Metro State of Safety Report

Appendix to the Regional Transportation Safety Strategy

A compilation of information on roadway-related crashes, injuries, and fatalities in the greater Portland region and beyond, 2011-2015 crash data

January 2018

Executive Summary

No death or life changing injury from a traffic crash is acceptable on our region's roadways, which is why Metro and regional partners are adopting a Vision Zero target for 2035 and implementing a safe systems approach to transportation safety.

The information in this State of Safety Report was used to inform the development of the 2018 Regional Transportation Safety Strategy and to develop performance measures to meet federal requirements required in the federal transportation bill MAP-21.

Between 2011 and 2015, there were 304 Fatal crashes in the Portland Metro region, killing 311 people, and an additional 2,102 crashes resulting in incapacitating injury. Nationwide, crashes killed an average of 33,305 people per year between 2011 and 2015, and roadway safety remains one of the most pressing health issues nationwide. The 8% increase in traffic deaths in 2015 is the highest increase in fifty years, and it is expected that the number of Serious crashes in 2016 and 2017 will be even higher. For young people between the ages of 5 and 24, motor vehicle crashes are the leading cause of death.

It is the Portland Metro region's adopted goal to progressively reduce the number of people killed or seriously injured on the region's roadways to zero by 2035. The purpose of this report is to document roadway crash data, patterns, and trends in the Portland Metro area and beyond to inform the pursuit of this goal. The Oregon Department of Transportation (ODOT) has assembled and distributed statewide crash data since 2007. This is a rich dataset, including numerous information fields for each geocoded crash, and is complemented by Metro's rich datasets of transportation infrastructure, transportation operations, and spatial data. The combination of these provides the opportunity of detailed analyses of the safety of the region's transportation system and land use patterns. Further, a large amount of US and international data is available to document national and international patterns and trends. This information is important to provide context for local data.

In 2010-2011, Metro staff worked with staff from cities and counties of the Metro region, ODOT, TriMet, and other local safety experts to develop a strategy for analyzing and summarizing this data from 2007 to 2009. The 2012 State of Safety report was the result of this collaboration. This report updates these findings, using the most recent five years of crash data – through 2015. It identifies trends and relationships of Serious crashes with environmental factors including roadway characteristics. This report provides the data for the update of the 2018 Regional Transportation Safety Action Plan.

The findings include:

- Nationally and in Oregon, fatalities have stabilized for automobile occupants and motorcyclists, while fatalities have been increasing for pedestrians and bicyclists. *(Section 1)*
- Higher levels of vehicle miles travelled (VMT) correlate with more Fatal and Serious crashes due to increased exposure. (*Section 1)*
- The Portland Metro region has less than half the annual fatalities per million residents compared to Oregon's and the national average. (*Section 1)*

- Arterial roadways comprise 73% of the region's Serious crashes, 77% of the Serious Pedestrian crashes, and 65% of the Serious Bicyclist crashes, while accounting for 12% of road miles. (*Sections 2, 5, and 6)*
- Alcohol or drugs were a factor in 57% of Fatal crashes. *(Section 2)*
- Excessive speed is a contributing factor in 33% of Fatal crashes, and aggressive driving is a factor in 34% of Fatal crashes. *(Section 2)*
- Seat belt use in the region as reported exceeds 99%. *(Section 2)*
- The percent of Serious crashes for male drivers age 70-79 and female drivers age 80-84 is double the regional average. (*Section 2)*
- Streets with more lanes have higher Serious crash rates per road mile and per VMT. This follows trends documented in AASHTO's Highway Safety Manual. *(Section 3)*
- Streets with more lanes have an especially high Serious crash rate for pedestrians, producing higher crash rates per mile and per VMT as compared to other modes. *(Section 5)*
- The most common Serious crash types were Turning and Rear End. For Fatal crashes, the most common types were Pedestrian and Fixed Object. *(Section 3)*
- Serious Pedestrian crashes are disproportionately represented after dark. While 39% of all Serious crashes happen at night, 64% of Serious Pedestrian crashes happen at night. (*Section 5)*

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Introduction

It is the Portland Metro region's adopted goal to progressively reduce the number of people killed or seriously injured on the region's roadways to zero by 2035. Part of a safe systems approach to transportation safety is to use a 'data-driven' approach identify what causes crashes and strategies and actions to address those causes.

The purpose of this report is to document roadway crash data, patterns, and trends in the Portland Metro area and beyond to inform the pursuit of this goal. The Oregon Department of Transportation (ODOT) has assembled and distributed statewide crash data since 2007. This is a rich dataset, including numerous information fields for each geocoded crash, and is complemented by Metro's rich datasets of transportation infrastructure, transportation operations, and spatial data. The combination of these provides the opportunity of detailed analyses of the safety of the region's transportation system and land use patterns.

Further, a large amount of US and international data is available to document national and international patterns and trends. This information is important to provide context for local data.

Methodology

In this report, crashes are broken down by a number of factors contained in the dataset provided by ODOT.

- Injury Type: Each crash is identified by the worst injury incurred in the crash: Fatal, Injury A (incapacitating), Injury B (moderate), Injury C (minor) or Property Damage Only (PDO). This report largely focuses on Fatal/Incapacitating crashes (the sum of Fatal and Injury A), referred to as 'Serious Crashes' throughout this report. These are the types of crashes that the region is primarily focused on eliminating.
- Location
- Date and Time
- Weather and Pavement Conditions
- Roadway Location: the location on the roadway system allows data from Metro's mapping databases to be attributed to the crash.
- Contributing Factors: These include speeding, alcohol, drugs, school zone, work zone, and hit and run.

ODOT's crash data is reliant on crash information collected by police. Quality of crash data is dependent upon thoroughness of information collected at the crash scene. ODOT checks the data for quality and geo-codes the data to the street network. This process results in Metro acquiring the crash data one to one and half years later.

Metro's mapping database includes:

- Roadway data, such as speed, geometry, traffic volumes, traffic congestion, transit routes, bicycle routes, and sidewalk inventory
- Spatial data, such as land use, population, density, socioeconomic factors, and walkability

Note that many figures in this document are in color, and while colors are generally selected to be legible when printed in black and white, they are most readable in full color.

Definitions

Terms that are used throughout this report are defined as follows:

"**Portland Metro region**" is the scope of this study, and is defined as the area within the Metropolitan Planning Area (MPA) as of December 31, 2016. The MPA is slightly larger than the Urban Growth Boundary (UGB).

"**Serious Crashes**" in this report refers to the total number of Fatal and Injury A crashes. The words "Serious" and "Fatal" are capitalized throughout the report for emphasis.

"**Injury A**" and "**Incapacitating injury**" are used interchangeably. Incapacitating injuries typically are injuries that the victim is not able to walk away from. They are synonymous with the term "**Severe injury**"

"**Injury B**" and "**Moderate injury**" are used interchangeably.

"**Injury C**" and "**Minor injury**" are used interchangeably.

Per capita is used to describe crash rate per population. Except where otherwise noted, crash rates are per million residents.

Per VMT is used to describe crash rate per vehicle miles. Except where otherwise noted, crash rates are per 100-million vehicle miles travelled.

Arterial is a functional classification for surface streets. AASHTO defines arterials from the motor vehicle perspective as providing a high degree of mobility for the longer trip lengths and high volumes of traffic, ideally providing a high operating speed and level of service and avoiding penetrating identifiable neighborhoods.

Collector is a functional classification for surface streets. AASHTO defines collectors as providing both land access and traffic circulation within neighborhoods and commercial and industrial areas. The role of the collector system, from the motor vehicle perspective, is to distribute traffic to and from the arterial system.

Local is a functional classification for surface streets that includes all public surface streets not defined as arterial or collector. Local streets are typically low-speed streets with low traffic volumes in residential areas, but also include similar streets in commercial and industrial areas.

Section 1 – Regional, State, National, and International Trends

Data from the National Highway Traffic Safety Administration (NHTSA) were compiled and analyzed along with population data from the US Census to identify trends in national, state, regional and city crashes. NHTSA summarizes traffic fatality data by state and by major city, including number of fatalities, fatalities per capita and per vehicle-miles travelled (VMT), and by travel mode. Five years of data between 2011 and 2015 were generally considered for this analysis, while longer term trends were identified where additional earlier years of data were available.

Travel and Fatality Patterns: US and Oregon

Travel patterns in the US have changed in the last decade due to a variety of external factors. While the population has continued to increase, VMT per capita and absolute VMT have declined. Roadway fatality rates declined after 2005, but have increased significantly since 2010. In Oregon, these trends have been consistent with national patterns, although fatalities in Oregon increased more dramatically since 2013. This rapid increase does not appear to be a statistical outlier as the trend has continued in 2016 and 2017 (official data is not yet available for 2016-17). Figures 1-1 and 1-2 show the national and state trends of population, VMT, and crash-related fatalities.

Figure 1-1

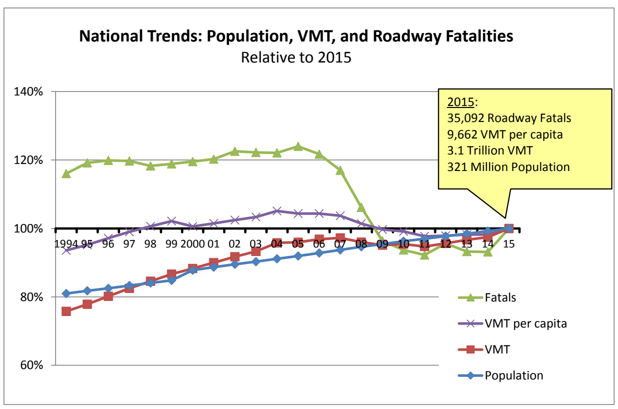
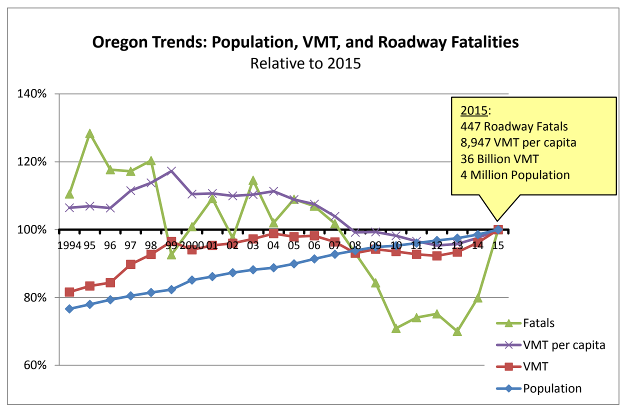


Figure 1-2



It is common practice to normalize roadway fatality rates by both population and traffic volumes. Normalization by population is useful in measuring the overall safety of the roadway system. Normalization by traffic volumes is useful in measuring the safety per distance travelled. Figures 1-3 and 1-4 show national and state trends for fatalities and fatality rates.

Figure 1-3

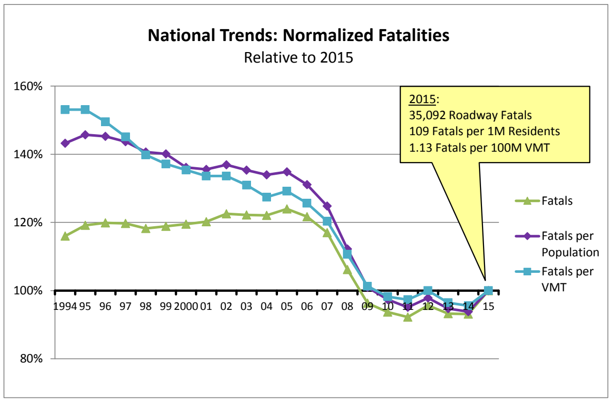
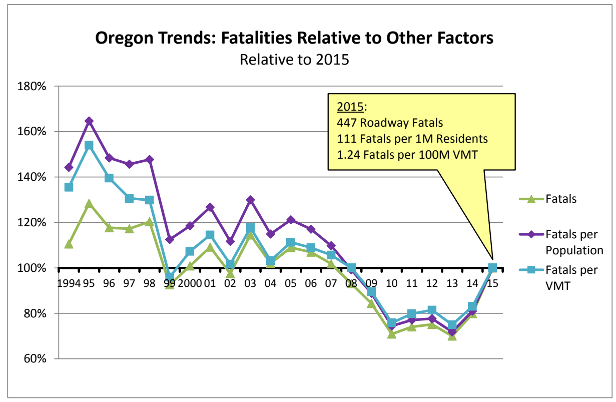


Figure 1-4



Total fatalities, fatalities per capita, and fatalities per VMT are all generally decreasing over time, although there has been a notable uptick since 2010. The increases in Oregon since 2013 are more pronounced than national trends.

Fatality Patterns by Mode: US and Oregon

The NHTSA data are broken out by mode: automobile occupants, motorcyclists, bicyclists, and pedestrians. Figures 1-5 and 1-6 show the recent national and state trends for each mode.

Figure 1-5

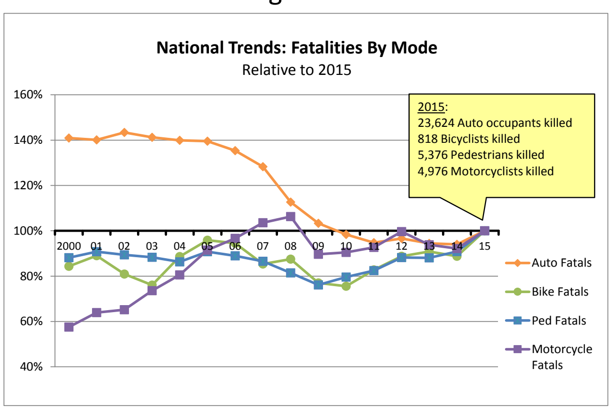
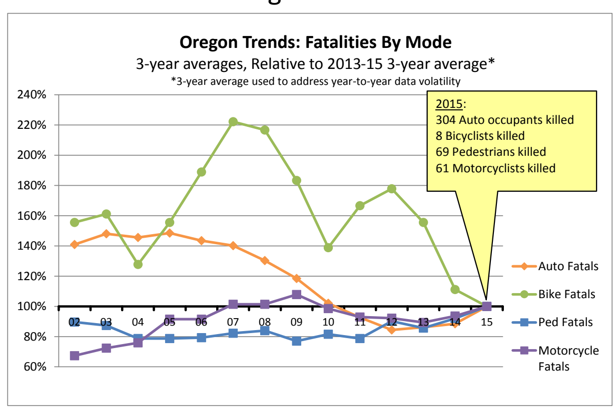


Figure 1-6



Fatalities have recently stabilized nationally for automobile occupants and motorcyclists, while Fatalities have been increasing nationally for pedestrians and bicyclists. The decrease in Fatalities for people in automobiles is likely due to advancements in vehicle technology, such as air bags.

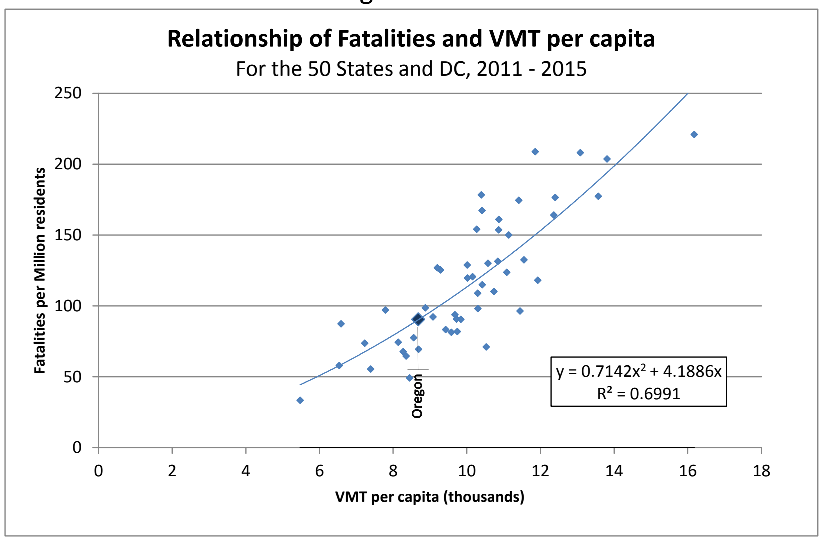
Annual Vehicle-Miles Traveled (VMT)

One of the clearest trends in crash data nationally and locally, is the correlation between fatality rates and annual per capita VMT. Figure 1-7 shows the relationship by US state for all fatalities, and Figure 1-8 shows the relationship for pedestrian or bicyclist fatalities.

States with higher per capita VMT typically also have higher per capita fatality rates, as the typical exposure to risk is increased. A polynomial equation with a good R-squared value can be fitted to the relationship between roadway fatalities and VMT, and is shown in Figure 1-7.

All Fatalities

Figure 1-7



It is apparent from the data that states with more auto travel typically exhibit higher fatality rates. The District of Columbia has the lowest per capita VMT at 5,480, and exhibits the lowest annual fatality rate of 33 per million residents – less than one-third of the national average. Of the states, Massachusetts has the lowest fatality rate, with the 7th lowest per capita VMT. Wyoming, with the highest per capita VMT of 16,200, also has the highest annual fatality rate at 221 per million residents – more than double the national average.

As with the 2012 State of Safety report, which looked at 2005 – 2009 data, a polynomial equation with a good R-squared value can be generated for the VMT-fatality relationship by setting the intercept to zero. While the equation is likely to vary slightly year-to-year, the relationship appears to be permanent. The relationship for 2011 – 2015 data is shown in Figure 1-7.

The national average is 9,500 VMT per capita and 105 fatalities per million residents.

Oregon statistics are 8,680 VMT per capita (91% of the national average) and 90 fatalities per million residents (86% of the national average).

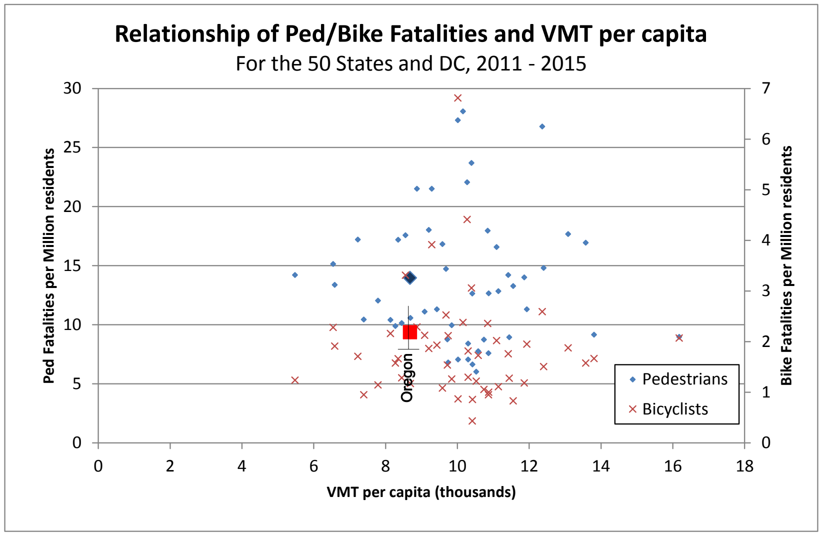
Pedestrian/Bicyclist Fatalities

The relationship between statewide VMT per capita and pedestrian/bicyclist fatalities is unclear. As can be seen in Figure 1-8, the data are scattered, and unlike the overall fatality data, no clear trend exists. This may be due to the complex relationships at play – higher VMTs can make pedestrian/bicyclist travel more dangerous, but discourage travel by these modes thereby reducing pedestrian/bicyclist exposure.

