APPENDIX G: TRANSPORTATION SAFETY ACTION PLAN (2017)

City of Hillsboro

Transportation Safety Action Plan

Hillsboro, Oregon

October 2016

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Federal Rule 409

Notwithstanding any other provision of the law, reports, surveys, schedules, lists, or data compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential accident sites, hazardous roadway conditions, or railway-highway crossings, pursuant to sections 130, 144, and 148 of this title or for the purpose of developing any highway safety construction improvement project, which may be implemented utilizing Federal-aid highway funds shall not be subjected to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data.

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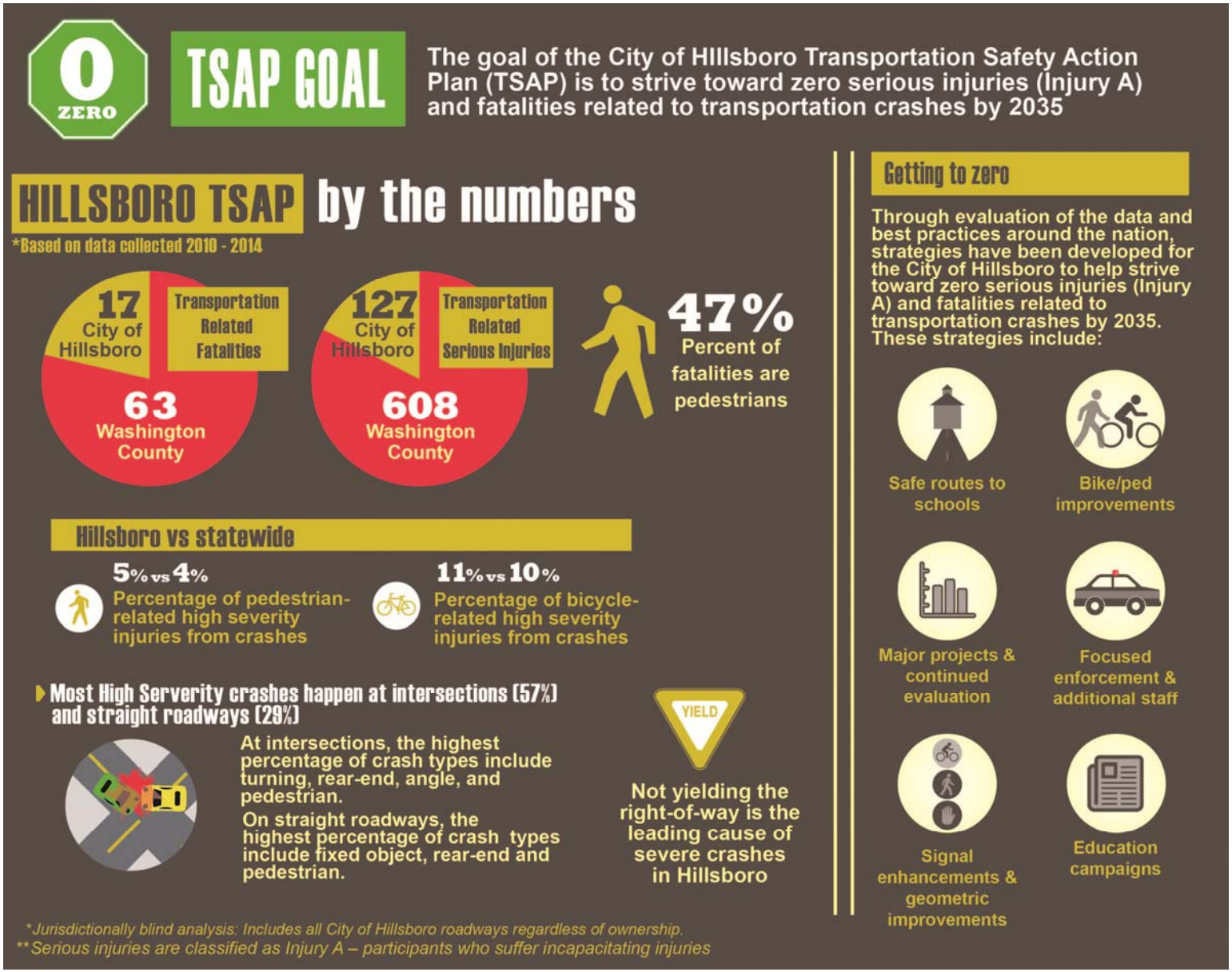
Acronyms and Initialisms

CDC	Center for Disease Control and Prevention
FHWA	Federal Highway Administration
FTE	Full Time Equivalent
FYA	Flashing Yellow Arrow
HSM	Highway Safety Manual
MAP-21	Moving Ahead for Progress in the 21st Century
MPO	Metropolitan Planning Organization
NACTO	National Association of City Transportation Officials
NCHRP	National Cooperative Highway Research Program
ODOT	Oregon Department of Transportation
RRFB	Rectangular Rapid Flashing Beacon
RTFP	Regional Transportation Functional Plan
RTP	Regional Transportation Plan
SAFETEA-LU	Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users
SRTS	Safe Routes to School
TEA-21	Transportation Equity Act for the 21st Century
TSAP	Transportation Safety Action Plan

Executive Summary



Introduction

Transportation related crashes account for over 30,000 deaths nationwide and are considered a leading cause of death in the United States.[1] Many local agencies are proactively addressing these fatalities by developing Transportation Safety Action Plans (TSAP) specific to their jurisdictions. This document will function as the City of Hillsboro TSAP and characterize City of Hillsboro's current state of transportation safety; it outlines potential strategies to address transportation safety issues and helps identify ways to implement these strategies.

"Motor vehicle crashes are a leading cause of death in the U.S. More than 2.5 million drivers and passengers were treated in emergency departments as the result of being injured in motor vehicle crashes in 2012. The economic impact is also notable: in a one-year period, the cost of medical care and productivity losses associated with injuries from motor vehicle crashes exceeded $80 Billion" – Center for Disease Control and Prevention (CDC)

Policy Framework

In 1998, the Federal Government passed the Transportation Equity Act for the 21st Century (TEA-21) focused on programs for highway safety in planning efforts throughout major metropolitan areas. This transportation bill was followed by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) in 2005, which identified the need for states to develop Strategic Highway Safety Plans for addressing fatalities and serious injury crashes on all public roads.

More recently, in 2012, the Moving Ahead for Progress in the 21st Century (MAP-21) transportation bill was introduced to create a streamlined and performance-based surface transportation program that builds upon many of the already existing highway, transit, bike, and pedestrian programs. MAP-21 continues to fund state efforts in increasing safety for high severity crashes (Injury A and Fatalities) on all roadways, and requires states and metropolitan planning organizations (MPOs) to establish statewide safety performance measures to support performance based planning. Consistent with these federal requirements to integrate safety into planning and programming, many states have also adopted the Toward Zero Death philosophy to convey the importance of roadway safety. To further the statewide efforts, many city, county, and regional governments have undertaken comprehensive safety plans to improve safety in their communities. This TSAP captures the strategic approach to improving multi-modal transportation safety for the City of Hillsboro.

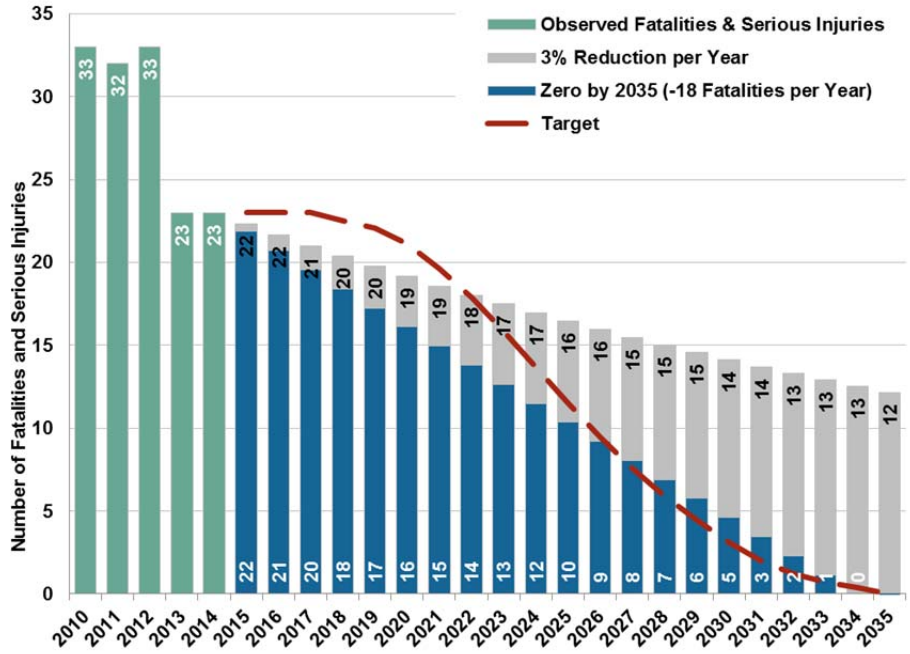
[1] National Center for Statistics and Analysis (NCSA). "CrashStats, Quick Facts 2014." 2014. *National Highway Traffic Safety Administration (NHTSA).* https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812234. 11 July 2016.

Goals of the City of Hillsboro TSAP

The purpose of the City of Hillsboro TSAP is to identify strategies to reduce the number of serious injuries and fatalities related to crashes within the city. While the city aims to reduce the total number of crashes overall, the focus of this TSAP is on serious injuries (where the victim's normal life functions are severely impacted) and fatalities related to transportation crashes. **The goal of this TSAP is to strive toward zero serious injuries and fatalities related to transportation crashes by 2035.** This goal is consistent with that set forth by the Oregon Department of Transportation (ODOT) and for communities within the state as well as Oregon Metro's goal for the Portland region. Figure 1 provides a summary of what the next 20 years looks like to reach our traffic safety goal.

This TSAP is a near-term action plan providing strategies to address current safety issues in Hillsboro. This plan will be used to identify ways to reduce serious (Injury A[2]) injuries and fatalities and prioritize actions for the City to fund as part of planning, programming, and design activities.

Figure 1 – Reduction Needed to Reach Zero Serious Injuries and Fatalities by 2035



When evaluating safety conditions and developing improvement strategies to reach these goals, the four E's (Engineering, Enforcement, Education, and Emergency Response)[3] of safety are typically used as a framework to understand the safety components and provide focused strategies based on what can be implemented to improve safety. For the purpose of this document, much of the focus will be around engineering and enforcement strategies, as the Washington County TSAP is tackling the education and emergency response components in the area.

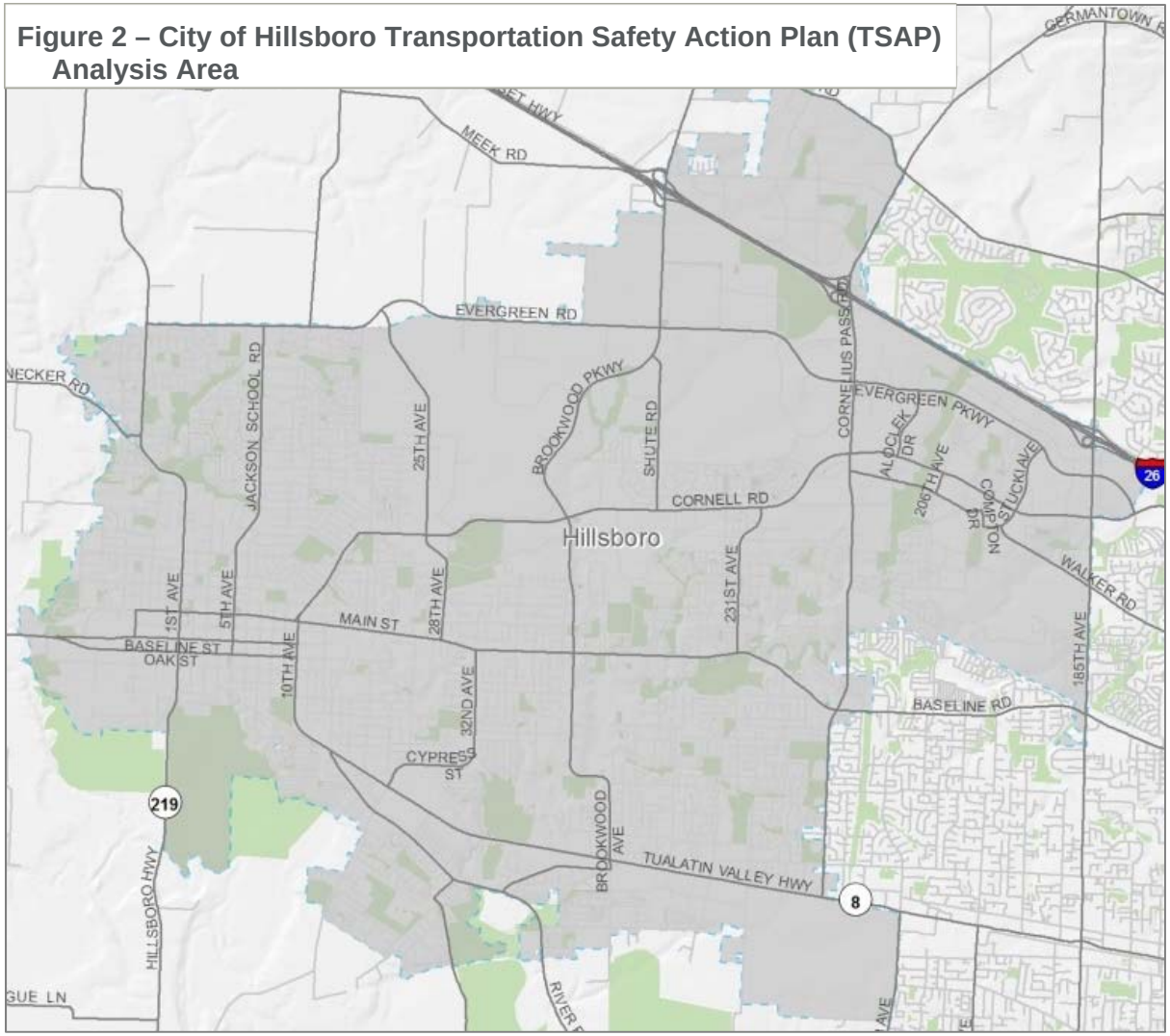
[2] Injury A – Participants who suffer incapacitating injuries.
[3] http://safety.fhwa.dot.gov/legislationandpolicy/fast/shsp_guidance.cfm July 2016

Study Area: City of Hillsboro

The City of Hillsboro is approximately 23.91 square miles, located 30 minutes from downtown Portland. Hillsboro is the county seat and the fifth-largest city in the State of Oregon (over 91,000 residents per the 2010 US Census[4]). The City of Hillsboro TSAP analysis area can be seen in Figure 2.

The City of Hillsboro maintains over 220 center line miles of pavement, 31 traffic signals, eight solar school zone beacons, six pedestrian activated beacons, thousands of traffic signs, and hundreds of miles of pavement markings.[5] The roads are mainly urban facilities and classified as arterials, collectors, and local roads. The City of Hillsboro is also a major employment hub, home to several large technology companies, and the Hillsboro Airport.

Figure 2 – City of Hillsboro Transportation Safety Action Plan (TSAP) Analysis Area



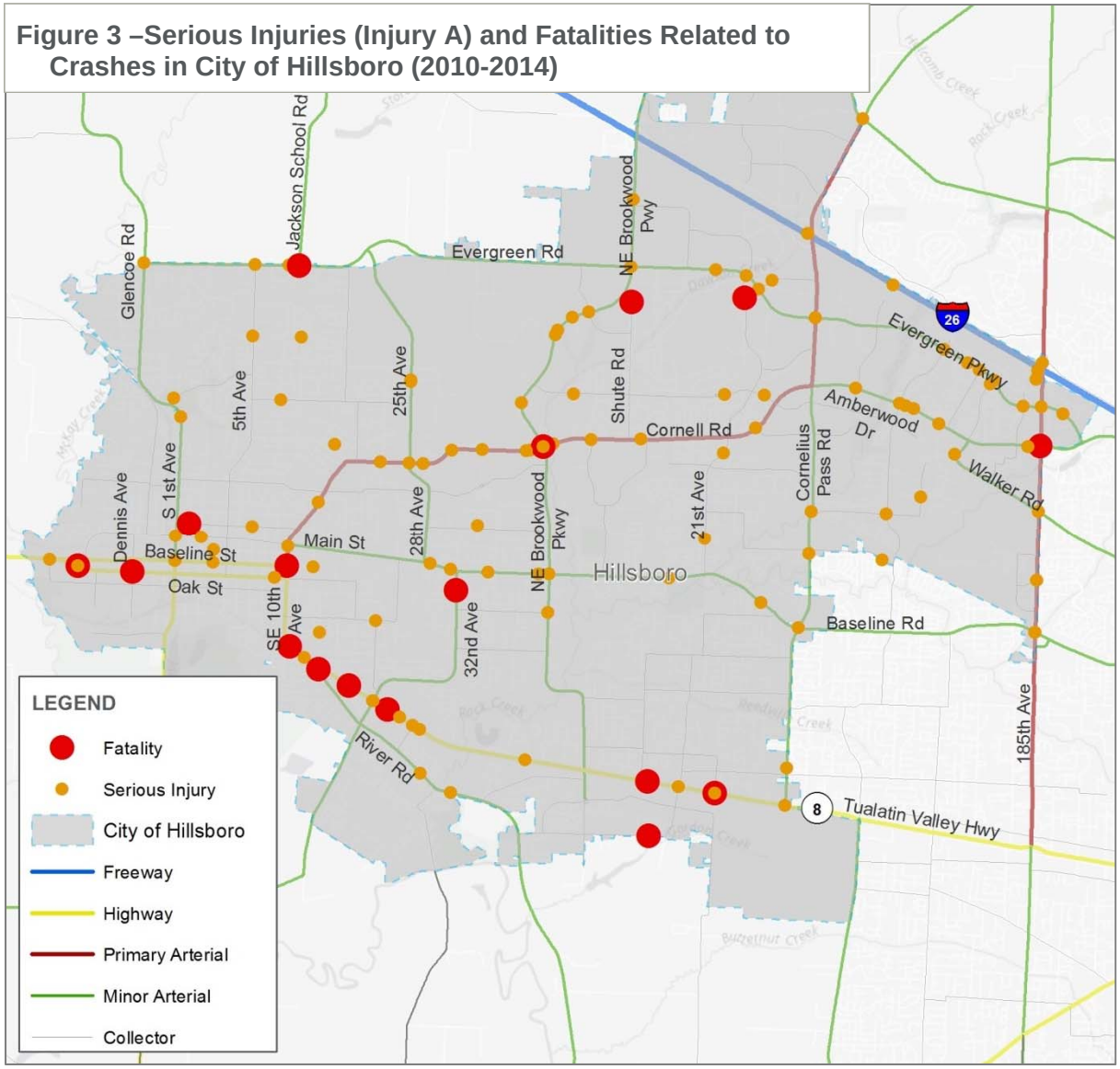
[4] United States Census Bureau. "United States Census Bureau." 2010 . *American FactFinder.* http://www.census.gov/quickfacts/table/POP010210/4134100,00. 11 July 2016.

