



TECHNICAL MEMORANDUM

City of Bend Arterial and Collector Safety Project Program Development

Phase B Memorandum: Benchmarking and Identification of Focus Areas

Date: September 4, 2012

Project #: 11645.0

To: Robin Lewis, PE, City of Bend

From: Casey Bergh, PE and Brian Ray, PE

The City of Bend and Kittelson & Associates, Inc. (KAI) are developing and implementing a data-driven transportation safety management program. The framework for the program was documented by KAI in our July 9, 2012 memo (draft prepared in June 2012) and is generally illustrated in Figure 1. Benchmarking, the first program phase, is described in this memorandum. The Benchmarking phase is intended to help the City understand crash trends and identify safety priorities. This memorandum summarizes the analysis conducted and outcomes of benchmarking that will inform network screening.

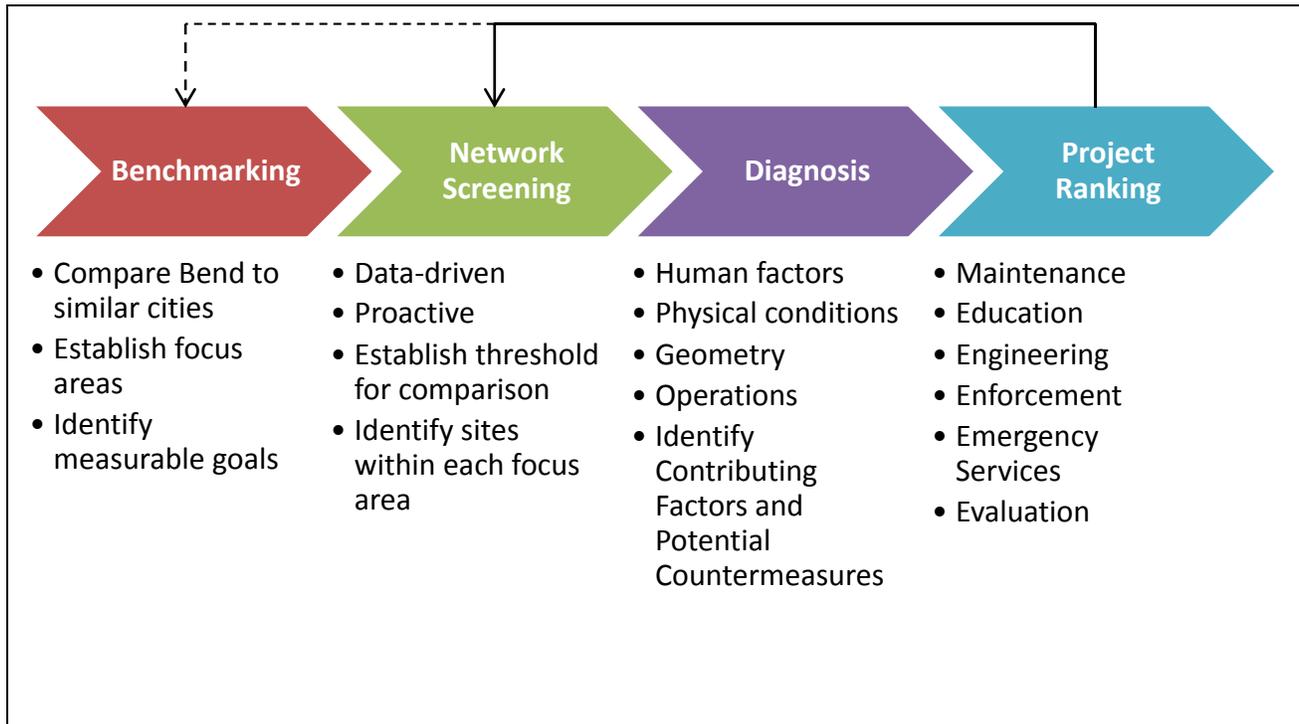


Figure 1 City of Bend Arterial and Collector Safety Project Program Framework

OVERVIEW

Crash data analyses conducted as part of Benchmarking ultimately resulted in five crash characteristics (or “focus areas”) the City will prioritize to reduce crash frequency and severity. The crash analysis allowed the City to compare its crash history with other cities of similar size and provide a general point of reference with regards to traffic safety. Conducting these comparisons and analyzing reported crashes within the City of Bend yielded the following five focus areas:

- Fatal crashes,
- Alcohol-involved crashes,
- Speed-involved crashes,
- Pedestrian and bicycle crashes, and
- Roadway Departure crashes.

