducing bicyclist crashes can help reduce the risk of higher-severity crash outcomes.

As shown in Figure 36, 91 percent of bicyclist crashes resulted in some level of injury or fatality. Although bicyclist crashes represent two percent of all crashes in Bend, they account for nine percent of all fatal/incapacitating crashes (including one fatality).

As shown in Figure 37 through Figure 39, the majority of bicyclist crashes in the three comparison cities resulted in injury or fatality. Compared to the three comparison cities, Bend had the highest percentage of bicyclist crashes resulting in fatal or incapacitating injury (seven percent in Bend; five percent in Corvallis; four percent in Medford; and four percent in Springfield).

Figure 36: Bicyclist Crashes by Severity, Bend 2012-2016

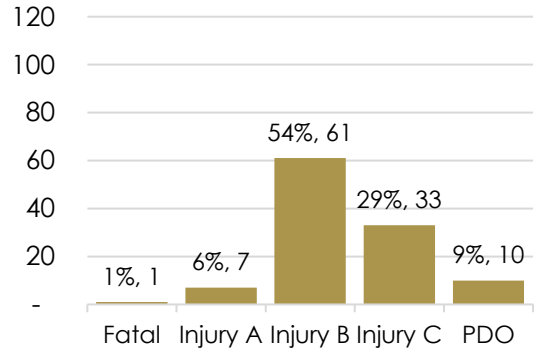


Figure 37: Bicyclist Crashes by Severity, Corvallis 2012-2016

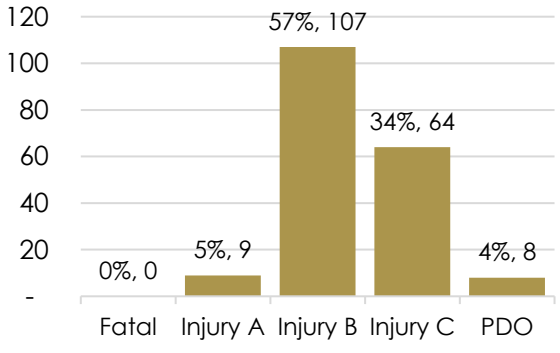


Figure 38: Bicyclist Crashes by Severity, Medford 2012-2016

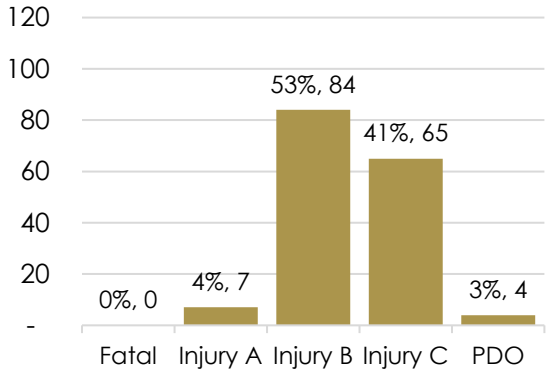
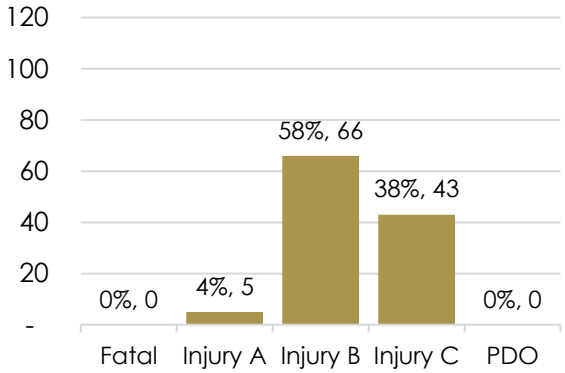


Figure 39: Bicyclist Crashes by Severity, Springfield 2012-2016



SUMMARY OF SIMILAR CITIES COMPARISON

Based on the comparison of similar cities presented in the previous sections, the following findings are identified for the Bend Area:

Table 3. Summary of Similar Cities Comparison (Based on 2012-2016 Reported Crash Data)

Topic	Bend UGB Area	Comparison
Crash Severity	59 percent of crashes did not result in injury (highest among comparison cities).	53 percent of crashes in Corvallis did not result in injury (second highest among comparison cities).
	Two percent of crashes in Bend, Medford, Corvallis, and Springfield resulted in fatal/incapacitating injuries.	
Crash Frequency	Crashes in Bend, Medford, Corvallis, and Springfield have increased from 2012 to 2016.	
	Bend had the highest average annual increase in crash frequency at 11 percent per year —higher than its associated population and VMT increase over the same time period.	The average annual increase in crash frequency among comparison cities was: 3.3 percent for Corvallis, 7.8 percent for Medford, and 4.9 percent for Springfield.
Trends Over Time	Crashes in Bend and in each of the comparison cities show a slight increase in crashes in the fall or winter months (September through December).	
	Bend, Medford and Springfield exhibited sharp increases in the number of fatal/incapacitating crashes between the months of July and September: the highest fatal/incapacitating crash frequency occurring during the months of August in Bend, September in Medford, and July in Springfield.	
Crashes by Light Conditions	Experienced the lowest share of fatal/incapacitating crashes occurring in dark, dawn, or dusk conditions (33 percent)	
	13 percent of reported crashes occurred in darkness with no streetlights	Corvallis, Medford, and Springfield observed three to four percent of reported crashes occurring in darkness with no streetlights
	Crashes in Bend and the three comparison cities show between 22 and 28 percent of crashes occurring in dark, dawn, or dusk conditions. However, the percentage of fatal/incapacitating crashes occurring in dark, dawn, or dusk conditions is substantially higher in all four cities.	
Collision Type	Crashes in Bend and the three comparison cities share similar frequent collision types among reported crashes: rear-end, turning movement, and angle crashes are the most common. Pedestrian crashes account for a small share of total reported crashes in the four cities but a meaningful share of fatal/incapacitating crashes.	
Behavioral Characteristics	Six percent of reported crashes involved alcohol or drug use; this number is tied for the highest percentage among the three comparison cities.	The percentage of total reported crashes involving alcohol or drugs in the three comparison cities is: six percent in Springfield, five percent in Medford, and three percent in Corvallis.

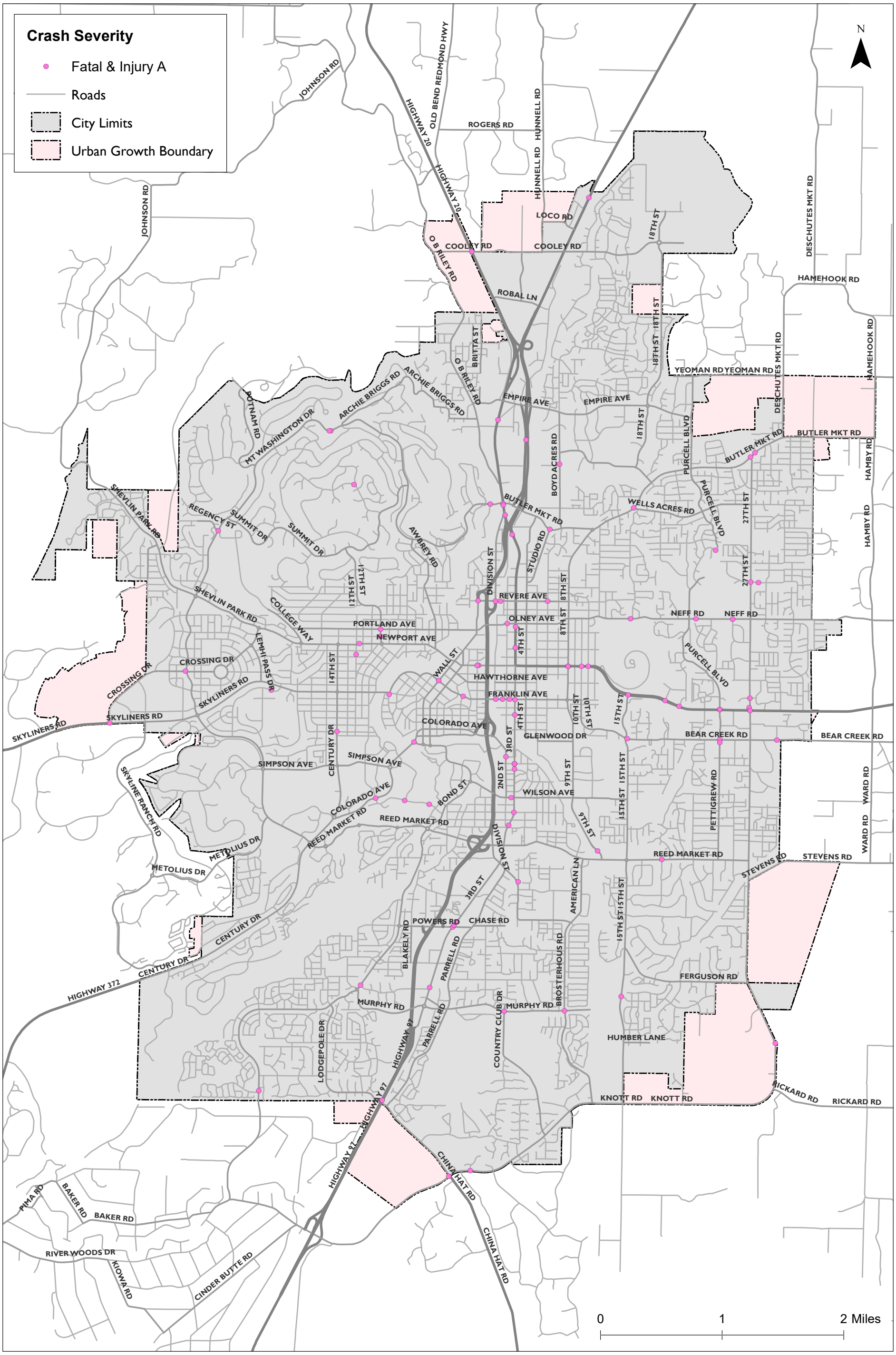
	Twenty percent of fatal/incapacitating crashes involve alcohol and/or drug use; this percentage is the highest among the three comparison cities.	The percentage of fatal/incapacitating crashes involving alcohol or drugs in the three comparison cities is: 18 percent in Springfield, 18 percent in Medford, and 15 percent in Corvallis.
Vulnerable Road Users	Twenty-four percent of reported pedestrian crashes and seven percent of reported bicyclist crashes resulted in fatality or severe injury. This percentage is higher than that of the three comparison cities.	Corvallis had the second highest fatal/incapacitating share among pedestrian and bicyclist crashes: 19 percent of pedestrian crashes and five percent of bicyclist crashes in Corvallis resulted in fatal/incapacitating injury.
	The majority (over 90 percent) of pedestrian and bicycle crashes in Bend and the three comparison cities resulted in some level of injury or fatality.	

BEND AREA CRASH ANALYSIS

This section presents additional crash data analysis for the Bend UGB area. Data from previous figures is often referred to below; additional data is presented when applicable.

CRASH LOCATIONS

Figure 40 illustrates the locations of fatal and incapacitating crashes in Bend between 2012 and 2016. As shown in the figure, a large percentage of fatal and incapacitating crashes in Bend occurred on major arterials, including Third Street and Highway 20. These roads carry high traffic volume, typically have wider cross-sections with up to five lanes, and have posted speed limits between 35 and 45 miles per hour (mph). However, Third Street and Highway 20 are not access controlled and each have frequent driveway access points to local businesses and side streets.



Fatal & Injury A Crashes (2012 - 2016)
Bend Area TSAP

Figure **40**

H:\23\23156 - Bend Area TSAP\gis\Mxd_Maps 1-2019\Ped Sidewalk.mxd - ahunter - 7:50 PM 3/5/2019

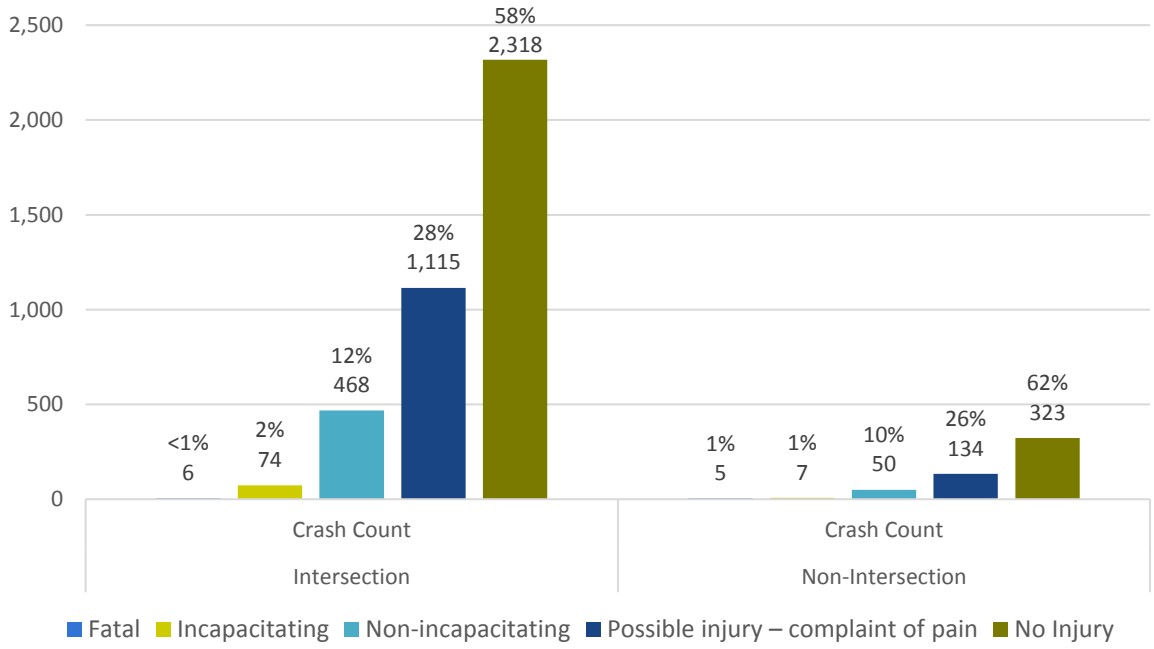
KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Coordinate System: NAD 1983 StatePlane Oregon South FIPS 3602 Feet Intl
Data Source: Bend MPO, City of Bend, Deschutes County, 2019.