The national average (2011 – 2015) is 15.3 pedestrians killed in crashes per million residents and 2.3 bicyclists killed in crashes per million residents.

Oregon crash statistics are 14.0 pedestrians killed per million residents (91% of the national average) and 2.2 cyclists killed per million residents (94% of the national average).

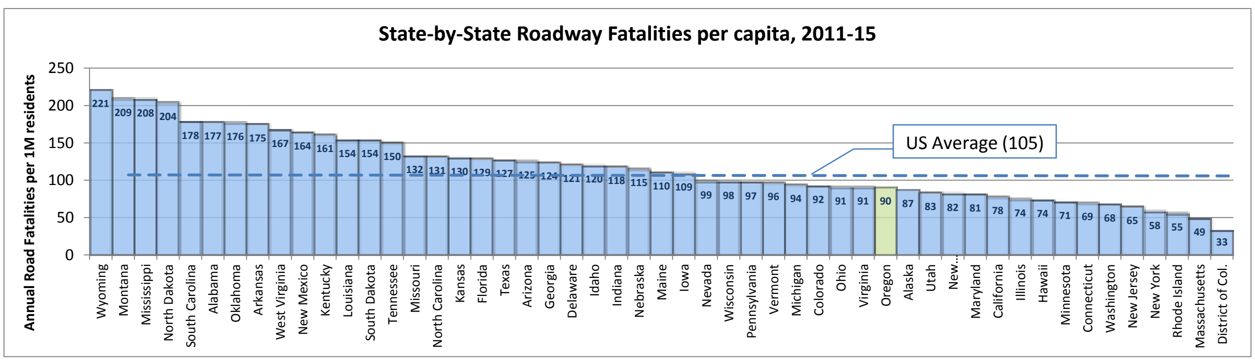
Figure 1-8



State-by-State Fatality Trends

Figure 1-9 shows the per capita fatality rate by state. Oregon is slightly better than the US average.

Figure 1-9



European Data

Data from the EU Road Federation's publication "European Road Statistics" were compiled in order to provide a comparison to US data. European practices are often considered as a best practice as their transportation systems are generally safer and more efficient than US systems.

Figures 1-10 and 1-11 present European roadway fatality rates per capita and per VMT.

Of the 28 EU countries, 22 of them exhibit lower rates of roadway fatality per capita than the US average. On a per-VMT basis, 19 of them exhibit lower fatality rates than the US average.

Figure 1-10

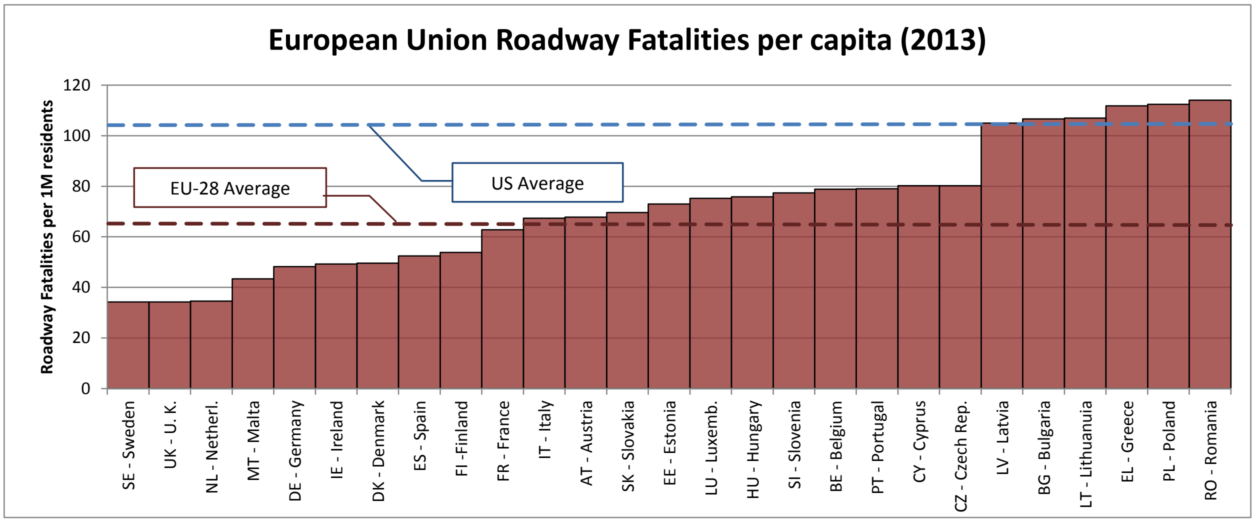
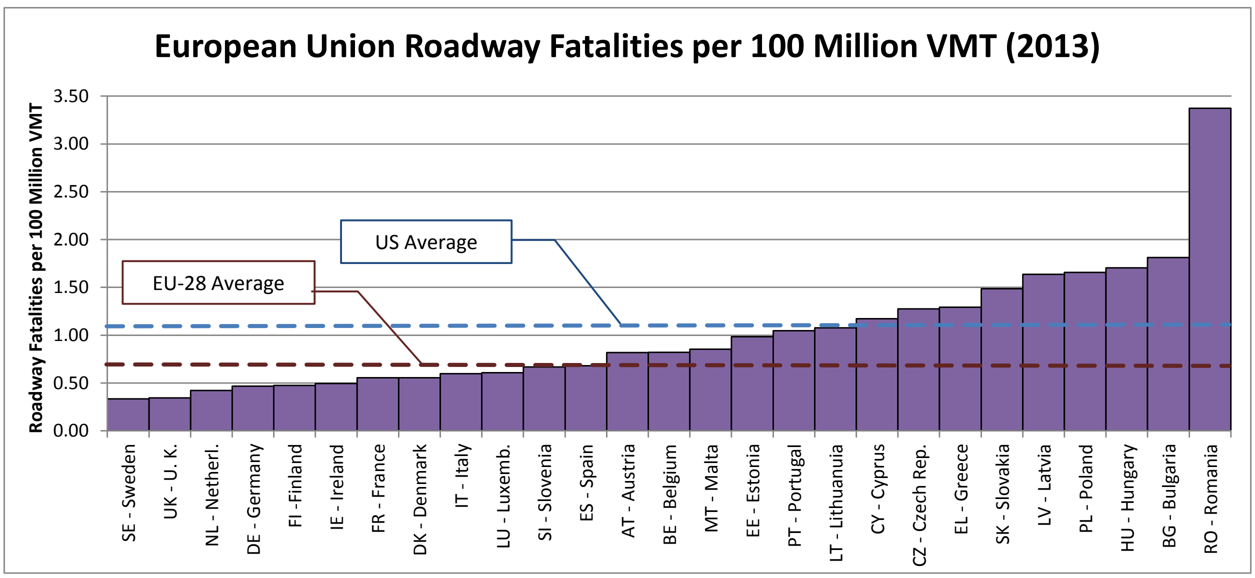


Figure 1-11

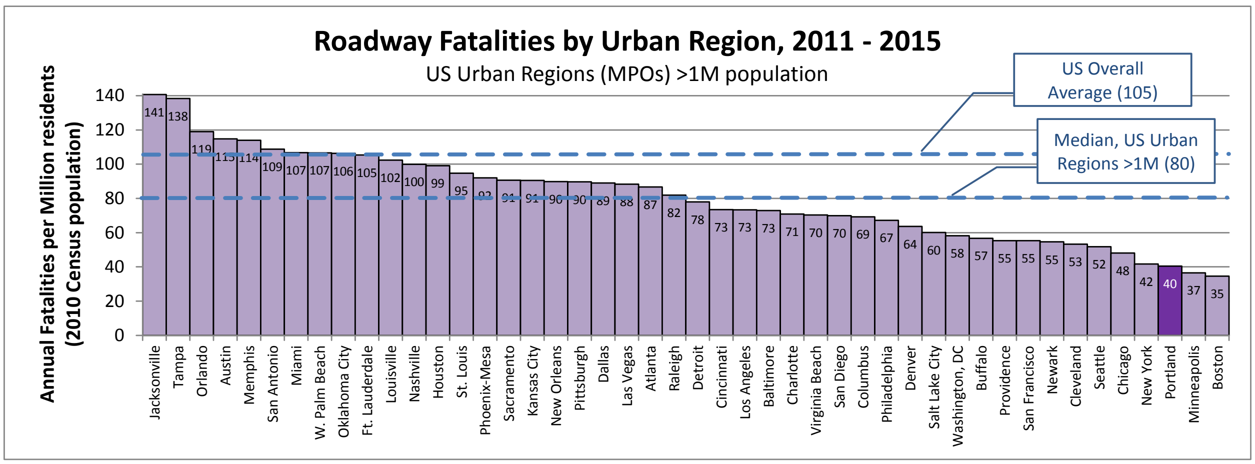


European countries appear to be limiting roadway fatalities both by managing safer roadways and developing transportation systems and development patterns which require less driving.

Urban Region Fatality Trends

Crash and population data was reviewed for the urban regions in the US (using Metropolitan Planning Organization boundaries), using FHWA's Roadway Safety Data Dashboards. A comparison was made of the large urban regions – those with populations of over 1 million people as of the 2010 Census. Figure 1-12 shows the per capita fatality rate by urbanized region. Note that the rate is slightly overstated since it is based on fatal crashes between 2011 and 2015 compared to a 2010 population due to the limited availability of regional population data. Roadway fatalities per capita in the Portland Metro region are less than 40% of the US average and less than half the State of Oregon's average.

Figure 1-12



Fatality rates

The worst regions in the nation for overall fatality rates are concentrated in Florida and the Sun Belt, where driving is the completely dominant mode of travel. The safest regions in the nation for overall fatality rates are Boston, Minneapolis-St. Paul, Portland, New York, and Chicago. In general, the safest urban regions are those that exhibit dense urban environments and higher usage of non-auto travel modes.

US City Data

NHTSA data include counts of all fatalities and pedestrian fatalities in US cities. This information is of special interest for this report given that the the Portland Metro region is highly urbanized and that the adopted growth concepts call for accomodating growth by increasing urbanization.

The figures below summarize overall fatality rates and pedestrian fatality rates for the best and worst 15 cities with population above 300,000. The figures are five-year averages (2011 – 2015). Asterisks (*) indicate that the city was also in the best or worst 15 for the 2012 State of Safety report, which looked at 2005 – 2009 data. There is a high degree of consistency between the best and worst cities between the two reports despite the differing analysis periods, indicating an established long-term relationship.

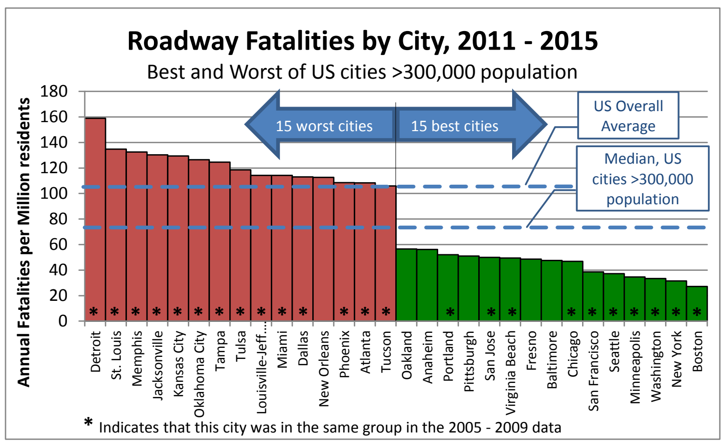
Overall fatality rates

The worst cities in the nation for overall fatality rates are Detroit, St. Louis, Memphis, Jacksonville, and Kansas City MO. In general, the worst cities are in states which have higher levels of VMT per capita, such as Michigan, Missouri, Florida, Texas, Oklahoma, and Arizona.

The safest cities in the nation in terms of roadway fatalities per capita are Boston, New York, Washington DC, Minneapolis, and Seattle. In general, the safest cities are those that exhibit dense urban environments and higher usage of non-auto travel modes.

As of 2014, the city of Portland ranks well in this list, at 13th best out of the 65 cities of population 300,000 or more. In the prior State of Safety report, Portland ranked 8th best.

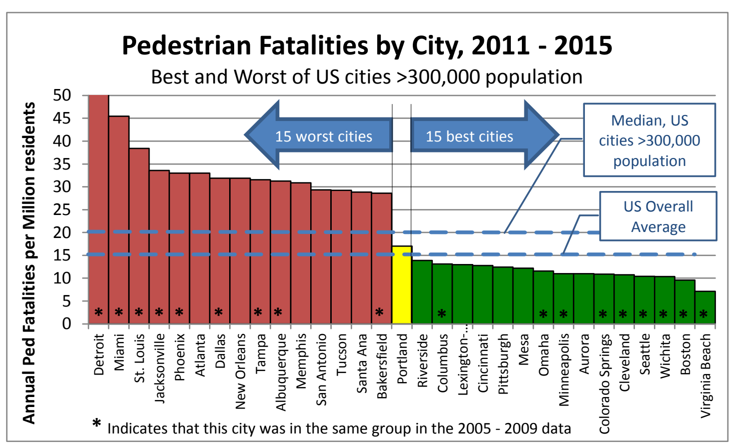
Figure 1-17



Pedestrian fatality rates

The worst cities in the nation for pedestrian crash fatality rates are Detroit, Miami, St. Louis, Jacksonville, and Phoenix. Many of the most dangerous cities for pedestrians are in states which have higher levels of VMT per capita.

Figure 1-18



The safest cities in the nation for pedestrians per capita in terms of crash fatalities are Virginia Beach, Boston, Wichita, Seattle, and Cleveland. The city of Portland ranks in the middle of the pack, at 43rd of the 65 cities of population 300,000 or more.

Discussion

In general, overall fatality rates per capita in cities are less than the national average for all areas. For example, the city of Portland's average annual fatality rate of 52 fatalities per million residents is much less than the national average of 105 and the Oregon statewide average of 90. Fifteen of the 65 cities exhibited crash fatality rates above the overall national average, with 50 exhibiting crash fatality rates below the national average.

This is likely due to a number of factors including fewer miles driven per capita due to the proximity of services, and the lower speeds of urban streets compared to rural highways, resulting in lower crash severity.

In general, cities which are more urban and which have lower levels of VMT per capita show substantially lower overall crash fatality rates. Those which have invested disproportionately in auto infrastructure, and therefore have higher VMT per capita, exhibit higher crash fatality rates.

Regarding pedestrian fatality rates, the relationships are complex, as cities with better pedestrian infrastructure encourage use by people walking, thereby increasing exposure. So while it may be safer to walk a given distance, the increased walking that results may increase pedestrian exposure and thus pedestrian crashes. Increasing walking may lead to more pedestrian fatalities because of the increased exposure but fewer overall fatalities because of the reduced VMT.

Cities which have managed to consistently demonstrate both low overall fatality rates and low pedestrian fatality rates include Boston, Seattle, Virginia Beach, and Minneapolis.

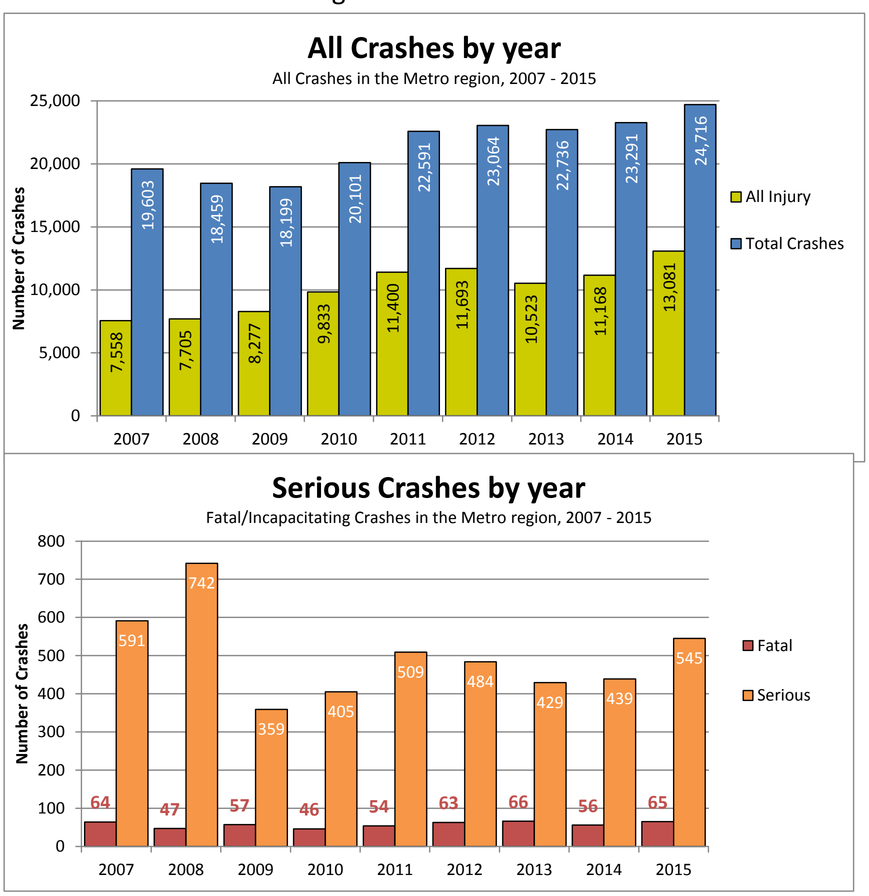
Section 2 – All Crashes

This section summarizes all crashes occurring in the Portland Metro region. The term "Serious crashes" refers to all Fatal or incapacitating injury (Injury A) crashes.

Crashes By Year

Year	Total Crashes	Fatal Crashes (Fatalities)	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes (Injuries)	Serious Crashes
2011	22,591	54 (54)	455	2,487	8,404	11,400	509
2012	23,064	63 (66)	421	2,654	8,555	11,693	484
2013	22,736	66 (68)	363	2,428	7,666	10,523	429
2014	23,291	56 (57)	383	2,512	8,217	11,168	439
2015	24,716	65 (66)	480	2,655	9,881	13,081	545
METRO	**116,398**	**304 (311)**	**2,102**	**12,736**	**42,723**	**57,865 (81,718)**	**2,406**

Figures 2-1 and 2-2



Total reported crashes and injury crashes have increased since 2007 (Figure 2-1). Fatal and Serious crashes have fluctuated since 2007, but have more recently been increasing (Figure 2-2). Data prior to 2011 is included where available.