TIER I CRASH DATA ANALYSIS

Tier I benchmarking activities qualitatively compared Bend crash experience with that of other Oregon cities of similar size, as reflected by their population. The cities of Corvallis, Medford, and Springfield had similar populations as Bend from 2006 to 2010¹. The cities and their respective annual populations are shown in Figure 2.

Each city differs from Bend in terms of roadway characteristics (e.g., percent of roadway system composed of principle arterials), driver behavior (e.g., percent of drivers that exceed the speed limit by more than 10 miles per hour), and land use (e.g., percent of roadways fronted by commercial developments). These factors are inherently reflected in the crash reports from each city. Therefore, the crash data comparisons between cities are not a direct indication one city has a “safety issue” if that city has more crashes of one type or severity than another city.

Data was provided by the Oregon Department of Transportation for reported crashes on all roads within the city limits of each comparison city for a five-year period from 2006 through 2010. Data includes crashes reported by individuals or police when a crash results in injury, fatality, or at least \$1,500 in damage. ODOT provided latitude and longitude coordinates of all crashes from 2007 to 2010.

Table 1 describes crash trends observed through multiple comparisons of crash characteristics (i.e., type, severity, contributing factors, etc.).

¹ Population estimates prepared by the Population Research Center at Portland State University.

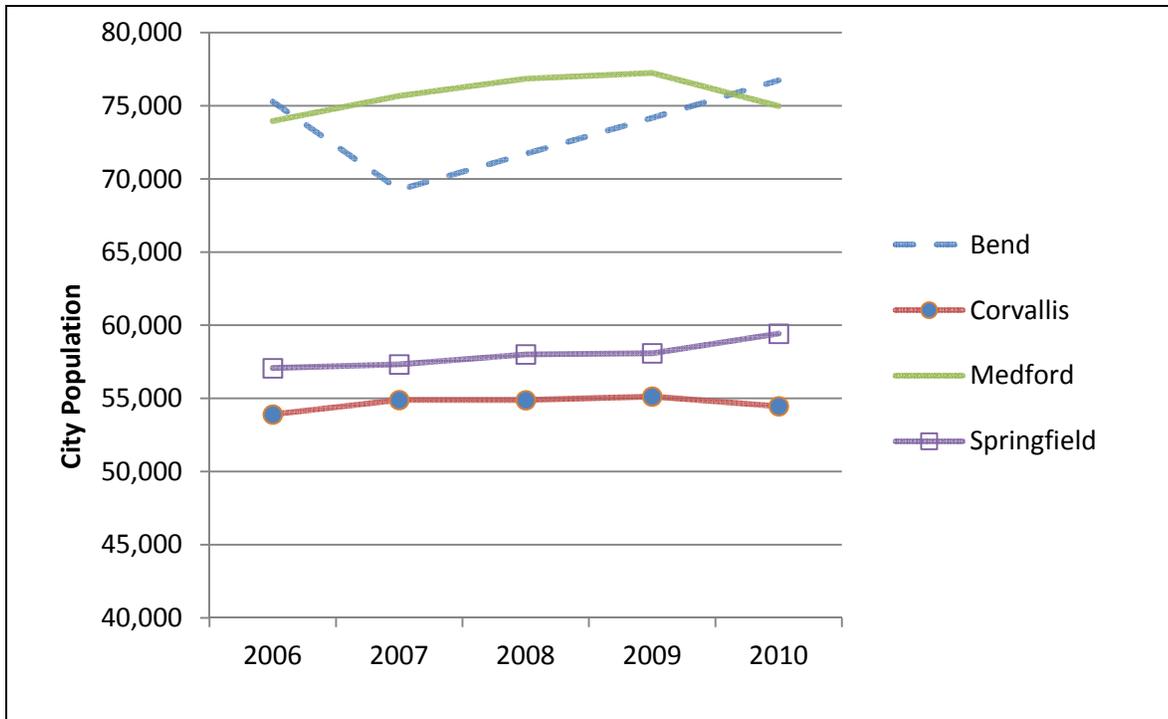


Figure 2 City Population by Year (2006-2010)