[5] City of Hillsboro. "Hillsboro Oregon." 2016. *Transportation.* http://www.hillsboro-oregon.gov/index.aspx?page=496. 11 July 2016.

Existing Transportation Safety Conditions

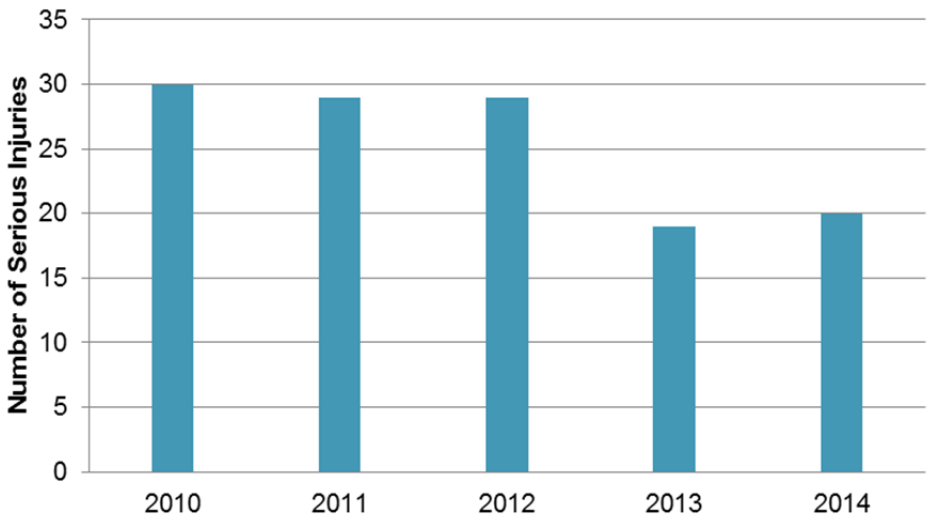
ODOT's statewide crash data was collected for the most recently available 5 years (from 2010 through 2014) for the City of Hillsboro. Five years of data is typically used to normalize averages and trends, which prevent anomalies from influencing or skewing the results. This data was used for analysis purposes to evaluate existing safety conditions within the city. Even with the extensive efforts to accurately collect crash data, not all crashes are recorded and some may be incorrectly reported. Crashes with greater severity are often reported with greater reliability than crashes of lower severity. More details on the data gathered for this plan and its potential limitations are provided in Appendix A, as well as ODOT's Statewide Motor Vehicle Traffic Crash Analysis and Code Manual[6].

Figure 3 –Serious Injuries (Injury A) and Fatalities Related to Crashes in City of Hillsboro (2010-2014)

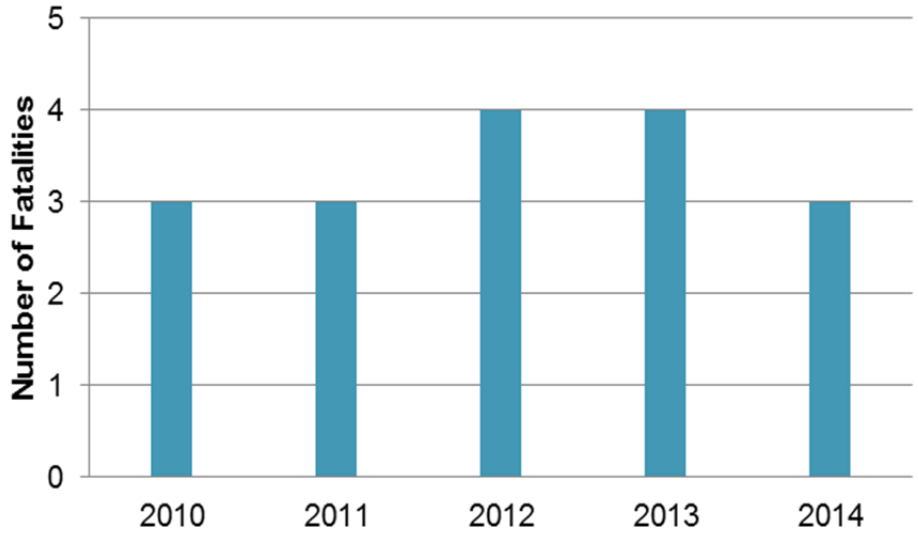


[6] Oregon Department of Transportation (ODOT) "Trans Data – Crash Data" December 2014 *Motor Vehicle Traffic Crash Analysis and Code Manual* http://www.oregon.gov/ODOT/TD/TDATA/car/docs/CDS_CodeManual.pdf. 12 July 2016

Graph 1 - Serious Injuries (Injury A) in the City of Hillsboro (2010-2014)



Graph 2 - Fatalities in the City of Hillsboro (2010-2014)



To develop strategies to meet the City's goal to strive towards zero serious injuries and fatalities related to crashes, it is important to understand the existing trends of these events. The crashes associated with serious injuries (Injury A) and fatalities are mapped in Figure 3. **From 2010 – 2014, the City of Hillsboro had 127 serious injuries (Injury A) and 17 fatalities related to crashes.** It should be noted that this analysis was conducted jurisdictionally blind, and all roadways within the city limits of the City of Hillsboro were analyzed, regardless of who owns the facility.

As shown in Graph 1, serious injuries (Injury A) related to crashes have slightly decreased since 2010 in the City of Hillsboro. Fatalities have been fairly consistent with three to four fatalities occurring each year since 2010 (see Graph 2).

Who, What, When, and Where?

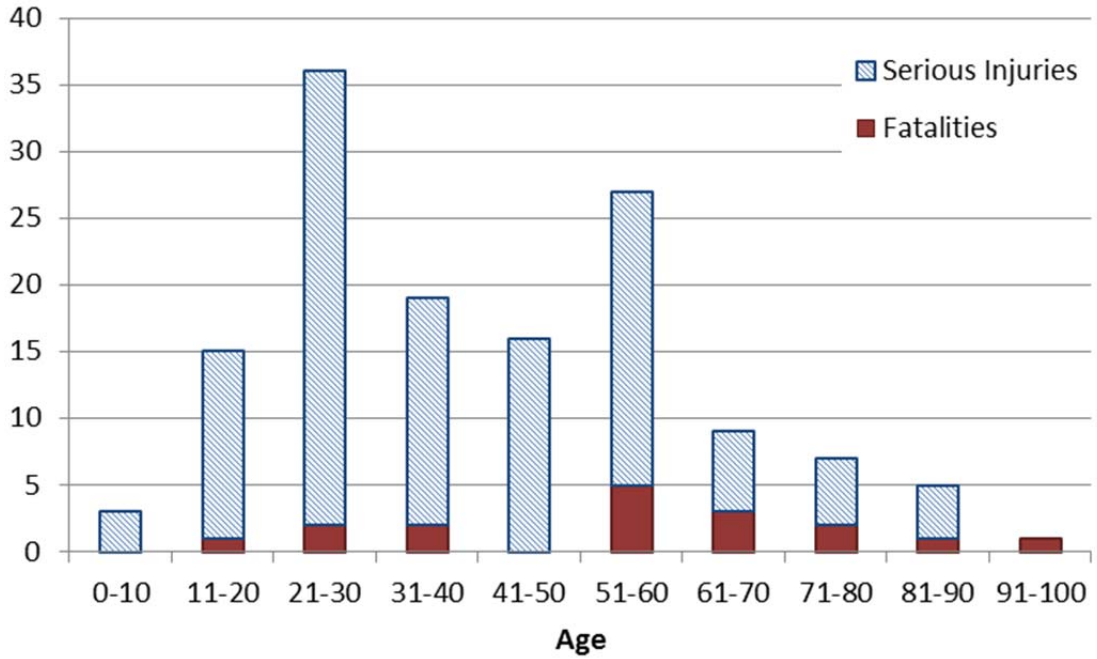
The following section includes the "who," "what," "when," and "where" of crashes that resulted in serious injuries and fatalities within the City of Hillsboro.

Who is Impacted by High Severity Crashes?

Understanding who is involved with crashes can help focus safety-related educational efforts. Age is an important factor to consider when evaluating crash trends. Graph 3 shows the breakdown of serious injuries (Injury A) and fatalities related to crashes by age group. In the City of Hillsboro, **crashes resulting in serious injuries and fatalities have occurred most frequently for drivers and passengers in their late-teens to early-twenties, and again in their mid to late fifties**. This data is consistent with findings from insurance companies, and is often aggregated and used to determine insurance rates. Younger drivers typically have higher insurance premium rates because they are involved in a disproportionate number of crashes that result in serious injury (Injury A) or fatalities.[7] Likewise, drivers age 70 and older, although less likely to drive, have increased fatal crash rates, which is often due to their increased susceptibility to injury rather than an increased tendency to get into crashes.[8] When compared to the City's age distribution, the higher number of serious injuries (Injury A) and fatalities for 21-30 year olds and 51-60 years olds is proportionate with the city's population.

It is worth noting that this analysis does not include who is at-fault, but still provides a valuable look at overall trends. Additional analysis into age breakdown by driver, pedestrians, bicyclists, driver vs. passenger, and intoxication are provided in Appendix B. From that data it is worth noting that intoxication appeared to be most relevant in the high severity injuries for the 21 to 30 age group. Details on pedestrian and bicycle crashes are provided in a later section of this report.

Graph 3 - Serious Injuries (Injury A) and Fatalities by Age (2010-2014)

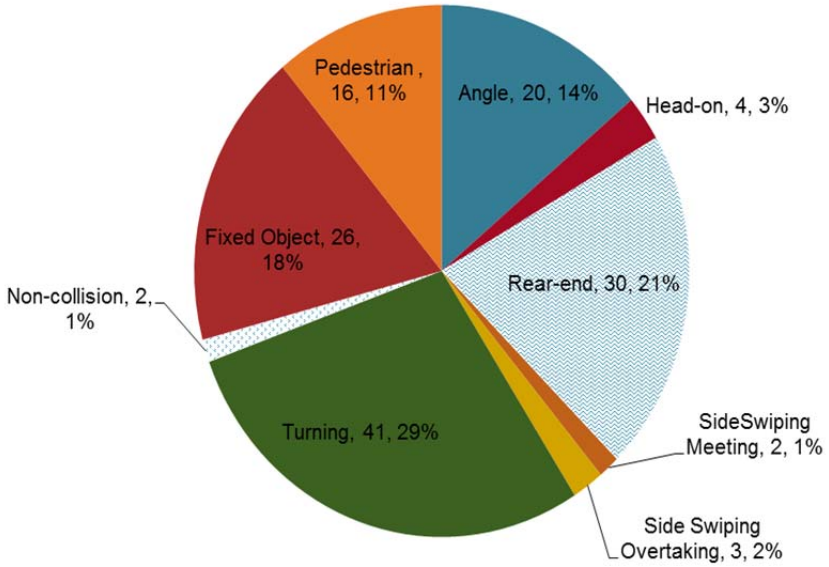


[7] http://www.iihs.org/iihs/topics/t/teenagers/fatalityfacts/teenagers.
[8] http://www.iihs.org/iihs/topics/t/older-drivers/fatalityfacts/older-people/2014.

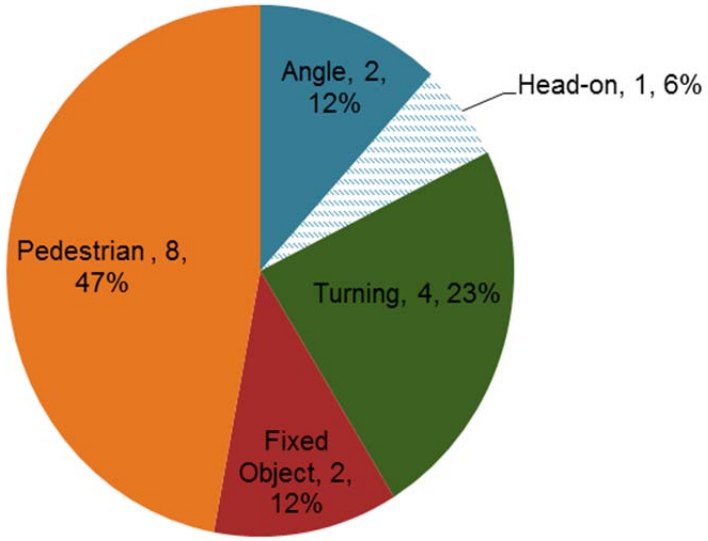
What Types of Crashes result in Serious Injuries (Injury A) and Fatalities?

Graph 4 shows distribution of serious injuries and fatalities by collision type, and Graph 5 show fatalities by collision type. In Graph 4 the largest collision types contributing to serious injuries and fatalities are turning collisions, rear-end collisions, fixed object collisions, and angle collisions. Considering only fatalities (Graph 5), **pedestrians represent almost 50 percent of the total fatalities occurring within the City of Hillsboro**. Of the eight pedestrian fatalities that occurred from 2010-2014, four happened on SE Tualatin Valley Highway, with two occurring at intersections, and two occurring along straight roadway segments. Additionally, three of the pedestrian fatalities occurred during darkness with no street lights present (two of these collisions were the same ones noted above, which occurred on SE Tualatin Valley Highway). **All eight fatalities involving a pedestrian were classified as either "illegally in the roadway" or "disregarding a traffic signal".** Locations of the pedestrian fatalities can be seen in Figure 5.

Graph 4 – Serious Injuries (Injury A) and Fatalities by Collision Type (2010-2014)



Graph 5 – Fatalities by Collision Type (2010-2014)



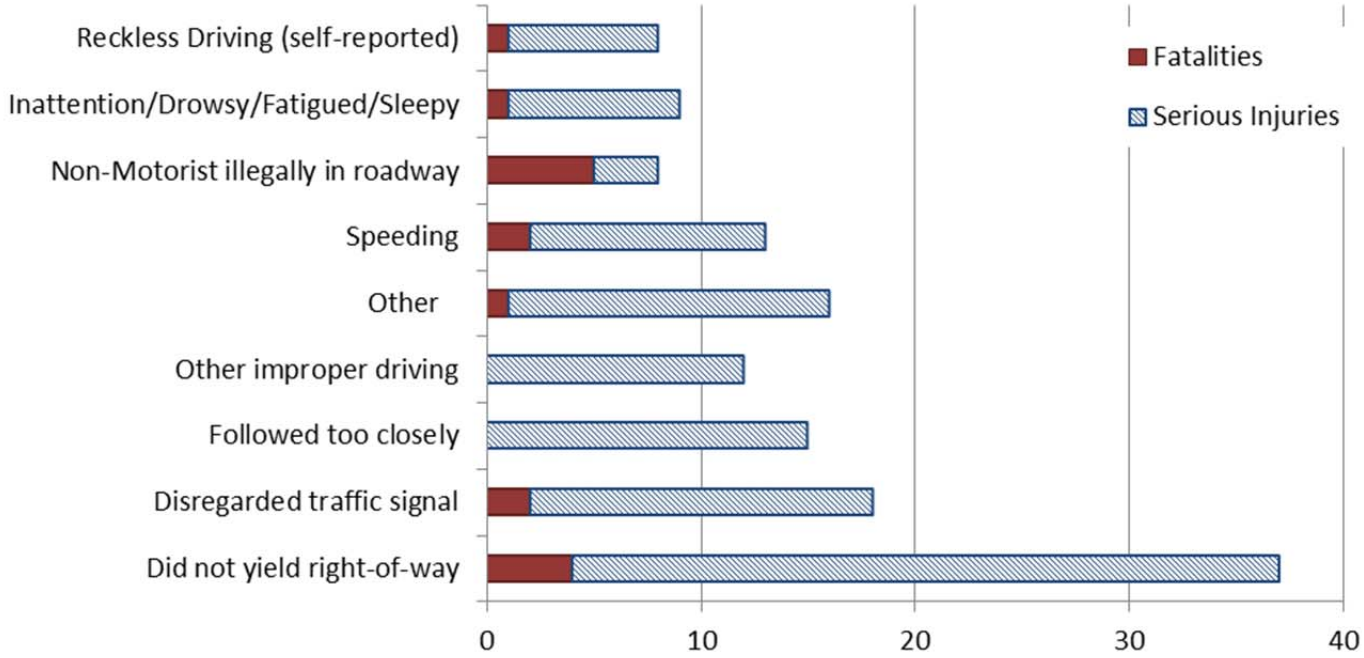
Note: First value represents the frequency, and the second value represents the percentage of the total.

What are the Crash Causes?

Identification of crash causes, as classified in ODOT's crash database, provides information about conditions contributing to crashes. ODOT has 36 categories to classify crash causes. Many of these crash causes have very few reported serious injuries or fatalities. Of the 36 total categories, eight categories represent approximately 78 percent of all serious injuries and fatalities (see Graph 6); all other crashes are classified as "other".

It is important to note that for this analysis only the primary crash cause was analyzed, because in order of predominance, a second or third crash cause is rarely reported. However, there are often instances where multiple causes resulted in the crash and severity of the injury. For example, speeding combined with following too closely could be the cause of a serious injury (Injury A) crash. Graph 6 provides a summary of the most frequent crash causes (the predominant reported cause) for the years 2010-2014. As can be observed, **not yielding the right-of-way is by far the leading cause of high severity (Injury A) crashes** in the City of Hillsboro. Overall, the crash cause results show that human behavior is the primary cause of the majority of high severity crashes and that crashes appear to generally be occurring at intersections or other access point.

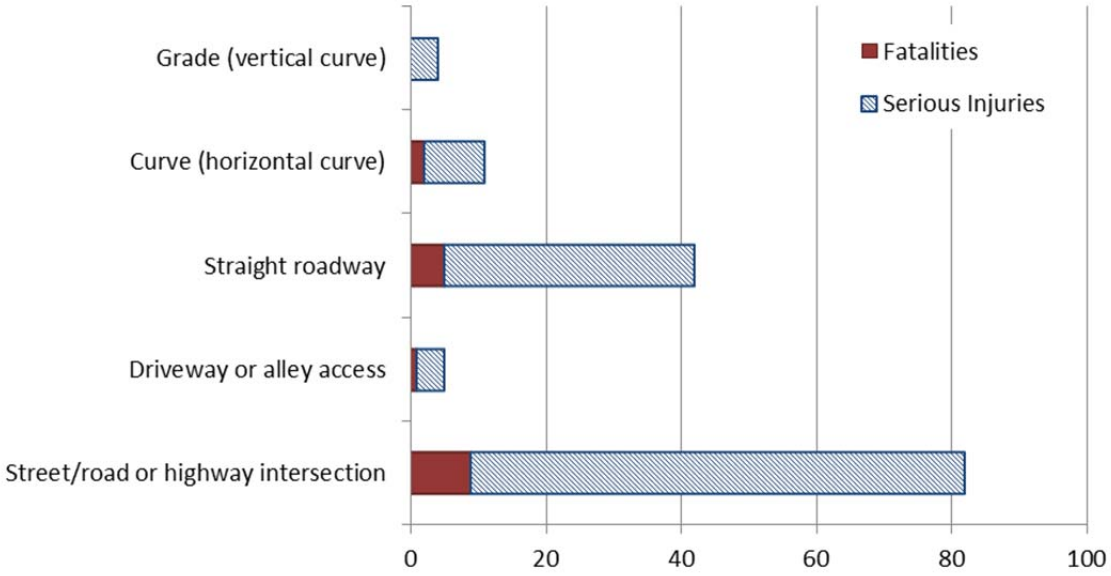
Graph 6 – Serious Injuries (Injury A) and Fatalities by Crash Cause (2010-2014)



Where the Crashes Occurring?