Metro crash rates compared to other places

2011-2015	Population (2015)	Annual VMT (2015)	Annual Injury crashes per 1M residents	Annual Injury crashes per 100M VMT	Annual Serious crashes per 1M residents	Annual Serious crashes per 100M VMT
Metro	1,603,229	10,437,000,000	7,219	111	300	4.6

2011 - 2015	Average Annual Fatalities	Population (2015)	Annual VMT (2015)	Annual Fatality rate per 1M residents	Fatality rate per 100M VMT
Metro	62.2	1,603,229	10,437,000,000	39	0.60
Median, regions >1M pop.*				*78*	n/a
City of Portland	31.8	620,540	4,303,000,000	51	0.74
*Median, cities >300,000 pop.**				*72*	n/a
Oregon	356	4,028,977	36,000,000,000	88	0.99
Oregon excl. Metro region	294	2,425,748	25,562,000,000	121	1.15
US	*35,092*	*321,418,820*	*3,095,373,000,000*	*109*	*1.13*
UK**	2,123	64,128,226	520,600,000,000	33	0.41
EU – 28**	32,463	506,592,457	4,322,500,000,000	64	0.75

* All data for other regions and cities is 2010 - 2014

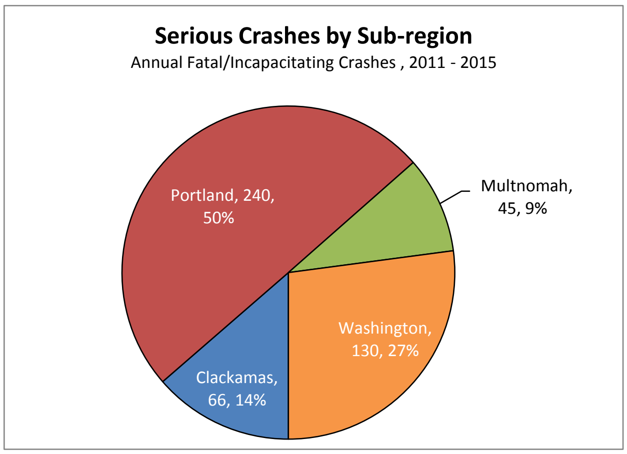
** All data for UK and EU is for year 2013

The City of Portland, the Portland Metro region, and the State of Oregon all have fatality rates below the national average. The fatality rates in the State of Oregon when the Metro region is excluded from consideration are higher than the national average. The United Kingdom and European Union data are included for reference as international best practice.

By Sub-Region

Sub-Region	2011-2015 Annual Crashes						
	All	Fatal (Fatalities)	Injury A	Injury B	Injury C	All Injury	Serious
Clackamas	3,482	10.2 (10.4)	55	395	1,362	1,822	66
Portland	11,475	31.2 (31.8)	209	1,216	4,078	5,534	240
Multnomah (excl. Portland)	1,870	6.2 (6.2)	39	245	727	1,017	45
Washington	6,452	13.2 (13.6)	117	692	2,378	3,200	130
METRO	**23,280**	**60.8 (62.2)**	**420**	**2,547**	**8,545**	**11,573**	**481**

Figures 2-3 and 2-4



Map of Metro Sub-regions

Sub-Region	Population (2015)	Annual VMT (2015)	Annual Injury crashes		Annual Serious crashes	
			per 1M residents	per 100M VMT	per 1M residents	per 100M VMT
Clackamas	290,630	2,102,000,000	6,269	87	226	3.1
Portland	620,540	4,303,000,000	8,918	129	387	5.6
Multnomah (excl. Portland)	152,611	744,000,000	6,664	137	296	6.1
Washington	539,448	3,287,000,000	5,932	97	242	4.0
METRO	**1,603,229**	**10,437,000,000**	**7,219**	**111**	**300**	**4.6**

With the highest population and VMT, Portland has the largest share of the region's Serious crashes (Figure 2-3). Portland has the highest rate of Serious crashes per capita, while Multnomah (excludes Portland) has the highest rate of Serious crashes per VMT. Clackamas County has the lowest rate of Serious crashes per capita and per VMT.

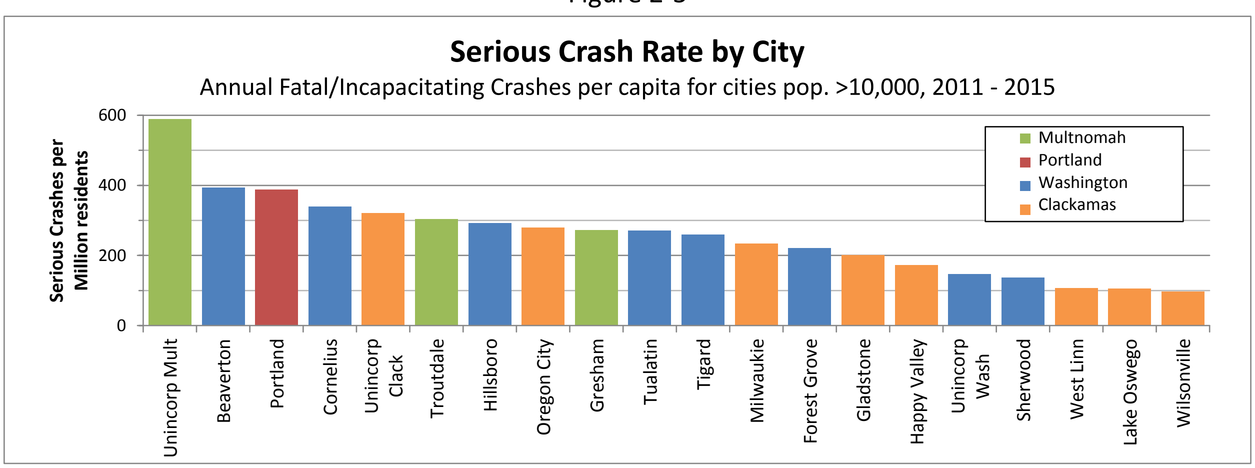
By City

City	2011-2015 Annual Crashes						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Beaverton	1,987	3.0	35	179	729	946	38
Cornelius	101	0.0	4	11	37	52	4
Durham	13	0.0	0	1	6	7	0
Fairview	88	0.2	1	13	35	49	1
Forest Grove	137	0.6	5	19	45	69	5
Gladstone	136	0.4	2	16	51	70	2
Gresham	1,356	3.4	27	170	546	747	30
Happy Valley	221	1.0	3	28	91	123	4
Hillsboro	1,413	3.6	26	177	545	751	29
Johnson City	0	0.0	0	0	0	0	0
King City	9	0.0	0	1	1	2	0
Lake Oswego	282	0.0	4	29	96	130	4
Maywood Park	27	0.0	1	2	12	15	1
Milwaukie	210	0.4	5	28	77	109	5
Oregon City	588	1.8	8	62	232	304	10
Portland	11,479	31.2	209	1,216	4,079	5,536	240
Rivergrove	1	0.0	0	0	0	0	0
Sherwood	160	0.2	2	18	58	79	3
Tigard	935	1.6	12	91	353	457	13
Troutdale	167	0.8	4	22	63	89	5
Tualatin	486	0.4	7	50	199	256	7
West Linn	213	0.6	2	23	78	104	3
Wilsonville	218	0.0	2	23	76	102	2
Wood Village	67	0.2	1	7	24	32	1
Unincorp Clack	1,651	6.0	30	187	670	893	36
Unincorp Mult	155	1.6	4	29	45	81	6
Unincorp Wash	1,180	3.8	26	144	397	571	30
METRO	**23,280**	**60.8**	**420**	**2,547**	**8,545**	**11,573**	**481**

These two tables and the accompanying Figure 2-5 summarize crash data within the region by City and for the unincorporated sections of each of the three counties. Crash rates were determined per capita but not per VMT, as the VMT estimates for the smaller cities are not considered reliable enough for such an analysis.

City	Population (2015)	2011-2015 Annual crashes	
		All Injury per 1M residents	Serious per 1M residents
Beaverton	96,704	9,782	393
Cornelius	12,389	4,230	339
Durham	1,430	4,895	0
Fairview	9,357	5,194	150
Forest Grove	23,630	2,903	220
Gladstone	11,990	5,805	200
Gresham	111,716	6,683	272
Happy Valley	20,835	5,894	173
Hillsboro	100,109	7,506	292
Johnson City	588	0	0
King City	3,817	576	52
Lake Oswego	38,156	3,397	105
Maywood Park	809	19,036	1,236
Milwaukie	21,365	5,121	234
Oregon City	35,004	8,673	280
Portland	620,540	8,921	387
Rivergrove	321	623	0
Sherwood	19,012	4,134	137
Tigard	51,642	8,849	259
Troutdale	16,486	5,411	303
Tualatin	26,617	9,625	271
West Linn	26,267	3,967	107
Wilsonville	22,932	4,448	96
Wood Village	4,056	7,988	247
Unincorp Clack	113,172	7,889	320
Unincorp Mult	10,187	7,932	589
Unincorp Wash	204,098	2,796	147
METRO	**1,603,229**	**7,219**	**300**

Figure 2-5



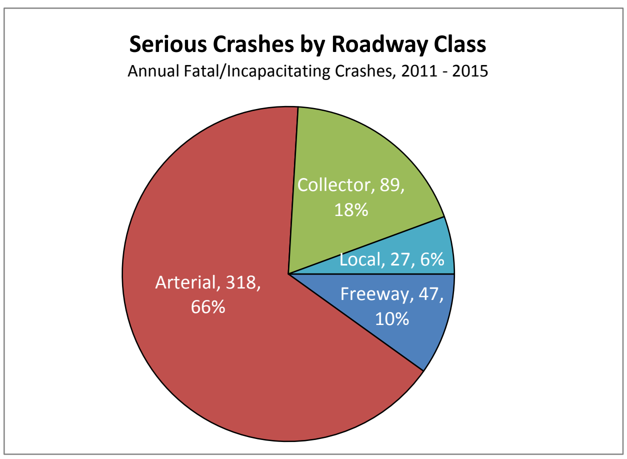
By Roadway Classification

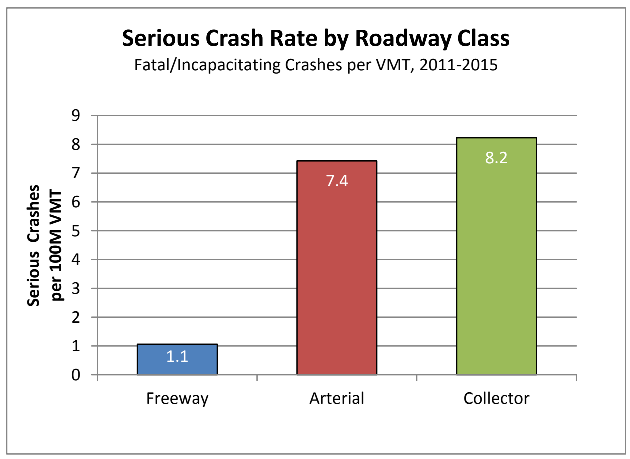
Roadway Classification	2011-2015 Annual Crashes							Percent Serious
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious	
Freeway	3,688	4.4	43	301	1,454	1,802	47	1.3%
Arterial	14,463	41.8	276	1,606	5,605	7,529	318	2.2%
Collector	3,609	12.6	76	476	1,140	1,705	89	2.5%
Local	1,519	2.0	25	164	345	536	27	1.8%
METRO	**23,280**	**60.8**	**420**	**2,547**	**8,545**	**11,573**	**481**	**2.1%**

Roadway Classification	Total Road-Miles	Annual VMT (2015)	Annual Crashes per Road-Mile		Annual Crashes per 100M VMT	
			All Injury	Serious	All Injury	Serious
Freeway	304	4,455,000,000	5.9	0.16	40	1.1
Arterial	772	4,281,000,000	9.8	0.41	176	7.4
Collector	994	1,081,000,000	1.7	0.09	158	8.2
Local	4,565	620,000,000*	0.1	0.01	87	4.3
METRO	**6,635**	**10,437,000,000**	**1.7**	**0.07**	**111**	**4.6**

* VMT for local streets is a low-confidence estimate

Figures 2-8 and 2-9

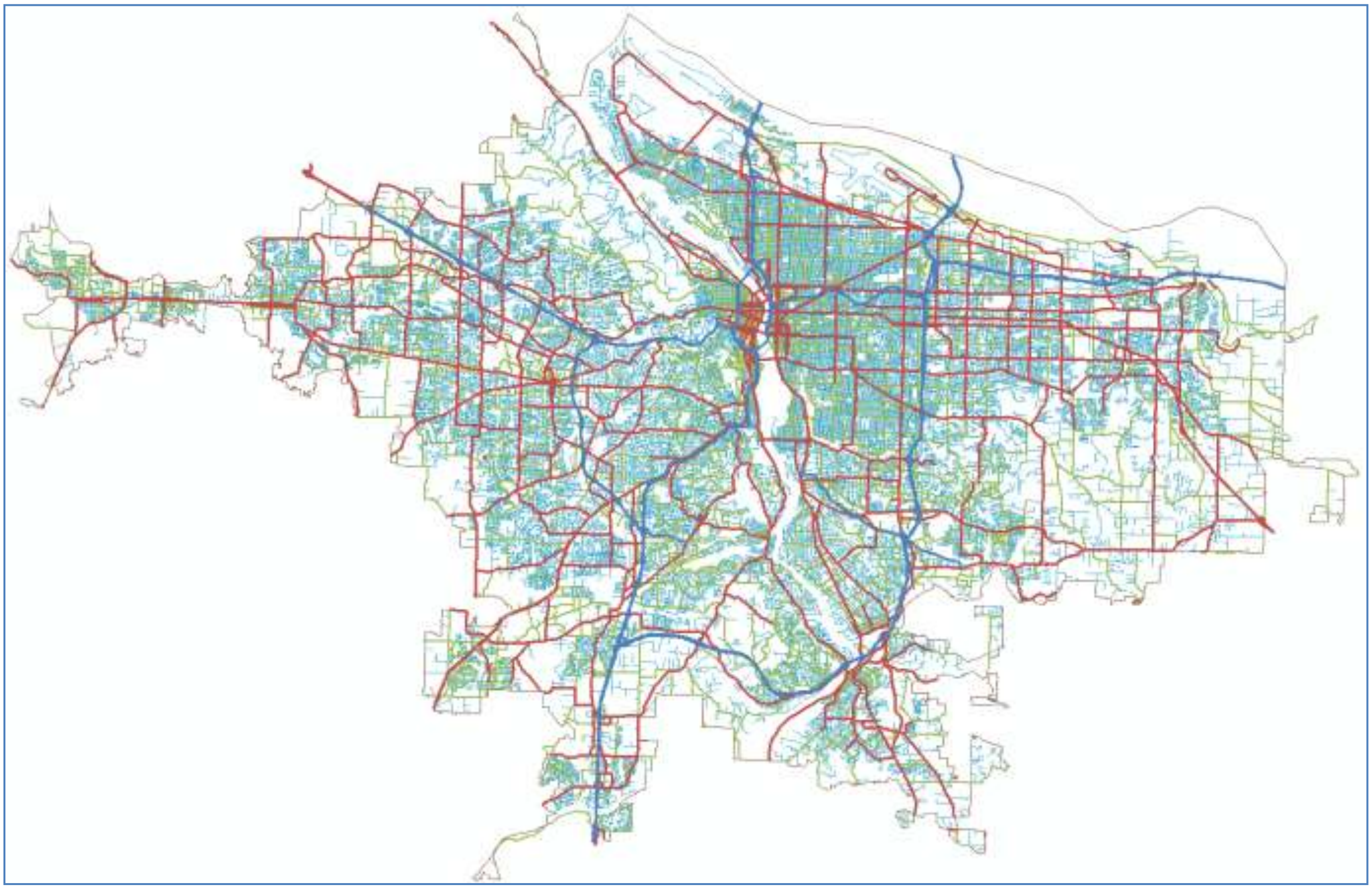




A review of the distribution of the region's Serious crashes by roadway classification reveals one of the most conclusive relationships in this study. Arterial roadways are the location of the majority of the Serious crashes in the region (Figure 2-8). A similar relationship is evident for pedestrians and cyclists, as detailed in Sections 5 and 6. Freeways and their ramps are relatively safe, per mile travelled, compared to arterial and collector roadways (Figure 2-9).

Figure 2-10 presents the functional classification of the region's roadways. Blue are freeways, red are arterial roadways, green are collectors roadwyas, and light blue are local.

Figure 2-10

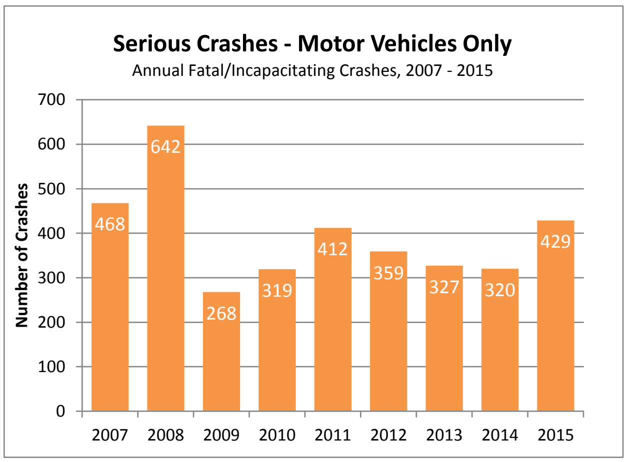


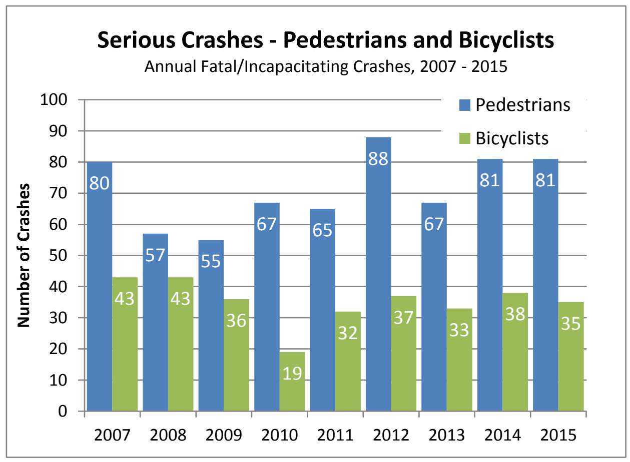
Map of Roadway Functional Classifications

By Mode

Year	Pedestrians		Bicyclists		Autos Only		Motorcycle		Truck Involved	
	All Injury	Serious	All Injury	Serious	All Injury	Serious	All Injury	Serious	All Injury	Serious
2011	418	65	481	32	10,502	412	312	72	250	20
2012	511	88	560	37	10,622	359	353	63	277	16
2013	428	67	485	33	9,607	327	356	76	238	11
2014	480	81	509	38	10,179	320	302	55	281	22
2015	474	81	477	35	12,129	429	339	86	320	19
METRO	**2,311**	**382**	**2,512**	**175**	**53,039**	**1,847**	**1,662**	**352**	**1,366**	**88**

Figures 2-11 and 2-12





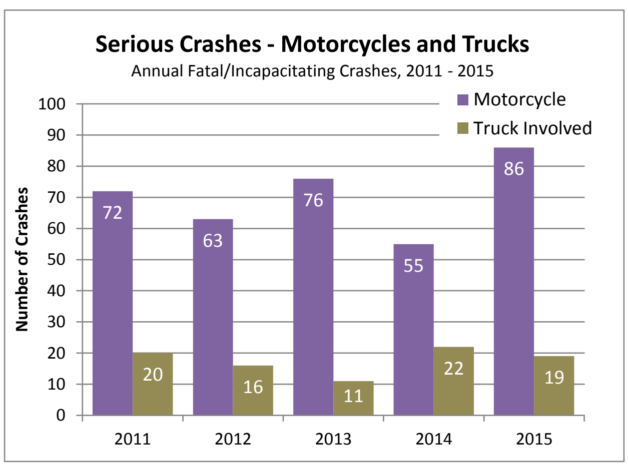


Figure 2-13

Figure 2-11 presents the annual number of Serious crashes involving only motor vehicles (no pedestrians or cyclists). Figure 2-12 presents the annual number of Serious crashes involving pedestrians and cyclists. Figure 2-13 presents the annual number of Serious crashes involving motorcycles and large trucks. Data prior to 2011 is included where available.