Table 1 Summary of Bend Crash Trends vs. Comparison Cities

Crash Comparison Category	Observed Trend
Crash Frequency	Fewer crashes were reported in Bend per year than Medford, but Bend has more reported crashes than Springfield and Corvallis each year in the study period. These trends are generally reflective of estimated populations of each city.
Fatal Crash Frequency	More fatal crashes have been reported in Bend than any of the other three comparison cities over the 5-year study period.
Crash Frequency by Contributing Factors	Speed has been cited as a factor in more crashes in Bend than any of the other three comparison cities over the 5-year study period. Alcohol has been cited as a factor in more crashes in Bend than any of the other three comparison cities over the 5-year study period.
Pedestrian and Bicycle Crashes	Fewer crashes in Bend have involved pedestrians than any of the other three comparison cities over the 5-year study period. Only Springfield had fewer reported crashes involving bicyclists than Bend over the 5-year study period.
Crash Frequency by Crash Type	More fixed-object and sideswipe-meeting crashes occurred in Bend than other cities over the 5-year study period. Collectively these crash types will be referred to as "roadway departure" crashes.

Tier I Findings

As described in Table 1, there appears to be more fatal crashes, alcohol-involved crashes, speed-involved crashes, and roadway departure crashes in Bend than the other three comparison cities over the 5-year period from 2006 through 2010. These trends were identified for further evaluation. Although Bend has fewer bicycle and pedestrian crashes than most of the comparison cities, the City desires to identify opportunities to reduce the frequency of those crashes in order to encourage use of non-motorized transportation modes in Bend. Therefore, pedestrian and bike crashes were evaluated in greater detail as part of the Tier II analysis.

TIER II CRASH DATA ANALYSIS

Five crash trends were identified through the Tier I analysis. Overall, the Tier II analysis confirmed the crash trends identified in Tier I represent opportunities to reduce crash frequency and severity within the City of Bend. Tier II analysis built on Tier I analysis that included five years of crash data from 2006 through 2010. Where trends were identified within the City limits on arterial and collector streets, the data was limited to 2007 through 2010, when ODOT's crash database includes coordinates of all reported crashes. The trends observed within the City of Bend are described below.

Fatal Crashes

There were 22 reported fatal crashes in the City over the 5-year study period. Due to the limited number of fatal crashes, no clear patterns were identified. Figure 8 shows a variety of crash types have resulted in fatal crashes. Fixed-object and turning crashes are the most commonly-reported crash types while three pedestrian crashes resulted in fatalities. The 5 fixed-object crashes and 1 head-on crash were grouped for analysis as "roadway departure" crashes. Roadway departure crashes are being evaluated separately, but the correlation with fatal crashes emphasizes the need to evaluate them.