As speed and volumes increase, the severity of traffic crashes also increases. Higher speeds, volumes, and roadway complexity tends to occur on roadways with higher functional classifications, such as arterial roadways. Consistent with that trend**, the majority of the City of Hillsboro serious injuries (Injury A) and fatalities related to crashes occur on either highways or, primary and minor arterials (major roadways),** as can be seen in Figure 3. ODOT's geometric location classification was evaluated to further identify where the high severity crashes were occurring. As shown in Graph 7, **the majority of serious injuries (Injury A) and fatalities occurred at intersections** with a much smaller percentage occurring on straight roadways.

Graph 7 – Serious Injuries (Injury A) and Fatalities by Location (2010-2014)



To gain a better understanding of why the high severity crashes may be occurring and possible mitigation strategies, the high severity crashes at intersections and straight roadways were broken down by crash types, see Table 1.

Table 1 – Injury Classification on Crash Type by Location (2010-2014)

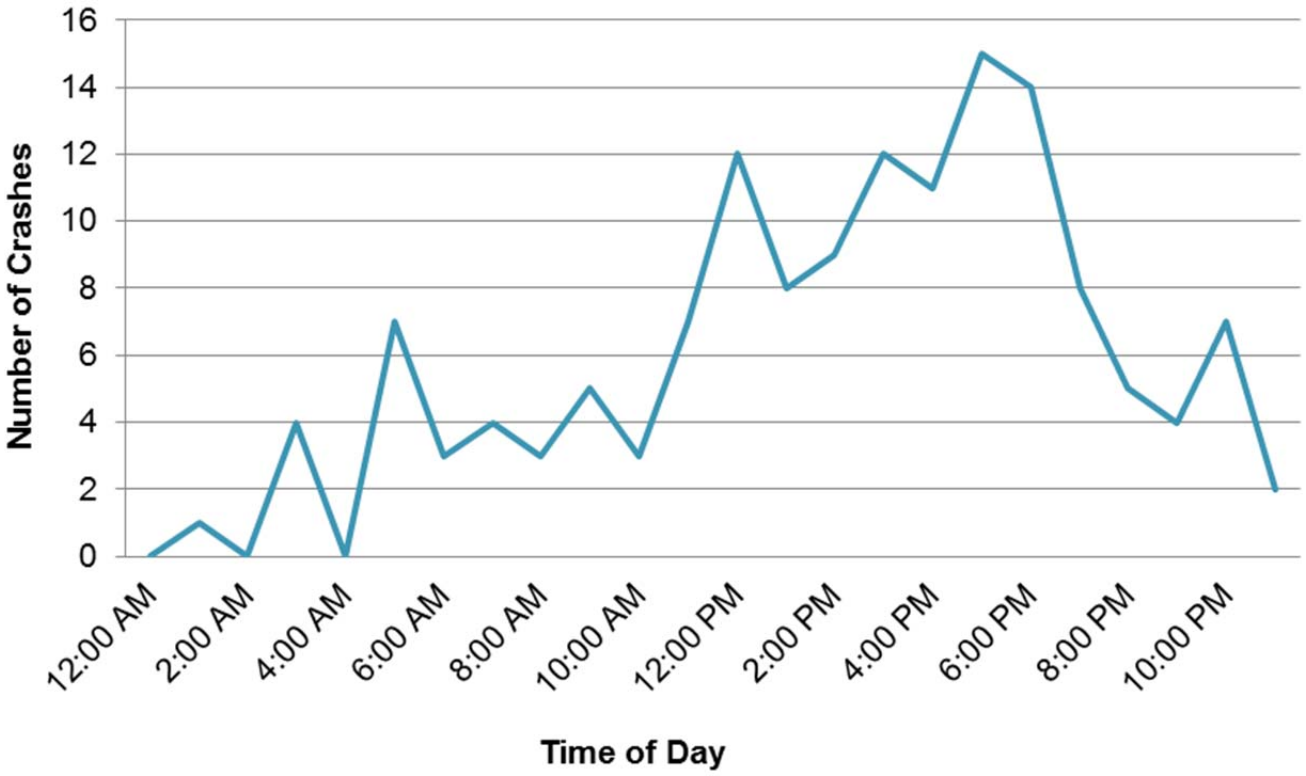
Crash Types	Intersection			Straight Roadway		
	Fatalities	Serious Injuries	Percentage	Fatalities	Serious Injuries	Percentage
Angle	0	16	20%	1	1	5%
Head-on	1	1	2%	0	2	5%
Rear-end	0	17	21%	0	12	29%
Side Swiping	0	0	0%	0	3	7%
Turning	4	32	44%	0	2	5%
Fixed Object	0	2	2%	1	16	40%
Pedestrian	4	5	11%	3	1	10%
Total	9	73	100%	5	37	100%

Note: Location of crashes is based on ODOT's classification in its crash reporting system

When are the Crashes Occurring?

Evaluating the time of day crashes occur can help to identify contributing factors, such as motor vehicle volumes and roadway lighting. As shown in Graph 8, serious injuries and fatalities related to crashes peak during both the evening peak period and to a lesser extent during the mid-day peak period. These time periods reflect typical peak commute times and correspond with increased motor vehicle volumes on the roadway. This matches the data that was evaluated for the lighting category (see Appendix B).

Graph 8 – Serious Injuries (Injury A) and Fatalities by Time of Day (2010-2014)



The data showed that:

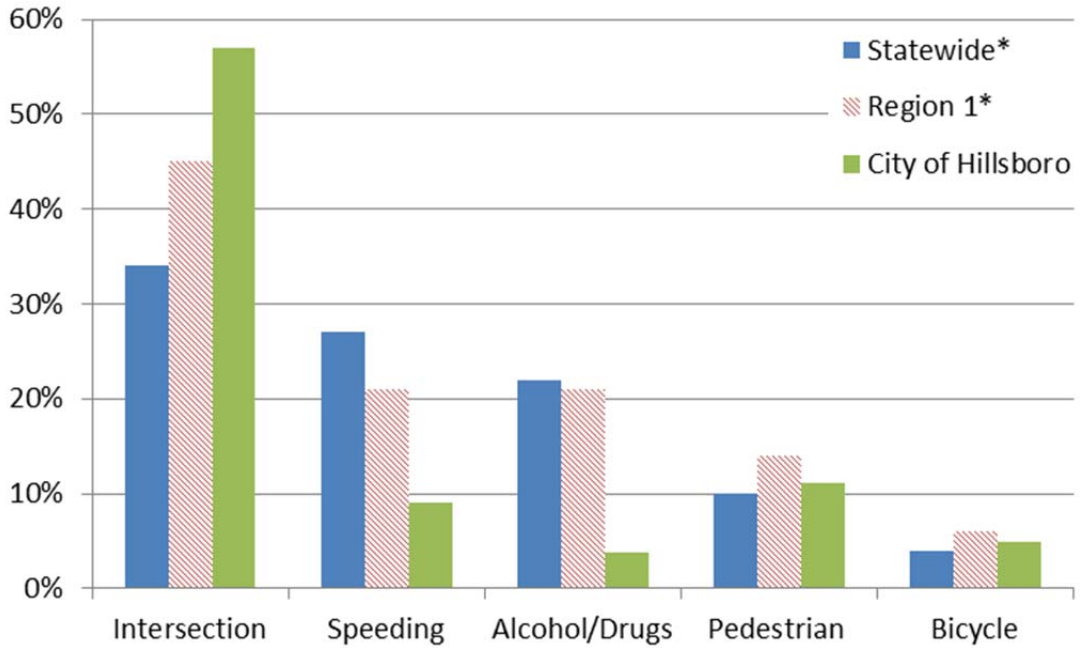
- Over 65 percent of high severity crashes occurred during the daylight (typically from 6:00 a.m. to 6:00 p.m.)
- Less than 10 percent occurred in the dark without street lights

Considering the influence of weather, the majority of high severity crashes (56 percent) occurred on a clear day, and the remaining high severity crashes (41 percent) occurred when it was cloudy and/or rainy.

Other Crash Type Areas of Interest

The characteristics of crashes related to intersections, speeding, alcohol and drug impairment, and pedestrian and bicycle travel were also investigated. A comparison of these categories compared to ODOT's recent safety evaluation[9] is shown in Graph 9. As can be seen, the City of Hillsboro is better than expected for speeding and crashes including alcohol or drug use, but worse than expected for intersections. Additional information related to crashes near schools, crashes near transit locations, and other potential points of interest is found in the following sections.

Graph 9 – Serious Injuries (Injury A) and Fatalities Compared to ODOT Statewide and Region 1 of ODOT



**2009 to 2013 Fatalities and Serious Injuries*

Intersections

Given the frequency of crashes occurring at intersection locations, different factors were evaluated to determine the most critical intersections in the City. One methodology applied to the City of Hillsboro was a Highway Safety Manual (HSM) critical crash rate analysis. The analysis was conducted on 35 intersections within the City where traffic volumes were available, and at locations that appeared to have a higher frequency of crashes (see Appendix B for more details). Intersections with crash rates that exceed the calculated critical crash rate are identified in Table 2. Critical intersections were identified based on variance from critical crash rate, and the number of fatalities and serious injuries (Injury A) - bolded in Table 2. Crash rates were developed using the following formula:

$$R = \frac{C \times 100{,}000{,}000}{V \times 365 \times N \times L}$$

[9] Oregon Transportation Safety Action Plan, Cambridge Systematics, 2016

Table 2 – Highway Safety Manual Intersection Critical Crash Rate Analysis Summary

Intersection	Ownership	Total Crashes		Fatalities	Serious Injuries	Fatal and Serious Injury Crash Rate
		Crash Rate	Critical Crash Rate*			
NE Brookwood Parkway & NE Cornell Road	**Washington County**	**2.23**	**0.87**	**1**	**2**	**0.05**
NW 185th Avenue & Westbound Highway 26	ODOT	1.79	0.85	0	1	0.00
S 1st Avenue & SE Oak Street	ODOT	1.61	0.91	0	0	0.00
SE Minter Bridge Road & SE Tualatin Valley Highway	**ODOT**	**1.37**	**0.89**	**0**	**3**	**0.06**
S 1st Avenue & SW Baseline Street	**ODOT**	**1.41**	**0.92**	**0**	**3**	**0.07**
SW Cornelius Pass Road & W Baseline Street	Washington County	1.31	0.90	0	1	0.02
NE Brookwood Parkway & W Baseline Street	Washington County	1.27	0.89	0	1	0.02
NW 231st Avenue & NE Cornell Road	Washington County	1.20	0.87	0	0	0.00
NE 25th Avenue & NE Cornell Road	Washington County	1.12	0.87	0	1	0.02
SE 10th Avenue & SE Oak Street	ODOT	1.14	0.89	0	0	0.00
NE 185th Avenue & NW Evergreen Road	ODOT	1.08	0.85	0	1	0.01
SE Century Boulevard & SE Tualatin Valley Highway	ODOT	1.05	0.88	0	0	0.00
NW 185th Avenue & NW Cornell Road	**Washington County**	**1.00**	**0.85**	**1**	**2**	**0.04**
SE River Road & SE Tualatin Valley Highway	ODOT	1.03	0.88	1	0	0.02
SW 209th Avenue & SW Tualatin Valley Highway	ODOT	0.98	0.84	0	2	0.02
SE 10th Avenue & SE Walnut Street	ODOT	1.02	0.89	0	0	0.00
SE 10th Avenue & SE Baseline Street	ODOT	1.02	0.90	1	0	0.02
NW 185th Avenue & NW Walker Road	Washington County	0.94	0.86	0	1	0.01

*Rates were developed using all reported crashes.

Critical Crash Rate $Rc = Ra + K * \left(\frac{Ra}{m}\right) 2 - \frac{0.5}{m}$

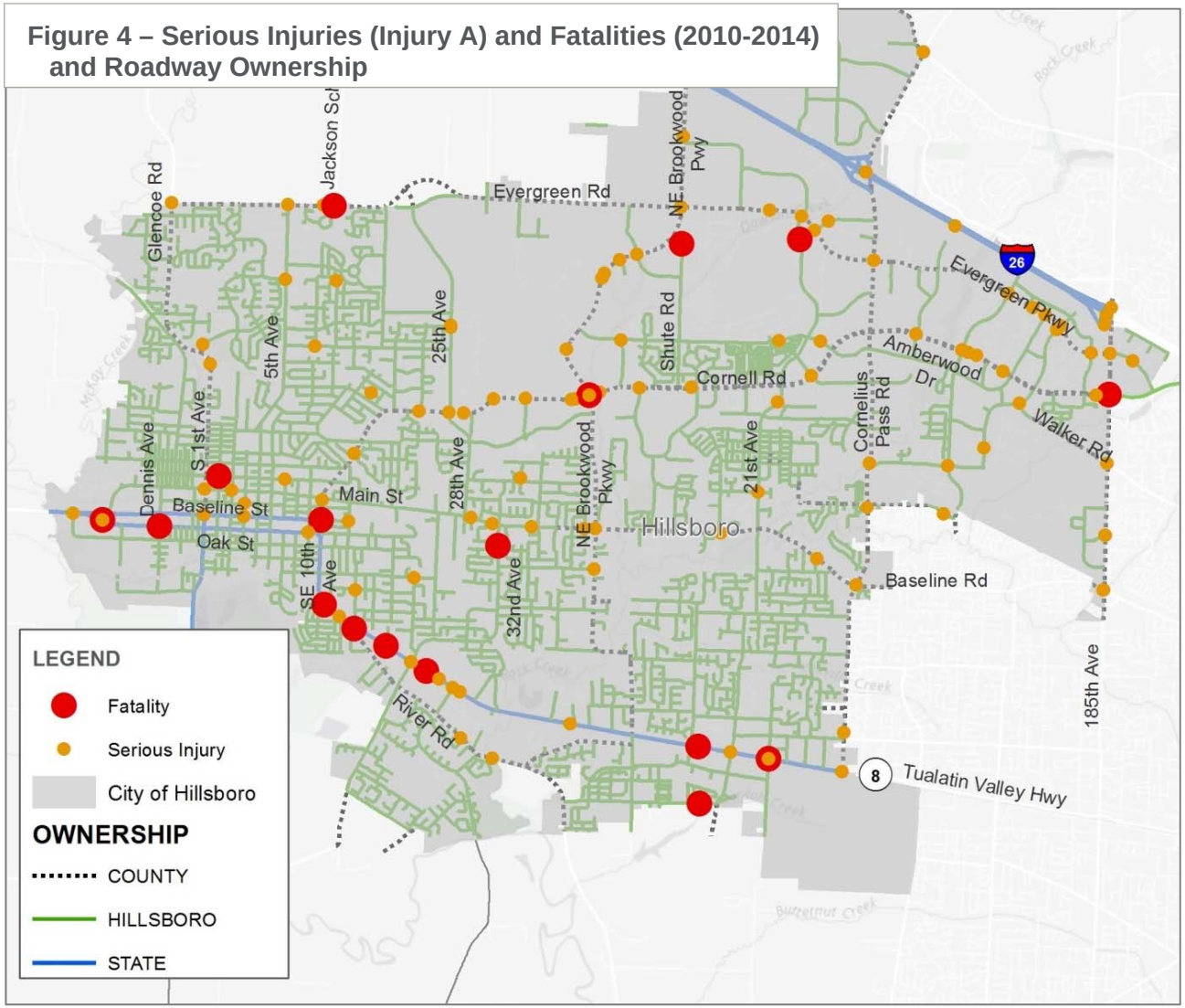
Rc=Critical Crash Rate, Ra= Average Crash Rate, M= Vehicle Exposure During Study Period, K=Constant based on Level of Confidence

Bold = Critical Intersections

As identified in the intersection analysis, the high frequency and higher severity crash locations are occurring on Washington County and ODOT facilities (see Figure 4). For the purpose of identifying potential projects for the City of Hillsboro on their own facilities, a visual inspection was conducted on City of Hillsboro owned intersections. The visual inspection identified intersections owned by the City of Hillsboro that had fatalities and/or and ones that had pedestrian or bicycle crashes serious injuries. The list of critical intersections based on this inspection includes:

- NE Estate Drive/NE Jackson School Road – one pedestrian serious injury
- NW 231st Avenue/NE Campus Way – one pedestrian serious injury
- NW 231st Avenue/NW Ostrich Road – one bicycle serious injury
- SE 12th Avenue/SE Baseline Street – one pedestrian serious injuries
- NE 2nd Avenue/NE Lincoln Street – one pedestrian fatality
- SE Hare Avenue/SE Davis Road – one pedestrian serious injury – one fatality

Figure 4 – Serious Injuries (Injury A) and Fatalities (2010-2014) and Roadway Ownership