Kittelson classified crashes by their location relative to intersections: those within 250 feet of an intersection were classified as *intersection crashes*, and those further than 250 feet from an intersection were classified as *non-intersection crashes*. Intersections represent locations within the street network with the highest concentration of conflict points (i.e., vehicle paths crossing). The majority of crashes (3,981 crashes, or 88 percent) occurred at intersections; a representative 87 percent of fatal/incapacitating crashes occurred at intersections. In comparison, the Oregon TSAP indicates that 34.4 percent of fatal/incapacitating crashes were intersection crashes statewide between 2009 and 2013; however, this includes reported crashes in the entire state, not just urban areas.

As shown in Figure 41, the injury severity distribution of intersection and non-intersection crashes in Bend is relatively similar, with two percent of crashes resulting in fatal/incapacitating injury, 10 to 12 percent of crashes resulting in non-incapacitating injuries, and 26 to 28 percent of crashes resulting in possible injuries.

Figure 41. Crashes by Location (Intersection and Non-Intersection), Bend 2012-2016



Intersection Traffic Control

Intersections in the City of Bend are typically either stop-controlled, signalized, or roundabouts. Stop-controlled intersections may be two-way stop-controlled (referred to as "stop" in the figure and table below), in which the major road traffic does not stop, or all-way stop-controlled (referred to as "4-way stop-controlled" below), in which every approach is required to stop. Using the City's GIS database of intersection control devices, Kittelson assigned the reported crash data with the corresponding intersection traffic control configuration. The resulting data is summarized in Figure 42.

Table 4 shows the distribution of intersection crashes by traffic control type. Almost half of fatal/incapacitating intersection crashes occurred at stop-controlled intersections, 28 percent at traffic signals, five percent at all-way stop-controlled intersections, and three percent at roundabouts.

Figure 42: Crashes by Intersection Control Type, Bend 2012-2016

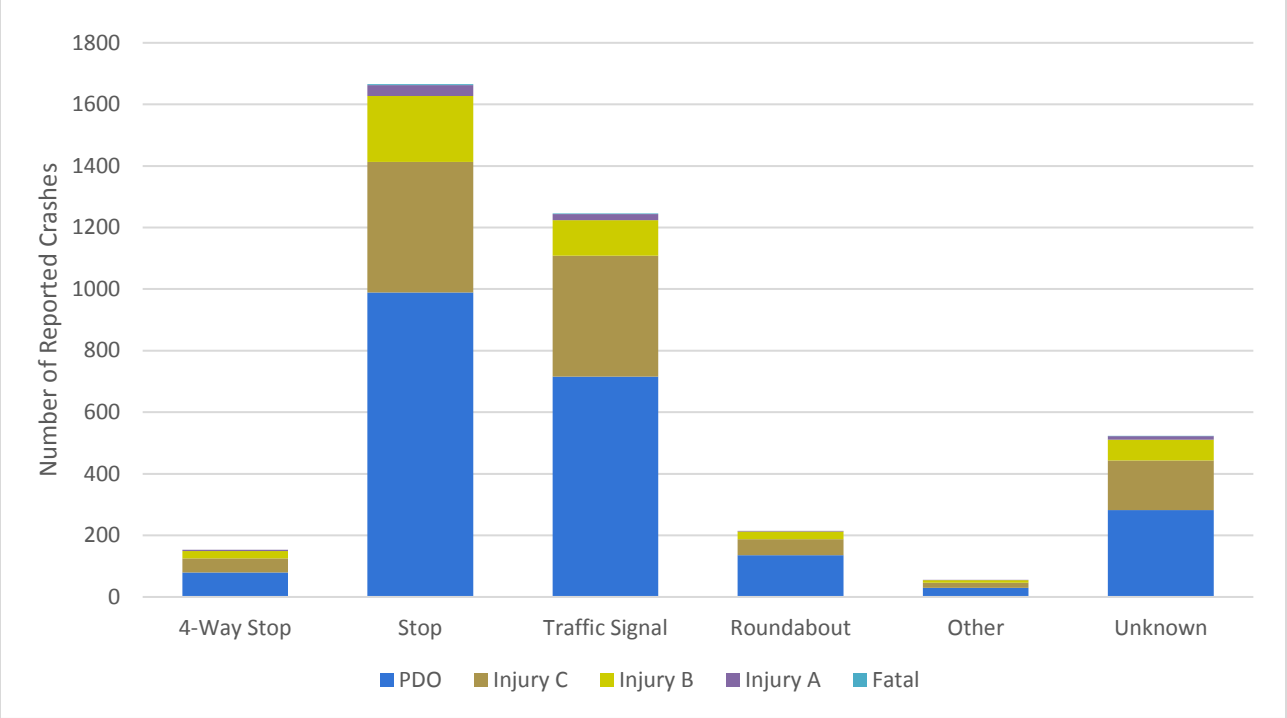


Table 4. Summary of Distribution by Intersection Control Type

Intersection Control	Percentage of Reported Intersection Crashes (Total)	Percentage of Fatal/ Incapacitating Intersection Crashes
4-Way Stop-Controlled	4%	5%
Stop-Controlled	43%	49%
Traffic Signal	32%	28%
Roundabout	6%	3%
Other	1%	1%
Unknown	14%	15%

TRENDS OVER TIME CRASH SUMMARY

Crashes by Month

As previously discussed and presented in Figure 16, overall crash frequency in Bend peaks in November and December while fatal and incapacitating crashes peak in August. The fatal and incapacitating crashes were also evaluated by year to understand if the number of fatal/incapacitating crashes was high each year; Kittelson found that the number of fatal/incapacitating crashes in August varied from one to six per year: five in 2012, two in 2013, one in 2014, three in 2015, and six in 2016. This section further evaluates light and road conditions by month to understand possible contributing factors to the monthly trends.

Figure 43 breaks down the monthly trend by reported light conditions. Crashes occurring in darkness constitute a higher share of reported crashes in winter months (November through January, when there is more darkness).

Figure 44 shows a breakdown of the monthly trend by roadway surface conditions. The majority of crashes occur in dry conditions, while crashes occurring on snow and ice were most common November through February. December had the highest percentage of crashes, 67 percent of reported crashes, in snow, ice or wet conditions.

Figure 43: Crashes by Month and Light Conditions, Bend 2012-2016

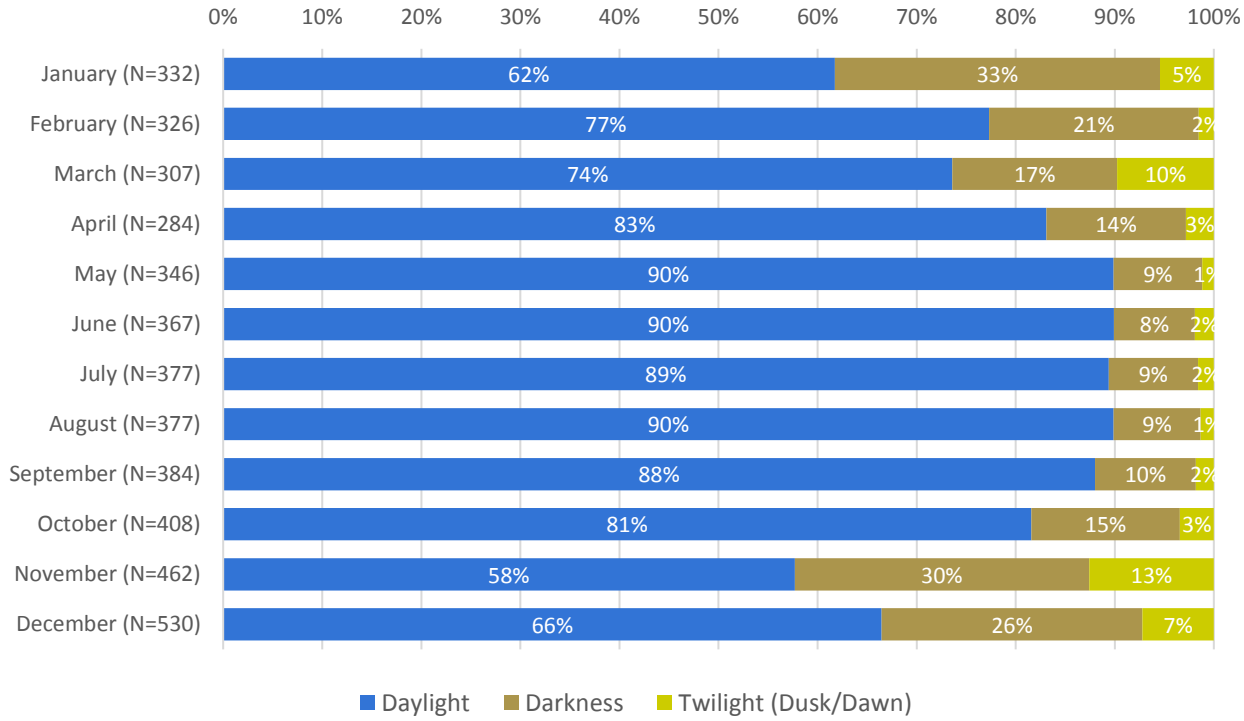
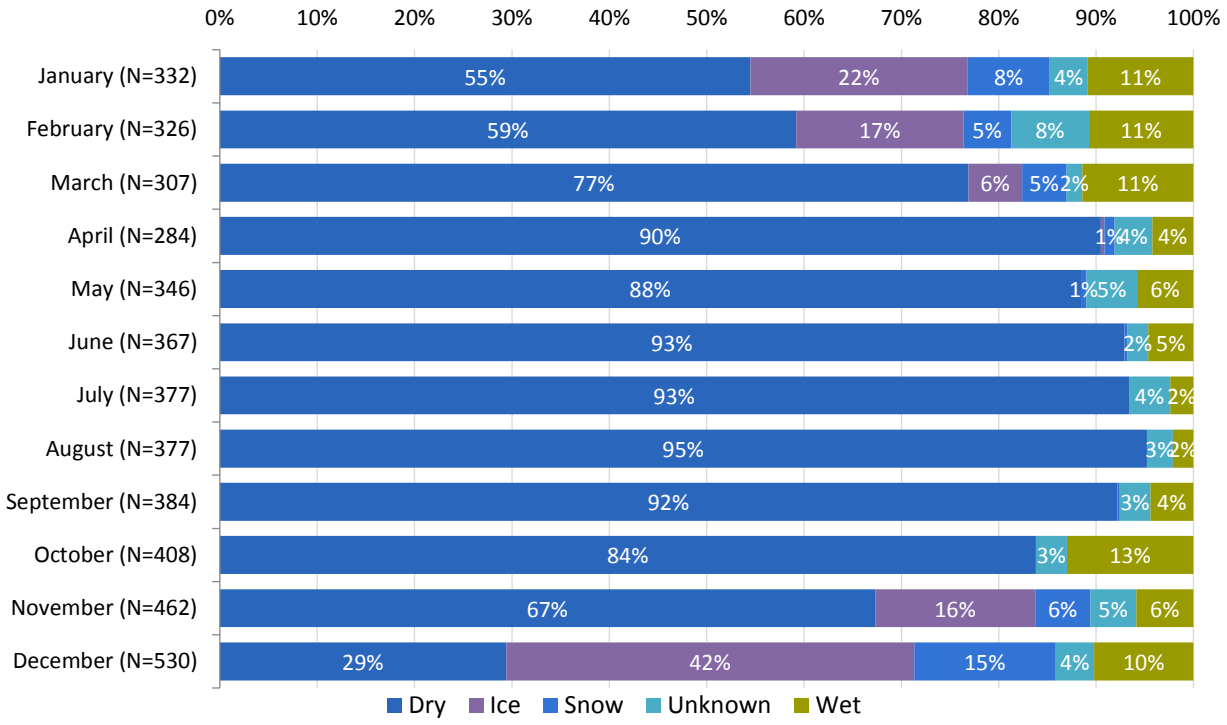


Figure 44: Crashes by Month and Roadway Conditions, Bend 2012-2016



Closer inspection of fatal/incapacitating crashes shows that among the 92 fatal/incapacitating crashes, 17 crashes (18 percent) occurred in August, notably higher than any other month. These 17 crashes were further