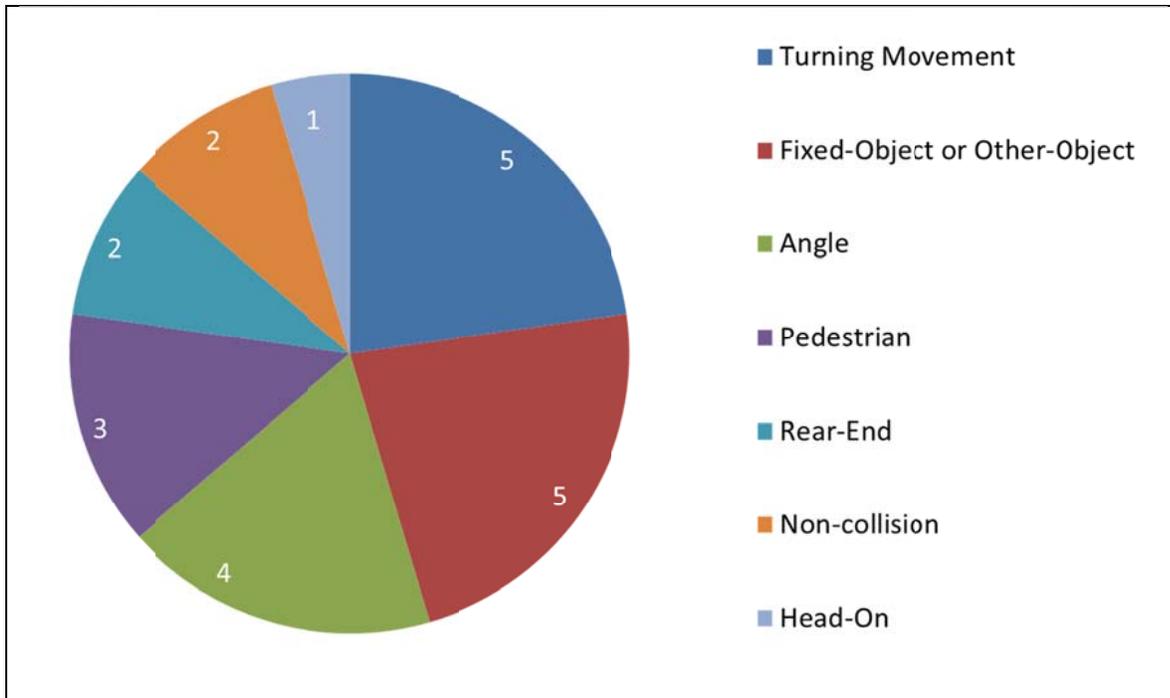


Figure 3 Reported Fatal Crash Types (2006-2010)

Approximately 13 of the 22 reported fatal crashes in Bend occurred on state highways; these will not be evaluated in detail as part of this project. At least 9 occurred on City arterial and collector streets. Of those on City arterial and collector streets, 5 occurred at intersections or driveways, 3 occurred on roadway segments, and 1 was not related to a collision (i.e., involved a single vehicle). The crash types at intersections or driveways include 3 turning, 1 fixed object, and 1 pedestrian. Speed was noted as a factor in 4 of the 9 crashes.

Given the correlation between fatal crashes and two other observed crash trends (roadway departure and speed-involved crashes), and the significant impact of every fatal crash, fatal crashes were identified as a focus area and will be subjected to additional analysis, diagnosis, and countermeasure selection.

Alcohol-involved Crashes

There were 145 reported crashes on all streets within the Bend city limits involving alcohol over the five-year study period. Over 65 percent (100 crashes) were on City streets. Five crashes on city arterial and collector streets resulted in fatalities. 67 crashes resulted in injury. The locations of the reported crashes on City arterial and collector streets from 2007 through 2010, when ODOT has geocoded crash locations, are shown in Figure 4. The map includes crashes at intersections between city facilities and ODOT facilities. The map indicates alcohol-involved crashes are occurring throughout the city and on all types of roadway facilities.

Given the majority of alcohol-involved crashes result in fatality or injury, this area was identified as a focus area.