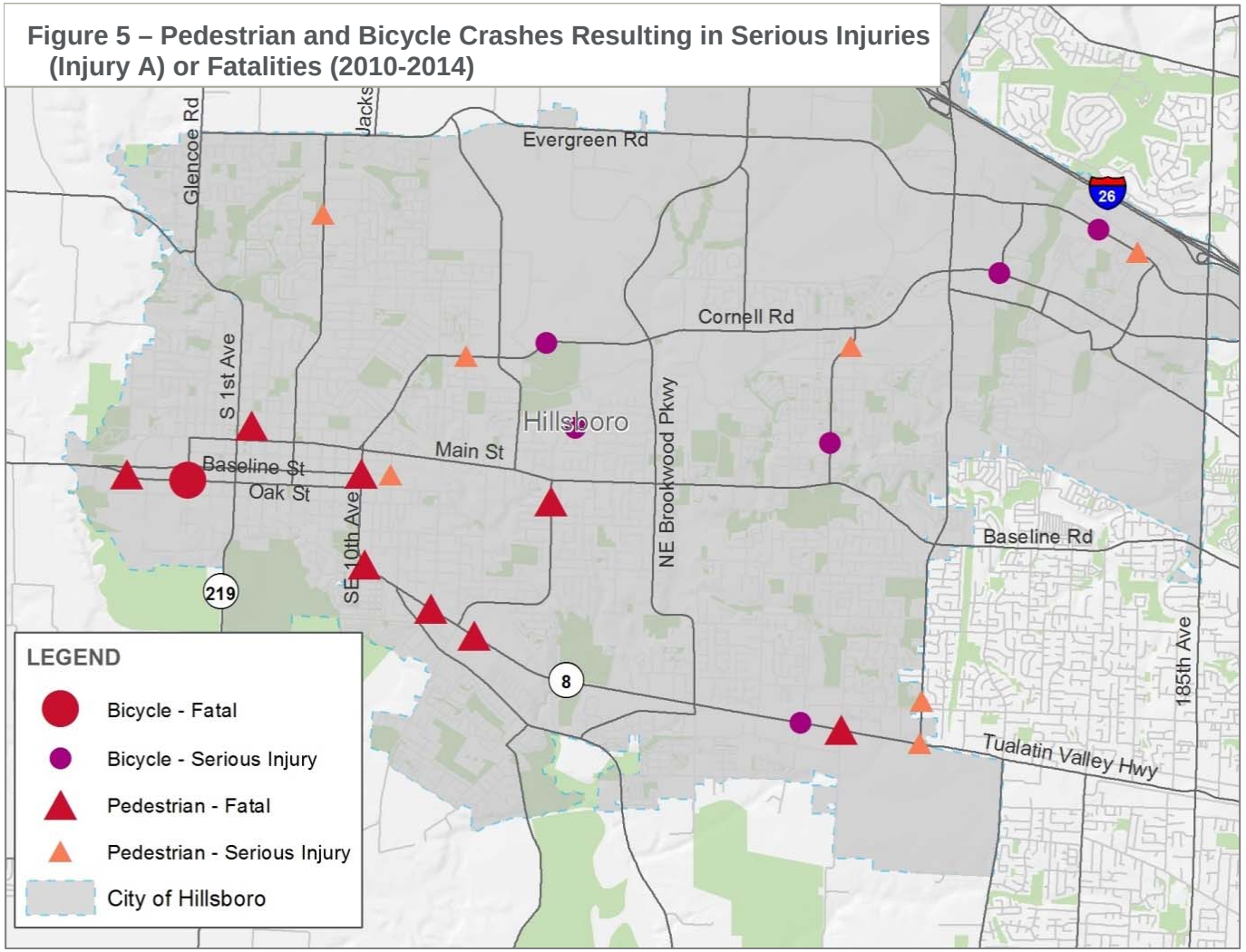
Pedestrian and Bicycle

Pedestrians and bicyclists are some of the most vulnerable users of public roadways. Crashes involving these roadway users may result in more serious injuries simply because pedestrians and bicyclists do not have the protection of a vehicle. In the last five years (2010 to 2014) there were:

- 8 Pedestrians/1 Bicyclist fatalities related to crashes
- 9 Pedestrians/6 Bicyclists serious injuries (injury A) related to crashes

Figure 5 shows the locations of all pedestrian and bicycle crashes that resulted in a serious injury (Injury A) or fatality reported between

Figure 5 – Pedestrian and Bicycle Crashes Resulting in Serious Injuries (Injury A) or Fatalities (2010-2014)

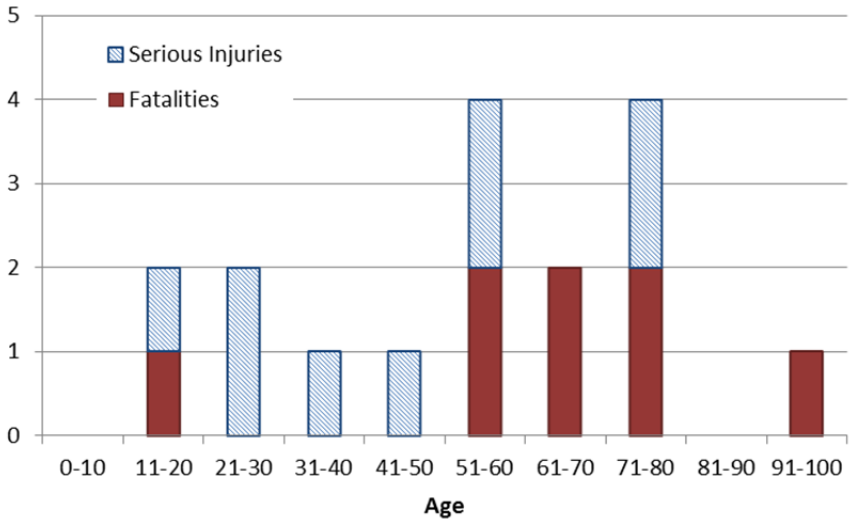


2010 and 2014. **The frequency of fatalities and serious injuries (Injury A) related to pedestrian and bicycle crashes in City of Hillsboro (5% and 11%) are slightly higher than Oregon statewide (4% and 10%).**[10]

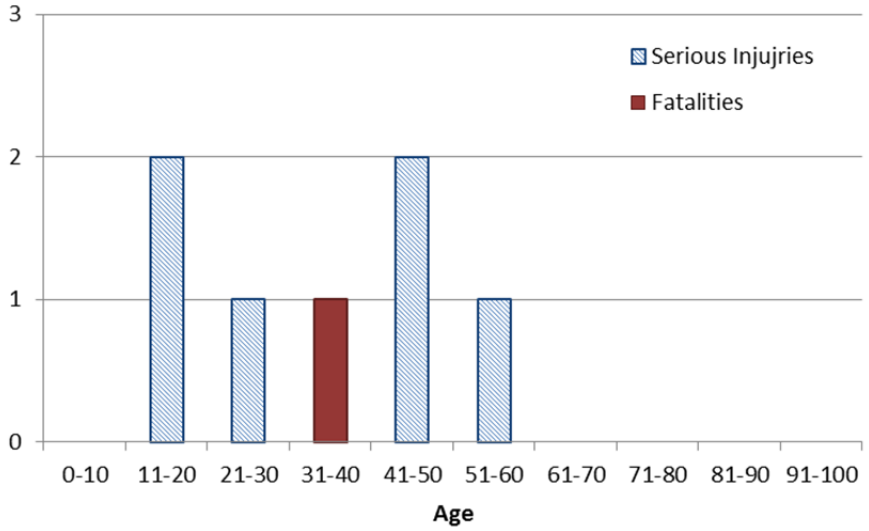
When evaluating additional factors that may have an influence on pedestrian and bicycle related crashes, it was determined that there were no trends in weather and lighting related to pedestrian and bicycle related crashes.

When evaluated for age, the distribution of serious injuries (Injury A) and fatalities across age groups for pedestrians and bicyclists is fairly even with peaks in high severity injuries for people 51 and older, as can be seen in Graph 11 and Graph 11; while high severity injuries occurred only in participants under 60 for those involved in bicycle crashes.

Graph 11 - Serious Injuries (Injury A) and Fatalities Related to Pedestrian Crashes by Age (2010-2014)



Graph 11 - Serious Injuries (Injury A) and Fatalities Related to Bicycle Crashes by Age (2010-2014)



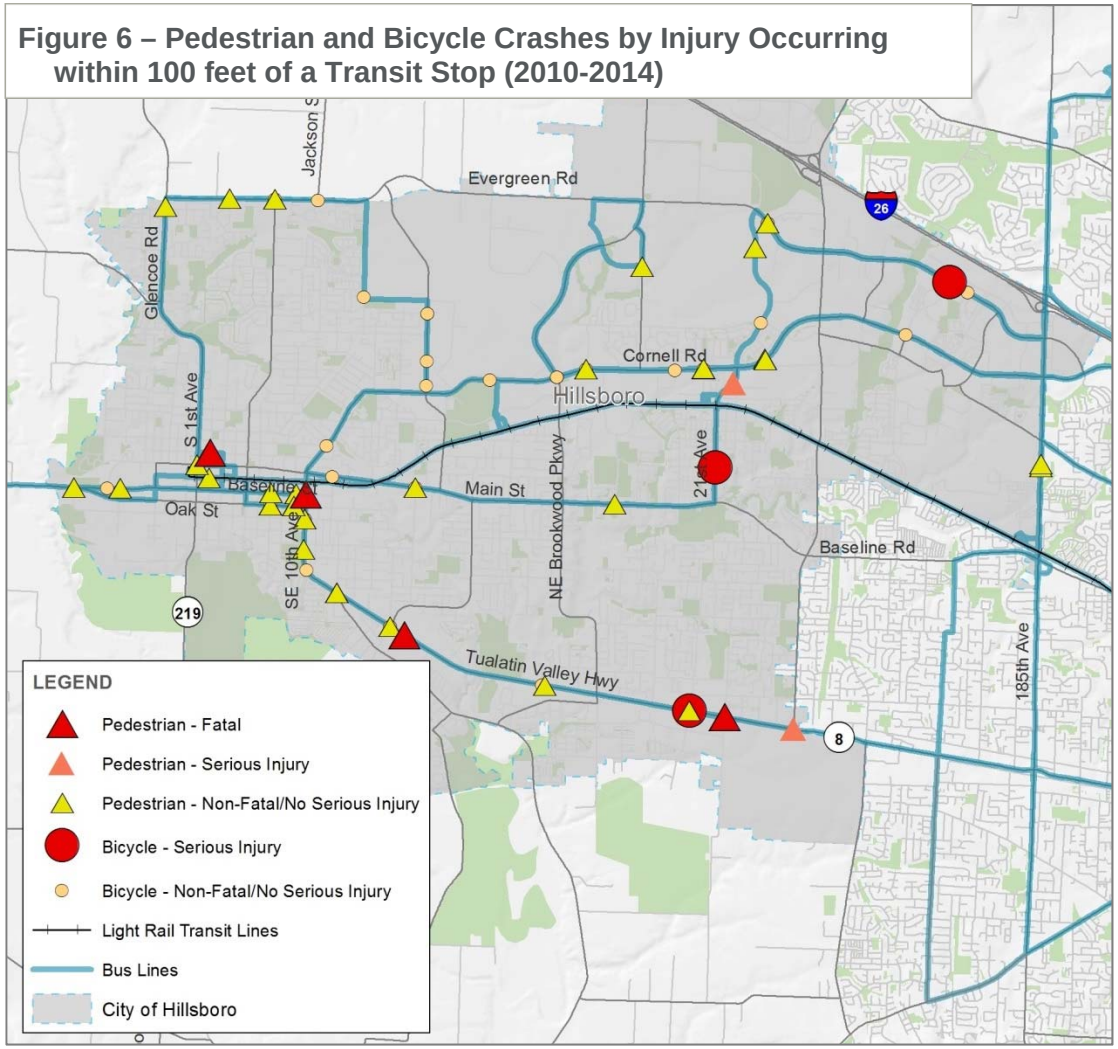
[10] ODOT crash data averages from 2009 to 2013

Transit

City of Hillsboro residents are provided transit service by TriMet via buses and MAX light rail service. Bus lines serving the City of Hillsboro include the 46, 47, 48, 52, 57, 67, and 88. The westside light rail Blue Line also serves the City of Hillsboro with a western most terminus at the Hatfield Government Center.[11]

A combination of thirty-nine fatalities and serious injuries (Injury A) occurred within 100 feet of a transit stop, accounting for 26 percent of the total fatalities and serious injuries (Injury A) in City of Hillsboro. As can be seen in Figure 6, there are six pedestrian and three bicycle crashes that resulted in a serious injury (Injury A) or fatality within 100 feet of a transit stop, accounting for almost half of all pedestrian and bicycle related crashes in the City of Hillsboro.

Figure 6 – Pedestrian and Bicycle Crashes by Injury Occurring within 100 feet of a Transit Stop (2010-2014)



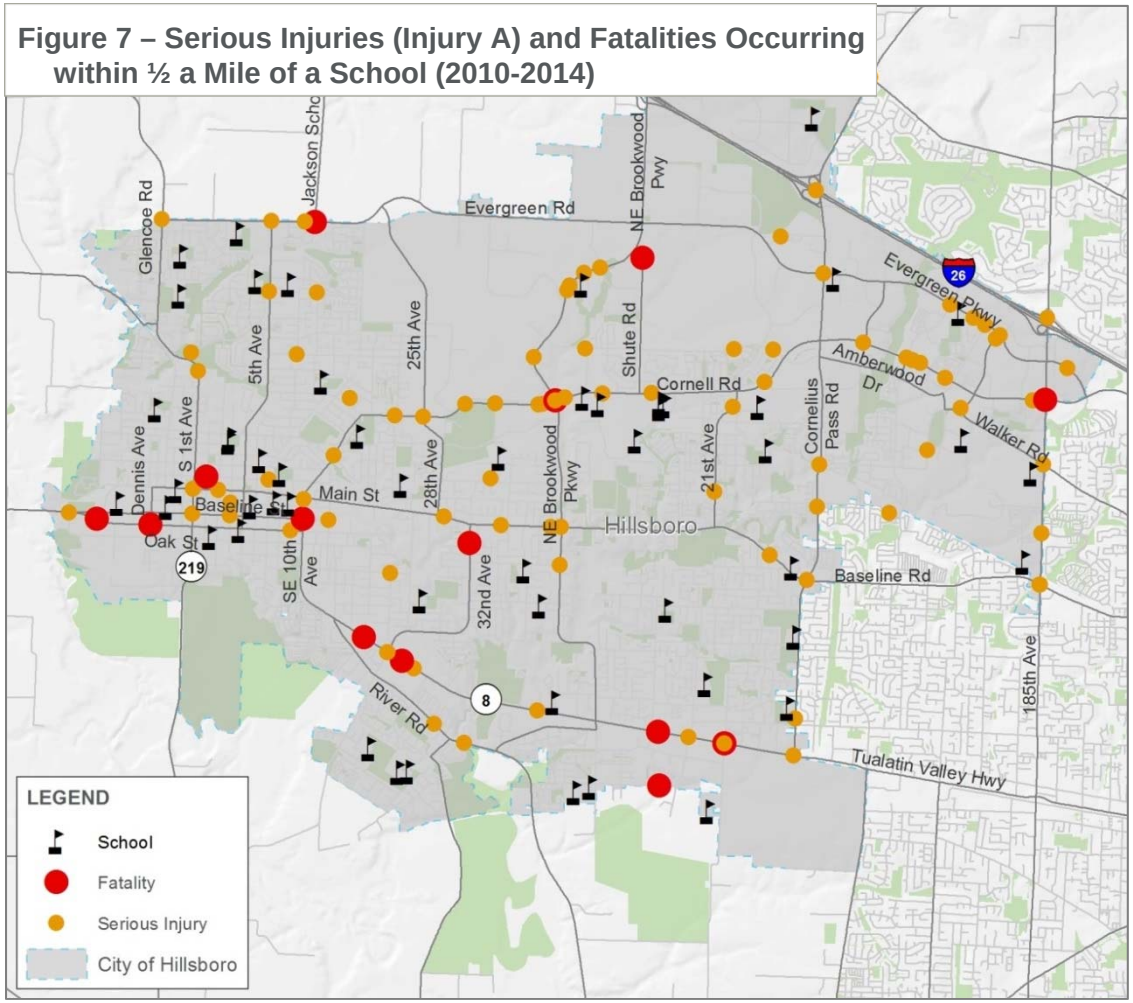
[11] TriMet. 2016. TriMet At-A-Glance 2016. https://trimet.org/ataglance/TriMet-At-a-Glance-2016.pdf. 13 July 2016.

Schools

The Hillsboro School District has 25 elementary schools, five middle schools, four high schools, and three alternative education options, providing education to almost 21,000 students.[12] Due to the size of the school district, the City of Hillsboro places a strong focus on biking and walking to schools.

An evaluation of crashes that either occurred in "school zones" according to the reporting police officer, or crashes that occurred within a half mile radius of a school[13] was conducted. The data showed that 14 fatalities and 103 (see Figure 7) serious injuries (Injury A) occurred within a half mile of a school, this accounts for 81% of the fatalities and serious injuries in the City. Specifically, 96% of all serious injuries (Injury A) and fatalities that involved a bicycle or pedestrian occurred within a half a mile of a school. Of the high severity crashes occurring within half a mile of school, the most frequent crash causes are not yielding the right-of-way (26%), disregarding traffic signal (12%), speeding (11%), and following too closely (11%). **It should be noted that although these crashes occurred within a half mile of a school, not all of these crashes are related to school activities.**

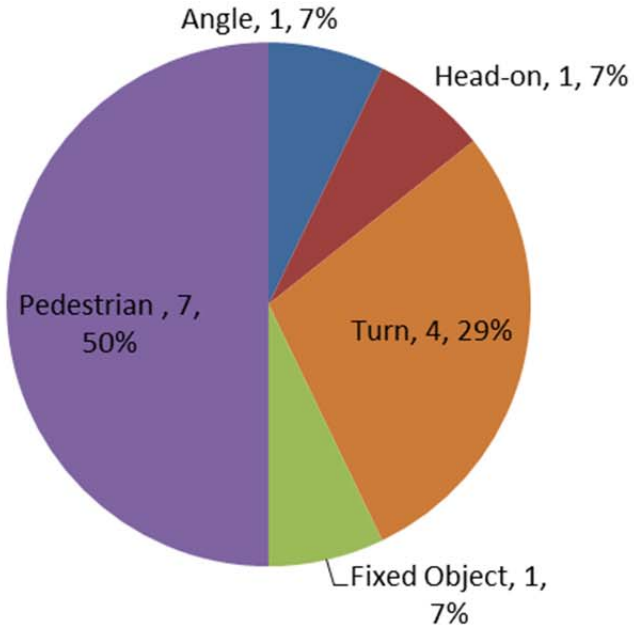
Figure 7 – Serious Injuries (Injury A) and Fatalities Occurring within ½ a Mile of a School (2010-2014)



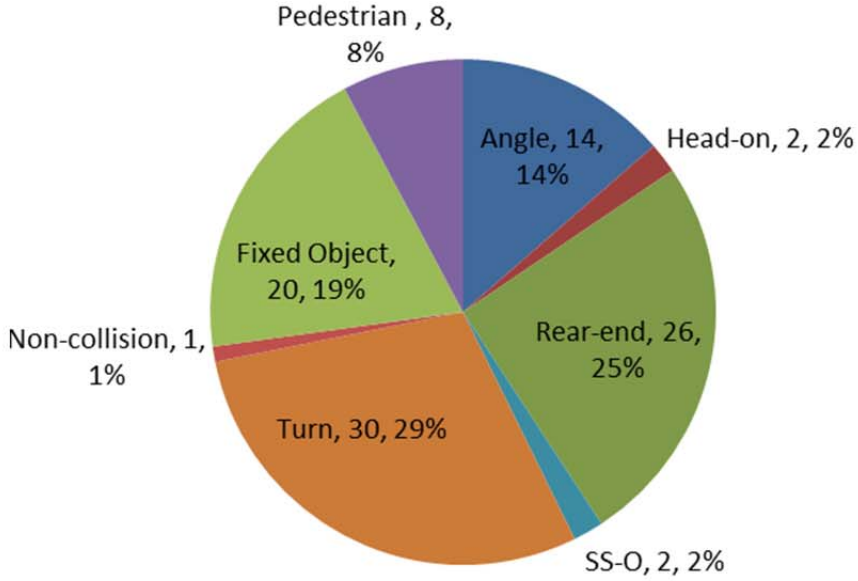
[12] http://www.hsd.k12.or.us/AboutHSD/PublicDataPortal/FactsandFigures.aspx. 13 July 2016.
[13] ½ a mile was used as it is consistent with the Safe Routes to School Program conducted by Washington County

Further breakdown of the fatalities and serious injuries within half a mile of schools by collision type are provided in Graph 13 and Graph 13. The percentages of fatalities and serious injuries by collision type are very similar to the breakdowns city wide. This is to be expected as 81% of all fatalities and serious injuries in the city occurred within half a mile of a school. It is worth noting that the percentage of pedestrian and bicycle related fatalities and serious injuries within a half a mile of a school is slightly higher than city wide (19% vs 16%).