By Month

Month	2011-2015 Annual Crashes	
	All	**Serious**
January	1,787	39
February	1,679	36
March	1,788	36
April	1,859	33
May	1,881	38
June	1,922	43
July	1,922	44
August	1,971	47
September	1,995	45
October	2,200	39
November	2,102	41
December	2,173	41
12 MONTHS	**23,280**	**481**

Figure 2-14

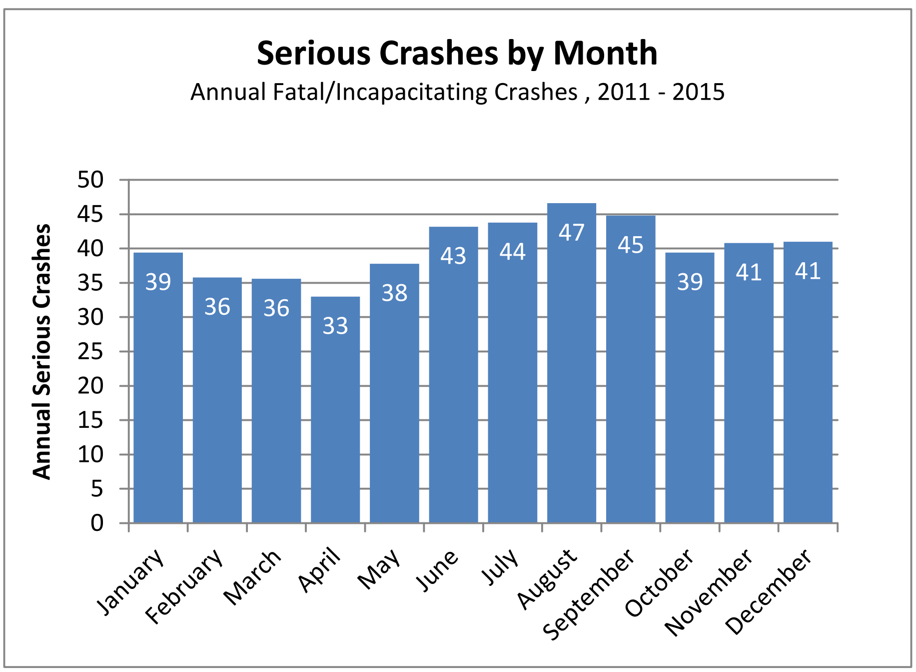


Figure 2-14 presents the annual average number of Serious crashes by month. No clear trend is evident.

By Time of Day

Figure 2-15

Serious Crashes by Day of Week and Hour

Annual Fatal/Incapacitating Crashes, 2011 - 2015

Hour	Sun	Mon	Tue	Wed	Thu	Fri	Sat
12 AM	2.2	1.8	0.8	0.6	1.8	1.8	3.0
1 AM	2.6	2.0	0.8	1.6	0.6	1.6	2.0
2 AM	4.8	0.6	1.0	1.8	1.2	2.8	3.6
3 AM	1.2	0.6	0.4	0.8	0.6	1.2	2.0
4 AM	1.4	0.2	1.2	0.6	0.2	0.2	0.6
5 AM	0.6	1.2	1.2	1.0	1.4	1.8	0.8
6 AM	0.8	1.8	1.4	3.0	1.8	2.8	0.6
7 AM	2.8	2.6	3.0	4.2	2.8	2.6	1.8
8 AM	0.6	3.2	2.4	4.2	3.4	3.0	1.0
9 AM	1.6	1.6	2.8	2.2	2.8	2.4	1.2
10 AM	2.0	2.0	2.6	2.4	3.2	2.0	3.4
11 AM	2.2	2.6	2.6	3.0	3.0	5.0	3.0
12 PM	3.0	2.0	1.8	3.4	4.8	4.8	3.6
1 PM	3.0	3.2	4.2	3.4	3.0	4.2	4.2
2 PM	3.6	5.6	4.6	3.0	4.2	3.0	2.8
3 PM	4.2	4.8	5.6	4.6	4.4	5.4	5.4
4 PM	2.8	6.2	5.8	6.6	5.8	5.2	2.8
5 PM	4.6	5.0	7.8	7.4	6.4	6.6	5.0
6 PM	3.4	4.8	5.0	5.0	5.2	5.8	5.2
7 PM	3.0	3.2	4.2	3.8	5.0	4.6	4.8
8 PM	3.4	1.4	2.8	2.0	2.2	2.2	2.6
9 PM	2.6	3.2	2.4	3.6	3.8	3.6	1.8
10 PM	1.8	2.0	1.8	2.8	2.6	3.0	3.4
11 PM	1.4	1.2	1.4	2.0	1.6	2.8	1.8

Hour	Avg Wkday	Avg Wkend
12 AM	1.4	2.6
1 AM	1.3	2.3
2 AM	1.5	4.2
3 AM	0.7	1.6
4 AM	0.5	1.0
5 AM	1.3	0.7
6 AM	2.2	0.7
7 AM	3.0	2.3
8 AM	3.2	0.8
9 AM	2.4	1.4
10 AM	2.4	2.7
11 AM	3.2	2.6
12 PM	3.4	3.3
1 PM	3.6	3.6
2 PM	4.1	3.2
3 PM	5.0	4.8
4 PM	5.9	2.8
5 PM	6.6	4.8
6 PM	5.2	4.3
7 PM	4.2	3.9
8 PM	2.1	3.0
9 PM	3.3	2.2
10 PM	2.4	2.6
11 PM	1.8	1.6

	Sun	Mon	Tue	Wed	Thu	Fri	Sat
All Day	59.6	62.8	67.6	73.0	71.8	78.4	66.4

	Avg Wkday	Avg Wkend
All Day	70.7	63.0

Figure 2-15 presents the rate of Serious crashes by day of the week and hour of the day using a "heat map" format. Dark cells indicate the highest relative crash time periods; light cells indicate the lowest relative crash time periods. The average weekday and weekend day are summarized on the right side of the figure, while each day is summarized and compared at the bottom of the figure.

The weekday evening peak hours produce the highest number of Serious crashes, with the 5:00 – 5:59 pm hour as the worst. Late Friday night/early Saturday morning and late Saturday night/early Sunday morning also stand out with high rates of Serious crashes.

By Weather

Weather	2011-2015 Annual Crashes	
	All	**Serious**
Cloudy/Clear	17,658	384
Rain/Fog	4,462	84
Sleet/Snow	189	3
Unknown	970	10
METRO	**20,947**	**481**

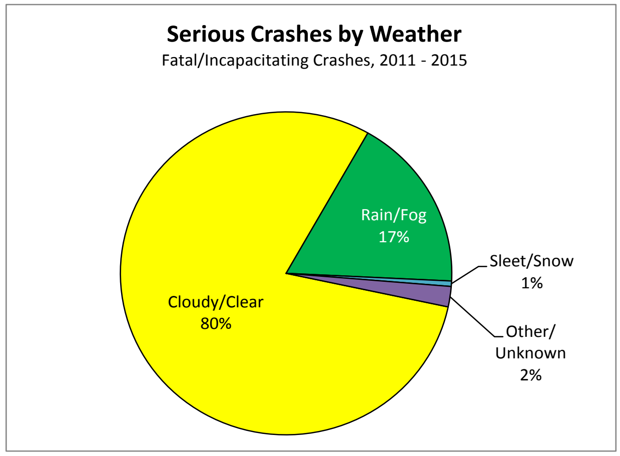


Figure 2-16

The majority (80%) of Serious crashes occurred in clear or cloudy conditions (Figure 2-16).

By Road Surface Condition

Road Condition	2011-2015 Annual Crashes	
	All	**Serious**
Dry	16,378	349
Ice/Snow	342	6
Wet	5,715	120
Unknown	844	6
METRO	**20,947**	**481**

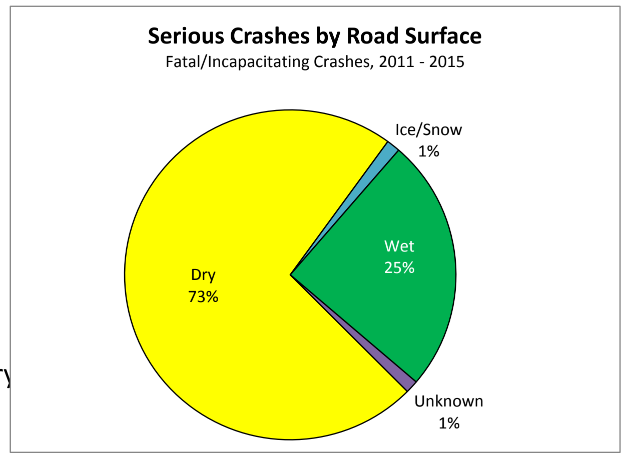


Figure 2-17

The majority (73%) of Serious crashes occurred in dry conditions (Figure 2-17).

By Lighting

Lighting	2011-2015 Annual Crashes	
	All	**Serious**
Daylight	16,508	282
Dawn/Dusk	1,657	33
Night - Dark	892	40
Night - Lit	4,153	125
Unknown	70	1
METRO	**20,947**	**481**

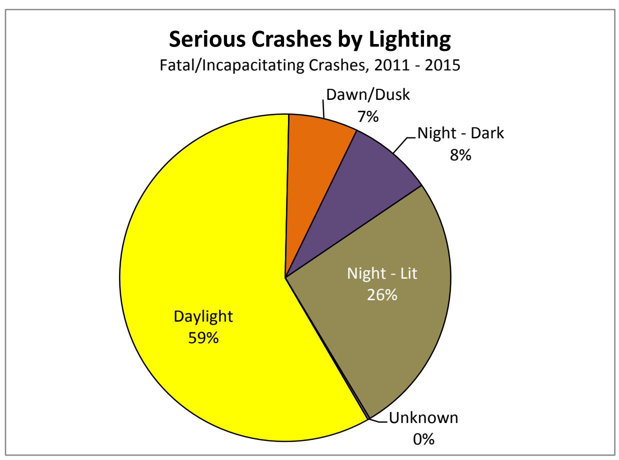


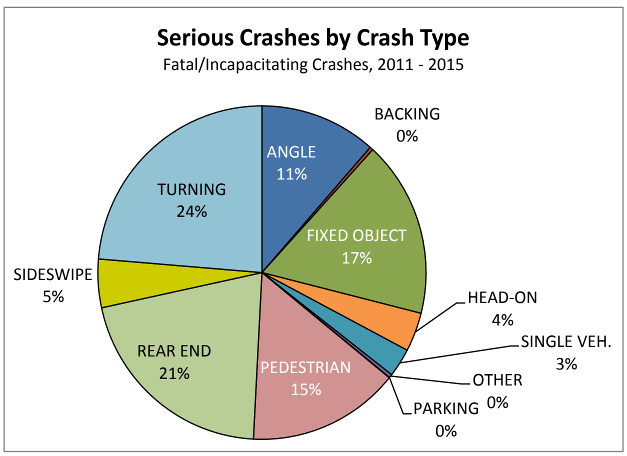
Figure 2-18

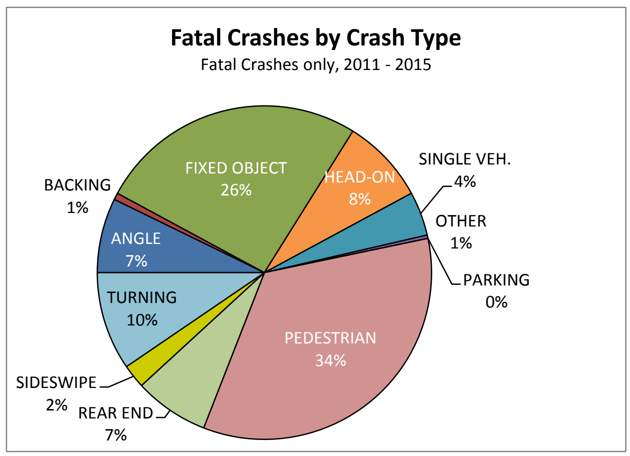
The majority (59%) of Serious crashes occurred in daylight (Figure 2-18).

By Crash Type

Collision Type	2011-2015 Annual Crashes						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Angle	2,304	4	51	388	803	1,246	55
Backing	336	0	1	6	71	79	2
Fixed Object	1,734	16	67	289	341	712	82
Head-on	151	5	13	34	44	96	18
Single Vehicle	101	3	11	43	23	79	13
Other	78	0	1	10	10	21	2
Parking	201	0	0	8	30	38	0
Pedestrian	450	21	51	214	160	447	72
Rear End	10,573	4	96	661	4,948	5,710	100
Sideswipe	2,198	1	21	136	476	635	23
Turning	5,154	6	108	758	1,638	2,510	114
METRO	**23,280**	**61**	**420**	**2,547**	**8,545**	**11,573**	**481**

Figures 2-19 and 2-20





Figures 2-19 and 2-20 present Serious crash types and Fatal crash types. Fatal crashes are specifically broken out here because the distribution is substantially different. For the purpose of establishing crash type, bicycles are considered vehicles, and so there is no separate bicycle crash type.

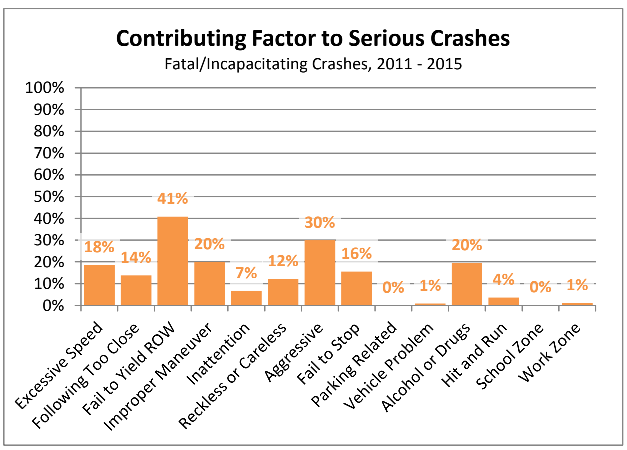
The most common Serious crash types were Turning and Rear End.

The most common Fatal crash types were Pedestrian and Fixed Object.

By Contributing Factor

Collision Type	2011-2015 Annual Crashes (All Crashes)						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Excessive Speed	2,897	20.6	68	372	1,019	1,480	89
Following Too Close	7,806	1.4	65	486	3,660	4,212	66
Fail to Yield ROW	7,081	19.2	177	1,227	2,369	3,793	196
Improper Maneuver	4,636	16.4	79	400	1,137	1,633	96
Inattention	1,279	3.0	29	166	533	731	32
Reckless or Careless	1,086	6.8	52	234	375	668	59
Aggressive	9,663	21.2	123	771	4,198	5,114	144
Fail to Stop	8,979	1.6	73	514	4,228	4,817	75
Parking Related	136	0.0	0	4	18	22	0
Vehicle Problem	124	0.8	4	18	35	57	4
Alcohol or Drugs	1,056	34.4	60	215	265	575	94
Hit and Run	1,382	5.0	12	104	452	572	17
School Zone	66	0.2	1	13	26	39	1
Work Zone	177	0.2	5	25	69	99	5
METRO	**23,280**	**60.8**	**420**	**2,547**	**8,545**	**11,573**	**481**

Figures 2-21 and 2-22



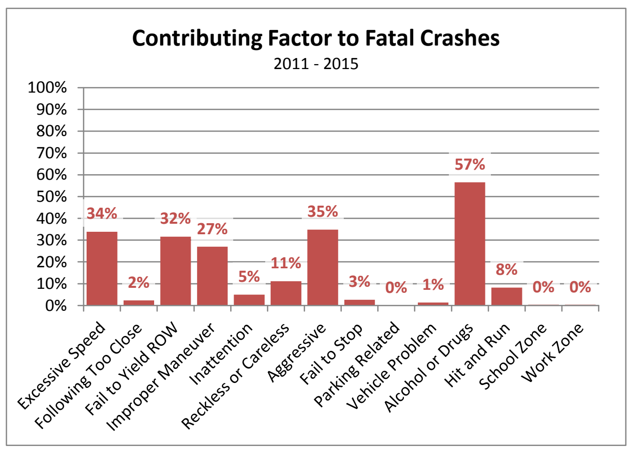


Figure 2-21 presents the the percentage of crashes of Serious severity (Fatal or Injury A) with each contributing factor. Figure 2-22 presents the the percentage of Fatal crashes with each contributing factor. Each crash may have several contributing factors. The determination of contributing factors is described in more detail in Section 7.

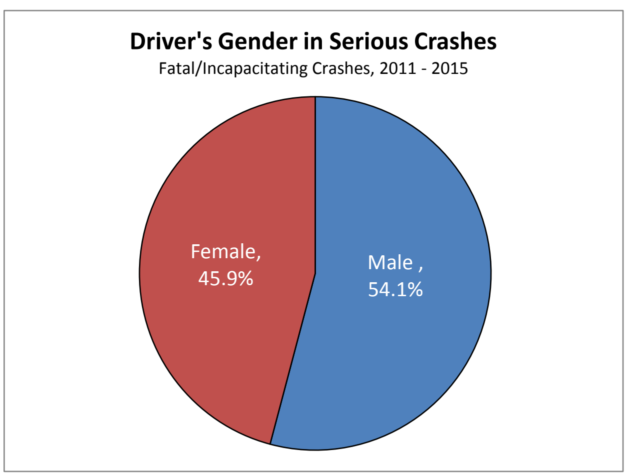
Alcohol and Drugs, Excessive Speed, Fail to Yield ROW, and Aggressive Driving are particularly common factors. Crashes involving Alcohol and Drugs have a much higher likelihood of being Fatal than other crashes.

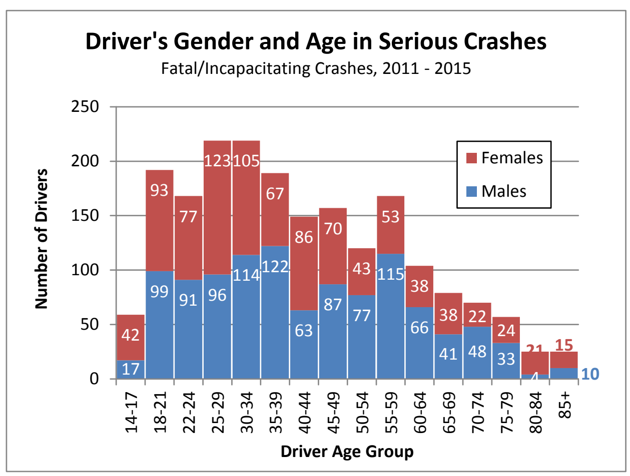
By Driver's Age and Gender

The age and gender of drivers involved in crashes, regardless of fault, are presented in the following table and Figures 2-23 and 2-24.