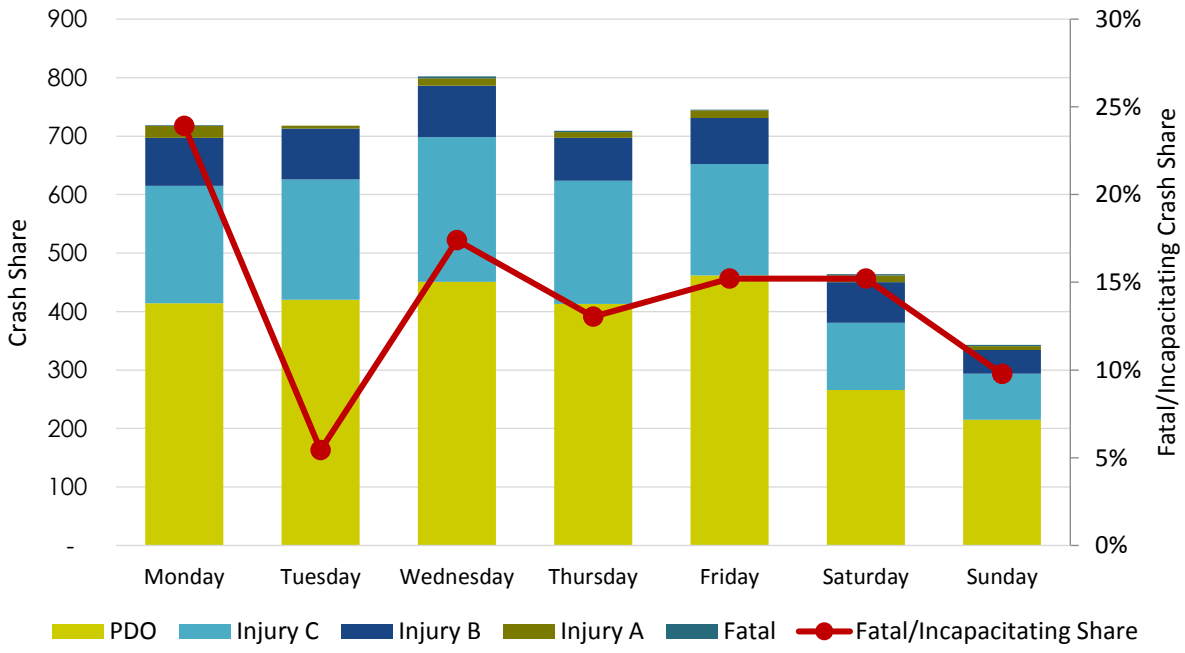
examined to determine what factors may be associated with this increase. No strong patterns were found. The following summaries pertain to crashes in August:

- Of the 17 reported fatal/incapacitating crashes in August, crash types included:
  - Rear-end crashes (6 crashes; 35 percent);
  - Turning movement and Angle (5 crashes, 29 percent);
  - Fixed object and Non-collision (4 crashes , 23 percent);
  - Sideswipe overtaking (1 crash, 6 percent);
  - Pedestrian (1 crash, 6 percent).
- Three of the reported crashes (18 percent) involved bicyclists (one turning movement, one angle, and one sideswipe overtaking crash).
- Four of the 17 crashes (24 percent) involved alcohol; none involved drugs.
- Three of the 17 crashes (18 percent) occurred in dark or dusk conditions.
- Two of the 17 crashes (12 percent) involved excessive speed.

Crashes by Weekday

Overall, crashes in Bend are highest on Wednesdays (18 percent of reported crashes occurred on Wednesdays, compared to 16 to 17 percent of crashes on other weekdays), as shown in Figure 45. The reported crash data for Medford, Corvallis, and Springfield showed a relatively constant trend throughout the week, but the highest overall frequency in those cities occurred on Friday. There is a sharp decrease in crash frequency in Bend on Saturdays and Sundays, which also occurred in Medford, Corvallis, and Springfield. The distribution of fatal and incapacitating crashes is relatively constant throughout the week, with a peak on Mondays and a drop on Tuesdays.

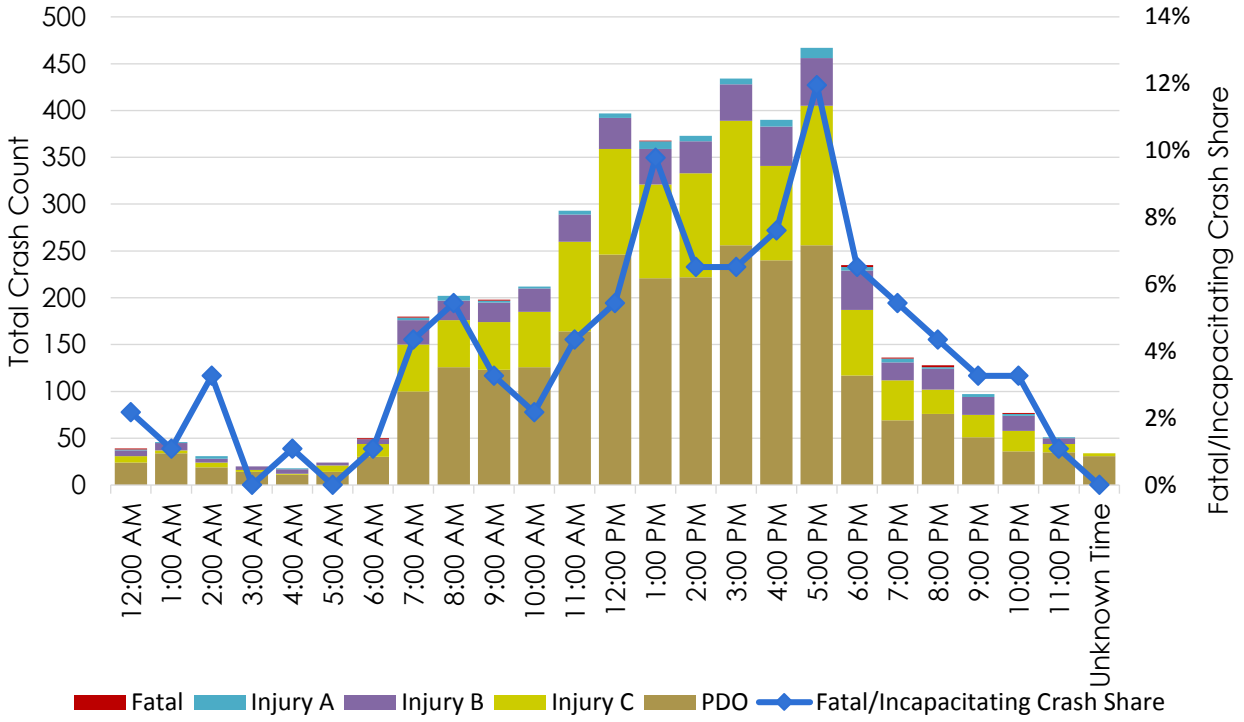
Figure 45: Crashes by Weekday and Severity, Bend 2012-2016



Crashes by Time of Day

Crashes overall – and fatal/incapacitating crashes – peak during the 5:00 p.m. hour, which is also when traffic volumes typically peak due to the evening commute. Twelve percent of fatal/incapacitating crashes occurred during the 5:00 pm hour, and 26 percent of fatal/incapacitating crashes occurred between 4:00 and 7:00 p.m.

Figure 46: Crashes by Hour, Bend 2012-2016

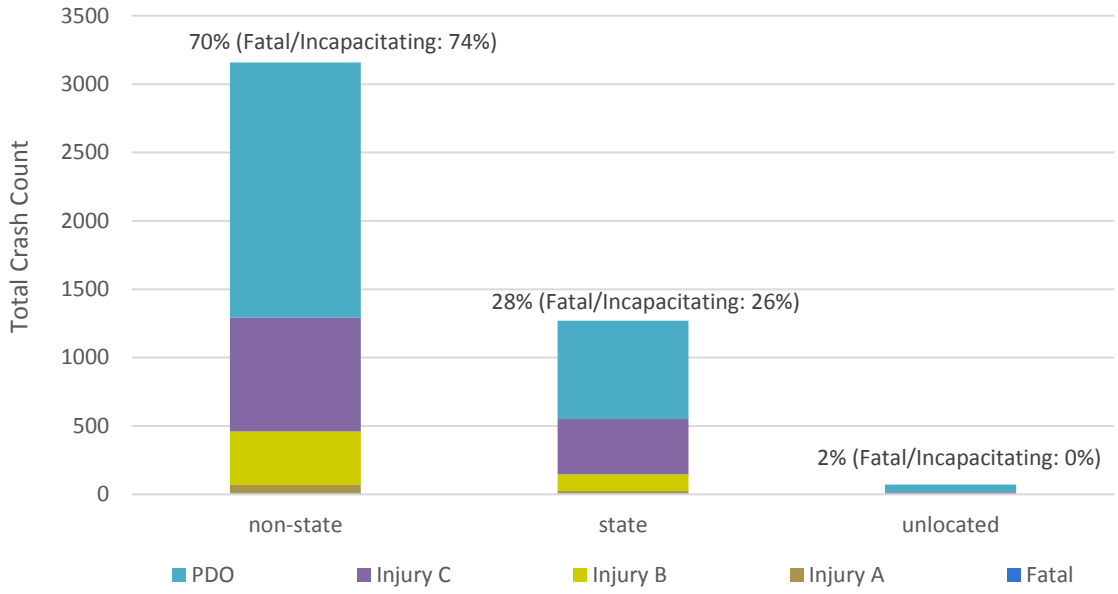


ROADWAY CHARACTERISTICS

State Highways

Figure 47 presents Bend crashes classified by location relative to state highways (US 97 and US 20). Crashes that occurred at the intersection on a state highway were assigned to the state highways for this summary. ODOT identified 71 crashes (no fatal or incapacitating injury crashes) that were unlocatable and therefore are not assigned to state or non-state roads). As shown in the figure, 28 percent of reported crashes in the UGB and 26 percent of fatal/incapacitating crashes in the UGB occurred on state highways.

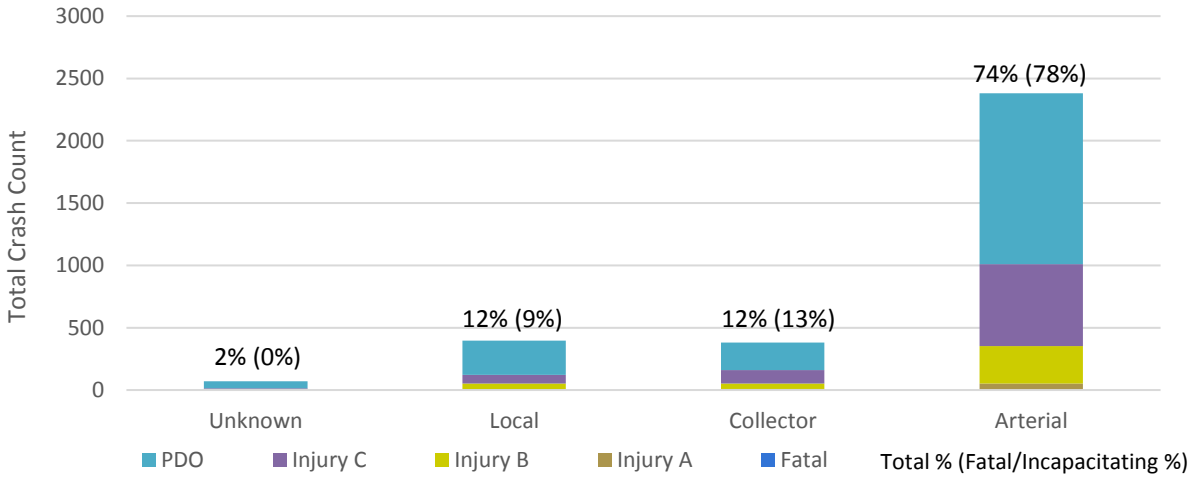
Figure 47. Highway vs Non-Highway Crashes, Bend 2012-2016



Roadway Functional Classification

Kittelson mapped crashes and spatially linked roadway attributes, including functional classification, to each crash. In the case of crashes occurring within intersection influence area (250 feet from the center of the intersection), crashes were assigned to the higher order roadway. Of the 3,230 crashes that occurred on non-state roads, 74 percent occurred on arterials. Among the 68 fatal and incapacitating crashes that occurred on non-state roads, 78 percent occurred on arterials.

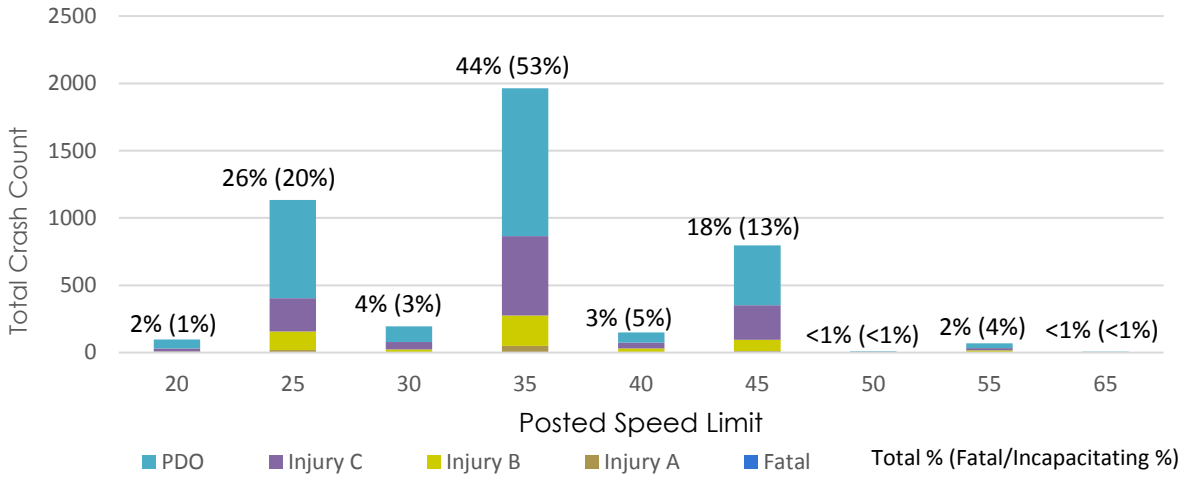
Figure 48. Non-Highway Crashes by Functional Classification and Severity, Bend 2012-2016



Posted Speed Limit

Crashes were categorized based on the posted speed limit of the road where they occurred, using the City of Bend's GIS network. When crashes occurred within an intersection influence area (250 feet), they were assigned the higher speed limit of the two roadways intersecting, similar to the approach taken for functional classification. As shown in Figure 49, the majority of crashes occurred on roads with posted speed limits of 35 miles per hour (mph), 25 mph, and 35 mph.