Graph 13 – Fatalities Within ½ a Mile of a School by Collision Type (2010-2014)



Graph 13 – Serious Injuries (Injury-A) Within ½ a Mile of a School by Collision Type (2010-2014)



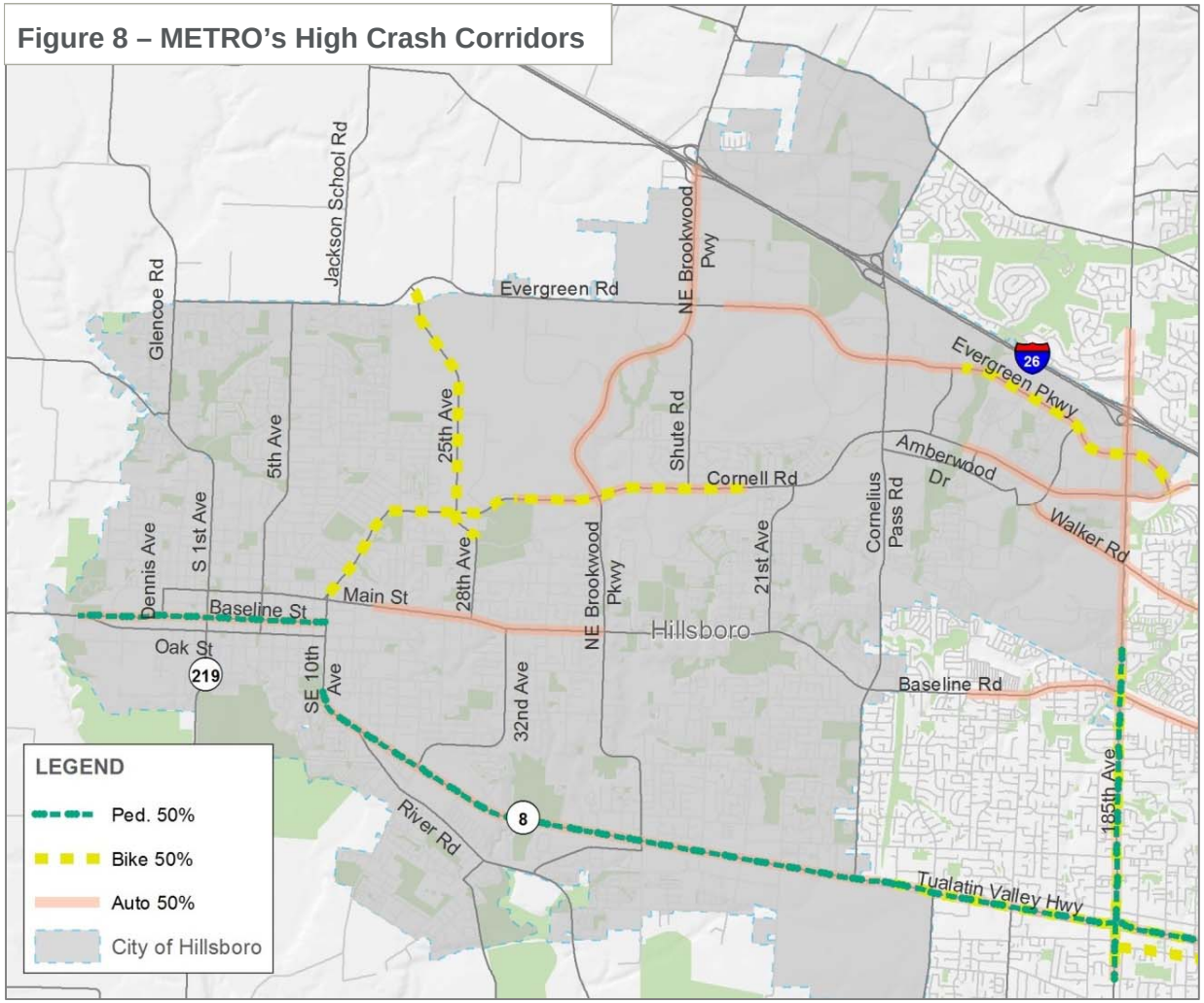
Note: First value represents the frequency, and the second value represents the percentage of the total.

High Crash Corridors

An analysis of high crash corridors was completed by METRO[14] for all roadways within the Portland METRO region. This analysis included evaluation of the top contributors to high severity crashes, pedestrian crashes, and bicycle crashes. The methodology for this work was to identify corridors that were greater than a quarter of a mile and less than three miles in length. It was identified through this analysis that:

- 57% of all severe crashes occurred on 7% of the roads
- 50% of severe automobile crashes occurred on 5% of the roads
- 50% of severe bicycle crashes occurred on 3% of the roads
- 50% of severe pedestrian crashes occurred on 2% of the roads

Figure 8 – METRO's High Crash Corridors



[14] Preliminary findings provided by METRO August 2016 (Appendix C)

Several corridors within the City of Hillsboro were flagged as contributing to the top 50% of crashes for all three of these categories: pedestrian, bicycle, and automobile crashes. Those corridors are highlighted in Figure 8 by mode and include the following:

- W Baseline Street; from SW Oak Street to SE 10th Avenue
- SW Tualatin Valley Highway (OR 8); from SE Maple Street to East of City Limits
- E Main Street; from NE 14th Avenue to NE Brookwood Parkway
- NE Cornell Road; from NE 28th Avenue (Hillsboro Airport) to NE 61st Avenue
- NE Cornell Road; from NW Aloclek Dr (Rock Creek Trail) to East of City Limits
- SW Brookwood Parkway; from NE Cornell Road to Highway 26
- SW Evergreen Parkway; from NW 235th Avenue to NE Cornell Road
- NW 185th Avenue; from North of the City limits to South of City Limits
- Walker Road; from NW Stucki Avenue/NW Amberglen Parkway to East of City Limits

Additional Crash Trends

While evaluating the City of Hillsboro crash data and other corresponding safety analysis documents in the region, other notable factors that attribute to serious injury (Injury A) and fatal crashes were noted:

- An analysis of high crash corridors was completed for the Washington County TSAP[15]. Several of those corridors are also located within the City of Hillsboro and should be an area of focus. They are as follows:
    - Tualatin Valley Highway (OR 8)
    - NW 185th Avenue
    - NE Cornell Road
- In the City of Hillsboro, there were a total of 5 serious injuries (Injury A) and fatalities related to crashes in the last five years that involved motorcycles. This accounts for less than six percent of the total crashes within the City of Hillsboro, which is much lower than the national average, where 14 percent of all traffic fatalities involved motorcyclists.[16]

[15] HDR. “Draft Washington County Transportation Safety Action Plan.” 2016.
[16] National Highway Traffic Safety Administration (NHTSA). "Motorcycles." June 2016. *Traffic Safety Facts, 2014 Data.* https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812292. 12 July 2016

Strategies

Trends in crashes that resulted in serious injuries (Injury A) and/or fatalities have been identified in the previous sections. These trends can be used by the City of Hillsboro to develop strategies to focus on reducing crashes that result in serious injuries or fatalities. Crash trends, improvement strategies, cost, best practices, and proven implementation can be found in Table 3.

Table 3 – Systemic Engineering and Enforcement Strategies for the City of Hillsboro TSAP

Crash Trend Identified	Improvement Strategy	Cost	Best Practices	Proven Implementation
Pedestrian and bicycle related crashes	Implement a Safe Routes to Schools (SRTS) Program	Work with Washington County to supplement work completed as part of the School Access Improvement Study17	• Develop a SRTS plan that outlines the 6 E's – encouragement, enforcement, education, engineering strategies, evaluation, and equity • SRTS education should include both classroom education and in the field education • Identify funding for the program – typical SRTS events can cost less than $100 • This will require a dedicated staff member to champion the SRTS program and guide implementation of events, projects, and strategies • Consider installing speed feedback signs for school zones to help inform drivers of their speeds while approaching the school zone • Work with current county and statewide SRTS coordinators for lessons learned	• In 2013, the National Center for SRTS Trends in Walking and Bicycling to School from 2007 to 2013, announced that the percentage of students who walked and bicycle to school had increased from 12.4% to 15.7% in the morning; and from 15.8% to 19.7% in the afternoon. [18] • A study done by the Texas Transportation Institute (TTI) found that Installing speed feedback signs in school zones can reduce speeds up to 9mph.[19] • Safe Route to School Programs have been implemented across Oregon. Safety education can be focused on safe crossing practices, safety near or around vehicles on the street, emphasis on being alert as pedestrians and bicyclists, the importance of adult supervision, and safe operating practices
	Pedestrian and Bicycle Specific Studies	Low to medium cost depending on the safety evaluation conducted	• Evaluate high crash pedestrian and bicycle locations to identify safety improvements • Evaluate pedestrian and bicycle crashes near transit stops and identify transit related solutions and best practices for future transit stop designs	• Not applicable – no data available
	Pedestrian and Bicycle Operational Improvements	Low to medium cost improvement	• Create pedestrian and bicycle maps to help users identify routes that best accommodate alternate modes • Consider using leading pedestrian intervals and adding bicycle detection zones • Consider developing logic for bicycle detection and gap dependent flashing yellow arrow operations	• Not applicable – no data available
	Pedestrian and Bicycle Focused Design Improvements	Low to medium cost improvements can be implemented as part of existing improvement projects	• Consider adopting the National Association of City Transportation Officials (NACTO) Urban Street Design Guidelines • Consider adopting the NACTO Transit Street Design Guide to better facilitate pedestrian and bicycle features into transit stop designs • Look for opportunities to install protected pedestrian and bicycle crossings • Identify better treatments for transitions for when bike lanes end • Limit right turn slip lanes which can encourage fast, careless turns, and increase pedestrian crossing distances.	• Not applicable – no data available
Crashes involving turning movements at signalized intersections	Gap Dependent Flashing Arrow	Low cost improvement; can involve updating existing signal heads and activating signal timing option.	• Recommend at urban signals • More effective when combined with enforcement. Enforcement strategies could include installment of Enforcement Assistance Lights (EALs) to identify vehicles running red lights, specific police monitoring of high crash locations, increased fines for violations that result in higher percentage of crashes with serious injuries or fatalities • Consider developing logic for bicycle detection and gap dependent flashing yellow arrow operations	• Several Crash Modification Factors exist and can be chosen to represent implementation of flashing yellow arrows (FYA). Most studies show the implementation of FYAs reduces crashes at intersection locations.[20]

[17] HDR, Washington County, Safe routes to School, *Washington County School Access Improvement Study.* Washington County, OR, March 2016
[18] Safe Routes to School Guide. *Community Success Stories*. 2015. http://guide.saferoutesinfo.org/introduction/promising_examples_and_community_success_stories.cfm. July 2016.
[19] Ulman, Gerald and Elisabeth Rose. "Texas Transportation Institute." 2004 January. *Effectiveness of Dynamic Speed Display Signs (DSDS) in Permanent Applications.* http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/0-4475-S.pdf. August 2016.
[20] Crash Modification Factors Clearinghouse. *CMFs Flashing Yellow Arrow*. 2016. http://www.cmfclearinghouse.org/results.cfm. July 2016.

Crash Trend Identified	Improvement Strategy	Cost	Best Practices	Proven Implementation
	Geometric Improvements for turns	Moderate cost, depending on the scale of the improvement	• Recommended for turning movements with pedestrians and bicyclists • Consider adding right-turn slip lanes where right-of-way is available and the need is present • Consider intersection realignment to "square up intersections" to allow for better sight distance for turning vehicles	• Crash Modification Factors exist for various turning related geometric improvements
Crashes involving younger drivers	Education and Law Enforcement Campaigns	Low cost educational outreach often can occur in a High School setting	• Review transportation plans for new/expanding high schools – many inexperienced drivers access the school. Avoid any design variances from the standards when designing roadways near schools i.e. reduced lane widths, sight distance, turn lane pockets, etc.	• The State of Oregon enacted a GDL program in March 2000. After GDL implementation, teen crash, traffic conviction, and license suspension rates were lower for all age groups, even among the unrestricted 18- and 19-year old novice drivers.[21]
	Focused Enforcement	Low cost improvement if staff is available	• Publicize and enforce laws pertaining to underage drinking and driving • Publicize and enforce safety belt laws	• Not applicable, enforcement is generally evaluated by reduction in tickets, and the total crashes is not compared
Rear-end collisions	Signal Timing Improvements	Low cost improvement; signal equipment/timing improvements	• Improve signal coordination to minimize the number of stops • Consider installing enforcement assistant lights (EALs) "Tattle tale lights"	• Federal Highway Administration (FHWA) has cited studies that show as high as 50% reduction in crashes with Green-light extension[22] • Several Crash Modification Factors exist and can be chosen to represent implementation of red light running enforcement cameras. Most studies show the implementation of these cameras can reduce crashes at intersection locations.[23]
	Speed Reduction	Low cost study to identify locations for potential speed reduction	• Evaluate rear-end collision locations and identify high frequency and high severity locations and implement speed reduction	•
Angled crashes	Red Light Improvements Signal Timing Improvements	Low cost improvement; signal equipment/timing improvements	• Implement green or red light extensions • Consider installing enforcement assistant lights (EALs) "Tattle tale lights"	• FHWA has cited studies that show as high as 50% reduction in crashes with Green-light extension[24] • Several Crash Modification Factors exist and can be chosen to represent implementation of red light running enforcement cameras. Most studies show the implementation of these cameras can reduce crashes at intersection locations.[25]
High critical crash rate intersection locations	Intersection Evaluation to Develop Improvements	Lower cost strategies can be applied for the short term, but high cost solutions are needed for the tiered intersections previously identified, more detail is provided in the proposed project list in the next section.	• Begin with a detailed safety and operations analysis • Budget for large scale improvements	• This is dependent on the type of improvement applied, more information is available via crash modification factors for various intersection improvements. [26]
Crashes where the driver disregarded traffic laws (i.e., did not yield the right-of-way, disregarded the traffic signals, followed too closely)	Focused Enforcement	Low cost improvement if staff is available	• Focus enforcement on locations where this is the most common and rotate enforcement between these locations	• EALs allow for red-light monitoring from any leg of the intersection, allow for one patrol officer to monitor intersections – downstream officers are not needed, do not use potentially controversial automated photography[27] • Enforcement is generally evaluated by reduction in tickets, and the total crashes is not compared
	Police Staff Dedicated to Safety Coordination within the City	Moderate cost	• Hire an experienced safety person, this should not be an administrative level position, this person would work with the data collected and analyzed by the city to ensure that enforcement was targeted to appropriate locations and behavior	• Not applicable – no data available

[21] National Highway Traffic Safety Administration. Evaluation of Oregon's Graduated Driver Licensing Program - Final Report. September 2007. http://www.oregon.gov/ODOT/TS/docs/DE/OR_GDL_Study07.pdf?ga=t. July 2016.
[22] US DOT Federal Highway Administration. *Making Intersections Safer: A Toolbox of Engineering Countermeasures to Reduce Red-Light Running*. 2015. http://safety.fhwa.dot.gov/intersection/conventional/signalized/rlr/rlr_toolbox/chap3.cfm. July 2016.
[23] Crash Modification Factors Clearinghouse. *CMFs Advanced technology and ITS*. 2016. http://www.cmfclearinghouse.org/results.cfm. July 2016.
[24] US DOT Federal Highway Administration. *Making Intersections Safer: A Toolbox of Engineering Countermeasures to Reduce Red-Light Running*. 2015. http://safety.fhwa.dot.gov/intersection/conventional/signalized/rlr/rlr_toolbox/chap3.cfm. July 2016.
[25] Crash Modification Factors Clearinghouse. *CMFs Advanced technology and ITS*. 2016. http://www.cmfclearinghouse.org/results.cfm. July 2016.
[26] Crash Modification Factors Clearinghouse. *CMFs Advanced technology and ITS*. 2016. http://www.cmfclearinghouse.org/results.cfm. July 2016.
[27] US DOT Federal Highway Administration. *CMFs - Queue Ahead Warning Signs*. 2016. http://www.cmfclearinghouse.org/results.cfm. July 2016.