Age Group	Total Male Drivers (2011 – 2015)			Total Female Drivers (2011 – 2015)		
	All Crashes	Serious	Percent Serious	All Crashes	Serious	Percent Serious
14-17	3,076	17	0.6%	3,579	42	1.2%
18-21	9,572	99	1.0%	9,413	93	1.0%
22-24	7,518	91	1.2%	7,466	77	1.0%
25-29	12,431	96	0.8%	11,968	123	1.0%
30-34	11,897	114	1.0%	10,804	105	1.0%
35-39	10,343	122	1.2%	9,247	67	0.7%
40-44	10,421	63	0.6%	8,898	86	1.0%
45-49	9,218	87	0.9%	8,053	70	0.9%
50-54	9,114	77	0.8%	7,500	43	0.6%
55-59	8,248	115	1.4%	6,810	53	0.8%
60-64	6,734	66	1.0%	5,529	38	0.7%
65-69	4,589	41	0.9%	3,823	38	1.0%
70-74	2,408	48	2.0%	2,180	22	1.0%
75-79	1,428	33	2.3%	1,306	24	1.8%
80-84	820	4	0.5%	813	21	2.6%
85+	747	10	1.3%	777	15	1.9%
Unknown	15,669	16	0.1%	11,098	14	0.1%
METRO	**124,233**	**1,099**	**0.9%**	**109,264**	**931**	**0.9%**

Figures 2-23 and 2-24





Seat Belt Use

The reported use of seat belts is shown in the following tables, for all crashes, for Serious crashes only, and for non-serious crashes.

Seat Belt Use (All crashes, 2011-2015)					
Gender	**Seat Belt Use**	**No Seat Belt**	**Unknown**	**% Seat Belt Use**	**% No Seat Belt**
Males	81,267	769	47,229	99.1%	0.9%
Females	80,854	445	34,213	99.5%	0.5%
Unknown	245	2	6,261	99.2%	0.8%
METRO	**162,366**	**1,216**	**87,703**	**99.3%**	**0.7%**

Seat Belt Use (Serious crashes, 2011-2015)					
Gender	**Seat Belt Use**	**No Seat Belt**	**Unknown**	**% Seat Belt Use**	**% No Seat Belt**
Males	622	79	164	88.7%	11.3%
Females	768	51	100	93.8%	6.2%
Unknown	0	0	0	-	-
METRO	**1,390**	**130**	**264**	**91.4%**	**8.6%**

Seat Belt Use (Injury B, C, and PDO crashes, 2011-2015)					
Gender	**Seat Belt Use**	**No Seat Belt**	**Unknown**	**% Seat Belt Use**	**% No Seat Belt**
Males	80,645	690	47,065	99.2%	0.8%
Females	80,086	394	34,113	99.5%	0.5%
Unknown	245	2	6,261	99.2%	0.8%
METRO	**160,976**	**1,086**	**87,439**	**99.3%**	**0.7%**

Seat belt use in the region as reported exceeds 99%.

Males were 71% more likely than females to be reported without a seat belt.

Occupants without seat belts were 12 times as likely to be seriously injured or killed as occupants wearing seat belts.

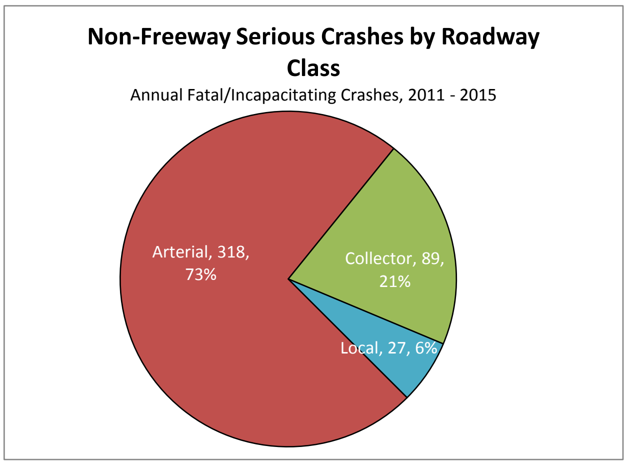
Section 3 – Roadway Characteristics of Non-Freeway Crashes

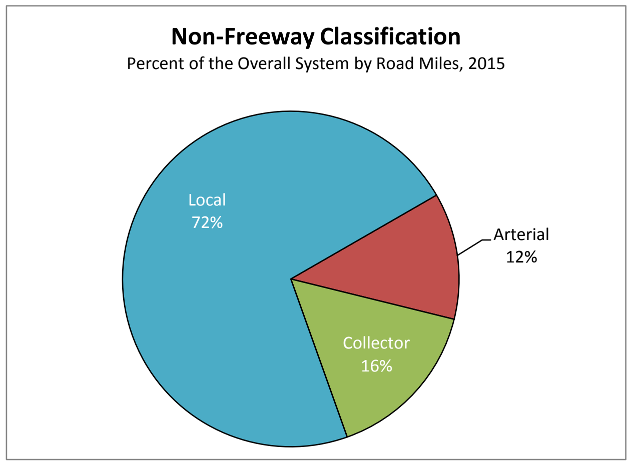
By Roadway Classification

Roadway Classification	Total Road-Miles	Annual VMT (2015)	2011-2015 Annual Crashes		
			All	All Injury	Serious
Arterial	772	4,281,000,000	14,463	7,529	318
Collector	994	1,081,000,000	3,609	1,705	89
Local	4,565	620,000,000*	1,519	536	27
METRO	**6,331**	**5,982,000,000**	**19,591**	**9,771**	**434**

* VMT for local streets is a low-confidence estimate

Figures 3-1 and 3-2





Roadway Classification	% crashes resulting in		Annual Crashes per Road-Mile		Annual Crashes per 100M VMT	
	All Injury	Serious	All Injury	Serious	All Injury	Serious
Arterial	52%	2.2%	9.8	0.41	176	7.4
Collector	47%	2.5%	1.7	0.09	158	8.2
Local	35%	1.8%	0.1	0.01	--	--
METRO	**50%**	**2.2%**	**--**	**--**	**--**	**--**

A review of the distribution of non-freeway Serious crashes by roadway classification reveals one of the most conclusive relationships in this report. Arterial roadways are the location of the majority of the Serious crashes in the region. Despite making up only 12% of the region's non-freeway road miles, they constitute 73% of the Serious crashes (Figures 3-1 and 3-2). A similar relationship is evident for pedestrians and cyclists, as detailed in Sections 5 and 6. In general, these roads have high traffic volumes, high travel speeds, and are challenging to pedestrians crossing.

As shown in Figure 3-3, collector streets have the highest crash rate per traffic volume, followed closely by arterial streets. Figure 3-4 presents the functional classification of the region's roadways. Red are arterial roadways and green are collector roadways.

Figure 3-3

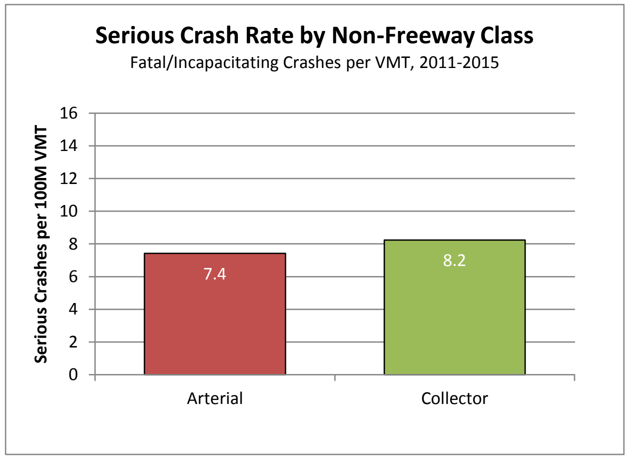


Figure 3-4

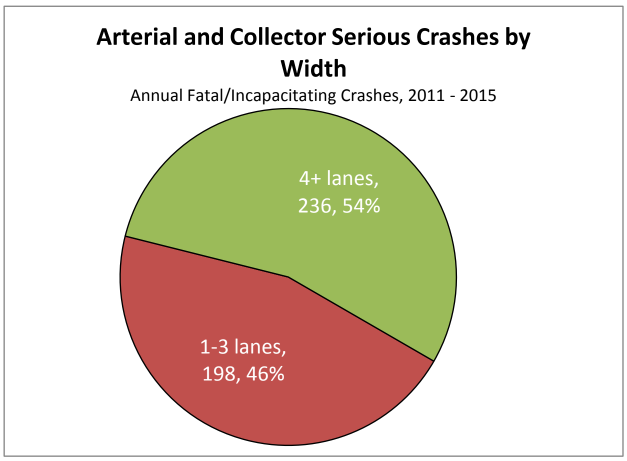
Map of Roadway Functional Classifications

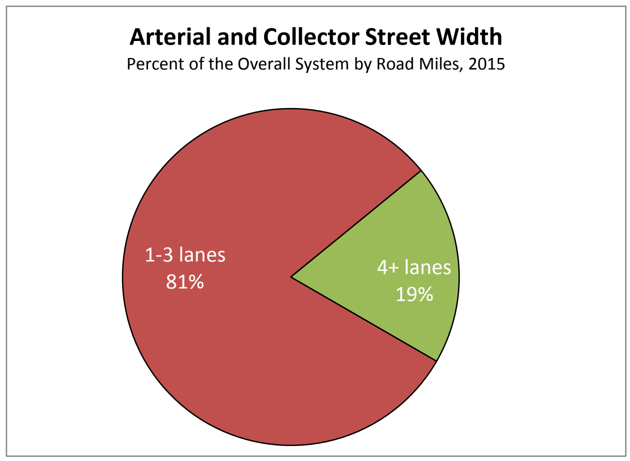
By Number of Lanes

The following tables and Figures 3-5 and 3-6 summarize crashes by number of lanes for arterial and collector roadways.

Number of Arterial/Collector Lanes	Total Road-Miles	Annual VMT (2015)	2011-2015 Annual Crashes		
			All	All Injury	Serious
1 – 3 Lanes	1,427	2,972,000,000	8,932	4,217	198
4+ Lanes	340	2,738,000,000	10,597	5,532	236

Figures 3-5 and 3-6





Number of Arterial/Collector lanes	% crashes resulting in		Annual Crashes per Road-Mile		Annual Crashes per 100M VMT	
	All Injury	Serious	All Injury	Serious	All Injury	Serious
1-3 lanes	47%	2.2%	3.0	0.14	142	6.6
4+ lanes	52%	2.2%	16.3	0.69	202	8.6
ALL ARTERIALS AND COLLECTORS	**50%**	**2.2%**	**5.5**	**0.25**	**171**	**7.6**

Figure 3-7 presents the crash rate per traffic volume, and Figure 3-8 presents the number of lanes for arterials and collectors in the region. The influence of street width is consistent with the influence of roadway classification. Wider roadways are the location of a disproportionate number of Serious crashes in relation to both their share of the overall system (Figures 3-5 and 3-6) and the vehicle-miles travelled they serve (Figure 3-7). Similar patterns are documented in AASHTO's Highway Safety Manual (2010), Chapter 12.

Figure 3-7

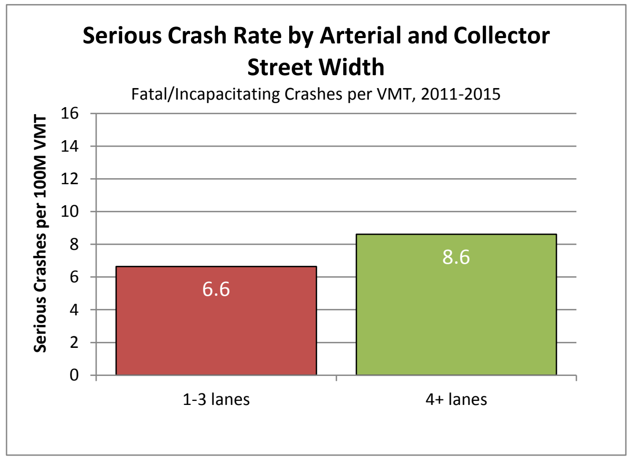
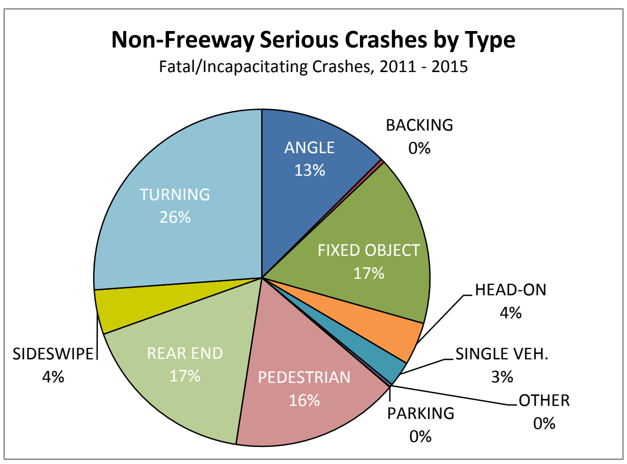


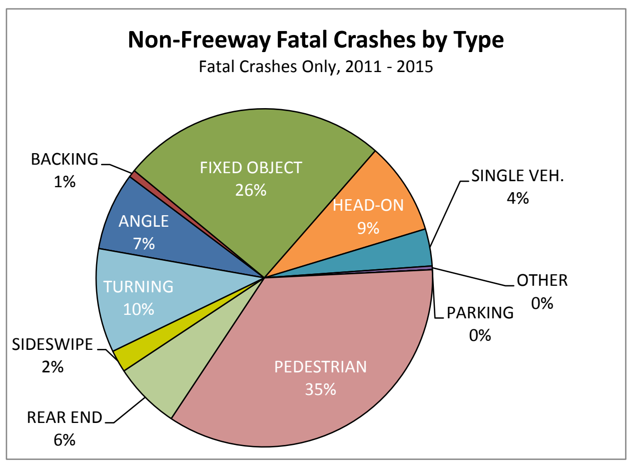
Figure 3-8 Map of Number of Lanes for Arterials and Collectors

By Crash Type

Collision Type	2011-2015 Annual Crashes						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Angle	2,296	4.2	50	386	801	1,241	55
Backing	329	0.4	1	6	70	78	2
Fixed Object	1,416	14.4	57	241	263	575	71
Head-on	145	5.0	13	33	41	93	18
Single Vehicle	79	2.0	9	35	18	64	11
Other	51	0.2	1	7	7	15	1
Parking	200	0.0	0	8	30	38	0
Pedestrian	446	19.8	51	212	160	442	70
Rear End	7,912	3.6	71	467	3,753	4,294	74
Sideswipe	1,608	1.2	17	100	324	442	19
Turning	5,108	5.6	108	754	1,623	2,490	113
METRO	**19,591**	**56.4**	**377**	**2,247**	**7,090**	**9,771**	**434**

Figure 3-9 and 3-10





Figures 3-9 and 3-10 present non-freeway Serious crash types and non-freeway Fatal crash types. Fatal crashes are specifically broken out here because the distribution is substantially different. For the purpose of establishing crash type, bicycles are considered vehicles, and so there is no separate bicycle crash type.

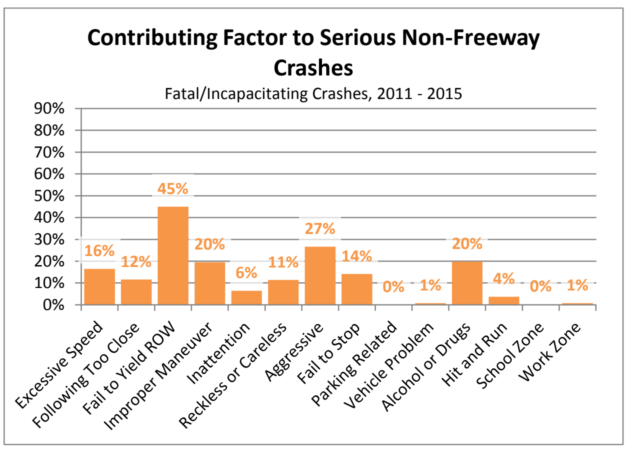
The most common Serious crash types were Turning and Rear End.

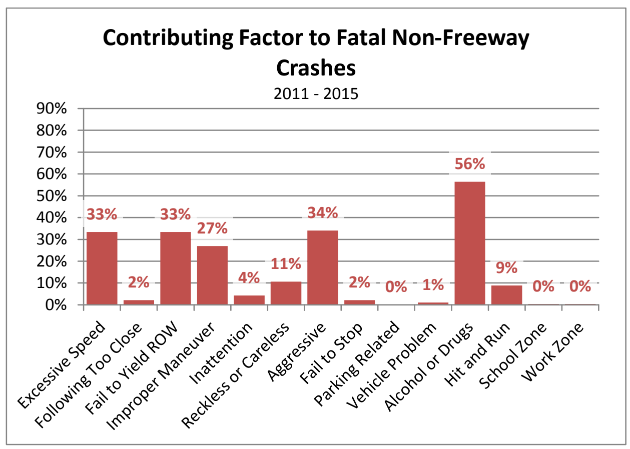
The most common Fatal crash types were Pedestrian and Fixed Object.

By Contributing Factor

Collision Type	2011-2015 Annual Crashes (Non-Freeway)						
	All	**Fatal**	**Injury A**	**Injury B**	**Injury C**	**All Injury**	**Serious**
Excessive Speed	1,982	18.8	53	276	644	991	71
Following Too Close	5,815	1.2	49	338	2,771	3,159	50
Fail to Yield ROW	7,000	18.8	176	1,219	2,344	3,758	195
Improper Maneuver	3,902	15.2	69	341	937	1,363	85
Inattention	1,071	2.4	25	144	445	617	28
Reckless or Careless	922	6.0	43	204	305	559	49
Aggressive	7,208	19.2	96	566	3,141	3,823	115
Fail to Stop	7,046	1.2	60	384	3,354	3,799	61
Parking Related	133	0.0	0	4	17	22	0
Vehicle Problem	90	0.6	3	15	28	46	3
Alcohol or Drugs	958	31.8	54	195	235	516	86
Hit and Run	1,161	5.0	11	92	374	482	16
School Zone	66	0.2	1	13	25	39	1
Work Zone	129	0.2	3	17	50	70	3
METRO	**19,591**	**56.4**	**377**	**2,247**	**7,090**	**9,771**	**434**

Figures 3-11 and 3-12





Figures 3-11 and 3-12 present the proportion of non-freeway crashes by contributing factor for Serious and Fatal crashes, respectively. Alcohol or Drugs, Fail to Yield ROW, Aggressive Driving, and Excessive Speed are the most common factors.

The determination of contributing factors is described in more detail in Section 7.

By Volume-to-Capacity Ratio

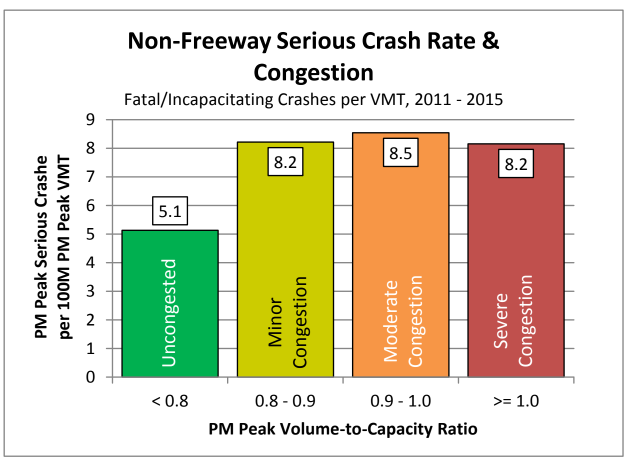
The combination of traffic data available from the region's travel demand model and crash data allowed for a comparison of traffic congestion with safety.