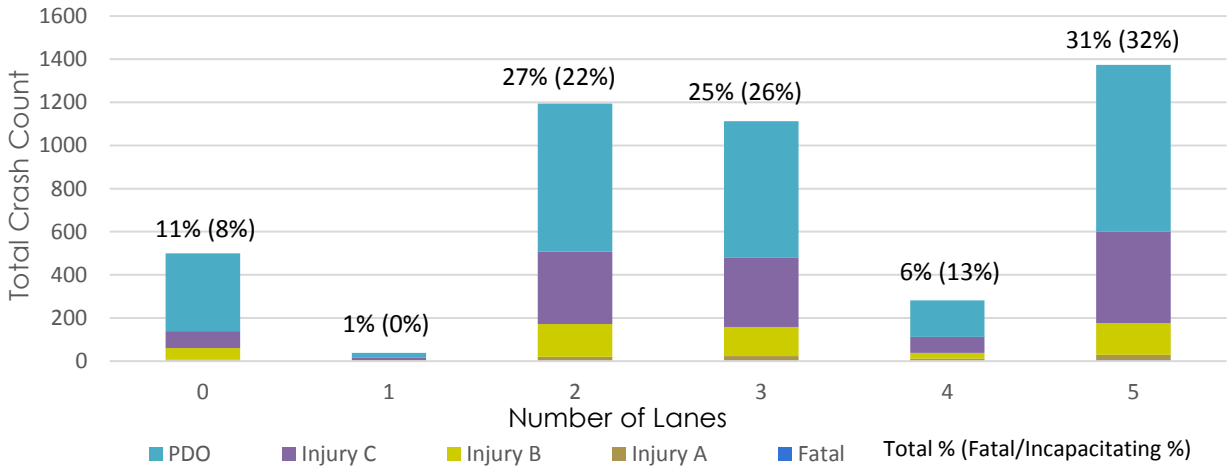
Figure 49. Crashes by Posted Speed, Bend 2012-2016



Number of Lanes

Crashes were categorized based on the number of lanes on the roadway where they occurred, using the City of Bend's GIS network. When crashes occurred within an intersection influence area (250 feet), they were assigned the higher number of lanes of the two roadways intersecting, similar to the approach taken for functional classification and posted speed limit. As shown in Figure 50, the highest percentage of reported crashes (and fatal/incapacitating crashes) occurred on roadways with five lanes.

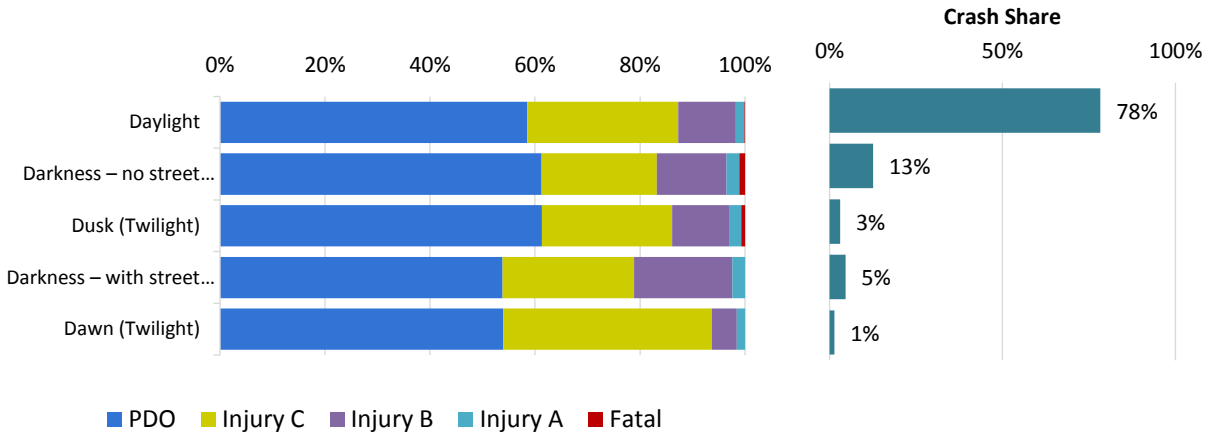
Figure 50. Crashes by Number of Lanes



Lighting Conditions

As previously discussed and shown in Figure 20, Bend experienced a lower percentage of crashes occurring in dark, dawn, or dusk conditions, relative to the three comparison cities. However, the share of crashes occurring in dark conditions with no streetlights was higher than that of the comparison cities. Figure 51 shows the breakdown of crashes in Bend by light condition and severity. As shown in the figure, crashes occurring in dark conditions were not substantially more likely to result in injury compared to crashes in daylight.

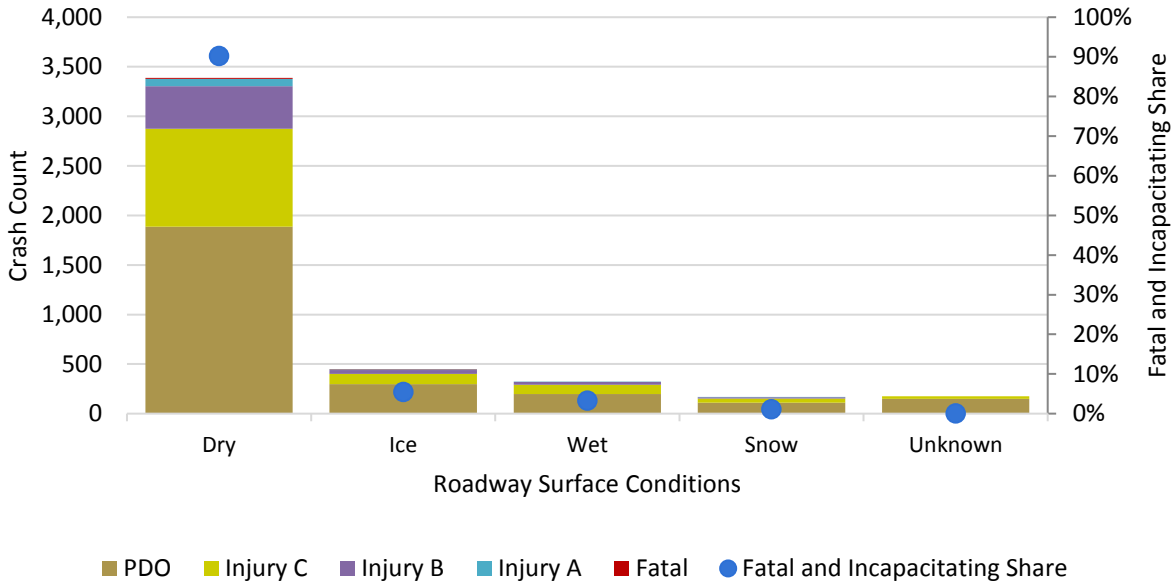
Figure 51. Crashes by Lighting Condition, Bend 2012-2016



Road Surface Conditions

As shown in Figure 52, the majority (75 percent) of crashes in Bend occurred on dry roadways. Fourteen percent occurred on snowy or icy roads. Among fatal and incapacitating crashes, 90 percent occurred on dry roads. Six percent of the fatal/incapacitating crashes occurred on snow or icy roads. Therefore, snow and ice conditions are not necessarily associated with an increase in severity of the crash.

Figure 52. Crashes by Road Surface Conditions, Bend 2012-2016



COLLISION TYPE AND CONTRIBUTING FACTORS

Collision types for Bend were presented in Figure 24. More detail is provided below.

Collision Type

The four most common collision types, accounting for 86 percent of total crashes, were (1) rear-end crashes (40 percent), (2) turning movement crashes (24 percent), (3) angle crashes (13 percent), and (4) fixed object or other object (nine percent). When isolating fatal/incapacitating crashes (presented in Figure 53), the top five crash types include the same four types plus pedestrian crashes. These five crash types collectively constitute 89 percent of fatal/incapacitating crashes.

The Oregon TSAP, summarized in Section 4 of this memo, identifies intersection crashes and roadway departure crashes as emphasis areas for the state. Turning movement, angle, and some rear-end crashes are typically associated with intersections. These three crash types account for 64 percent of fatal/incapacitating crashes in Bend. Roadway departure crashes, or lane departure crashes, include those in which vehicles leave their travel lane: fixed object or other object, head-on, sideswipe, and non-collision (rollover). These roadway departure crashes account for 20 percent of fatal/incapacitating crashes in Bend.

Figure 54 summarizes the injury severity of reported crashes based on collision type. As shown in Figure 54, pedestrian crashes, head-on crashes, and non-collision crashes are more likely to result in injury compared to other collision types.

Figure 53. Collision Type among Fatal/Incapacitating Crashes, Bend 2012-2016

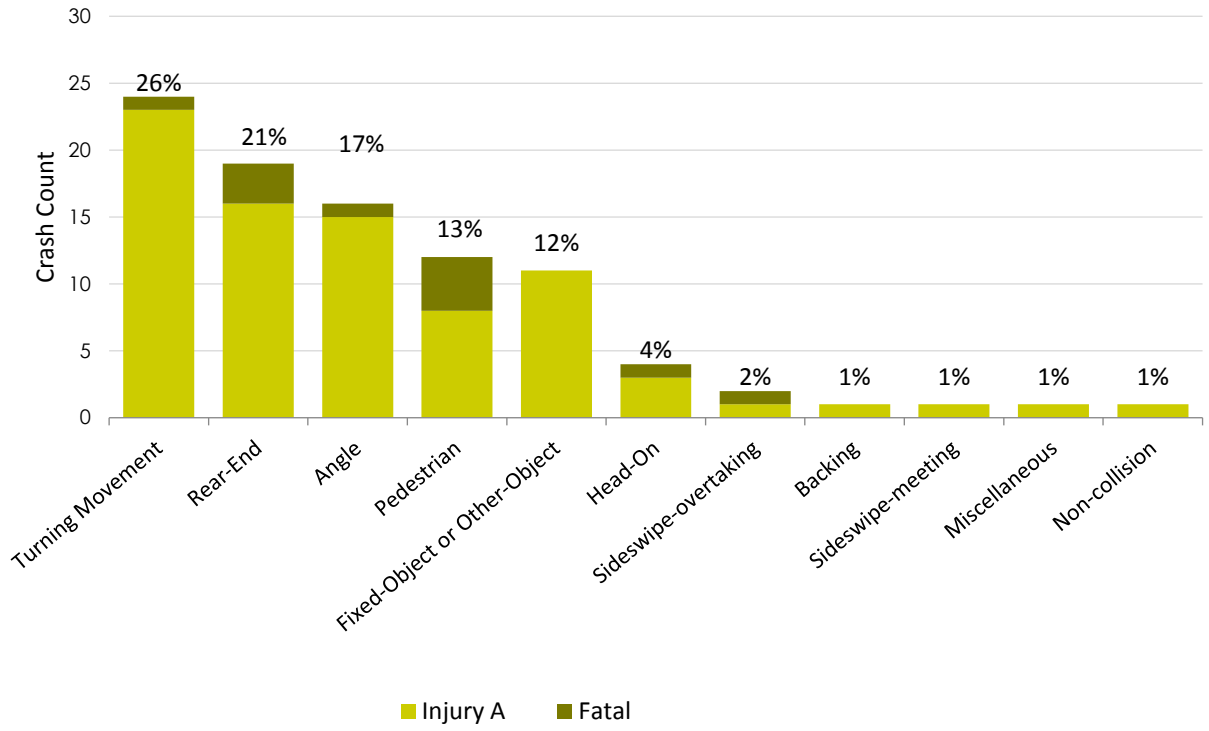
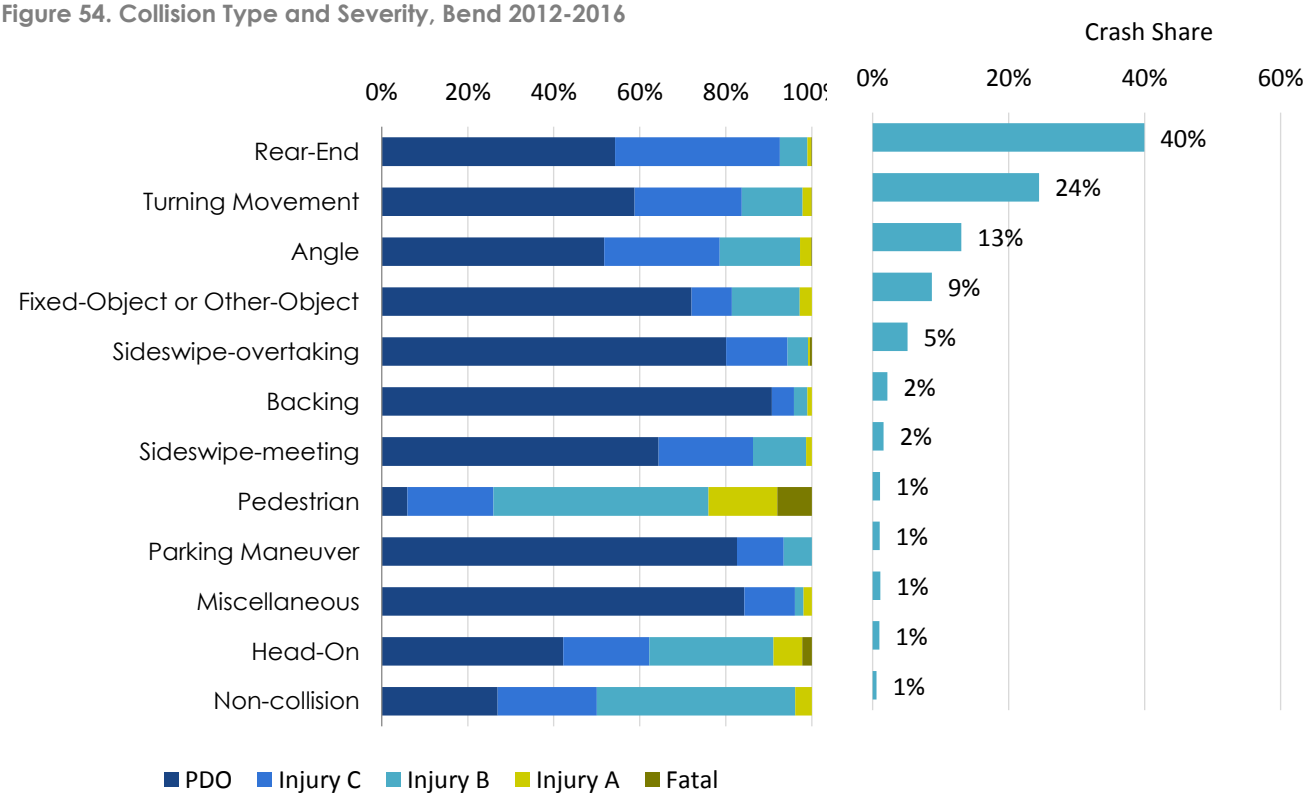