Crash Trend Identified	Improvement Strategy	Cost	Best Practices	Proven Implementation
	Adequate Police Staff	Moderate cost	• As the City of Hillsboro continues to grow, Police Officer positions needs to be added to support that growth. Additional officers should be accommodated in full time equivalent (FTE) projects to account for an increase in the number of citizens.	• Not applicable – no data available
	Education Campaigns	Moderate cost improvement, it depends on the level of education	• Integrate into driver's education programs at schools • Provide post cards or informational brochures at City of Hillsboro Public Works and open houses concerning rules of the road that highlight some of the most common traffic errors that result in serious injuries or fatalities • Continue Fix-it Ticket Program, where drivers receive a ticket and an educational brochure and are then given the opportunity to take a safety related class to have the ticket fee reduced. • Consider expanding the educational program "Safety Town" which is a week-long, half-day safety camp for five and size years olds that focuses on different safety concepts including bike, pedestrian, and motor vehicle safety.	• Not applicable – no data available
Crashes involving fixed-objects.	Remove fixed-objects from within the clear zone	Cost will vary depending on object and size	• Objects like trees, shrubs, utility and traffic related poles should be outside of the designated clear zone to avoid being a roadside hazard. Fixed objects primarily consist of curbs, walls, barriers, piers, signs and signal supports, mature trees, landscaping items, and power poles that can affect a driver's speed or lane position if located too close the roadway edge. • Where objects cannot be removed from the clear zone consider barricading the fixed object with guardrail or installing rumble strips to alert drivers who begin veering off the roadway.	• Several Crash Modification Factors exist and can be chosen to represent moving fixed objects outside of the clear zone or increasing the object's distance from the roadside. All five studies show that removing fixed objects from the clear zone or moving fixed objects further from the roadside reduce fixed-object crashes.[28]
General Purpose Strategy	Annual Hot Spot/Systemic Safety Study Program	Cost will vary depending on scope of safety study	• The City of Hillsboro should consider dedicating funding to a Hot Spot/Systemic Safety Study Program that would allow the City to more quickly address safety issues that arise within the City.	• Not applicable – no data available
General Purpose Strategy	Support Washington County's Safety Policy Development Effort	Low cost improvement	• Areas of focus for Washington County's safety policy development effort could include the following initiatives: o Improving Oregon's Distracted Driving Law o Update driver education and licensing requirements o Identify reliable funding for safety programs including enforcement and education	• Not applicable – no data available

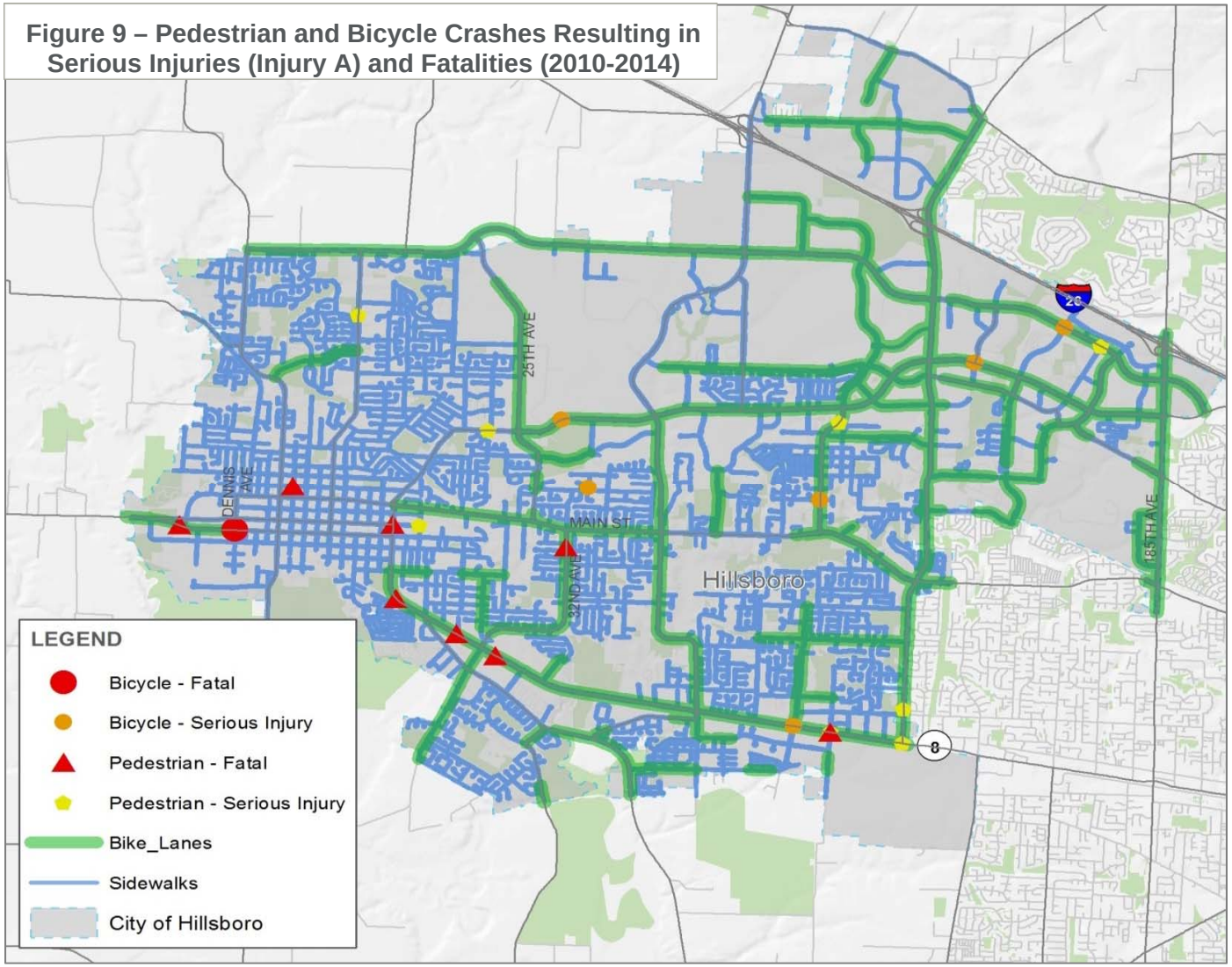
[28] Crash Modification Factors Clearinghouse. *CMFs Roadside – Fixed Object*. 2016. http://www.cmfclearinghouse.org/results.cfm. July 2016.

Pedestrian and Bicycle Infrastructure Enhancement Recommendations

Through the pedestrian and bicycle crash analysis, it was identified that all pedestrian and bicyclist fatuities and serious injuries (Injury A) occurred in locations with sidewalks or bike lanes, with the exception of one pedestrian crash (see Figure 9). Pedestrian and bicycle crashes do not generally correlate with missing infrastructure, as such, determining where to put new infrastructure to improve safety related to pedestrian and bicycles can be difficult.

It is worth noting that many of the bicycle and pedestrian crashes also occurred on County or State roadways. For those locations the specific agency guidelines should be followed. For the City of Hillsboro, there are no current documented guidelines identifying where to install enhanced mid-block crossings or how to prioritize the installation of new sidewalks and bike lanes.

Figure 9 – Pedestrian and Bicycle Crashes Resulting in Serious Injuries (Injury A) and Fatalities (2010-2014)



METRO does have Regional Crossing standards to help inform where crossing should occur under Chapter 308 of the Regional Transportation Functional Plan (RTFP).[29] Similarly, the Regional Transportation Plan (RTP) offers guidance on improving pedestrian access to transit, namely that street crossings should be spaced no more than 530 feet apart, although an ideal spacing would fall between 200-400 feet where feasible.[30]

Enhanced Crossings - While Oregon considers every intersection (signalized or unsignalized) a legal crossing, there are locations throughout the City that may benefit from enhanced pedestrian or multi-modal crossings. Currently, no documented guidelines exist for the City to use in determining what type of enhanced crossing to install, or where to locate enhanced crossings. It is therefore recommended that the guidelines outlined in the National Cooperative Highway Research Program (NCHRP) Report 562[31] be used to determine if an enhanced pedestrian crossing should be considered.

In 2006, the National Cooperative Highway Research Program issued NCHRP Report 562, entitled “Improving Pedestrian Safety at Unsignalized Crossings.” NCHRP Report 562 discusses the various ways of improving pedestrian crossings and their current applications throughout the United States based on quantitative procedures using real world data collection and analysis to develop the guidance provided. In Appendix A of the report, two worksheets are provided which aid in the selection of pedestrian crossing treatments at unsignalized intersections. The worksheets step through the analysis process for selecting the appropriate pedestrian crossing treatments based on pedestrian volumes, motor vehicle volumes, crossing distance, pedestrian delay, and other roadway characteristics to recommend a category of pedestrian crossing treatment. The four treatment categories are as follows:

- **Green**: A marked crosswalk is recommended.
- **Yellow**: An active/enhanced crosswalk is recommended in addition to a marked crosswalk. Within this category, types of pedestrian crossing improvements include in-street crossing signs, pedestrian crossing flags, high visibility signing, or actuated in-pavement roadway lighting. This category also includes Rectangular Rapid Flashing Beacons (RRFBs), which were given interim FHWA approval in 2008.
- **Red**: A signal/beacon is recommended in addition to a marked crosswalk. Within this category pedestrian crossing improvements include the midblock signal and the Pedestrian Hybrid Beacon (HAWK)[32] signal beacon.

[29] http://www.oregonmetro.gov/sites/default/files/chap308_regional_transportation_functional_plan.pdf,
[30] http://www.oregonmetro.gov/regional-transportation-plan, (p. 2-80)
[31] http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf
[32] HAWKS should only be considered when an RRFB won’t work due to signal coordination constraints

- **Signal**: A traffic signal controlling all traffic movements (motor vehicles, pedestrians, bicycles) is recommended.
- **Gray**: No marked pedestrian crossing is recommended. Instead, NCHRP Report 562 recommends the use of raised median refuge islands, curb extensions, or other traffic calming measures as feasible.

The NCHRP 562 report is not specific in the limitations on crossing spacing and proximity to other enhanced crossings, or how to prioritize crossing locations based on land use context. Below is the list of criteria that was developed based on engineering judgment and stakeholder input that should be considered when locating enhanced crossing treatments within the City of Hillsboro:

- Enhanced crossings should not be considered for locations within 250 feet of another signalized intersection or enhanced crossing location, and should be located at least 530 feet apart.
- Enhanced crossings should be prioritized near high concentrations of vulnerable users:
    - 200 feet of senior living homes
    - 200 feet of schools
    - 200 feet of transit stops
    - 200 feet of parks
    - 200 feet of denser urban areas

Sidewalks and Bike Lanes - For new sidewalks and bicycle infrastructure, locations with high frequency of users, and locations that generally include more vulnerable users should be prioritized for improvements. In order of prioritization are the following:

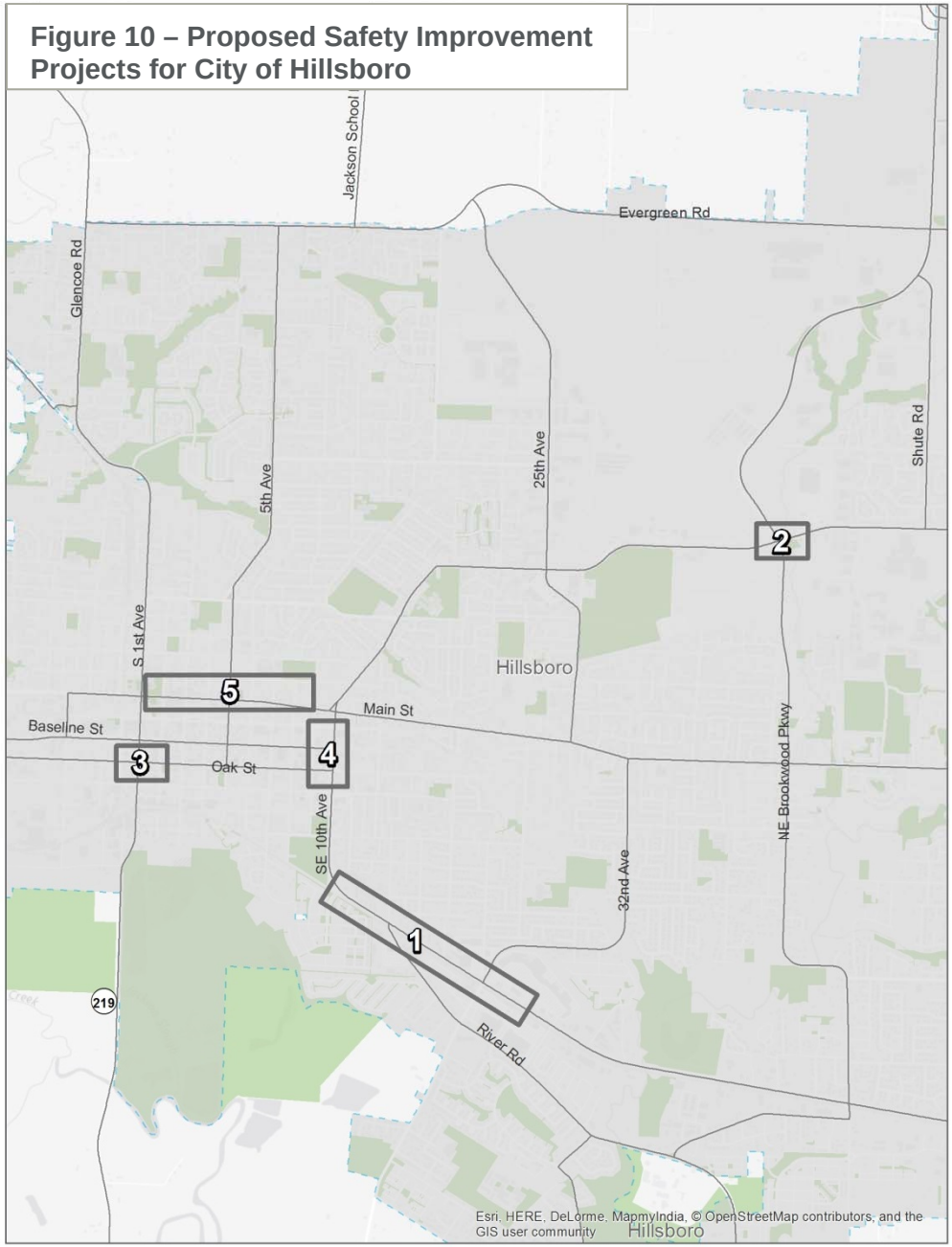
- ¼ mile of schools
- ¼ mile of parks
- ¼ mile of transit stops
- ¼ mile of denser urban areas
- ¼ mile of senior living homes

In addition, bike lane improvements should be done where the infrastructure stops without any warning or transitions. The improvements could be signage and tapering of lanes, but ideally the improvements would be continuation of the lanes. While the City would like bicycle lanes and sidewalks on both sides of the roadway, locations that do not have bike lanes or sidewalks on either side of the roadway should be prioritized over sections that have them on at least one side of the roadway.

Project Recommendations

Through the evaluation of crash data, there are five specific projects identified as locations where crashes were most concentrated. It is recommended that the previously listed strategies be applied, where applicable, to these locations for the short term and that these specific locations also become a focus for longer term safety improvements. The summary of these projects are shown in Figure 10. It is important to note that each of these locations will require a more detailed analysis to provide detailed solutions.

Figure 10 – Proposed Safety Improvement Projects for City of Hillsboro



1. Tualatin Valley Highway, SE 10th Ave to SE 30th Ave

Why this location: This location has had 3 fatalities & 2 serious injuries between 2010 and 2014. Some of these crashes have involved bicyclists and pedestrians and many have occurred near transit stops. There is one Tier 2 and one Tier 3 intersection in this corridor.

Anticipated Cost: $$$$

What this includes: Multi-modal Improvements, a more detailed safety analysis, land use evaluation, alternative mode evaluation, conceptual design, alternatives testing, design, and construction.

2. NE Brookwood Pkwy at NE Cornell Rd

Why this location: There have been 146 crashes between 2010 and 2014, resulting in 1 fatality and 2 serious injuries. Four bicycle related crashes occurred in this time period as well. Rear-end collisions are frequent at this intersection, which is rated a Tier 1 intersection in the HSM critical crash rate analysis.

Anticipated Cost: $$$$

What this includes: Intersection geometric and multi-modal improvements, more detailed safety analysis, conceptual design, alternative testing, design, and construction.

3. S 1st Ave at SE Oak St

Why this location: This intersection has had 68 crashes between 2010 and 2014, two of which were pedestrian-related. This is a Tier 1 intersection based on the HSM critical crash rate analysis.

Anticipated Cost: $$$

What this includes: A more detailed safety analysis, conceptual design, alternatives testing, design and construction.

4. SE 8th Ave to NE 10th Ave on Oak and Baseline

Why this location: There has been 1 pedestrian fatality in this segment between 2010 and 2014. This area includes one Tier 2 and two Tier 3 intersections based on the HSM critical crash rate analysis.

Anticipated Cost: $$$

What this includes: Multi-modal improvements, a more detailed safety analysis, conceptual design alternatives testing, design and construction.

5. City of Hillsboro Downtown Area Streets

Why this location: There is one fatality and three serious injuries in this area on City of Hillsboro roadways. This area includes low speed roadways which typically have lower severity crashes than higher speed roadways

Anticipated Cost: $$$

What this includes: A more. detailed safety analysis, conceptual design alternatives testing, design, and construction.

Appendix A - Crash Data FAQ's

Safety FAQs

Why do we use 5 year data?

As explained by FHWA[1]:

Crashes are relatively rare events, so it is important that a safety analysis includes an adequate time frame of study. Calculating average crashes per year across five years allows the practitioner to normalize crash data over a longer period than one year to account for annual anomalies that can skew analyses. Due to the randomness of traffic crashes, it is likely that any one year could have a much higher or lower number of crashes than the typical year. A rule of thumb is to collect data from the previous 3 to 5 years, with 3 years as a working minimum. A longer period of time increases the statistical value of the data; however, if the period is too long, there is a chance that the situation (e.g., roadway configuration, traffic volume and patterns) may have changed.

Why not use 2015 data?

There are a few reasons that crash data is not useable immediately and tends to have at least a year lag before it can be used:

- Reporting is done by hand and needs to be transferred to the online system
- Data needs to be "cleaned" and this takes a long time since it has to be done for the entire state. Cleaning the data means making sure the crash is assigned to the correct location, that all of the information about the crash is correct and makes sense.

What data is used?

ODOT's Statewide Crash Data was utilized. Crash data in Oregon are obtained from two sources, primarily citizen reports and secondarily enforcement, which are then compiled in the database. Not all crashes are reported, as a number of crashes do not qualify to be reported, and some crashes that qualify still go unreported. Law enforcement officials will file a police report for a portion of their crashes. The stipulations required for crashes to be reported are listed below:

Motor vehicle crashes must be reported when:

- There is more than $1,500 in damages to a vehicle or other property.
- Someone is injured (no matter how minor) or killed.
- Any vehicle is towed.

Crashes go unreported and are not entered into the ODOT database when:

- They do not meet reporting thresholds.
- A hit-and-run crash occurs with a parked vehicle or property.
- There is a serious injury litigation or ongoing criminal investigation that holds up the record.

[1] http://safety.fhwa.dot.gov/local_rural/training/fhwasaxx1210/s3.cfm

- The crash does not involve a motor vehicle, i.e., bike and pedestrian or pedestrian and train.
- The injury cause was ruled to be due to illness.
- The crash occurs on private property or not on a traffic way; i.e., on a beach.
- There was an industrial accident, i.e., backing over a worker with equipment.

The Oregon Department of Motor Vehicles (DMV) provides ODOT with crash data after the DMV collates driver and police reports and records any driver violations or suspensions. Crash data are coded into the crash database, with data specific to the individuals; vehicles; and all general data regarding the crash type, location, conditions, errors, etc. All data are validated by data analysts and errors are corrected before the file is finalized at the end of each year. This database can be retroactively corrected if errors are found after finalization and year-end submission.

Data Limitations:

Even with the extensive efforts to collect all crash data and to do so accurately, not all crashes are recorded and some may not be accurate. Studies have shown that crashes with greater severity are reported with greater reliability than crashes of lower severity. The data compiled in the Oregon Crash Database exhibits this tendency, especially as it applies to Property Damage Only (PDO) crashes. Additionally, crash data may contain only partial information. A report may fail to note that the crash occurred in a school or work zone or that the driver was on a cell phone when the crash occurred. In addition, the location of the crash recorded is often an approximation.

The coding of these data also has limitations. To gain a complete understanding of crashes it requires research into several categories. Ultimately, this in-depth analysis provides a clearer understanding of the safety needs for the corridor and will help influence smart decisions for future designs. More details on the crash database are provided in ODOT's System Motor Vehicle Traffic Crash Analysis and Code Manual[2].

Acronyms:

SPIS – Safety Priority Index System

TSAP - Transportation Safety Action Plan

HSM – Highway Safety Manual

[2] http://www.oregon.gov/ODOT/TD/TDATA/car/docs/CDS_CodeManual.pdf.