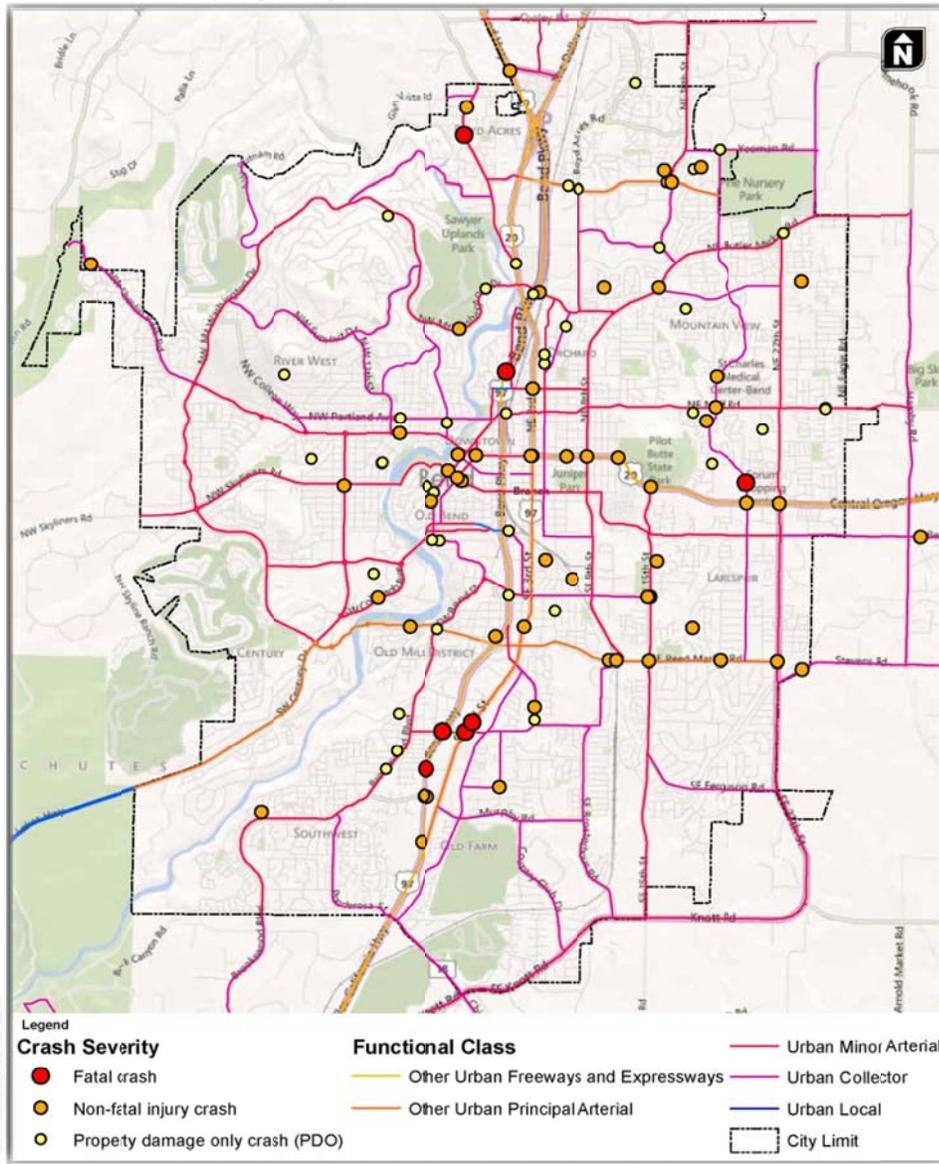


Figure 4 Reported Crashes Involving Alcohol by Severity (2007-2010)

Speed-involved Crashes

Speed was cited as a factor in 331 crashes on City of Bend arterial and collector roadways over the 5-year study period. The 331 speed-involved crashes resulted in 4 fatalities and 123 non-fatal injury crashes. The primary crash types associated with these crashes are rear-end (110 crashes) and fixed-object (103 crashes). Based on the frequency of crashes involving speed and the potential to apply non-engineering resources to address these crashes, this was identified as a focus area.

Pedestrian and Bicycle Crashes

The City desires to identify opportunities to reduce the pedestrian and bicycle crash frequency to encourage and expand non-motorized travel modes. There were 58 bicycle crashes and 25 pedestrian crashes on Bend arterial and collector streets from 2007-2010. Pedestrian and bicycle volumes are not available to estimate the level of exposure associated with these crash types.

Figure 5 illustrates the frequency of bicycle crashes by type. As shown, the majority of bicycle crashes have occurred as part of turning movement and angle crashes.