Figure 54. Collision Type and Severity, Bend 2012-2016



Bicycle crashes are distributing among the collision types rather than being identified as their own unique collision type. The following information summarizes the more detailed *crash data* information for bicycle crashes to understand the most common bicycle crash types:

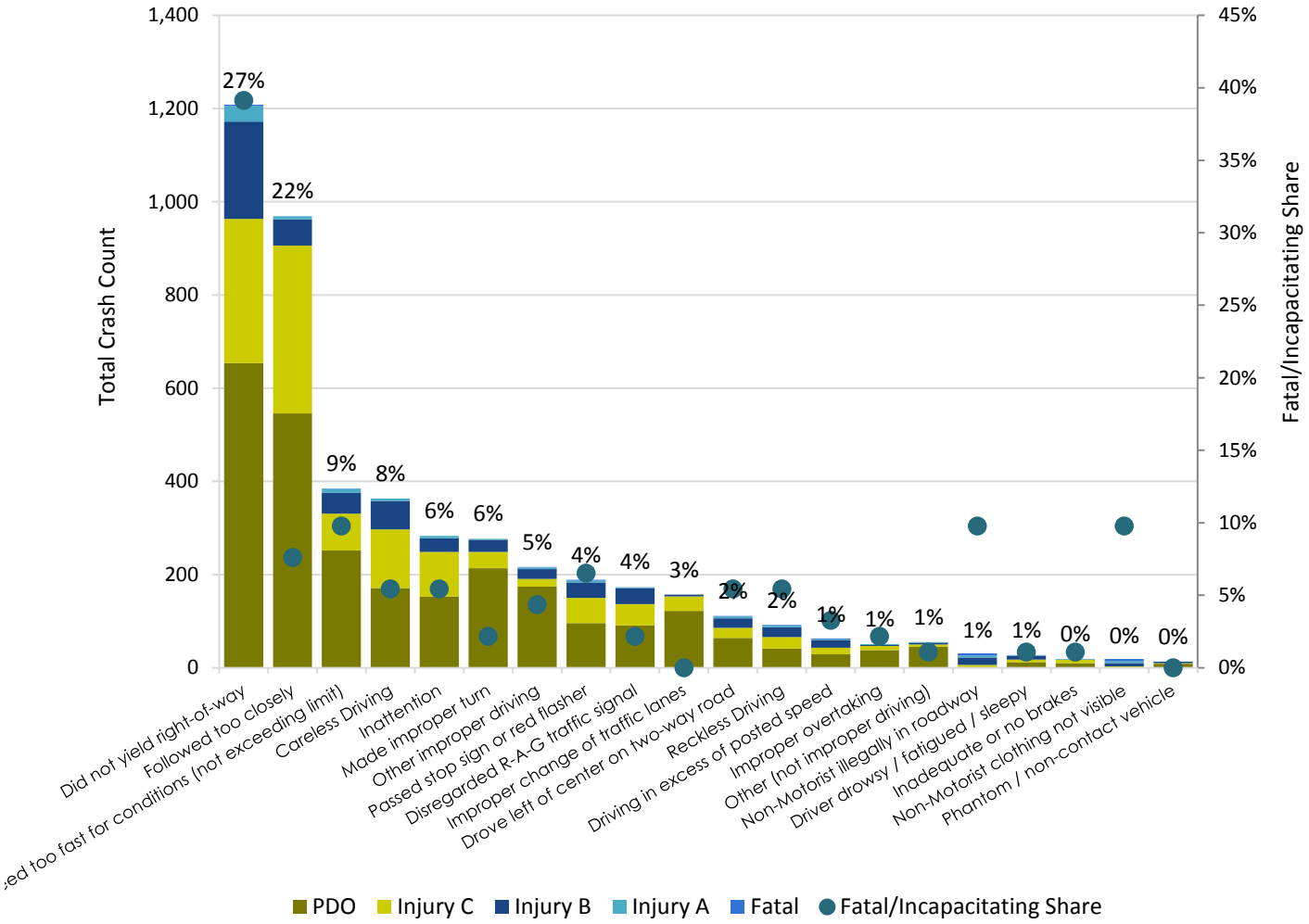
- 49 percent of reported bicycle crashes (55 crashes) were turning movement crashes;
- 37 percent of reported bicycle crashes (41 crashes) were angle crashes;
- 7 percent of reported bicycle crashes (8 crashes) were rear-end crashes;
- 4 percent of reported bicycle crashes (5 crashes) were sideswipe-overtaking crashes;
- 1 bicycle crash was a sideswipe-meeting crash;
- 1 bicycle crash was a backing crash; and
- 1 bicycle crash was a parking maneuver crash.

Crash Contributing Factors

Figure 55 summarizes the reported contributing factors for each crash. For each crash, the corresponding police officer codes up to three causes, or contributing factors. For example, a crash may be recorded as caused by a driver failing to yield the right-of-way and caused by reckless driving. For this analysis, each crash is counted by all applicable recorded factors; the example crash would be included in counts of both attributes. Thus, the totals in Figure 55 may total more than 100 percent. These figures have also filtered out crash factors that account for less than one percent of crashes in the city *and* account for no fatal crashes.

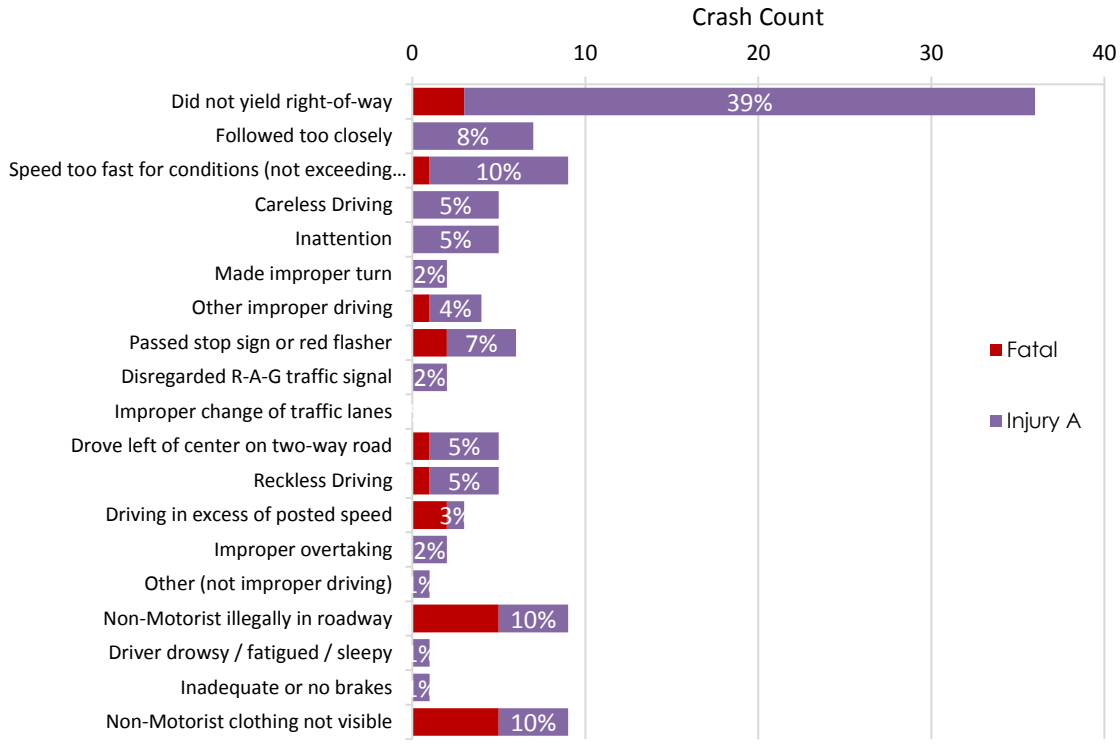
As shown in Figure 55, the most common reported causes in Bend were *did not yield right-of-way*, *followed too closely*, *speed too fast for conditions (not exceeding limit)*, *careless driving*, *inattention,* and *made improper turn*. The majority of crashes with a contributing factor of *did not yield right-of-way* were angle or turning movement crashes. The majority of crashes with a contributing factor of *followed too closely* were rear-end crashes.

Figure 55. Crashes by Contributing Factors and Severity, Bend 2012-2016



As with crash type comparison, many low-frequency crash types carry a relatively high proportional share of fatal and incapacitating crashes. Figure 56 presents the contributing factors cited by police for fatal/incapacitating crashes. The top cited cause remains failure to yield right-of-way (39 percent of fatal/incapacitating crashes); the next-highest causes are *speed too fast for conditions*, *non-motorist illegally in roadway*, and *non-motorist not visible* all constituting 10 percent of fatal/incapacitating crashes). These contributing factors are associated with excessive speed and with pedestrians, both of which represent previous safety focus areas for the City of Bend.

Figure 56. Crashes by Cause Among Fatal/Incapacitating Crashes, Bend 2012-2016



BEHAVIORAL CHARACTERISTICS

This section summarizes crash characteristics associated with driver behavior or driver characteristics. Although issues with some of these characteristics can be addressed through engineering treatments, many of these are often best addressed though education and enforcement programs targeted at behaviors.

Speeding

Speeding is captured specifically in two separate contributing factors: (1) exceeding the posted speed limit and (2) traveling too fast for conditions; though it may also be a contributor in other categories). ODOT summarizes this data from the two categories in an "excessive speeding" flag to identify crashes associated with speed as a factor. As shown in Table 5, excessive speeds were flagged in approximately 10 percent of all crashes in the Bend UGB. The fatal/incapacitating share is slightly higher, with 13 percent of crashes involving excessive speeds.

Table 5: Excessive Speeding, Bend 2012-2016

Excessive Speed Flag	Fatal	Injury A	Injury B	Injury C	PDO	Total
No	8	72	448	1,144	2,356	**4,028 (90%)**
Yes	3	9	70	105	285	**472 (10%)**
Total	**11**	**81**	**518**	**1,249**	**2,641**	**4,500**

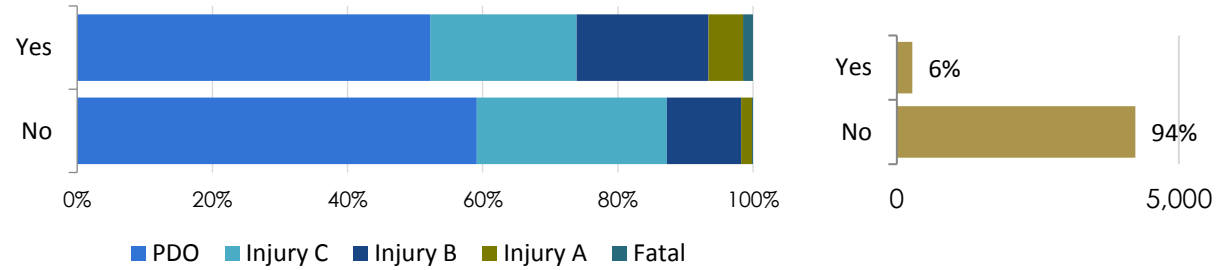
Distracted Driving

Data on distracted driving is difficult to collect. Police officers are able to indicate *cell phone use involved* as a contributing factor on the crash reports. However, officers are often unable to prove if a cell phone was involved. In addition, this does not capture other forms of distracted driving. Although this issue lacks adequate supporting data, it will be carried forward to identify recommendations to address the issue.