An analysis of Serious crash rates compared to congestion levels for non-freeway roadways was performed. The analysis included all roadways in the regional travel demand model, including all arterials and collectors, as well as certain local streets serving a collector function. The intent was to establish the relationship between congestion and safety.

PM peak 3-hour Volume-to-Capacity ratios as determined by the travel demand model were compared to the same 3-hours of weekday crash data. The results are shown in the table and Figures 3-13. Figure 3-14 presents the Volume-to-Capacity ratios for the region's non-freeway roadways.

PM Peak V/C Range	Total Road-Miles	Annual PM Peak VMT (2015)	2011-2015 Annual PM Peak Crashes (Non-Freeway)					
			Number of Crashes		Per Road-Mile		Per 100M VMT	
			All Injury	Serious	All Injury	Serious	All Injury	Serious
< 0.80	1,496	1,057,000,000	1,720	54	1.1	0.04	163	5.1
0.80 - 0.89	84	110,00,000	278	9	3.3	0.11	254	8.2
0.90 – 0.99	30	40,000,000	124	3	4.1	0.11	311	8.5
≥ 1.00	25	29,000,000	99	2	3.9	0.09	336	8.2

Figures 3-13 and 3-14



Map of V/C Ratios for Non-Freeway Roadways

The Serious crash rate per vehicle-mile travelled on arterials and collectors was highest with congestion.

The relationship is quite different from the analysis of 2007 – 2009 data, perhaps because of differences in travel demand model assignment procedures used and resulting Volume-to-Capacity ratio estimates. In order to provide a more conclusive analysis of this relationship, use of a more accurate tool for measuring real-world congestion, such as probe data, would be recommended.

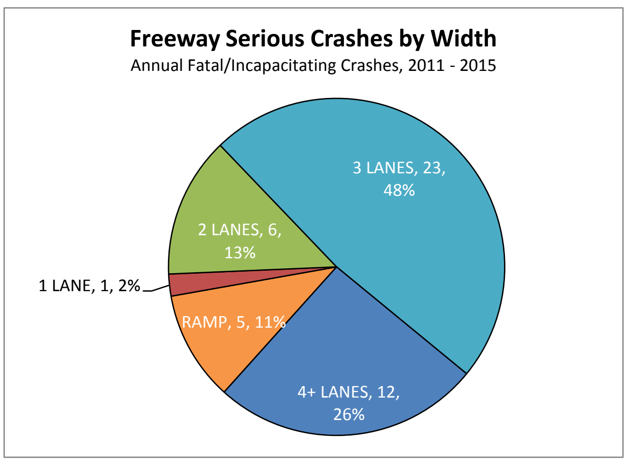
Section 4 – Roadway Characteristics of Freeway Crashes

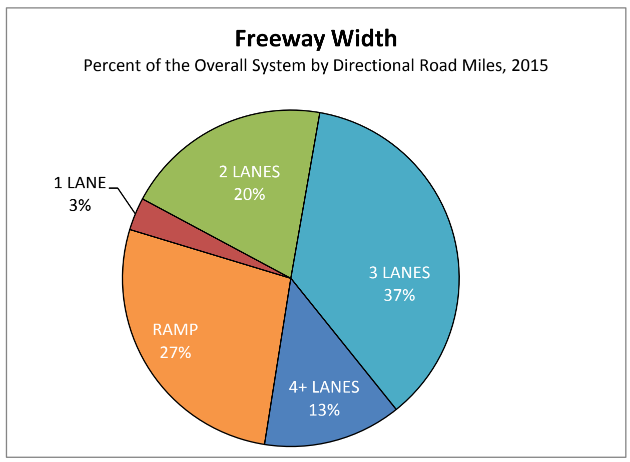
By Number of Lanes

Number of Freeway lanes (in one direction)	Total Road-Miles	Annual VMT (2015)	2011-2015 Annual Crashes		
			All	All Injury	Serious
Freeway ramp	83	275,000,000	300	151	5
1 Lanes	10	48,000,000	68	33	1
2 Lanes	61	758,000,000	493	234	6
3 Lanes	111	2,386,000,000	1,906	923	23
4+ Lanes	40	979,000,000	909	456	12
ALL FREEWAYS	**304**	**4,455,000,000**	**3,688**	**1,802**	**47**

Figures 4-1 and 4-2 present the distribution of freeway crashes by number of lanes. They also present the proportion of freeway crashes that occur on ramps.

Figure 4-1 and 4-2





Number of Freeway lanes (in one direction)	% crashes resulting in		Per Road-Mile		Per 100M VMT	
	All Injury	Serious	All Injury	Serious	All Injury	Serious
Freeway ramp	50%	1.7%	1.8	0.06	55	1.8
1 Lanes	49%	1.5%	3.5	0.10	70	2.1
2 Lanes	48%	1.3%	3.9	0.11	31	0.8
3 Lanes	48%	1.2%	8.3	0.21	39	1.0
4+ Lanes	50%	1.3%	11.3	0.30	47	1.2
ALL FREEWAYS	**49%**	**1.3%**	**5.9**	**0.16**	**41**	**1.1**

The influence of freeway width is not as pronounced as for non-freeway roadways. Freeways with two directional lanes (including auxiliary lanes) exhibit the lowest crash rates, while the rate increases for freeways with more or fewer lanes (Figure 4-3). Figure 4-4 presents the number of lanes for the region's freeways. Ramps (off-ramps and on-ramps) exhibit a higher Serious crash rate per mile travelled, while still representing a relatively small proportion (11%) of all Serious freeway crashes (Figure 4-1). Single-lane segments are uninterrupted ramps connecting freeways.

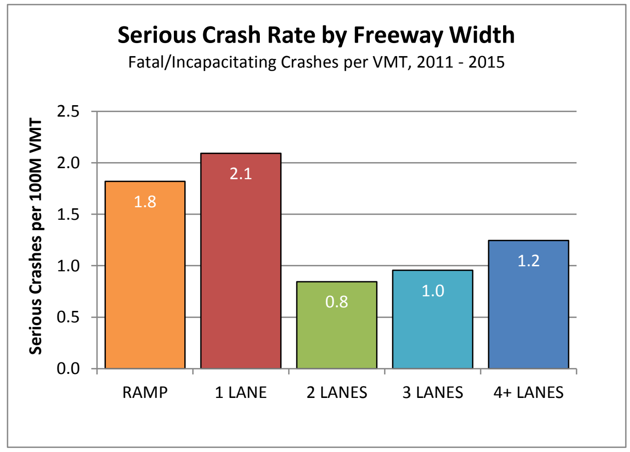
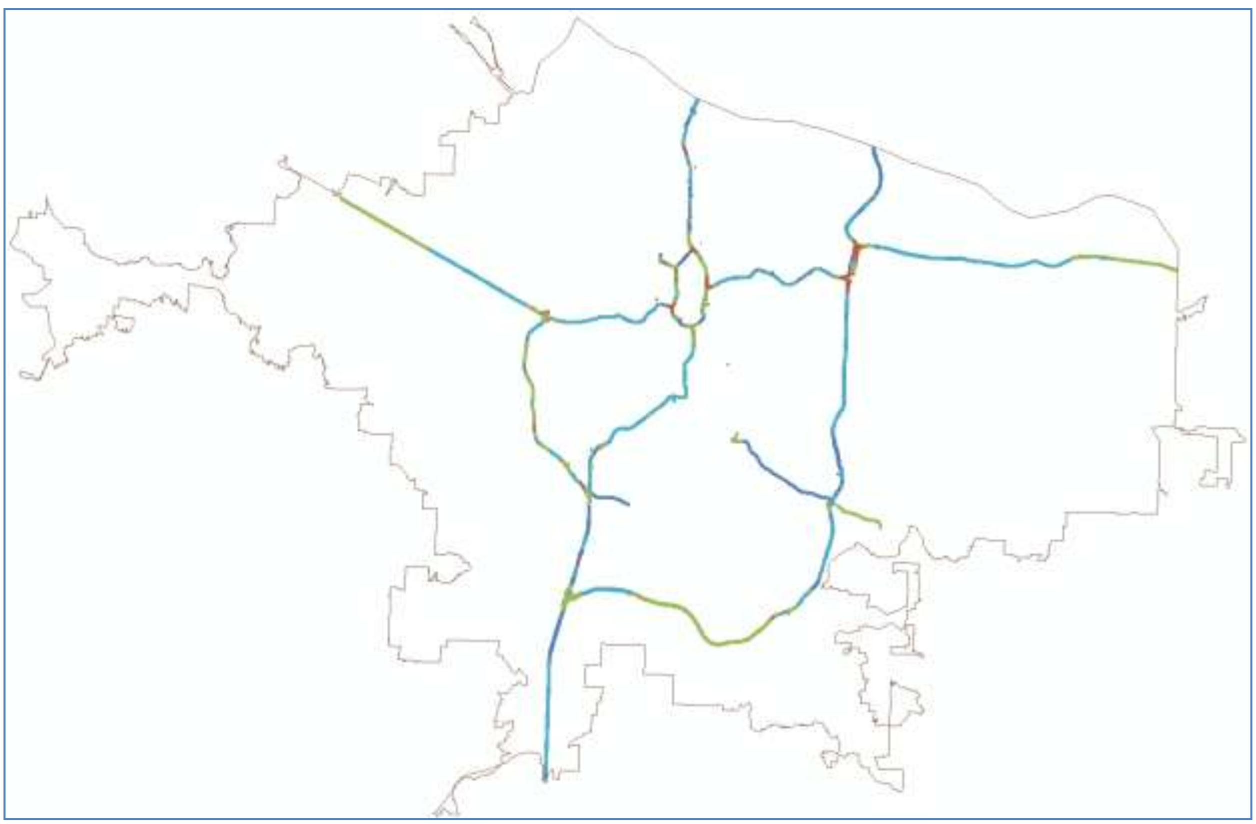


Figure 4-3

Figure 4-4

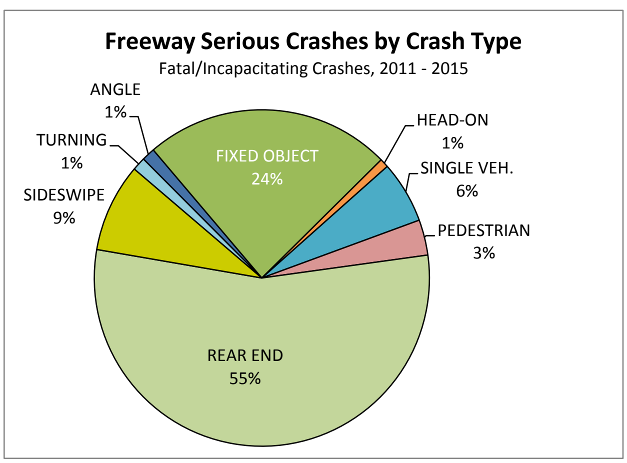


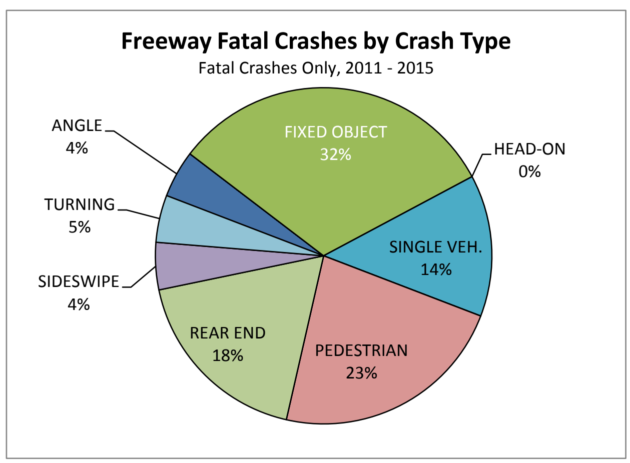
Map of Freeways by Number of Lanes

By Crash Type

Collision Type	2011-2015 Annual Crashes						
	All	**Fatal**	**Injury A**	**Injury B**	**Injury C**	**All Injury**	**Serious**
Angle	8	0.2	0	2	3	6	1
Backing	7	0.0	0	0	1	1	0
Fixed Object	318	1.4	10	48	77	136	11
Head-on	6	0.0	0	1	3	4	0
Single Vehicle	21	0.6	2	8	4	15	3
Parking	1	0.0	0	0	0	0	0
Pedestrian	4	1.0	1	2	0	4	2
Rear End	2,661	0.8	25	195	1,195	1,416	26
Sideswipe	589	0.2	4	36	152	192	4
Turning	46	0.2	0	5	15	21	1
Other	27	0	0	3	3	7	0
METRO	**3,688**	**4.4**	**43**	**301**	**1,454**	**1,802**	**47**
Total – Fwy Mainline	**3,117**	**3.8**	**37**	**252**	**1,230**	**1,522**	**41**
Total – Fwy Ramps	**572**	**0.6**	**6**	**48**	**225**	**280**	**7**

Figure 4-5 and 4-6





Figures 4-5 and 4-6 present freeway Serious crash types and freeway Fatal crash types. Fatal crashes are specifically broken out here because the distribution is substantially different.

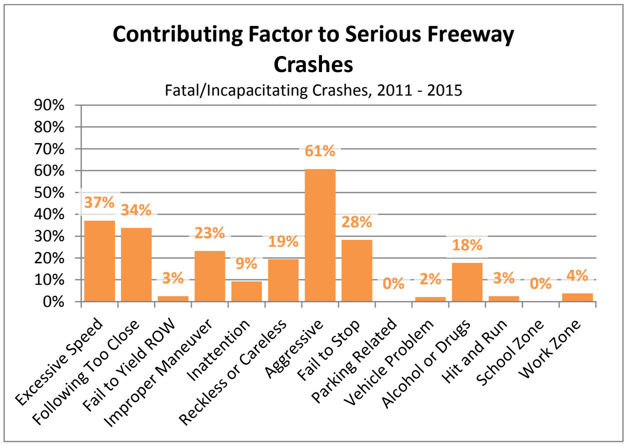
The most common Serious crash type was Rear End crashes.

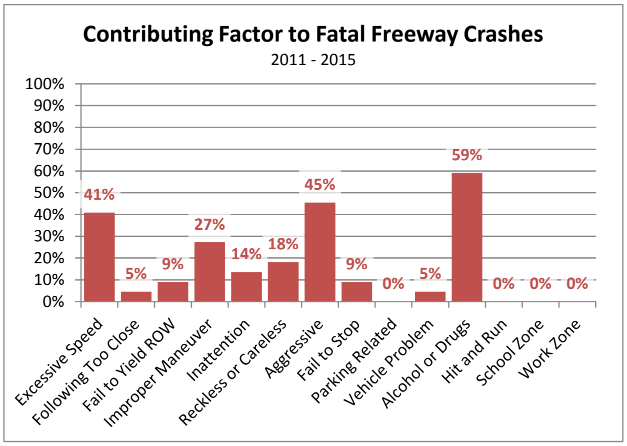
The most common Fatal crash type was Fixed Object crashes.

By Contributing Factor

Collision Type	2011-2015 Annual Crashes (Freeway)						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Excessive Speed	915	1.8	16	96	375	488	18
Following Too Close	1,991	0.2	16	148	889	1,053	16
Fail to Yield ROW	81	0.4	1	9	25	35	1
Improper Maneuver	734	1.2	10	58	200	269	11
Inattention	208	0.6	4	21	88	114	4
Reckless or Careless	164	0.8	8	30	70	109	9
Aggressive	2,456	2.0	27	205	1,057	1,291	29
Fail to Stop	1,932	0.4	13	131	874	1,018	13
Parking Related	2	0.0	0	0	0	1	0
Vehicle Problem	34	0.2	1	3	7	11	1
Alcohol or Drugs	98	2.6	6	20	31	59	8
Hit and Run	221	0.0	1	12	78	91	1
School Zone	0	0.0	0	0	0	0	0
Work Zone	48	0	2	8	19	29	2
METRO	**3,688**	**4.4**	**43**	**301**	**1,454**	**1,802**	**47**

Figures 4-7 and 4-8





Figures 4-7 and 4-8 present the proportion of freeway crashes by contributing factor for Serious and Fatal crashes, respectively. Alcohol and Drugs, Aggressive Driving and Excessive Speed are the most common factors.

The determination of contributing factors is described in more detail in Section 7.

By Volume-to-Capacity Ratio

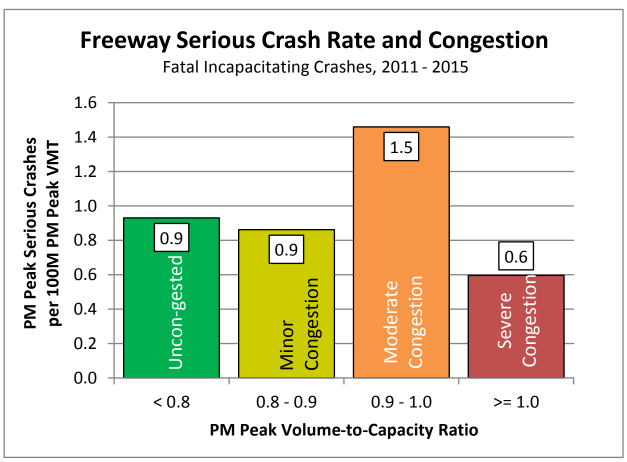
The combination of traffic data available from the region's travel demand model and crash data allowed for a comparison of traffic congestion with safety.

An analysis of Serious crash rates compared to congestion levels for freeways was performed. The intent was to establish the relationship between congestion and safety.

PM peak 3-hour Volume-to-Capacity ratios as determined by the travel demand model were compared to the same 3-hours of weekday crash data. The results are shown in the table and Figures 4-9. Figure 4-10 presents the Volume-to-Capacity ratios for the region's freeways, including ramps.

PM Peak V/C Range	Total Road-Miles	Annual PM Peak VMT (2015)	2011-2015 Annual PM Peak Crashes (Freeway)					
			Number of Crashes		Per Road-Mile		Per 100M VMT	
			All Injury	Serious	All Injury	Serious	All Injury	Serious
< 0.80	212	537,000,000	198	5.0	0.9	0.02	37	0.9
0.80 - 0.89	53	232,000,000	134	2.0	2.5	0.04	58	0.9
0.90 – 0.99	28	110,000,000	90	1.6	3.2	0.06	82	1.5
≥ 1.00	10	36,000,000	26	0.2	2.7	0.02	79	0.6

Figures 4-9 and 4-10



Map of V/C Ratios for Freeways

The Serious crash rate per vehicle-mile travelled on freeways increased with moderate congestion, but dropped and was lowest with severe congestion.