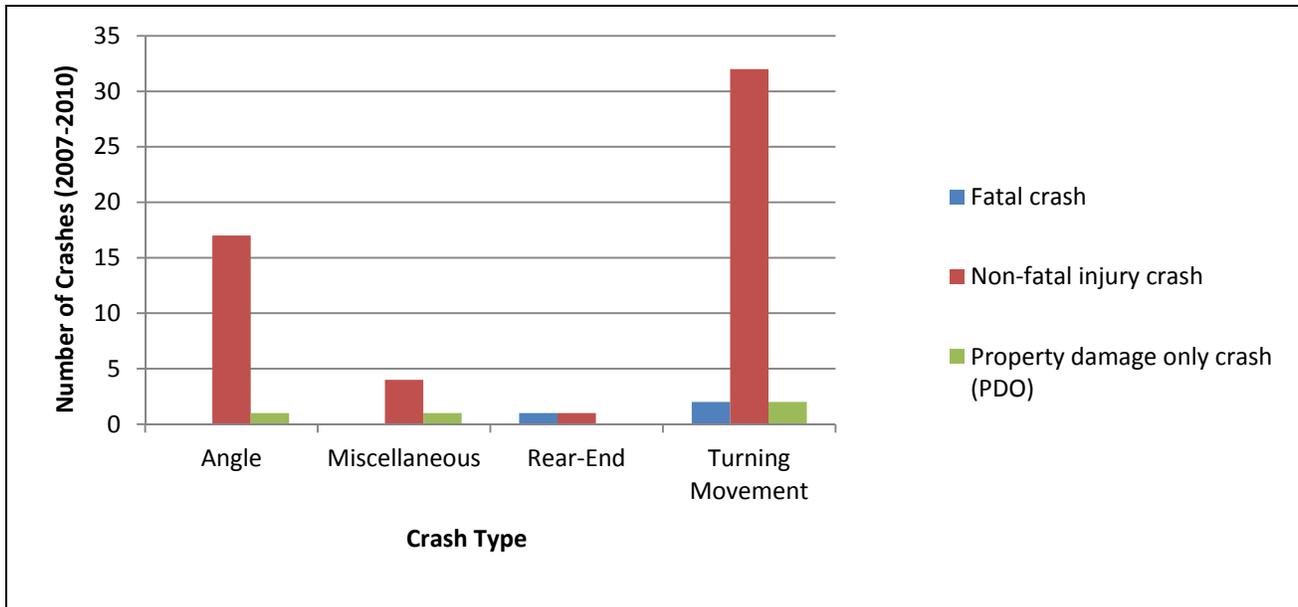


Figure 5 Reported Crash Types Involving a Bicycle (2007-2010)

Bicycle and pedestrian crashes are mapped in Figure 6. The map shows bicycle and pedestrian crashes have occurred throughout the city at intersections and along roadway segments. Pedestrian and bicycle crashes will be a focus area of network screening and individual crash locations will be identified for reducing these types of crashes.