Alcohol and Drug Use

Six percent of all crashes in Bend involved alcohol or drug impairment, and 20 percent of fatal/incapacitating crashes involved alcohol or drug impairment. As shown in Figure 57, impaired driving crashes are more likely to result in injury than those that do not involve impaired driving.

Figure 57. Alcohol and Drug Crashes, Bend 2012-2016



Driver Residence

Driver residence is listed for each driver involved in a crash. This information is provided at the level of specificity given in Table 6. Among drivers for whom this statistic was reported, the vast majority were within 25 miles of their residence, and only three percent of drivers were not Oregon residents.

Table 6: Driver Residence, Bend Crashes 2012-2016

Driver Residence	Crash Count	Share among Drivers
Non-resident	202	3%
Oregon Resident <25 mi of home	6,479	92%
Oregon Resident >25 mi of home	346	5%
Oregon Resident: Unknown Distance	40	1%
Total	**7,067**	**100%**

Safety Equipment Use

Crash data indicates the number of participants in a crash who used and did not use safety equipment. Safety equipment includes seat belts, child seats, booster seats, and bike helmets. Based on this data, shown in Table 7, ten percent of fatal/incapacitating crashes involved at least one participant who was not using safety equipment. Bend has relatively high safety equipment usage, with 97 percent of crashes involving all participants using safety equipment. However, of the crashes that involved participant(s) not using safety equipment, 84 percent resulted in injury and/or fatality.

Table 7: Safety Equipment Usage, Bend Crashes 2012-2016

	Fatal	Injury A	Injury B	Injury C	PDO	Total
Safety equipment used by all participants	7	76	460	1,204	2,619	**4,366 (97%)**
Safety equipment not used by at least one participant	4	5	58	45	22	**134 (3%)**
Total	**11**	**81**	**518**	**1,249**	**2,641**	**4,500**

VULNERABLE USERS

Pedestrian Crashes

Although pedestrian crashes accounted for less than one percent of reported crashes in Bend, they accounted for 13 percent of fatal/incapacitating crashes in the UGB. Among the 50 reported collisions involving pedestrians in the five-year period analyzed, 24 percent of collisions resulted in incapacitating injury or death, and 94 percent of reported pedestrian crashes resulted in some form of injury or fatality. The fatal/incapacitating injury share among all collisions in Bend was two percent. In total, four of 11 fatal collisions in Bend were pedestrian collisions.

Table 8: Pedestrian Collisions, Bend, 2012-2016

Collision Severity	Collision Frequency	Collision Share
Fatal	4	8%
Injury A	8	16%
Injury B	25	50%
Injury C	10	20%
PDO	3	6%
Total	**50**	**100%**

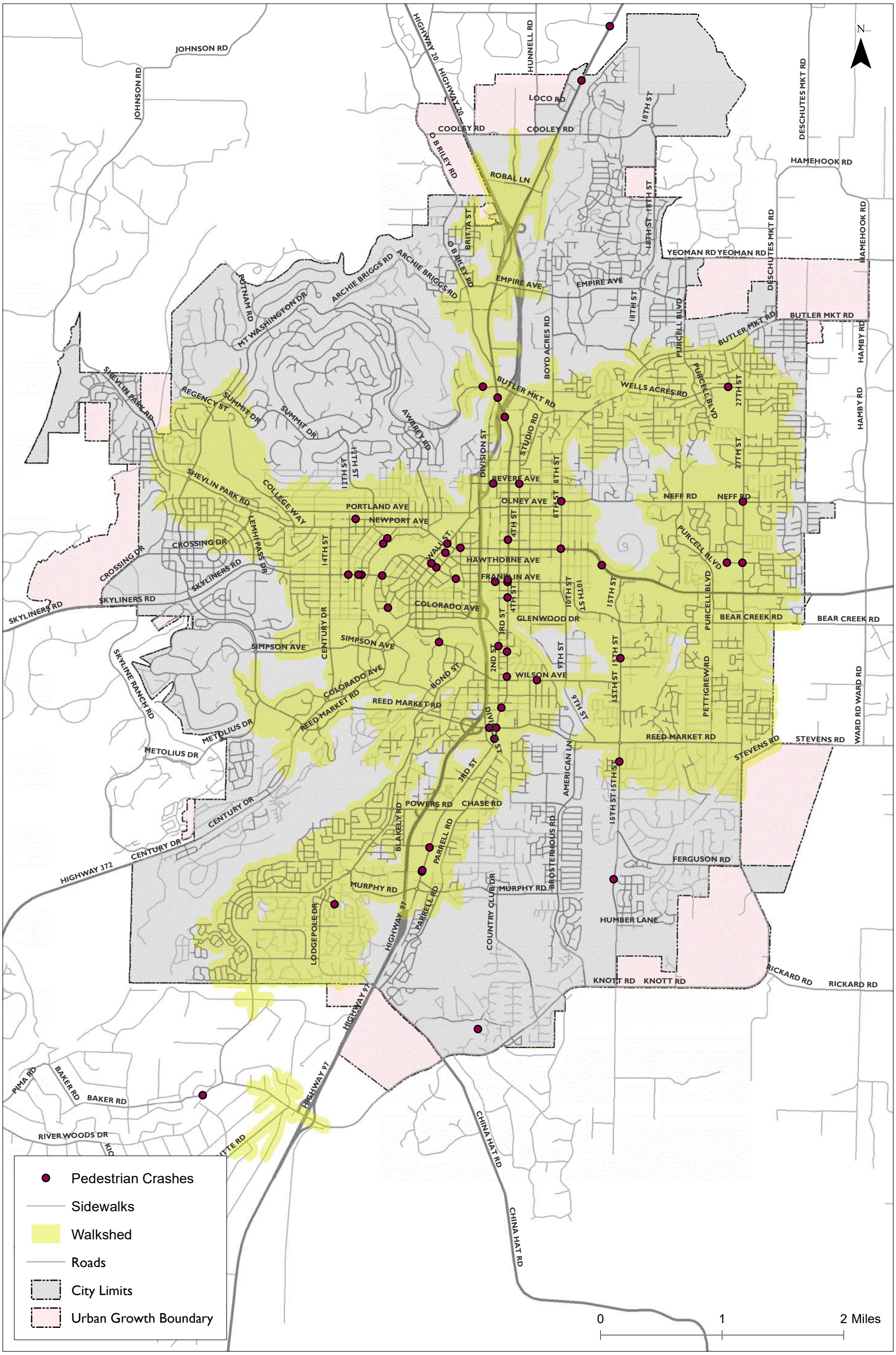
Figure 58 shows the location of pedestrian crashes in Bend, along with locations of existing sidewalks and a ½-mile walkshed around current transit stops. Pedestrian crashes were most common in the core area of the City, including downtown and along 3rd Street.

Ninety percent of the reported pedestrian crashes (45 crashes) occurred within 250 feet of an intersection. Of those at intersections, 53 percent (24 crashes) occurred at stop-controlled intersections, 31 percent (14 crashes) occurred at traffic signals, seven percent (3 crashes) occurred at all-way stop-controlled intersections, and nine percent (4 crashes) occurred at unknown intersections. No pedestrian crashes were reported at roundabouts during the study period.

Table 9 summarizes the number of pedestrian crashes by number of lanes on the road where they occurred. As shown in the table, the highest number of pedestrian crashes occurred on five-lane and three-lane roads.

Table 9: Pedestrian Collisions by Number of Lanes on Roadway, Bend 2012-2016

Number of Lanes on Roadway	Number of Reported Pedestrian Crashes	Percentage of Reported Pedestrian Crashes
0	8	16%
2	6	12%
3	12	24%
4	6	12%
5	18	36%
Total	**50**	**100%**



Pedestrian Crashes (2012 - 2016) & Sidewalks
Bend Area TSAP

Figure **58**

H:\23\23156 - Bend Area TSAP\gis\Mxd_Maps 1-2019\Ped Sidewalk.mxd - ahunter - 1:18 PM 3/5/2019

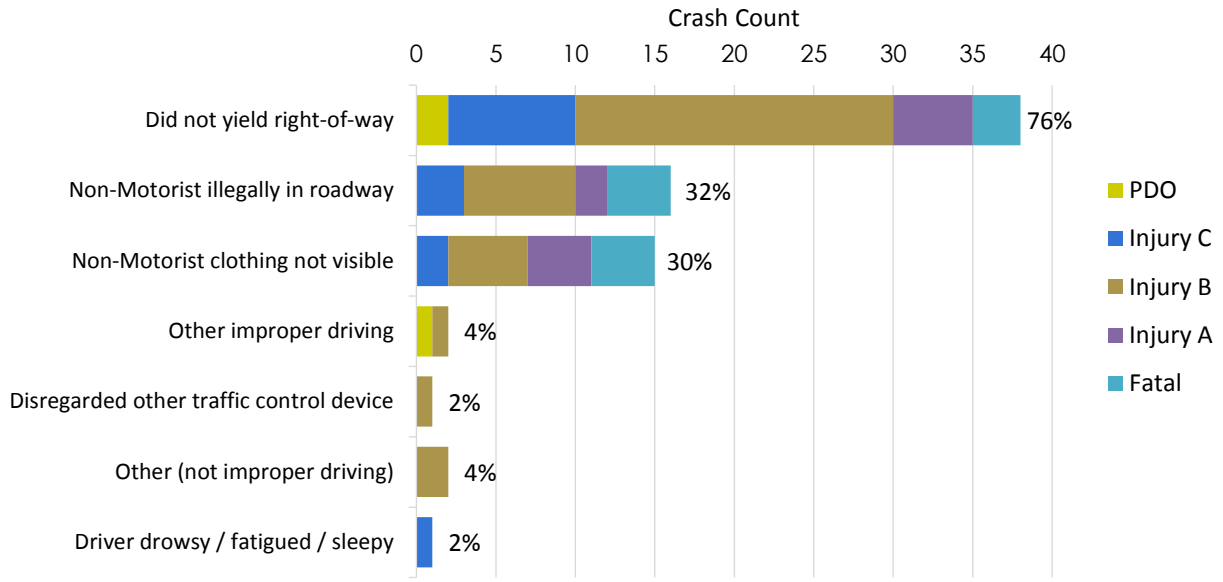
KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Coordinate System: NAD 1983 StatePlane Oregon South FIPS 3602 Feet Intl
Data Source: Bend MPO, City of Bend, Deschutes County, 2019.

Crash Contributing Factors (Pedestrian Crashes)

For each collision, up to three fields may be listed as the "crash-level contributing factors," indicating road user behavior that in part contributed to the collision. Figure 59 presents the reported contributing factors among pedestrian collisions in Bend. Because more than one may be reported per collision, the total sums to greater than 100 percent.

Figure 59. Pedestrian Collision Contributing Factors, Bend, 2012-2016



In 76 percent of cases, one contributing factor reported was *failure to yield the right-of-way*. This could include either a driver or a pedestrian failing to yield right-of-way. Fifteen (15) pedestrian collisions included a pedestrian wearing clothing recorded as not visible (presumably dark clothing or lacking reflective elements); all 15 of these collisions occurred in darkness—three with streets lights on and 12 in the absence of streetlights. More detail on time of day and lighting trends is shared in the subsequent section.

Time-of-Day / Light Conditions (Pedestrian Crashes)

Figure 60 presents pedestrian collisions by time of day. There is a clear peak in pedestrian collisions around the traditional p.m. peak hours; fatal and incapacitating collisions predominantly occurred in the evening/nighttime hours as well, with eight of 12 such collisions occurring between 5:00 p.m. and 11:00 p.m. lighting conditions are related to the time of day collisions occur. Figure 61 illustrates the four fatal pedestrian collisions occurred in the absence of streetlights (along with eight of 12 fatal/incapacitating pedestrian collisions combined).