Appendix B - County-wide Crash Data (electronic Excel)

Appendix C – METRO High Crash Corridors Summary

High Injury Corridors

Oregon Metro Region

Introduction

- The 2012 State of Safety report identified factors contributing to high severe crash rates in the region:
  - Arterial roadways, Multi-lane roadways, Lack of lighting, Behavioral factors
- Lacked ability to quantify risk by specific roadway
- The 2012 RTSP recommended development of performance measurements to identify high-crash arterials in the region.

Introduction

- The Regional High Injury Network (HIN) is an objective quantitative assessment of the crash performance of every roadway.
- Quantifies the concentrations of severe crashes (by mode) involving a motor vehicle.
- Identifies the corridors hosting the most severe crashes.
- Could inform policy approaches to improve safety.

Methodology

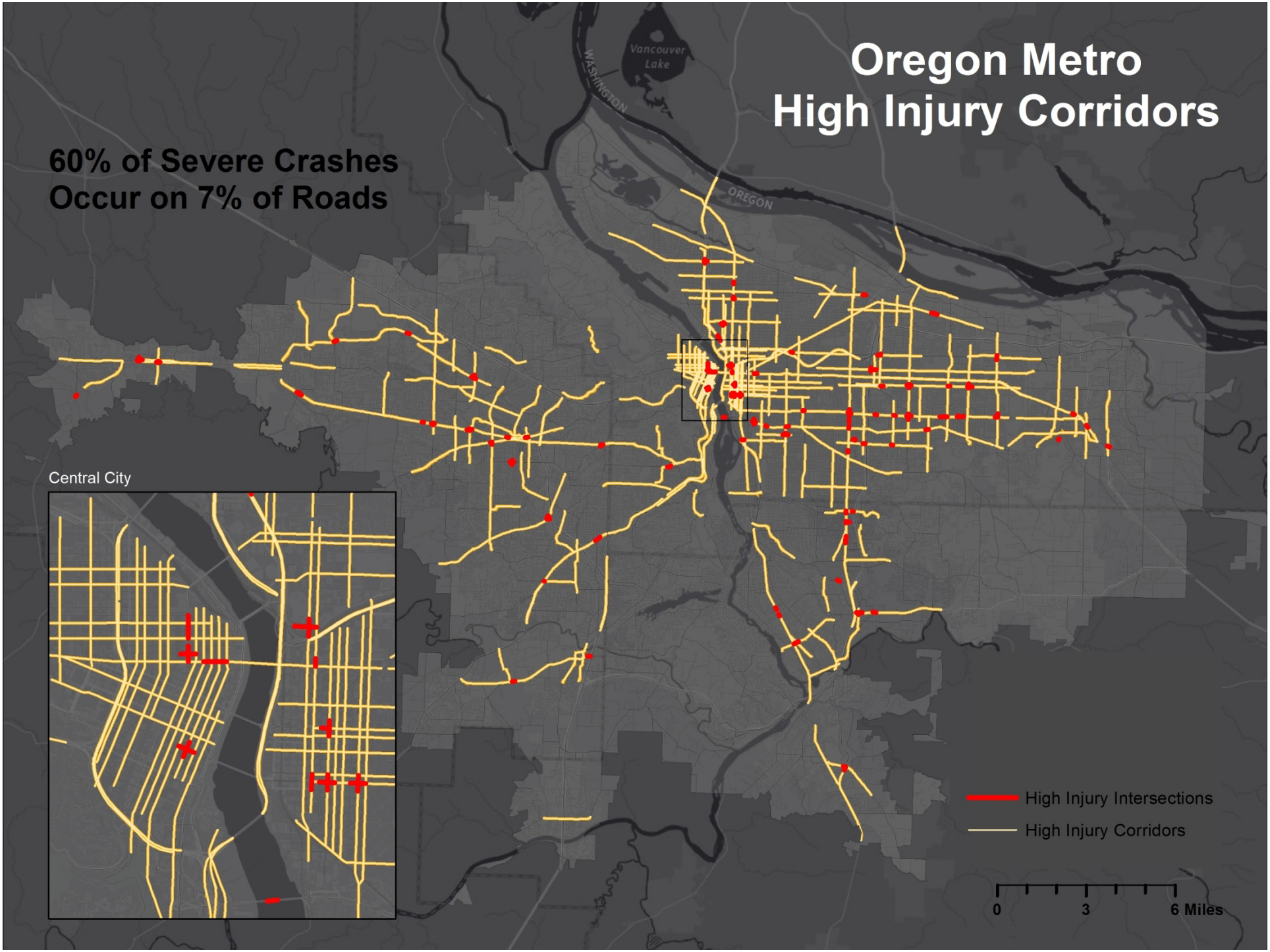
ODOT Crash data: 5-year window, 2010-2014

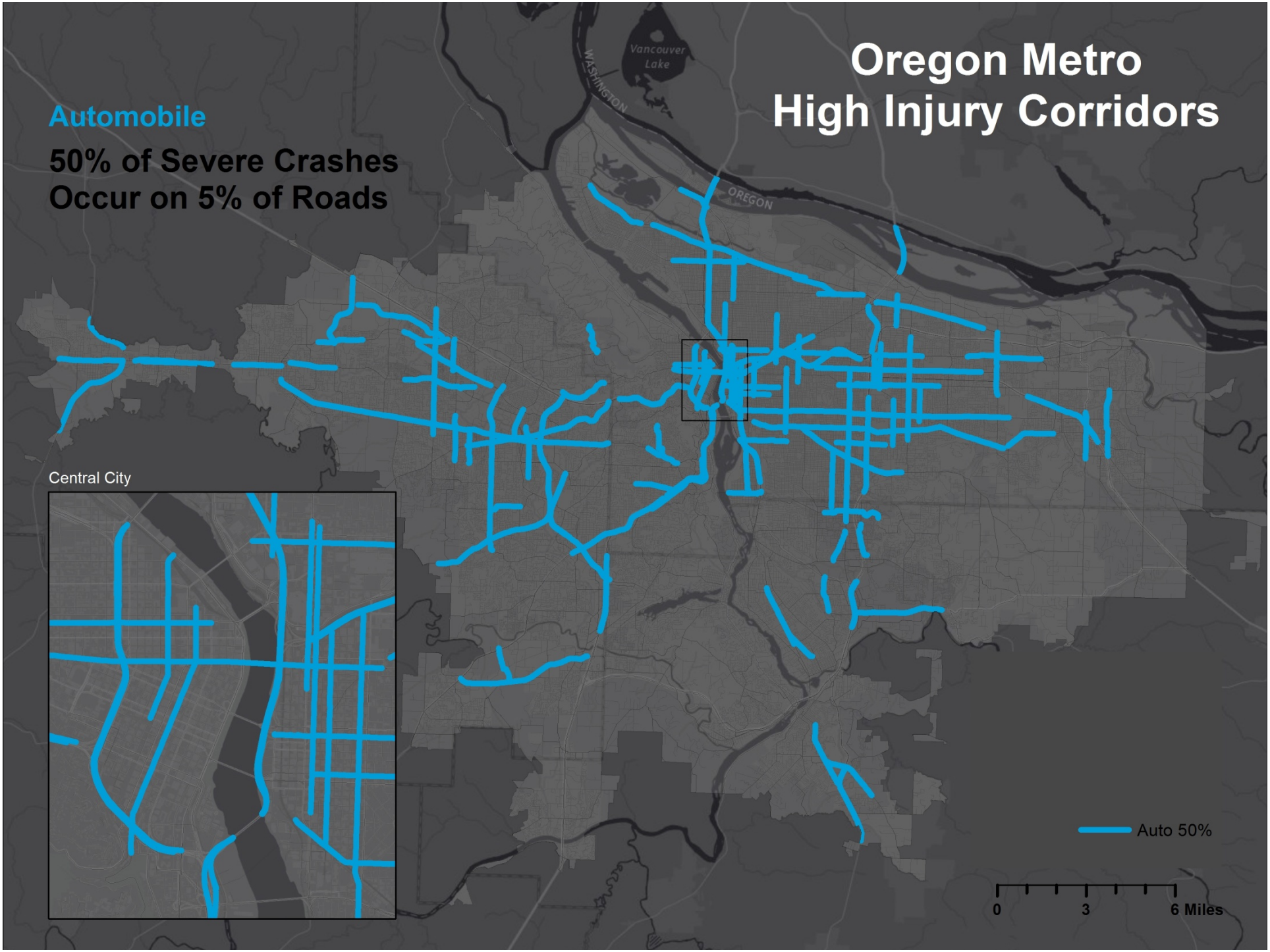
Analysis Area: **Metropolitan Planning Area**

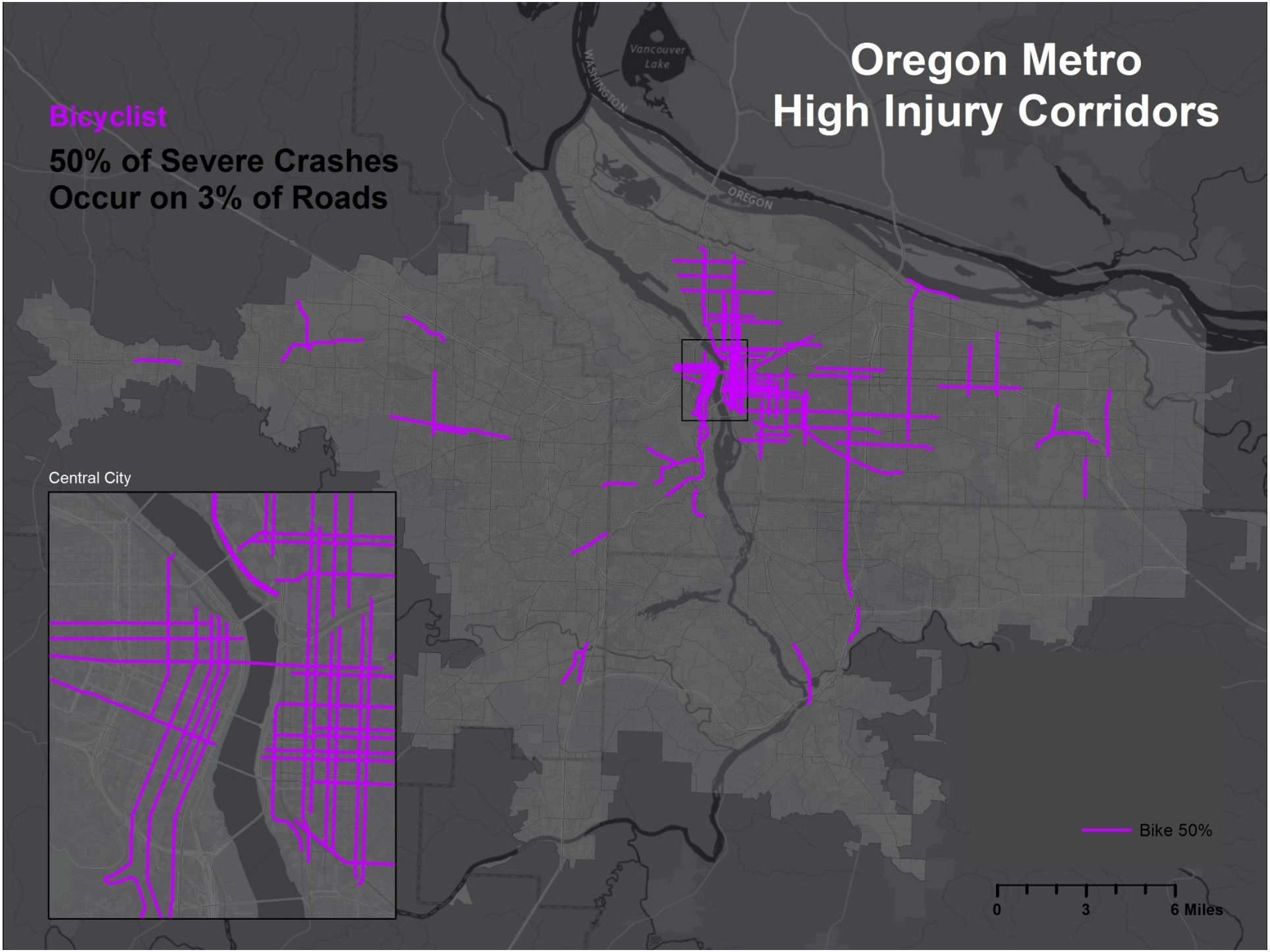
1. Create Corridors
   - Combine consecutive streets with the same name and highway direction
   - Remove corridors < ¼ mile
   - Divide corridors > 3 miles
2. Analyze Crashes
   - Weight crashes by severity of injury and mode (see table)
   - Summarize weighted crashes for each corridor
   - Normalize the crash score by the length of the corridor

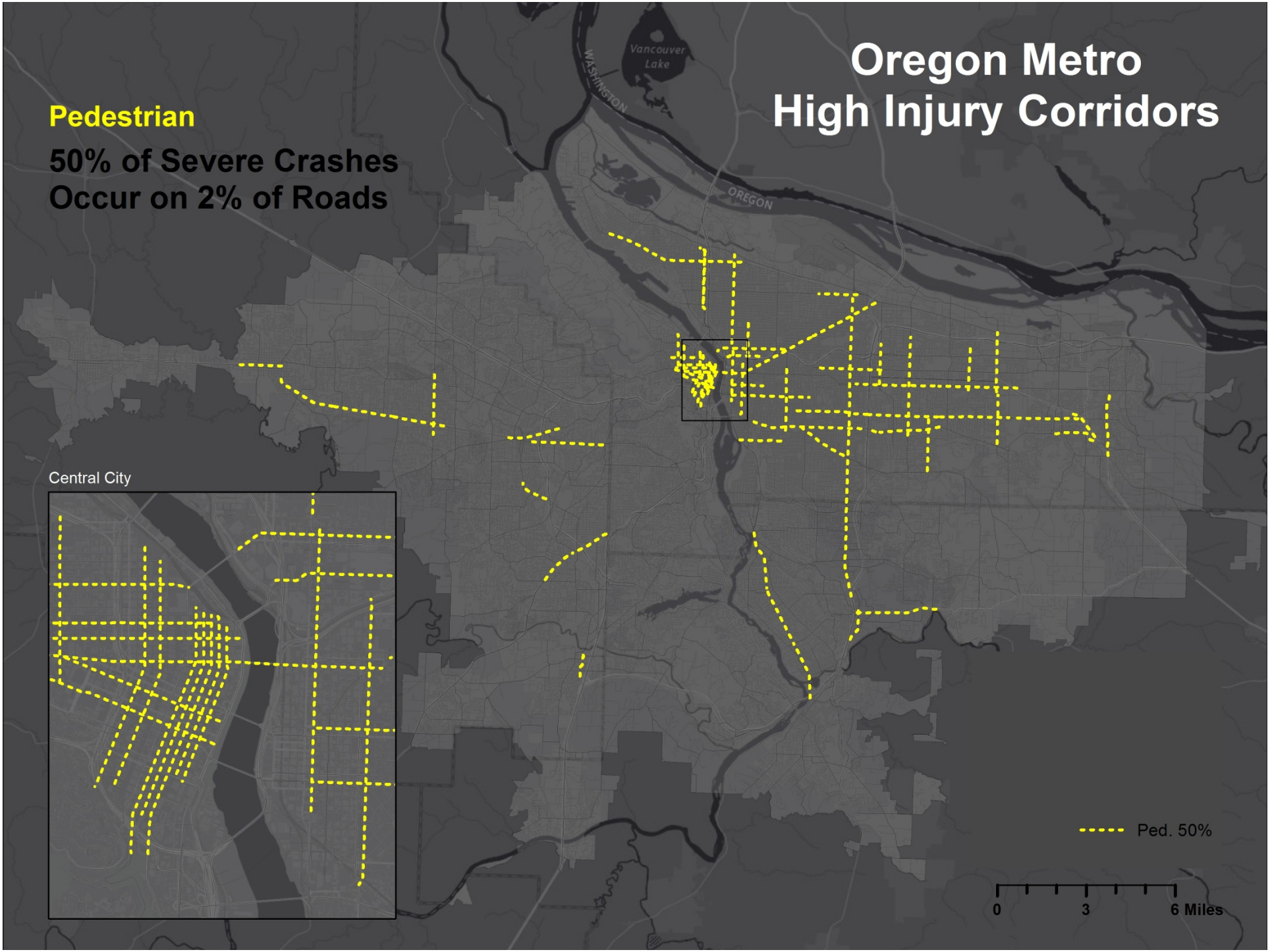
Crash Type Weighting Values

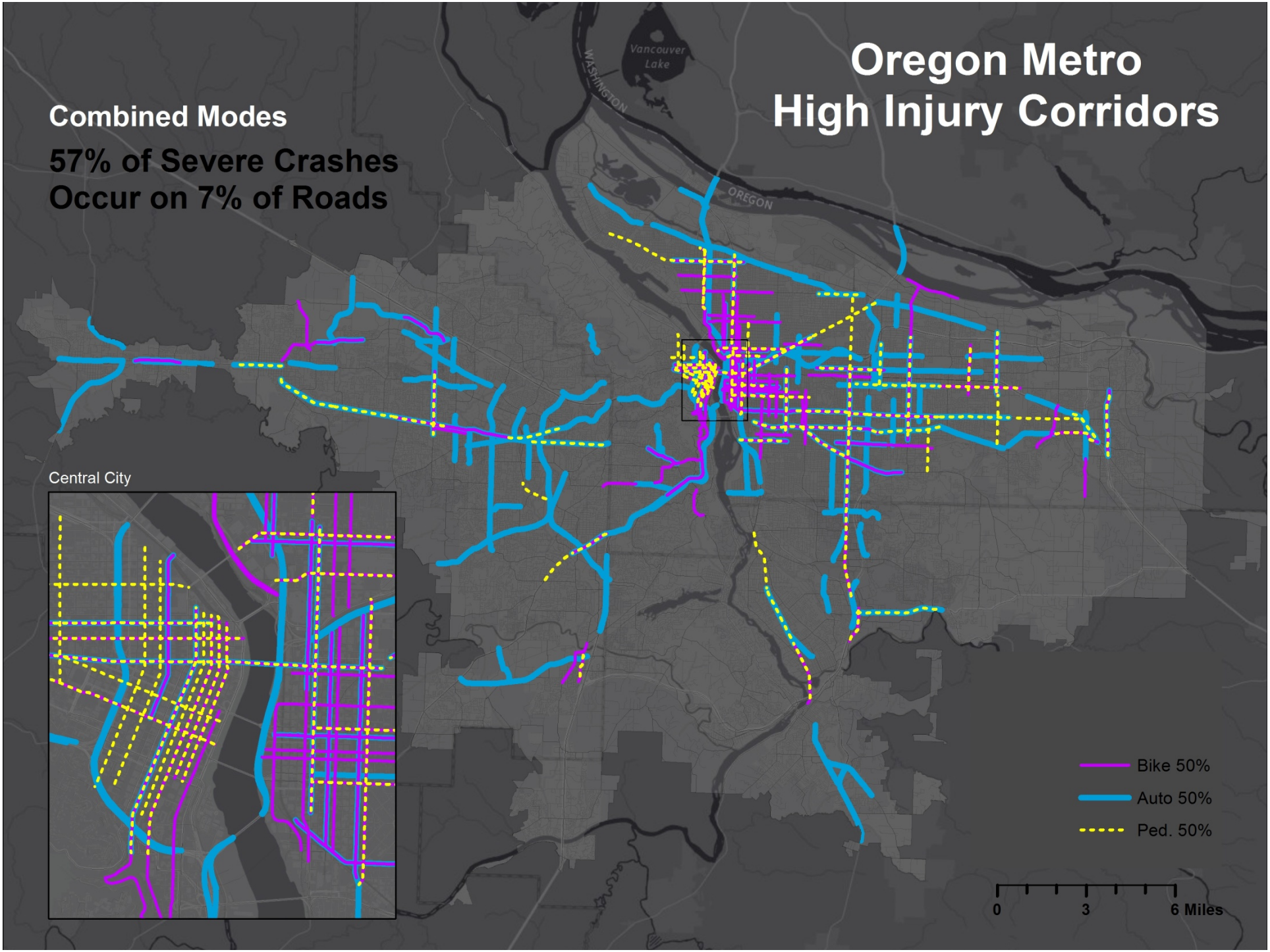
Type	Auto	Bike	Ped.
Fatal	10	10	10
Severe	10	10	10
Mod.	0	3	3
Minor	0	3	3
PDO	0	1	1