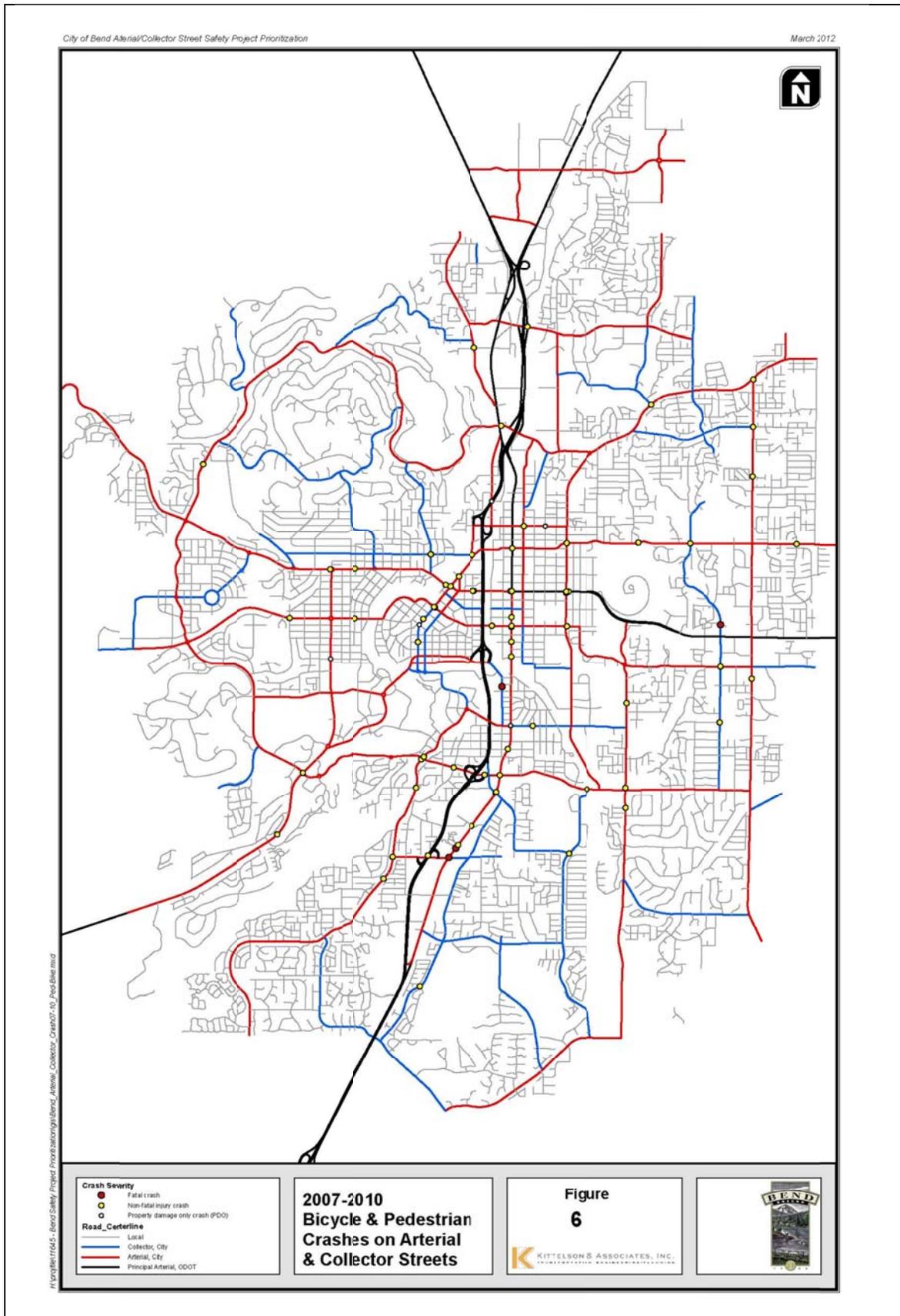


Figure 6 Bicycle and Pedestrian Crashes by Severity on Arterial and Collector Streets (2007-2010)

Roadway Departure Crashes

Roadway departure crashes include those where a vehicle leaves its travel lane, to the left or the right, and collides with another vehicle, fixed object, or overturns. ODOT crash data provides crash type and collision type descriptions that include one or more of the following descriptors: fixed object, overturned, other non-collision, fixed-object, other-object, head-on, and sideswipe-meeting. The number of roadway departures reported within the City limits on arterial and collector streets are summarized by crash severity in Table 2, based on the collision type and crash type descriptors from the ODOT database. Figure 7 illustrates the locations of the crashes by type.

Table 2 Summary of Roadway Departure Crash Types and Collision Types by Severity (2007-2010)

Collision Type/ Crash Type	Fatal crash	Non-fatal injury crash	Property damage only crash (PDO)	Total
Fixed-Object or Other-Object	2	51	88	141
Head-On		2	9	11
From opposite direction - both going straight		2	4	6
From opposite direction - one stopped			4	4
Parked motor vehicle			1	1
Miscellaneous		5	2	7
Other non-collision		1	1	2
Overturned		4	1	5
Non-Collision		6	1	7
Other non-collision		2		2
Overturned		4	1	5
Sideswipe-Meeting		10	25	35
From opposite direction - both going straight		9	20	29
From opposite direction - one stopped			2	2
Parked motor vehicle		1	3	4
Grand Total	2	74	125	201

There were 201 roadway departure crashes reported on City of Bend arterial and collector streets from 2007 to 2010. The majority of these crashes resulted in property damage only (125), 74 resulted in injury, and 2 resulted in fatalities. Of the 201 reported crashes, 110 roadway departure crashes were associated with “speed too fast for conditions.”

KAI recommends roadway departure crashes be included as a focus area and that the City conduct additional analysis to identify specific sites where enforcement and other types of treatments can be applied.