Figure 60. Pedestrian Collisions by Time-of-Day, Bend 2012-2016

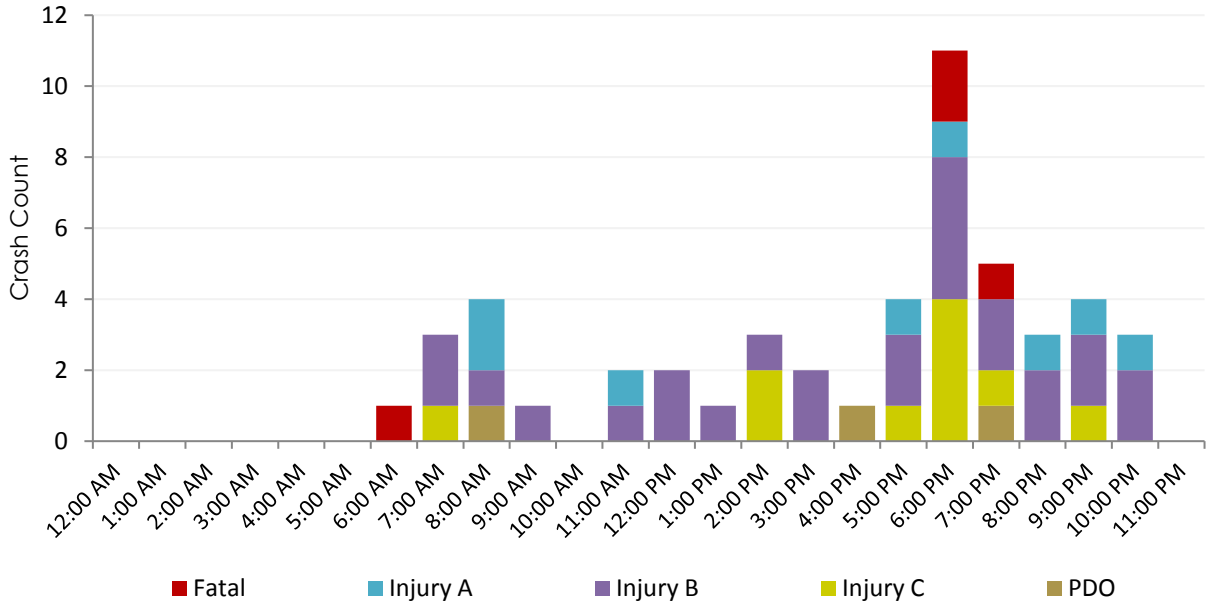
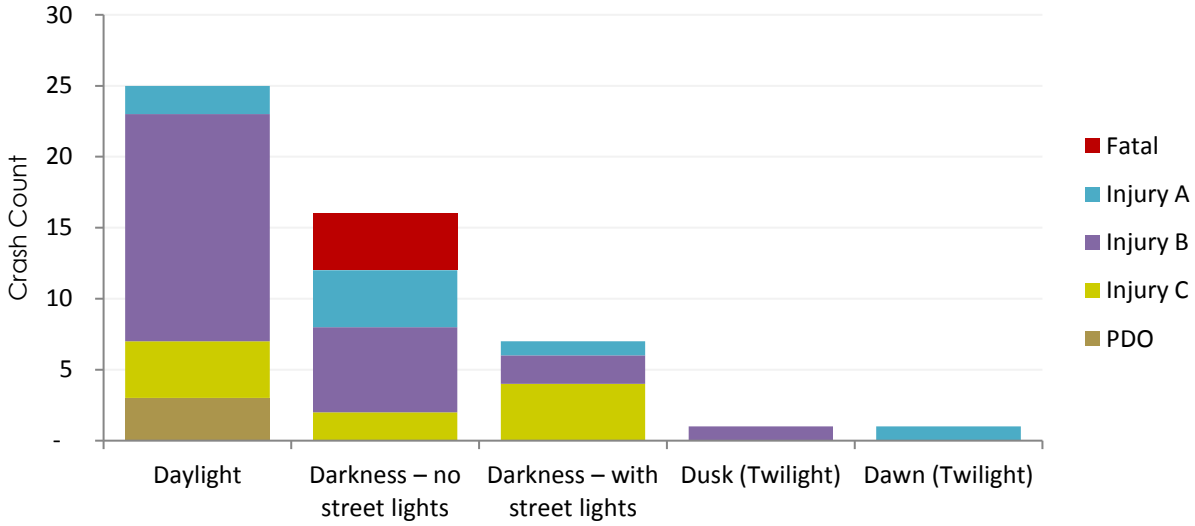


Figure 61. Pedestrian Collisions by Lighting Conditions, Bend 2012-2016



Alcohol/Drug Use (Pedestrian Crashes)

Thirteen (13) of the 50 pedestrian collisions (26 percent) were recorded as involving alcohol or drug impairment by at least one party. One of four fatal collisions, and three of five incapacitating collisions, were included among these collisions, indicating that 45 percent of fatal/incapacitating pedestrian crashes involved alcohol or drugs.

Further evaluation by user revealed that 12 of 54 pedestrians involved in reported crashes had used alcohol, according to the police officer. None of the pedestrian crash reports indicated that a pedestrian had been using drugs.

Pedestrian Age

There were 54 pedestrians involved in the 50 reported pedestrian crashes. The distribution of pedestrians by age was:

- Nine pedestrians (17 percent) were between ages five and 17;
- Eight pedestrians (15 percent) were between ages 18 and 24;
- Twelve pedestrians (22 percent) were between ages 25 and 44;
- Eighteen pedestrians (33 percent) were between ages 45 and 64;
- Five pedestrians (9 percent) were age 65 or older; and
- Two pedestrians (4 percent) did not have an age reported.

Bicycle Crashes

Bicycle crashes accounted for two percent of reported crashes in the Bend UGB and nine percent of fatal/incapacitating crashes between 2012 and 2016. Among the 112 reported collisions involving bicyclists in the five-year period analyzed, seven percent of collisions resulted in incapacitating injury or death, as shown in Table 10. By comparison, the fatal/incapacitating injury share among all collisions in Bend was two percent.

Table 10: Bicyclists Collisions, Bend, 2012-2016

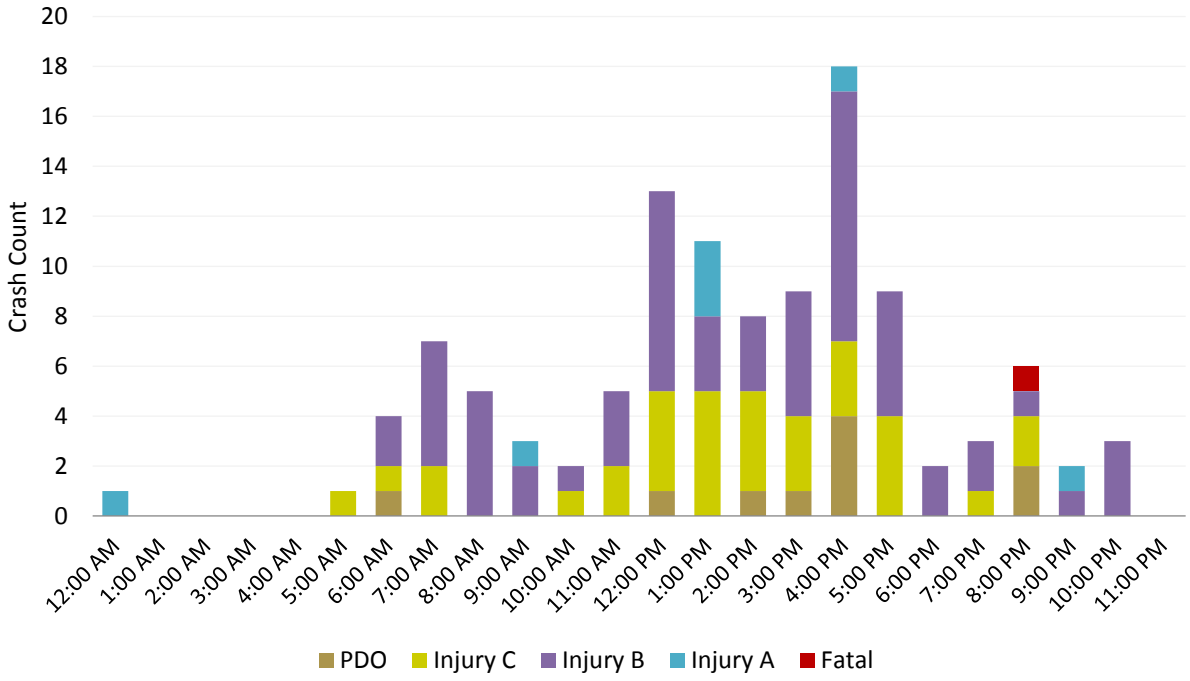
Collision Severity	Collision Frequency	Collision Share
Fatal	1 *	1%
Injury A	7	6%
Injury B	61	54%
Injury C	33	29%
PDO	10	9%
Total	**112**	**100%**

*The fatal bicycle crash was a motorcycle/bicycle crash in which the motorcyclist was the fatality.

Time-of-Day / Light Conditions (Bicyclist Crashes)

Figure 62 shows bicyclist crashes were most common during the afternoon period, with the highest number of crashes occurring during the 4:00 hour. Eighty-eight percent of bicyclist crashes occurred during daylight conditions. Eight crashes (seven percent) occurred during dark conditions without streetlights, and one crash occurred during dark conditions with streetlights.

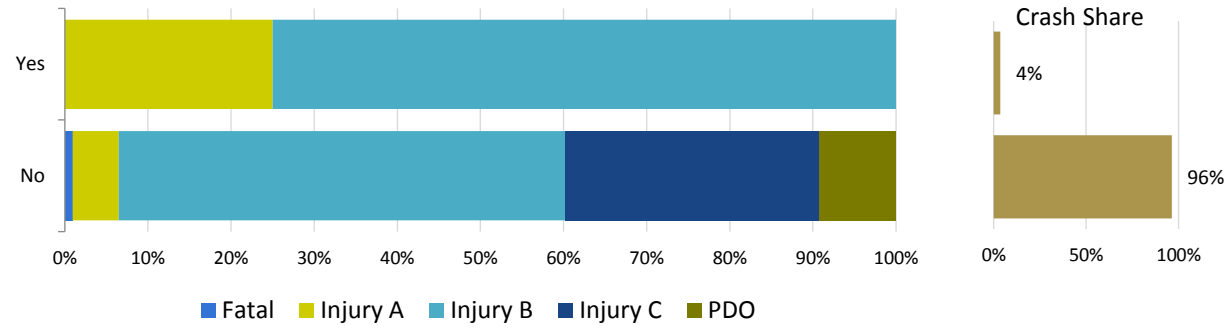
Figure 62. Bicyclist Crashes by Time of Day



Alcohol/Drug Use (Bicyclist Crashes)

Figure 63 summarizes the involvement of alcohol and/or drugs in bicyclist crashes in Bend. As shown in the figure, four percent of bicyclist crashes involved alcohol or drugs. This share is slightly lower than the overall percentage of crashes involving alcohol or drugs citywide (six percent). In addition, the figure shows all bicycle crashes involving alcohol or drugs resulted in injury.

Figure 63. Alcohol or Drug Use, Bicyclist Crashes, Bend 2012-2016



Further evaluation by user revealed that three of 115 bicyclists involved in reported crashes had used alcohol, according to the police officer. None of the bicyclist crash reports indicated that a bicyclist had been using drugs.

Bicyclist Age

There were 115 bicyclists involved in the 112 reported bicyclist crashes. The distribution of bicyclists by age was:

- 18 bicyclists (16 percent) were between ages five and 17;
- 27 bicyclists (23 percent) were between ages 18 and 24;
- 42 bicyclists (37 percent) were between ages 25 and 44;
- 16 bicyclists (14 percent) were between ages 45 and 64;
- 3 bicyclists (3 percent) were age 65 or older; and
- 9 bicyclists (8 percent) did not have an age reported.

Level of Traffic Stress (Bicyclist Crashes)

The City of Bend has assigned all roadways within the City a Level of Traffic Stress (LTS) score based on the relative traffic stress a bicyclist experiences using the roadway. The LTS score is based on the posted speed limit, number of lanes, traffic volume, and available bicycle facilities/separation from vehicular traffic. Roadways with low LTS scores (score of 1 or 2) reflect roadways where bicyclists experience the lowest stress; these facilities accommodate users of all levels, including young and inexperienced cyclists. Roads with high LTS scores (score of 3 or 4) are those where bicyclists experience the highest stress; these facilities are typically uncomfortable for most cyclists. The LTS scores from roadways were assigned to crashes in GIS and summarized below in Figure 64. Crashes within an intersection influence area (250 feet) were assigned the higher LTS score of the intersecting roadways. Level of traffic stress is a quality of service factor and does not necessarily reflect a safety performance measurement. The highest number of bicycle crashes occurred on the LTS 3 roadways, and the lowest number occurred on roads with LTS score 2.

Among the eight fatal/incapacitating bicycle crashes, two crashes occurred on roads with an LTS score of 1, four crashes occurred on roads with an LTS score of 3, and two crashes occurred on roads with an LTS score of 4.

Figure 65 shows the location of bicycle crashes relative to the LTS network. Table 11 summarizes the numbers of reported bicycle crashes and number of lanes on the road where they occurred. As shown in the table, bicyclist crashes were most common on 5-lane and 2-lane roads. The majority (93 percent) of bicycle crashes in the Bend UGB occurred within 250 feet of an intersection.