Oregon Metro
High Injury Corridors
60% of Severe Crashes
Occur on 7% of Roads
Vancouver Lake
WASHINGTON
OREGON
Central City
High Injury Intersections
High Injury Corridors
0
3
6 Miles


Oregon Metro
High Injury Corridors
Automobile
50% of Severe Crashes
Occur on 5% of Roads
Vancouver Lake
WASHINGTON
OREGON
Central City
Auto 50%
0
3
6 Miles


Oregon Metro
High Injury Corridors
Bicyclist
50% of Severe Crashes
Occur on 3% of Roads
Vancouver Lake
WASHINGTON
OREGON
Central City
Bike 50%
0
3
6 Miles


Oregon Metro
High Injury Corridors
Pedestrian
50% of Severe Crashes
Occur on 2% of Roads
Vancouver Lake
WASHINGTON
OREGON
Central City
Ped. 50%
0
3
6 Miles

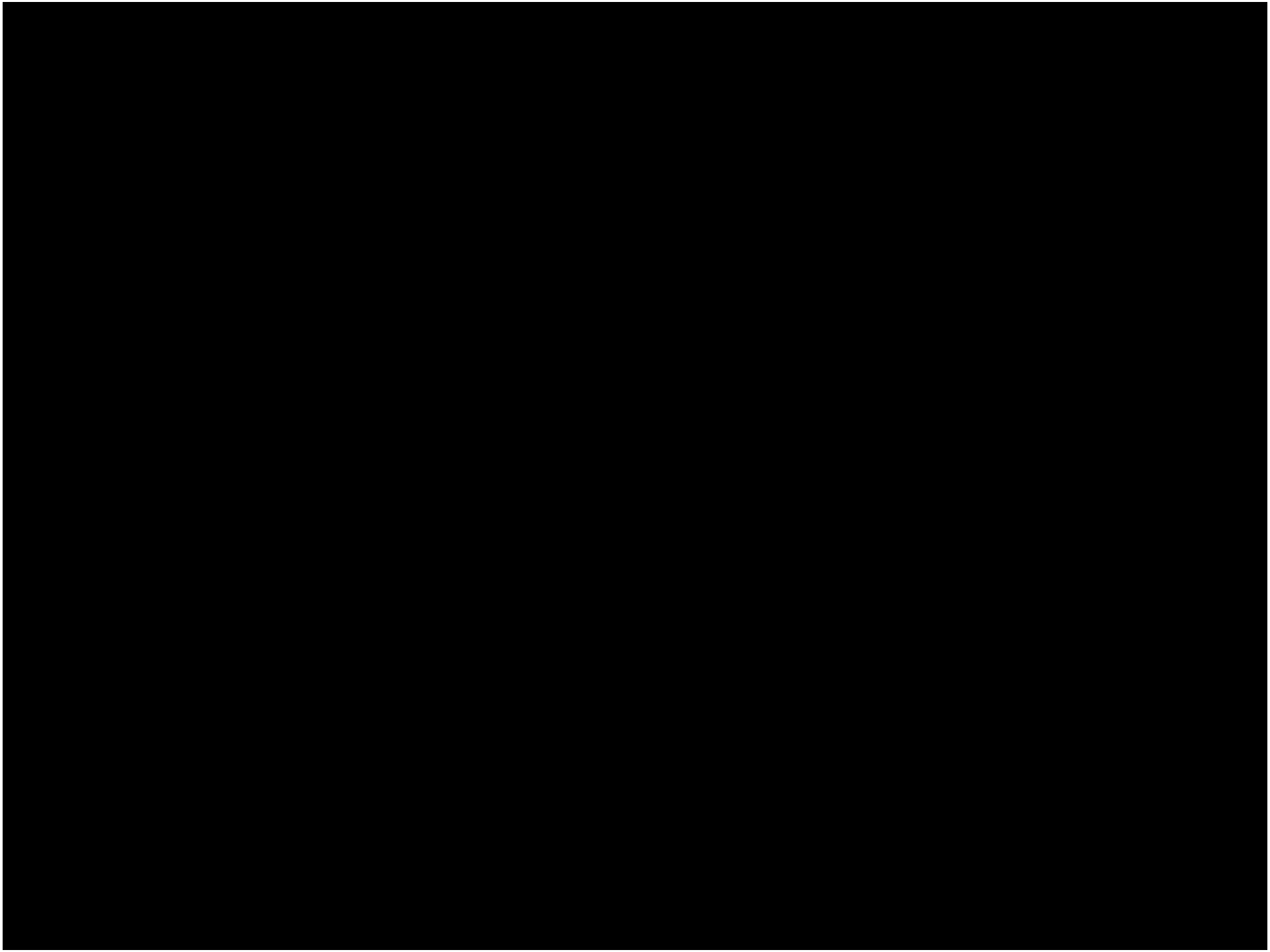

Oregon Metro
High Injury Corridors
Combined Modes
57% of Severe Crashes
Occur on 7% of Roads
Vancouver Lake
WASHINGTON
OREGON
Central City
Bike 50%
Auto 50%
Ped. 50%
0
3
6 Miles

Corridor Stats

6,565 miles of roads within the Metropolitan Planning Area

Mode	Severe Crashes*	70% Severe Crashes	60% Severe Crashes	50% Severe Crashes
All	2,259	665 mi / 10%	472 mi / 7%	331 mi / 5%
Auto	1,777	579 mi / 9%	422 mi / 6%	298 mi / 5%
Bike	161	330 mi / 5%	241 mi / 4%	177 mi / 3%
Ped.	368	300 mi / 5%	209 mi / 3%	138 mi / 2%

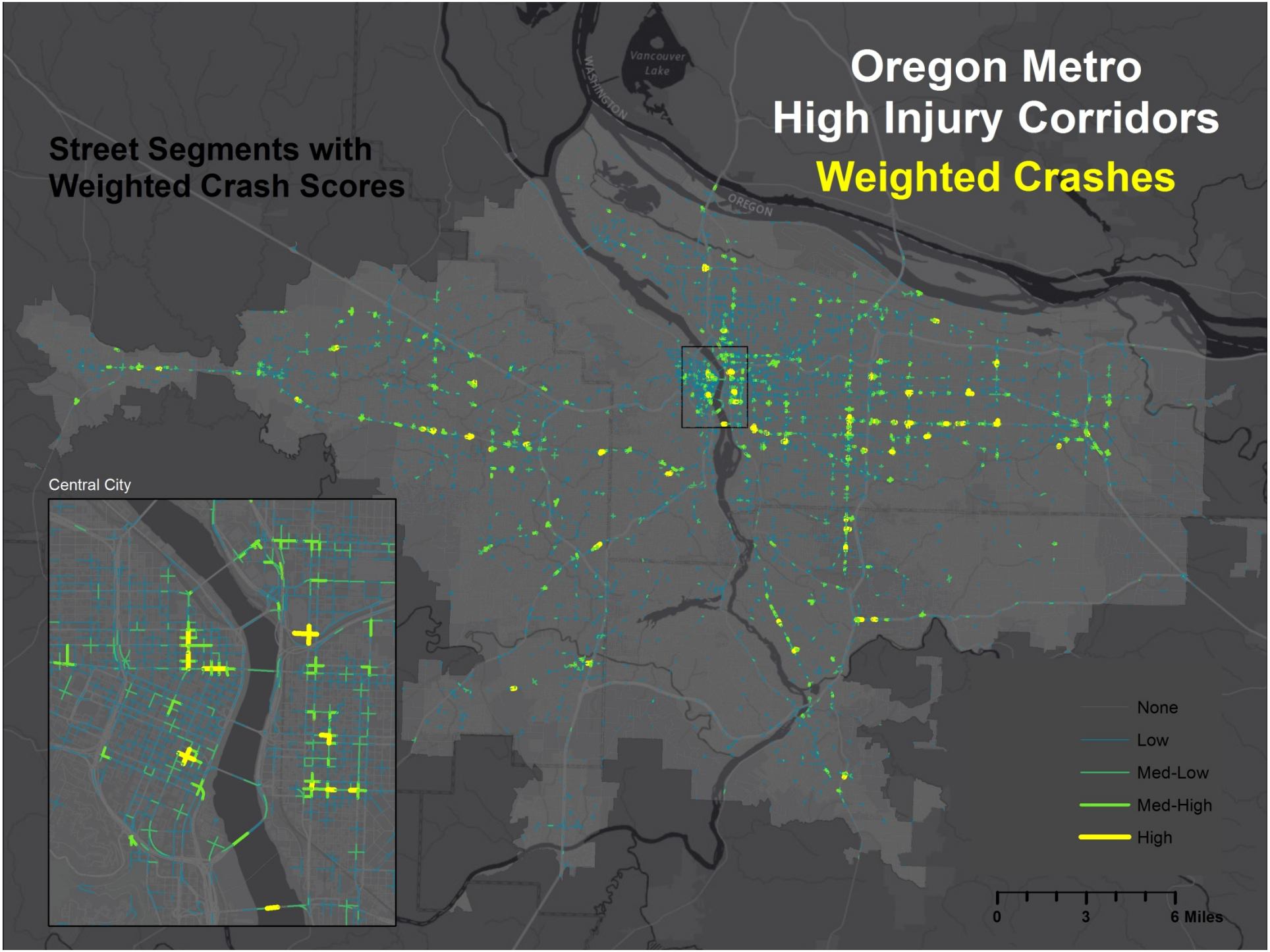
* ***severe crashes*** *are those that result in fatality or debilitating injury*



Weighting Crashes

Based on the State of Safety Report (2012, iii):
"A regional arterial safety program to focus on corridors with large numbers of **serious crashes, pedestrian crashes,** and **bicycle crashes**."

Type	Fatal	Severe	Moderate	Minor	PDO
Auto	10	10	0	0	0
Ped	10	10	3	3	1
Bike	10	10	3	3	1

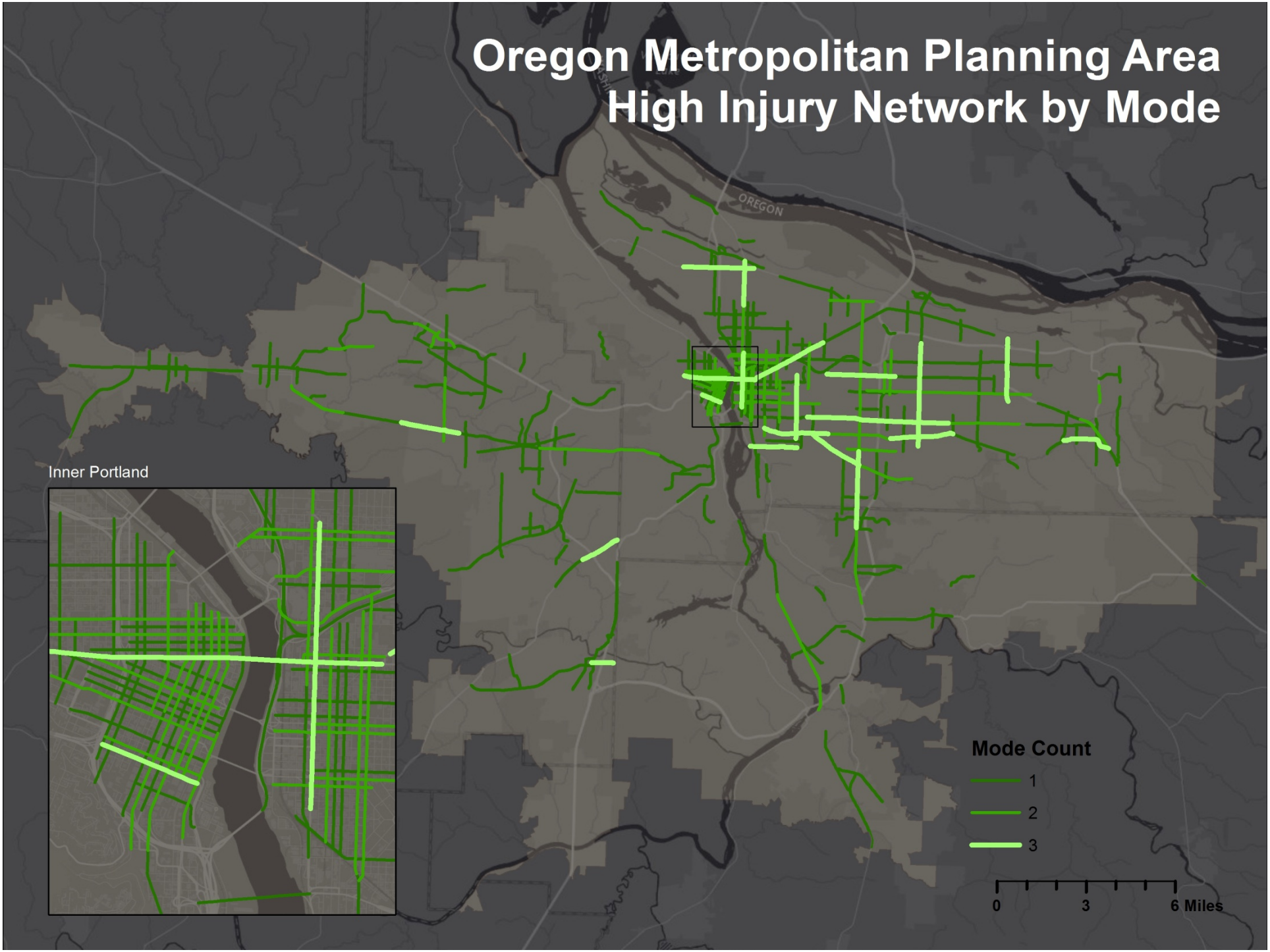

Oregon Metro
High Injury Corridors
Weighted Crashes
Street Segments with
Weighted Crash Scores
Vancouver
Lake
WASHINGTON
OREGON
Central City
None
Low
Med-Low
Med-High
High
0
3
6 Miles

Corridor Identification

1. Combine consecutive streets with the same name and highway direction
2. Split at the midpoint streets that are greater than a specified length
3. Add weighted crash totals
4. Normalize the crash scores by the length of the corridor

Mode Comparison

1. Combine the top corridors from each mode (auto, bike, and ped) that represent at least 50% of fatal and severe crashes
2. Dissolve the merged corridors by the UID and summarize the normalized crash scores
3. Resulting corridors contain a count for each street segment with the number of modes (1, 2, or 3)


Oregon Metropolitan Planning Area
High Injury Network by Mode
OREGON
Inner Portland
Mode Count
1
2
3
0
3
6 Miles

Overall Top 40 High Injury Corridors

1. SW Broadway
2. W Burnside
3. NE Broadway
4. NE Grand
5. SE 82nd
6. SE Division
7. NW 3rd
8. SE 7th
9. NE MLK Jr.
10. SE Division
11. SW Tualatin Valley
12. SE Powell
13. SW Pacific
14. NE Couch
15. SE 82nd
16. NE Burnside
17. NE 102nd
18. NW Everett
19. SE Foster
20. SW Naito
21. SE Division
22. NE Glisan
23. NE 181st
24. NE Lloyd
25. SE Hawthorne
26. SE McLoughlin
27. SE 122nd
28. SW 4th
29. SW Market
30. SW 2nd
31. NE MLK Jr.
32. SE Powell
33. SE 11th
34. SW Allen
35. SE 82nd
36. Ross Island Bridge
37. SE Powell
38. SW Nyberg
39. SW Cedar Hills
40. NE Multnomah

Top High Injury Corridors: All Modes

1. **Burnside** (NW 24th Pl./SE 14th Ave.)
2. **Grand** (SE Stephens St./NE Schuyler St.)
3. **SE Division** (SE 46th Ave./SE 142nd Ave.)
4. **SW Tualatin Valley** (SW 214th Ave./SW 174th Ave.)
5. **SE Powell** (SE 21st Ave./SE 61st Ave.)
6. **SW Pacific** (SW Greenburg Rd./SW Coronado St.)
7. **SE 82nd** (SE Otty St./SE Holgate Blvd.)
8. **SE Foster** (SE Powell Blvd./SE 82nd Ave.)
9. **NE Glisan** (NE 60th Ave./NE 105th Ave.)
10. **181st** (SE Yamhill St./NE Sandy Blvd.)
11. **122nd** (SE Boise St./NE Stanton St.)
12. **SW Market** (SW 13th Ave./SW Naito Pkwy)
13. **NE MLK Jr.** (NE Alberta St./NE Columbia Blvd.)
14. **SE Powell** (SE 102nd Ave./SE 145th Ave.)
15. **SW Nyberg** (SW Martinazzi Ave./SW 65th Ave.)
16. **Powell** (NW Ava Ave./Hwy 26)
17. **Cesar E. Chavez** (SE Francis St./NE Flanders St.)
18. **NE Sandy** (NE Couch St./NE 56th Ave.)
19. **Lombard** (N Seward Ave./NE 10th Ave.)
20. **SE Holgate** (SE McLoughlin Blvd./SE 40th Ave.)

High Crash Score Corridors: 2 Modes

Auto + Bike

1. NE Grand
2. SE 7th
3. NE MLK Jr.
4. SW Pacific
5. NE 181st
6. NE Lloyd
7. SE 11th
8. NW 9th
9. SE Clay

Auto + Pedestrian

1. SE 82nd
2. SE Division
3. SW Tualatin Valley
4. SW Pacific
5. NE 102nd
6. NE Glisan
7. SE McLoughlin
8. SE Powell
9. NE 82nd

Bike + Pedestrian

1. SW Broadway
2. NW 3rd
3. SW Pacific
4. SE Hawthorne
5. SW 4th
6. NE MLK Jr.