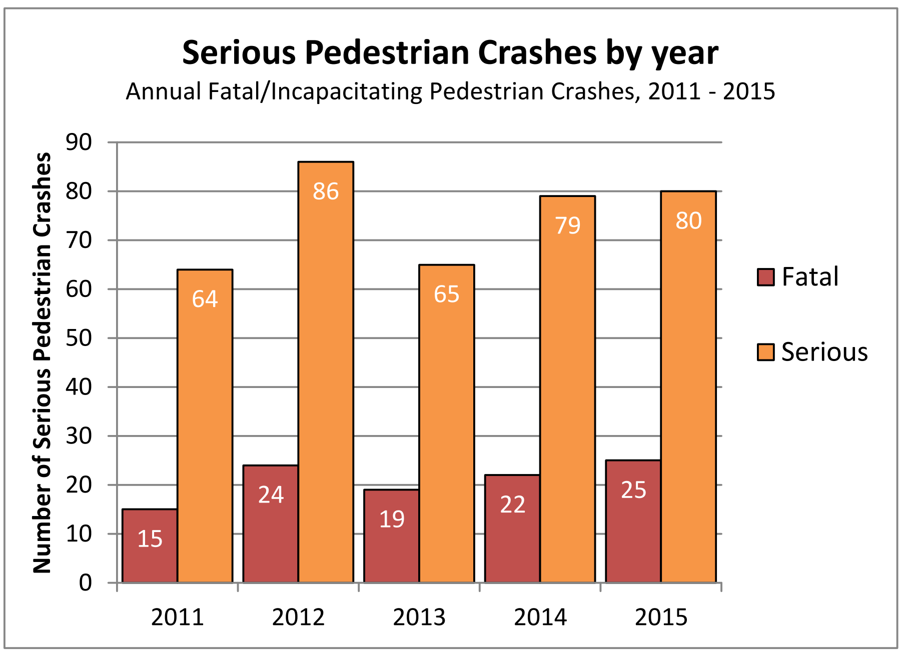
The relationship is consistent with the analysis of 2007 – 2009 data, and may result from traffic at free-flow speed encountering traffic stopped or slowed for congestion. In order to provide a more conclusive analysis of this relationship, use of a more accurate tool for measuring real-world congestion, such as probe data, would be recommended.

Section 5 – Pedestrians (Non-Freeway Crashes)

By Year

Year	Fatal Crashes (Fatalities)	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Serious
2011	15 (15)	49	191	161	416	64
2012	24 (24)	62	238	184	508	86
2013	19 (20)	46	227	132	424	65
2014	22 (22)	57	238	154	471	79
2015	25 (25)	55	196	190	466	80
METRO	**105 (106)**	**269**	**1,090**	**821**	**2,285**	**374**

Figure 5-1



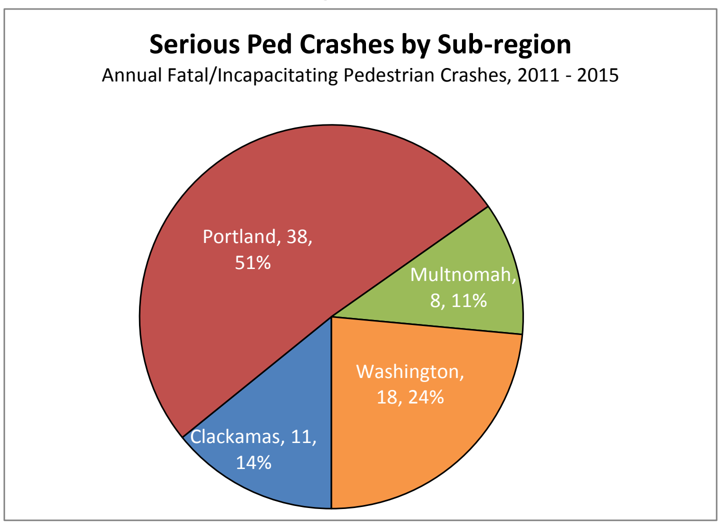
As presented in Figure 5-1, Serious and Fatal Pedestrian crashes increased somewhat over the 5-year period. Pedestrian fatalities have steadily increased to 2015.

By Sub-Region

Sub-Region	2011-2015 Annual Pedestrian Crashes					
	Fatal	**Injury A**	**Injury B**	**Injury C**	**All Injury**	**Serious**
Clackamas	3.0	8	25	19	54	11
Portland	10.4	28	119	86	243	38
Multnomah (excl. Portland)	1.8	7	27	18	54	8
Washington	5.8	12	47	42	106	18
METRO	**21.0**	**54**	**218**	**164**	**457**	**75**

Sub-Region	Population (2015)	Annual VMT (2015)	Annual Pedestrian Injury Crashes		Annual Serious Pedestrian Crashes	
			per 1M residents	**per 100M VMT**	**per 1M residents**	**per 100M VMT**
Clackamas	290,630	1,048,000,000	186	5.2	36	1.0
Portland	620,540	2,096,000,000	391	11.6	62	1.8
Multnomah (excl. Portland)	152,611	548,000,000	351	9.8	55	1.5
Washington	539,448	2,031,000,000	197	5.2	33	0.9
METRO	**1,603,229**	**5,723,000,000**	**285**	**8.0**	**47**	**1.3**

Figure 5-2



With the highest population, transit usage, VMT, and likely the largest number of pedestrians, Portland has 51% of the region's Serious Pedestrian crashes (Figure 5-2). Portland also has the highest rate of Serious Pedestrian crashes per capita and per VMT. Multnomah (excludes Portland) also has high rates of Serious Pedestrian crashes per capita and per VMT. Clackamas County and Washington County have relatively low rates of Serious Pedestrian crashes, which is likely largely due to fewer people walking.

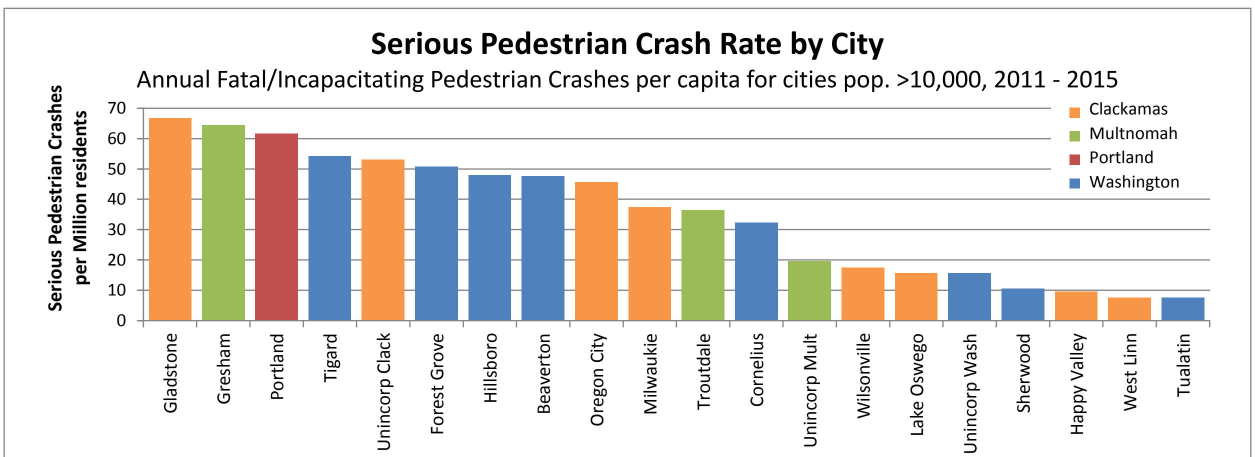
By City

City	2011-2015 Annual Pedestrian Crashes					
	Fatal	**Injury A**	**Injury B**	**Injury C**	**All Injury**	**Serious**
Beaverton	1.0	3.6	9.2	7.4	21.2	4.6
Cornelius	0.0	0.4	0.6	0.8	1.8	0.4
Durham	0.0	0.0	0.0	0.0	0.0	0.0
Fairview	0.0	0.0	1.4	0.4	1.8	0.0
Forest Grove	0.6	0.6	2.0	1.4	4.6	1.2
Gladstone	0.2	0.6	1.0	0.0	1.8	0.8
Gresham	1.6	5.6	22.6	14.4	44.2	7.2
Happy Valley	0.0	0.2	1.0	1.0	2.2	0.2
Hillsboro	2.0	2.8	13.0	13.0	30.8	4.8
Johnson City	0.0	0.0	0.0	0.0	0.0	0.0
King City	0.0	0.2	0.4	0.0	0.6	0.2
Lake Oswego	0.0	0.6	2.4	1.6	4.6	0.6
Maywood Park	0.0	0.2	0.0	0.0	0.2	0.2
Milwaukie	0.0	0.8	3.0	1.8	5.6	0.8
Oregon City	0.8	0.8	3.8	4.2	9.6	1.6
Portland	10.4	27.8	119.0	85.6	242.8	38.2
Rivergrove	0.0	0.0	0.0	0.0	0.0	0.0
Sherwood	0.2	0.0	2.0	0.8	3.0	0.2
Tigard	0.8	2.0	4.6	4.6	12.0	2.8
Troutdale	0.0	0.6	2.4	1.8	4.8	0.6
Tualatin	0.0	0.2	3.6	5.2	9.0	0.2
West Linn	0.0	0.2	1.4	0.4	2.0	0.2
Wilsonville	0.0	0.4	1.4	1.6	3.4	0.4
Wood Village	0.2	0.0	0.6	1.0	1.8	0.2
Uninc. Clackamas	2.0	4.0	11.0	8.2	25.2	6.0
Uninc. Multnomah	0.0	0.2	0.2	0.0	0.4	0.2
Uninc. Washington	1.2	2.0	11.4	9.0	23.6	3.2
METRO	**21.0**	**53.8**	**218.0**	**164.2**	**457.0**	**74.8**

While Portland has the largest number and rate of Serious Pedestrian crashes, it is apparent from Figure 5-3 that there are a number of other cities and areas with a high rate of Serious Pedestrian crashes per capita. Gladstone, Gresham, Tigard, unincorporated Clackamas County, Forest Grove, Hillsboro, Beaverton, and Oregon City all experience relatively high rates of Serious Pedestrian crashes.

City	Population (2015)	2011-2015 Annual Pedestrian Crashes	
		All Injury Per 1M residents	Serious per 1M residents
Beaverton	96,704	219	47.6
Cornelius	12,389	145	32.3
Durham	1,430	0	0.0
Fairview	9,357	192	0.0
Forest Grove	23,630	195	50.8
Gladstone	11,990	150	66.7
Gresham	111,716	396	64.4
Happy Valley	20,835	106	9.6
Hillsboro	100,109	308	47.9
Johnson City	588	0	0.0
King City	3,817	157	52.4
Lake Oswego	38,156	121	15.7
Maywood Park	809	247	247.2
Milwaukie	21,365	262	37.4
Oregon City	35,004	274	45.7
Portland	620,540	391	61.6
Rivergrove	321	0	0.0
Sherwood	19,012	158	10.5
Tigard	51,642	232	54.2
Troutdale	16,486	291	36.4
Tualatin	26,617	338	7.5
West Linn	26,267	76	7.6
Wilsonville	22,932	148	17.4
Wood Village	4,056	444	49.3
Uninc. Clackamas	113,172	223	53.0
Uninc. Multnomah	10,187	39	19.6
Uninc. Washington	204,098	116	15.7
METRO	**1,603,229**	**285**	**46.7**

Figure 5-3



By Month

Month	2011-2015 Annual Pedestrian Crashes	
	All Injury	Serious
January	53	11.0
February	41	7.2
March	35	5.4
April	29	4.2
May	30	4.0
June	27	4.6
July	30	3.8
August	30	6.0
September	33	5.8
October	46	6.6
November	50	8.0
December	53	8.2
12 MONTHS	**457**	**74.8**

Figure 5-4

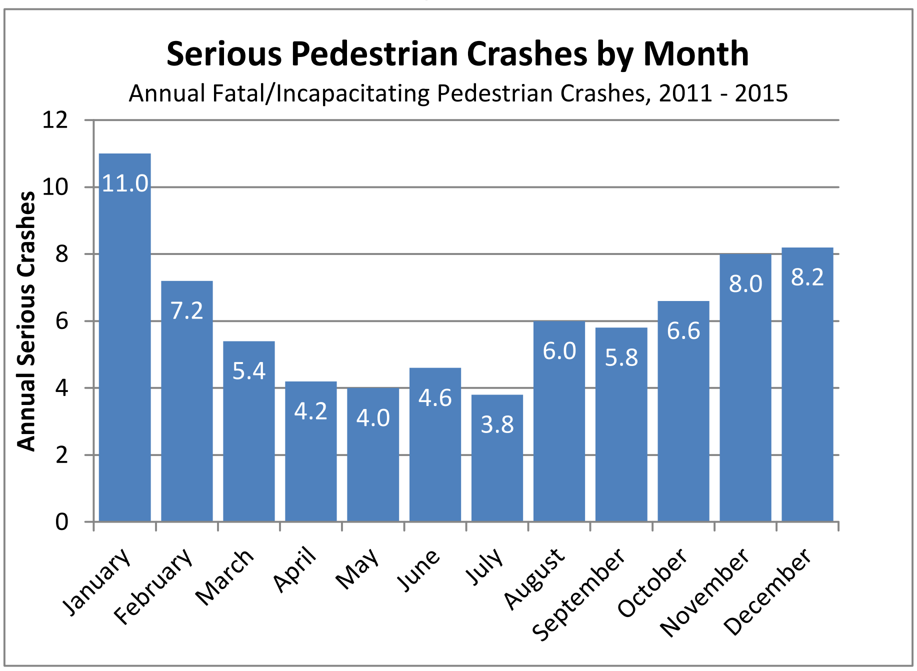


Figure 5-4 presents the annual average number of Serious crashes by month. Fall and winter months generally have more Serious Pedestrian crashes, coinciding with the darkest months.

By Time of Day

Figure 5-5

Serious Crashes by Day of Week and Hour

Annual Fatal/Incapacitating Pedestrian Crashes, 2011 - 2015

Hour	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Hour	Average Wkday	Average Wkend
12 AM	0.2	0.0	0.0	0.0	0.2	0.4	0.8	12 AM	0.1	0.5
1 AM	0.6	0.0	0.2	0.0	0.0	0.0	0.0	1 AM	0.0	0.3
2 AM	1.0	0.0	0.0	0.2	0.2	0.4	0.4	2 AM	0.2	0.7
3 AM	0.2	0.2	0.2	0.0	0.0	0.2	0.2	3 AM	0.1	0.2
4 AM	0.2	0.0	0.0	0.0	0.0	0.0	0.0	4 AM	0.0	0.1
5 AM	0.0	0.4	0.0	0.6	0.4	0.0	0.2	5 AM	0.3	0.1
6 AM	0.0	0.2	0.8	0.6	0.2	0.6	0.2	6 AM	0.5	0.1
7 AM	0.2	0.0	0.2	0.4	0.2	0.2	0.0	7 AM	0.2	0.1
8 AM	0.0	1.0	0.2	0.2	0.0	0.8	0.0	8 AM	0.4	0.0
9 AM	0.6	0.0	0.2	0.2	0.4	0.2	0.2	9 AM	0.2	0.4
10 AM	0.0	0.0	0.0	0.2	0.0	0.0	0.4	10 AM	0.0	0.2
11 AM	0.2	0.4	0.2	0.4	0.6	0.8	0.4	11 AM	0.5	0.3
12 PM	0.0	0.4	0.0	0.2	0.2	0.0	0.2	12 PM	0.2	0.1
1 PM	0.0	0.2	0.4	0.4	0.2	0.4	0.4	1 PM	0.3	0.2
2 PM	0.4	0.8	0.4	0.2	0.8	0.4	0.4	2 PM	0.5	0.4
3 PM	0.4	1.2	1.2	0.6	1.2	1.2	0.8	3 PM	1.1	0.6
4 PM	0.2	0.6	0.6	1.2	0.6	0.8	0.6	4 PM	0.8	0.4
5 PM	0.6	1.0	1.6	1.0	1.0	0.6	0.0	5 PM	1.0	0.3
6 PM	0.6	0.8	1.2	1.2	1.4	1.8	1.6	6 PM	1.3	1.1
7 PM	0.8	0.2	0.8	0.8	1.8	1.2	2.2	7 PM	1.0	1.5
8 PM	0.8	0.2	1.4	0.4	0.6	0.6	0.8	8 PM	0.6	0.8
9 PM	0.8	1.0	0.4	0.4	0.8	0.6	0.6	9 PM	0.6	0.7
10 PM	0.6	0.6	0.2	0.2	1.0	0.8	0.6	10 PM	0.6	0.6
11 PM	0.2	0.0	0.4	0.2	0.6	0.6	0.4	11 PM	0.4	0.3

	Sun	Mon	Tue	Wed	Thu	Fri	Sat		Average Wkday	Average Wkend
All Day	8.6	9.2	10.6	9.6	12.4	12.6	11.4	All Day	10.9	10.0

Figure 5-5 presents the rate of Serious Pedestrian crashes by day of the week and hour of the day using a "heat map" format. Dark cells indicate the highest relative crash time periods; light cells indicate the lowest relative crash time periods. The average weekday and weekend day are summarized on the right side of the figure, while each day is summarized and compared at the bottom of the figure.

The weekday late afternoon and evening peak hours produce the highest number of Serious Pedestrian crashes. A larger proportion of evening crashes are evident as compared to all crashes. Late Friday night/early Saturday morning and late Saturday night show somewhat high rates of Serious Pedestrian crashes. Thursday, Friday, and Saturday have the highest rates of Serious Pedestrian crashes, predominantly evening crashes.

By Weather

2011-2015 Annual Pedestrian Crashes	
Weather	**Serious Crashes**
Cloudy/Clear	53.6
Rain/Fog	19.6
Sleet/Snow	0.2
Unknown	1.4
METRO	**74.8**

The majority (72%) of Serious Pedestrian crashes occurred in clear or cloudy conditions (Figure 5-6), as compared to 80% for all crashes (Figure 2-16).

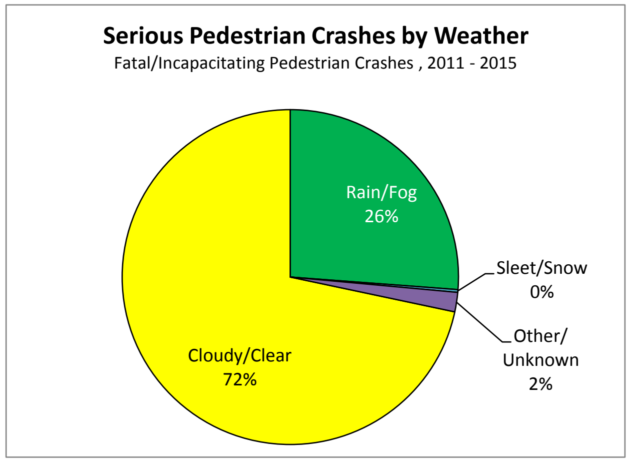


Figure 5-6

By Road Surface Condition

2011-2015 Annual Pedestrian Crashes	
Road Condition	**Serious Crashes**
Dry	48.4
Ice/Snow	0.4
Wet	25.0
Unknown	1.0
METRO	**74.8**

The majority (65%) of Serious Pedestrian crashes occurred in dry conditions (Figure 5-7), as compared to 73% for all crashes (Figure 2-17).