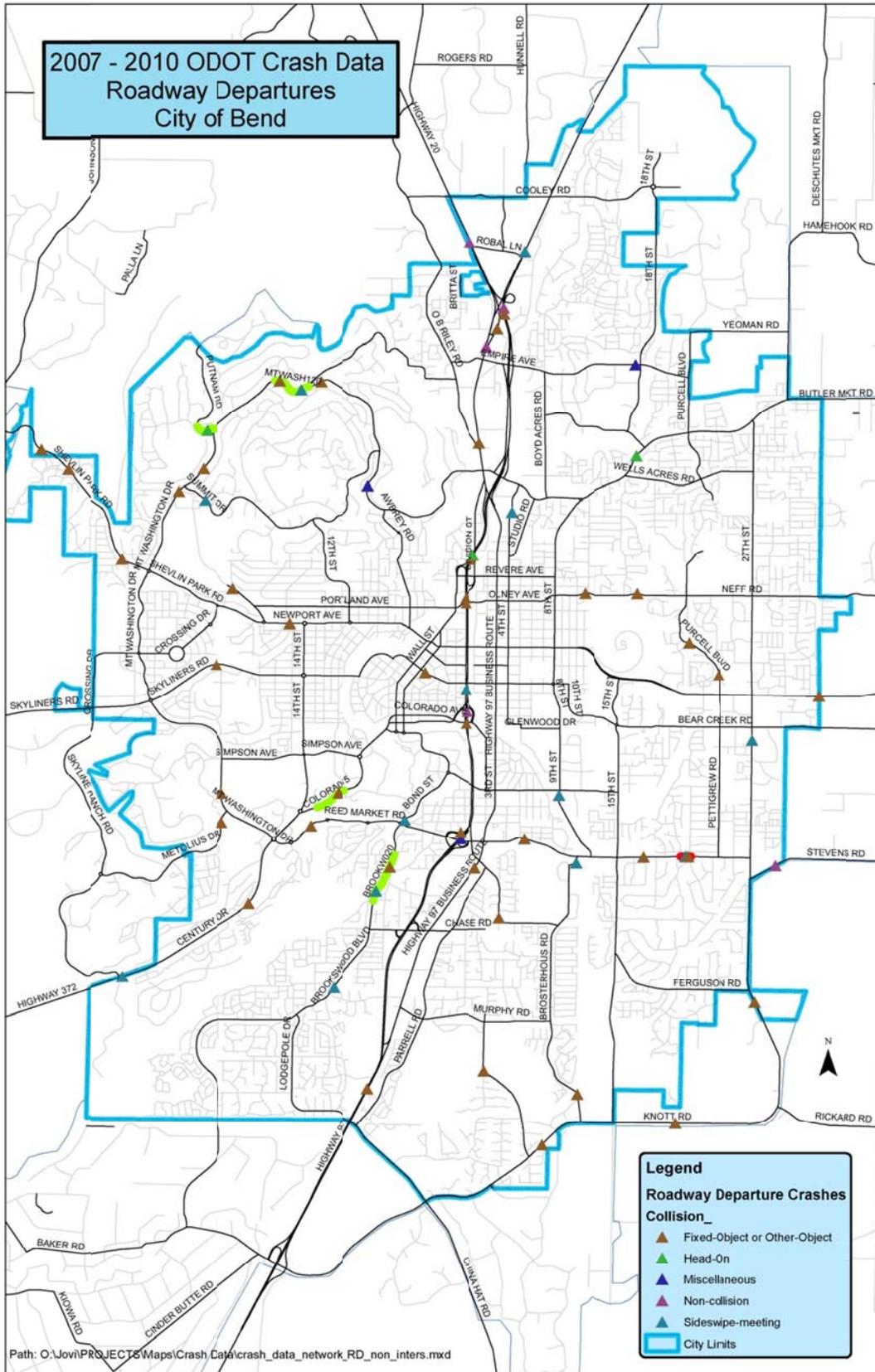


Figure 7 Reported Roadway Departure Crashes by Crash Type (2007-2010)

FINDINGS

Benchmarking and crash data analysis resulted in five crash characteristic focus areas:

- Fatal crashes,
- Alcohol-involved crashes,
- Speed-involved crashes,
- Pedestrian and bicycle crashes, and
- Roadway departure crashes.

The focus areas represent a range of crash types and contributing factors that will allow the City to consider engineering and non-engineering resources to reduce crash frequency and severity. The “5-E’s” (Engineering, Education, Enforcement, Emergency Response, and Evaluation) allow for customized approaches to reduce crash severity and frequency and emergency response while using a data-informed process to evaluate the effectiveness of the safety program. For example, enforcement may be the most effective treatment to address alcohol and speed-involved crashes, and education may be the most effective treatment for addressing the frequency of pedestrian and bicycle crashes. Collaboration with emergency responders can maximize the benefit of this safety net to treat injuries. Evaluating the effectiveness of specific treatments and the program as a whole provides a comprehensive roadway safety management approach.

NEXT STEPS

The focus areas identified through Benchmarking will inform the second phase of the Bend Arterial and Collector Safety Program. The second phase includes identifying the factors contributing to crash types within the focus areas and evaluating a range of countermeasures to address them.