Figure 64. Bicyclist Crashes by Level of Traffic Stress, Bend 2012-2016

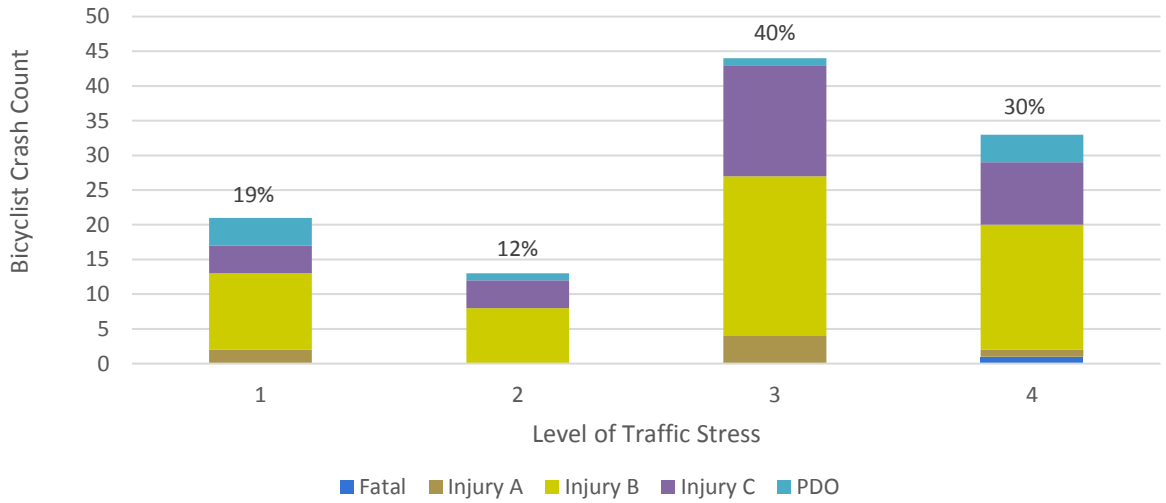
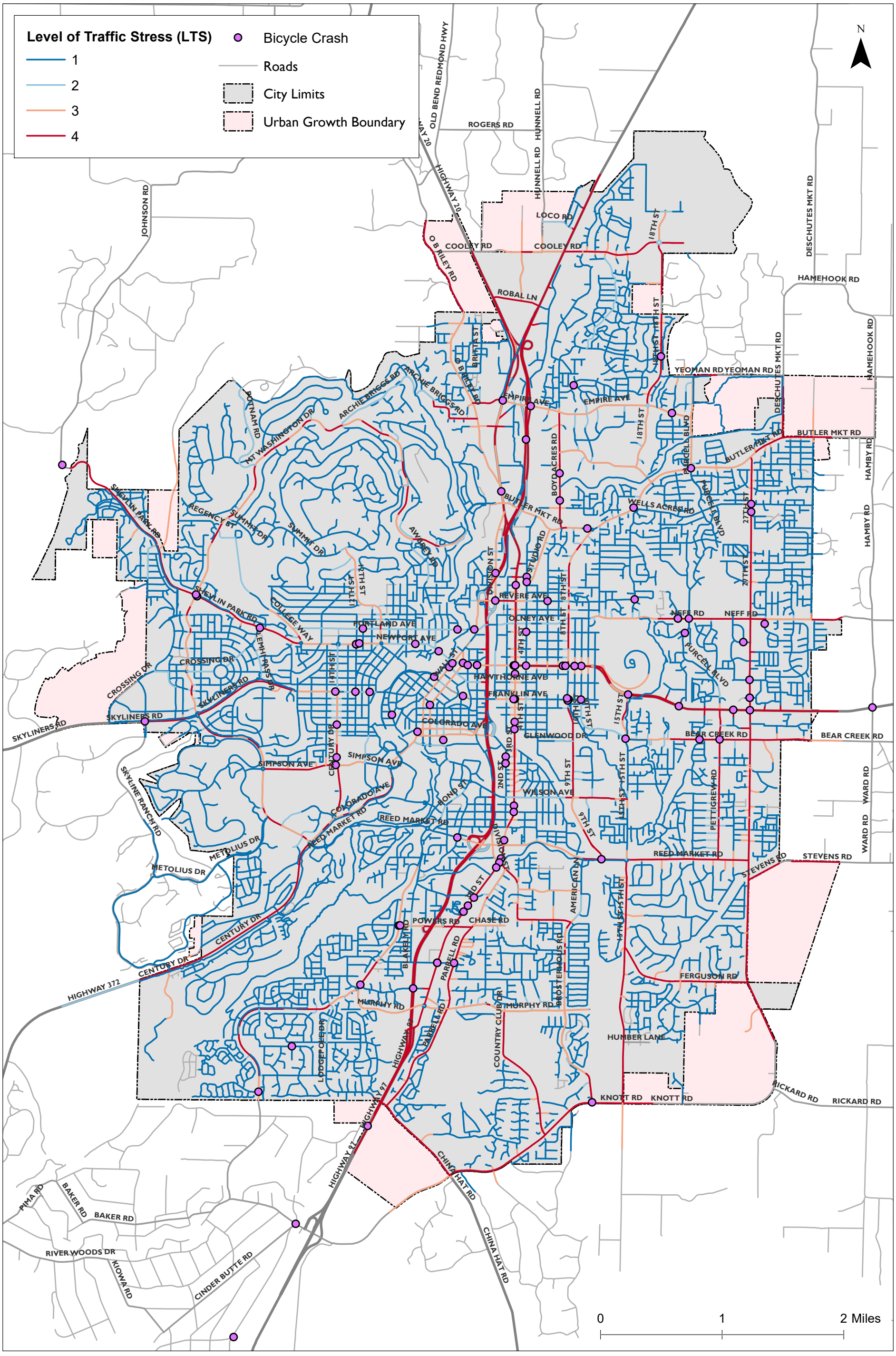


Table 11: Bicyclist Collisions by Number of Lanes on Roadway, Bend 2012-2016

Number of Lanes on Roadway	Number of Reported Bicyclist Crashes	Percentage of Reported Bicyclist Crashes
0	7	6%
2	35	31%
3	27	24%
4	7	6%
5	36	32%
Total	**112**	**100%**



Bicycle Crashes (2012 - 2016) & Levels of Traffic Stress Bend Area TSAP

Figure **65**

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KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Coordinate System: NAD 1983 StatePlane Oregon South FIPS 3602 Feet Intl
Data Source: Bend MPO, City of Bend, Deschutes County, 2019.

Motorcycle Crashes

Sixty-two motorcycle crashes were reported in the City of Bend between 2012 and 2016, accounting for one percent of reported crashes. Of these, two crashes (three percent) were fatal, and 13 crashes (21 percent) resulted in incapacitating injuries. Eighty-five percent of the crashes resulted in some level of injury. Overall, 16 percent of fatal/incapacitating crashes involved motorcycles.

The most common collision types among motorcycle crashes included *turning movement* crashes (21 crashes, including 6 fatal/incapacitating crashes), *rear-end* crashes (13 crashes, including 2 fatal/incapacitating crashes), and *non-collision* crashes (12 crashes, no fatal/incapacitating crashes).

Excessive speed was involved in 11 of the motorcycle crashes (18 percent), including two fatal/incapacitating crashes.

Further evaluation at the user level data indicated that five of the 67 motorcyclists involved in crashes in Bend had consumed alcohol, according to police reports. According to police reports, drugs were not a factor for any of the motorcyclists.

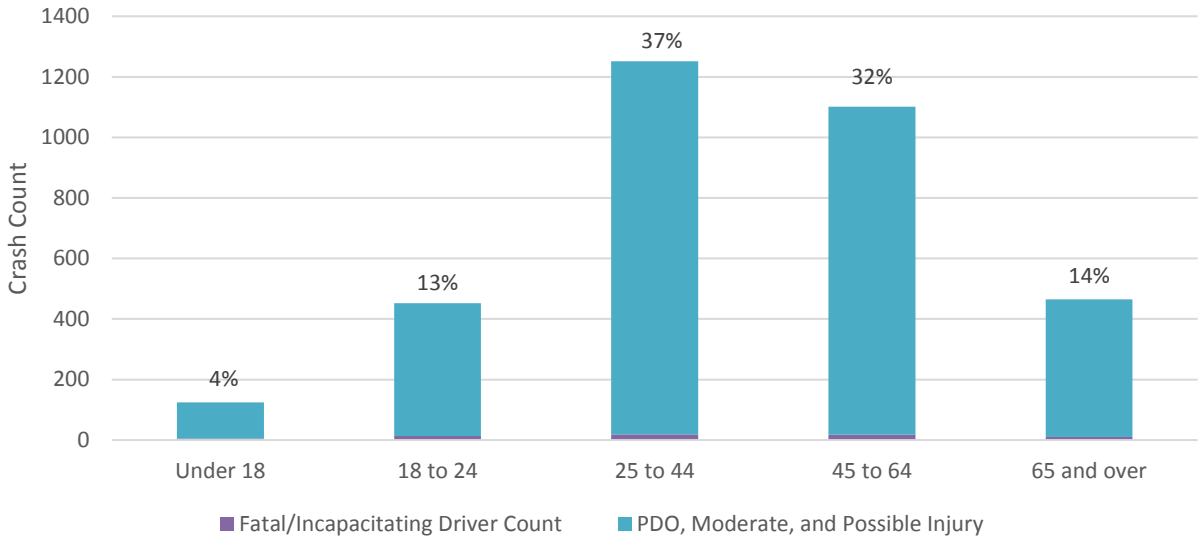
There were 67 motorcyclists involved in the 62 reported motorcyclist crashes. The distribution of motorcyclists by age was:

- 2 motorcyclists (3 percent) were between ages five and 17;
- 7 motorcyclists (10 percent) were between ages 18 and 24;
- 33 motorcyclists (49 percent) were between ages 25 and 44;
- 18 motorcyclists (27 percent) were between ages 45 and 64;
- 5 motorcyclists (7 percent) were age 65 or older; and
- 2 motorcyclists (3 percent) did not have an age reported.

Driver Age

Figure 66 summarizes the distribution of age for drivers involved in crashes in Bend. Fourteen percent of reported crashes, and 15 percent of fatal/incapacitating crashes, involve drivers age 65 and older. Seventeen percent of reported crashes, and 29 percent of fatal/incapacitating crashes, involve drivers under age 25. Of the 577 crashes involving drivers under age 25, three percent resulted in a fatality or incapacitating injury. Of the 465 crashes involving drivers over age 65, two percent resulted in fatal or incapacitating injury.

Figure 66. Driver Age in Crashes, Bend 2012-2016



SUMMARY OF BEND AREA EMPHASIS AREAS

Based on the crash data analysis, as well as the comparison to similar cities, Kittelson identified the following potential emphasis areas for the Bend UGB area:

- **Intersection-related crash types**
  - Sixty-four percent of fatal/incapacitating crashes were turning movement, angle, or rear-end
- **Crashes on arterial roadways**
  - Fifty-eight percent of fatal/incapacitating crashes occurred on arterial roadways.
- **Crashes on five-lane roadways**
  - Thirty-two percent of fatal/incapacitating crashes occurred on five-lane roadways.
- **Drivers under age 25**
  - Twenty-nine percent of fatal/incapacitating crashes involved drivers under age 25; and
  - Three percent of crashes involving drivers under age 25 resulted in fatality or incapacitating injury.
- **Crashes on state highways**
  - Twenty-six percent of fatal/incapacitating crashes occurred on state highways.
- **Crashes occurring in dark, unlit conditions**
  - Twenty-two percent of fatal/incapacitating crashes occurred in dark, unlit conditions; and
  - Four percent of crashes in dark, unlit conditions resulted in fatality or incapacitating injury.
- **Roadway departure crashes**
  - Twenty-one percent of fatal/incapacitating crashes were fixed object, sideswipe, head-on, or overturn crashes; and
  - Two percent of roadway departure crashes resulted in fatality or incapacitating injury.
- **Alcohol/drug use**
  - Twenty percent of fatal/incapacitating crashes involved alcohol or drug use; and
  - Seven percent of alcohol/drug involved crashes resulted in fatality or incapacitating injury.
- **Motorcycle crashes**
  - Sixteen percent of fatal/incapacitating crashes involved motorcycles; and
  - Twenty-four percent of motorcycle crashes resulted in fatality or incapacitating injury.
- **Pedestrian crashes**
  - Thirteen percent of fatal/incapacitating crashes involved pedestrians; and
  - Twenty-four percent of pedestrian crashes resulted in fatality or incapacitating injury.
- **Crashes involving excessive speeds**
  - Thirteen percent of fatal/incapacitating crashes involved excessive speeds; and
  - Ten percent of excessive speed crashes resulted in fatality or incapacitating injury.
- **Bicyclist crashes**
  - Nine percent of fatal/incapacitating crashes involved bicyclists; and
  - Seven percent of bicyclist crashes resulted in fatality or incapacitating injury.

04 | OREGON TSAP EMPHASIS AREAS

Table 12 summarizes how the City is performing in several Oregon TSAP emphasis areas, compared to the statewide performance in these areas. The table summarizes the share of fatal/incapacitating crashes involving various crash attributes. As shown in the table, Bend performance is similar to statewide data in the areas of alcohol/drug involved crashes, young drivers, and unrestrained occupants. Bend's fatal/incapacitating crashes reveal higher shares of crashes associated with intersections and pedestrians when compared to statewide data. Bend performs better than statewide averages in speed-related crashes, roadway departure crashes, and crashes involving older drivers. These comparisons may inform the priority emphasis areas for Bend.

Table 12: Percent of Fatal/Incapacitating Crashes by Attributes

Crash Attribute	Oregon Statewide Percentages*	Bend UGB Percentages
Roadway or Lane Departure Crashes	53.5%	20%**
Intersection Crashes	34.4%	64%**
Speed-Related Crashes	27.0%	10%
Alcohol and/or Other Drugs Involved	22.1%	20%
Young Drivers (<25) Involved	30.9%	29%
Unrestrained Occupants	13.4%	10%***
Older Drivers (65 or older) Involved	20.2%	15%
Pedestrian(s) Injured or Killed	10.0%	13%
Bicyclist(s) Injured or Killed	4.4%	9%

*Obtained from Oregon TSAP
**Based on intersection crash types.
***Reflects crashes that involve at least one participant not using safety equipment, which includes restraints as well as bicycle helmets.

05 | NEXT STEPS

Upon incorporating input from the City of Bend, Bend MPO, Deschutes County, and ODOT, this memorandum will be finalized with the priority emphasis areas identified. The next step of the project will involve network screening, as documented in the Framework Memorandum.

ATTACHMENT A: FRAMEWORK MEMORANDUM