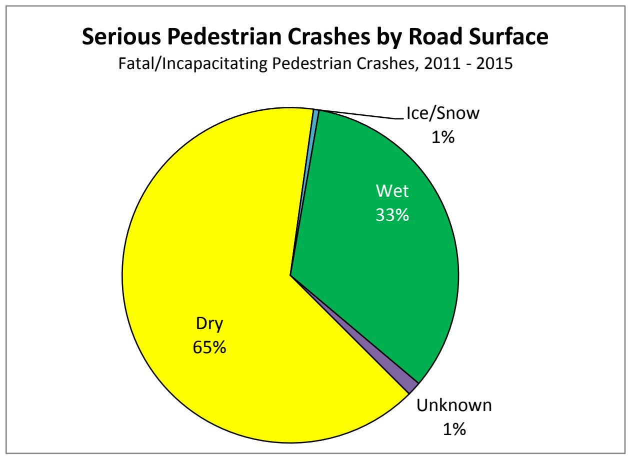


Figure 5-7

By Lighting

2011-2015 Annual Pedestrian Crashes	
Lighting	**Serious Crashes**
Daylight	27.2
Dawn/Dusk	8.4
Night - Dark	9.6
Night - Lit	29.6
Unknown	0.0
METRO	**74.8**

Only 36% of Serious Pedestrian crashes occurred in daylight (Figure 5-8), as compared to 59% for all crashes (Figure 2-18). **Serious Pedestrian crashes are significantly more likely after dark as compared to other modes.**

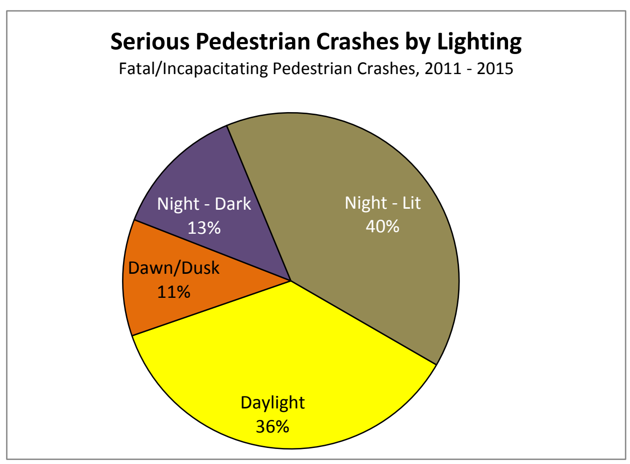


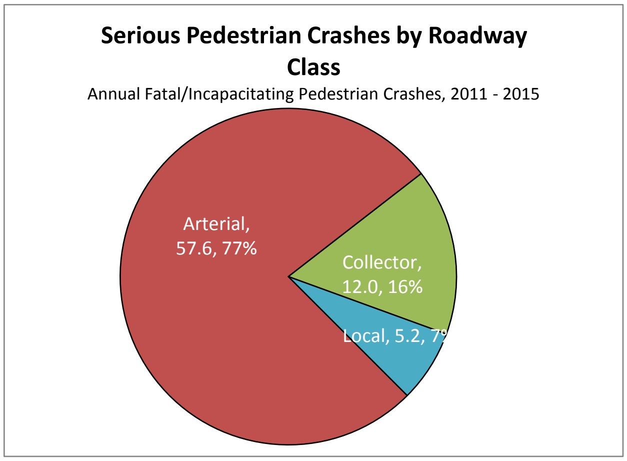
Figure 5-8

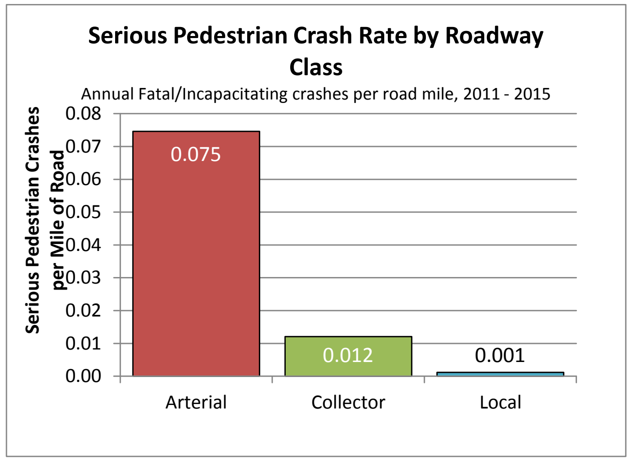
By Roadway Classification

Roadway Classification	Total Road-Miles	Annual VMT (2015)	2011-2015 Annual Pedestrian Crashes		
			Serious	**Serious per Road-Mile**	**Serious per 100M VMT**
Arterial	772	4,281,000,000	57.6	0.075	1.35
Collector	994	1,081,000,000	12.0	0.012	1.11
Local	4,565	620,000,000*	5.2	0.001	0.84
METRO	**6,331**	**5,982,000,000**	**74.8**	**0.012**	**--**

* VMT for local streets is a low-confidence estimate

Figures 5-9 and 5-10



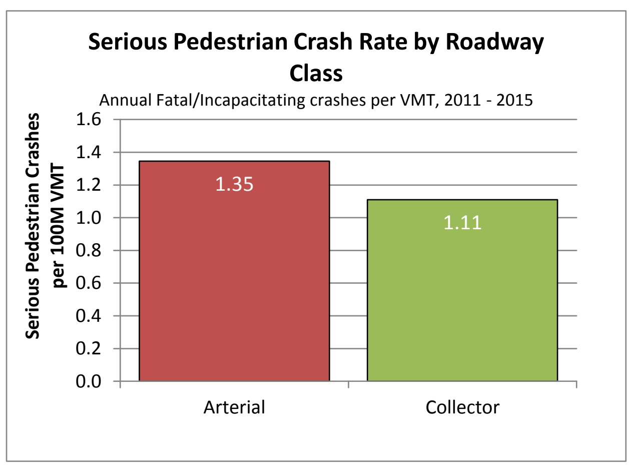


As with overall crashes, the region's Serious Pedestrian crashes occur primarily on the arterials, accounting for 77% of these crashes. Figure 5-9 presents the distribution of Serious Pedestrian crashes by roadway classification. As can be seen in Figure 5-10, which presents the rate of Serious Pedestrian crashes per mile of roadway, arterial roadways are about 6 times as likely as collectors per mile to be the location of a Serious Pedestrian crash, and more than 65 times as likely as local streets per mile to be the location of a Serious Pedestrian crash.

As can be seen in Figure 5-11, when normalized by motor vehicle traffic volume, the Serious Pedestrian crash rate on arterials is still higher than on collectors. A reliable estimate of vehicle miles travelled was not available for local streets.

Many transit routes follow arterial roadways, increasing the need for people to cross these roadways safely.

Figure 5-11

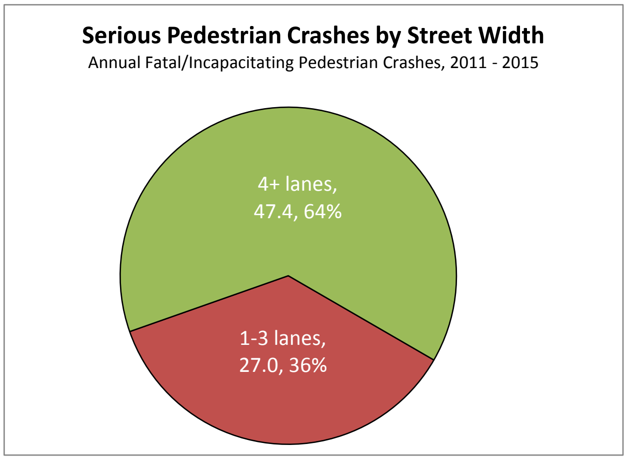


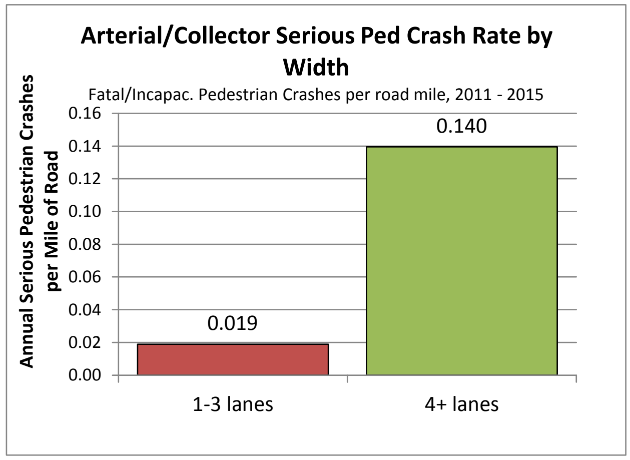
By Number of Lanes

Number of Lanes*	Total Road-Miles	2011-2015 Annual Pedestrian Crashes		
		Serious	Serious per Road-Mile	Serious per 100M VMT
1 – 3 Lanes	1,427	27.0	0.019	0.91
4+ Lanes	340	47.4	0.140	1.73
METRO	**1,766**	**74.4**	**0.042**	**1.31**

* Arterial and Collector roadways only

Figures 5-12 and 5-13



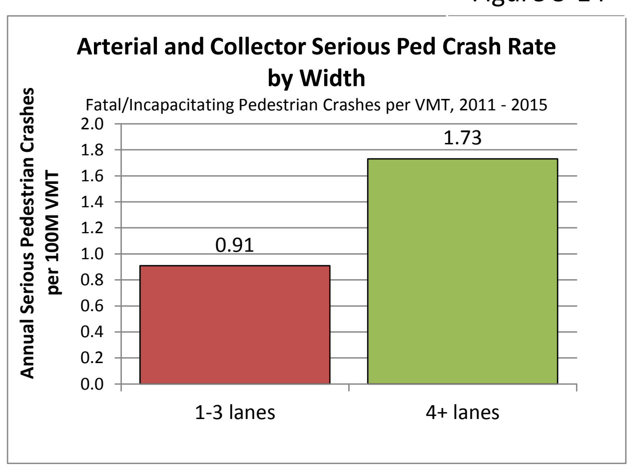


The influence of street width is consistent with the influence of roadway classification (Figure 5-12). Wider roadways are the location of a disproportionate number of Serious Pedestrian crashes in relation to both their share of the overall system (Figure 5-13) and the vehicle-miles travelled they serve (Figure 5-14). The Serious Pedestrian crash rate increases dramatically for roadways with 4 or more lanes. This effect is in spite of the fact that such arterials often discourage pedestrian travel in the first place, thereby reducing potential pedestrian exposure.

As can be seen in Figure 5-14, even when normalized by motor vehicle traffic volume, the Serious Pedestrian crash rate on wider roadways is still substantially higher than on narrower roads. Wider roadways are particularly hazardous to pedestrians.

Many transit routes follow wider roadways, increasing the need for people to cross these roadways safely.

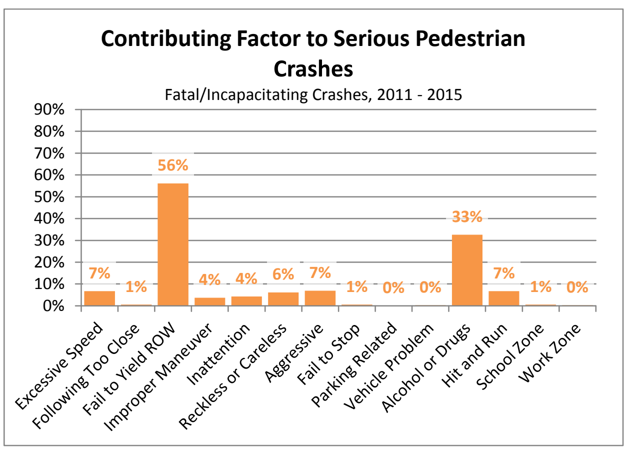
Figure 5-14

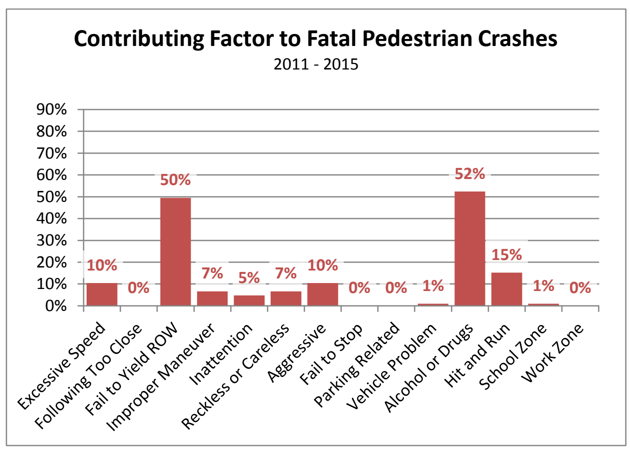


By Contributing Factor

Factor	2011-2015 Annual Crashes (Pedestrian)						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Excessive Speed	10	2.2	3	3	2	10	5
Following Too Close	1	0.0	0	1	0	1	0
Fail to Yield ROW	334	10.4	32	162	127	331	42
Improper Maneuver	18	1.4	1	8	6	17	3
Inattention	16	1.0	2	7	5	16	3
Reckless or Careless	16	1.4	3	8	3	16	5
Aggressive	11	2.2	3	4	2	11	5
Fail to Stop	3	0.0	0	1	2	3	0
Parking Related	1	0.0	0	0	1	1	0
Vehicle Problem	1	0.2	0	0	1	1	0
Alcohol or Drugs	53	11.0	13	20	9	53	24
Hit and Run	18	3.2	2	6	6	17	5
School Zone	6	0.2	0	3	3	6	0
Work Zone	4	0	0	2	2	4	0
METRO	**461**	**21.0**	**54**	**218**	**164**	**457**	**75**

Figures 5-15 and 5-16





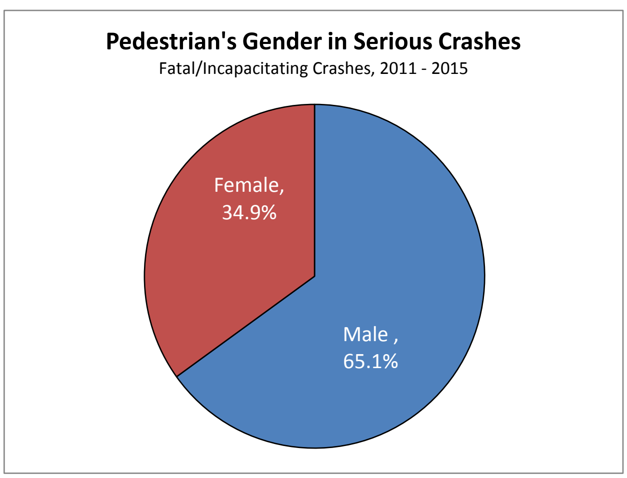
Figures 5-15 and 5-16 present the proportion of Pedestrian crashes by contributing factor for Serious and Fatal crashes, respectively. Alcohol or Drugs and Fail to Yield ROW are the most common factors. The determination of contributing factors is described in more detail in Section 7.

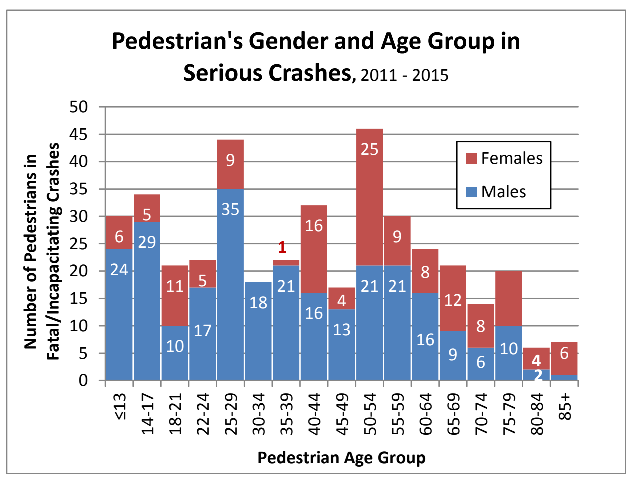
These data do not specify whether the driver, the pedestrian, or both were at fault, but fault in Pedestrian crashes is explored in more detail in Section 7.

By Pedestrian's Age and Gender

The age and gender of pedestrians involved in crashes are presented in the following table and Figures 5-17 and 5-18.

	Total Male Pedestrians (2011 – 2015)			Total Female Pedestrians (2011 – 2015)		
Age	**All**	**Serious**	**Percent Serious**	**All**	**Serious**	**Percent Serious**
≤13	117	24	20.5%	70	6	8.6%
14-17	126	29	23.0%	90	5	5.6%
18-21	113	10	8.8%	96	11	11.5%
22-24	101	17	16.8%	103	5	4.9%
25-29	154	35	22.7%	112	9	8.0%
30-34	105	18	17.1%	65	0	0.0%
35-39	59	21	35.6%	71	1	1.4%
40-44	97	16	16.5%	98	16	16.3%
45-49	110	13	11.8%	55	4	7.3%
50-54	113	21	18.6%	127	25	19.7%
55-59	73	21	28.8%	61	9	14.8%
60-64	61	16	26.2%	62	8	12.9%
65-69	33	9	27.3%	43	12	27.9%
70-74	26	6	23.1%	32	8	25.0%
75-79	23	10	43.5%	15	10	66.7%
80-84	11	2	18.2%	18	4	22.2%
85+	10	1	10.0%	22	6	27.3%
Unknown	66	1	1.5%	61	6	9.8%
METRO	**1,398**	**270**	**19.3%**	**1,201**	**145**	**12.1%**





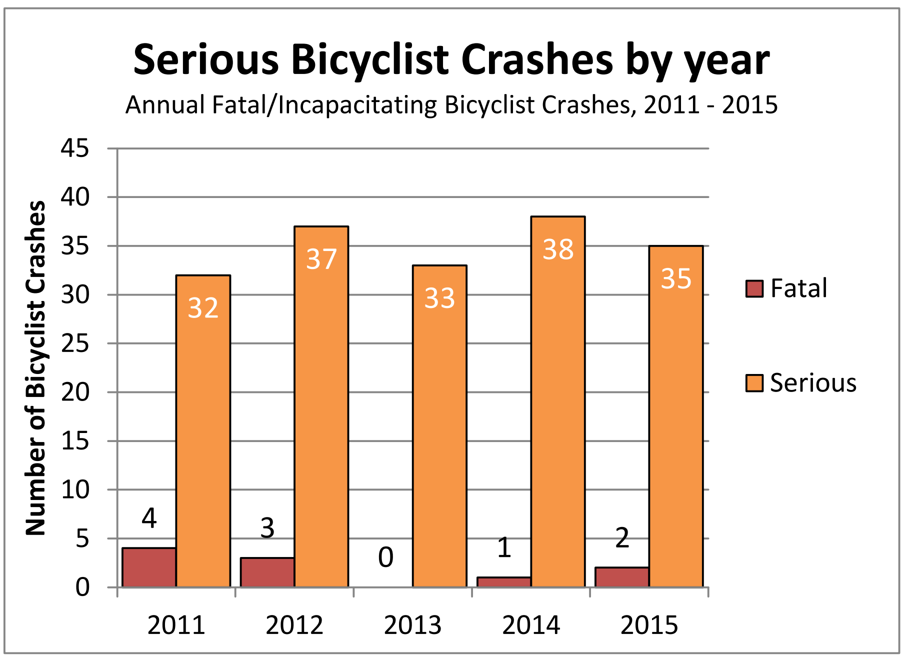
Figures 5-17 and 5-18

Section 6 – Bicyclists (Non-Freeway Crashes)

By Year

Year	Fatal Crashes (Fatalities)	Injury A Crashes	Injury B Crashes	Injury C Crashes	All Injury Crashes	Serious Crashes
2011	4 (4)	28	283	166	481	32
2012	3 (3)	34	357	167	561	37
2013	0 (0)	33	320	132	485	33
2014	1 (1)	37	311	160	509	38
2015	2 (2)	33	262	181	478	35
METRO	**10 (10)**	**165**	**1,533**	**806**	**2,514**	**175**

Figure 6-1



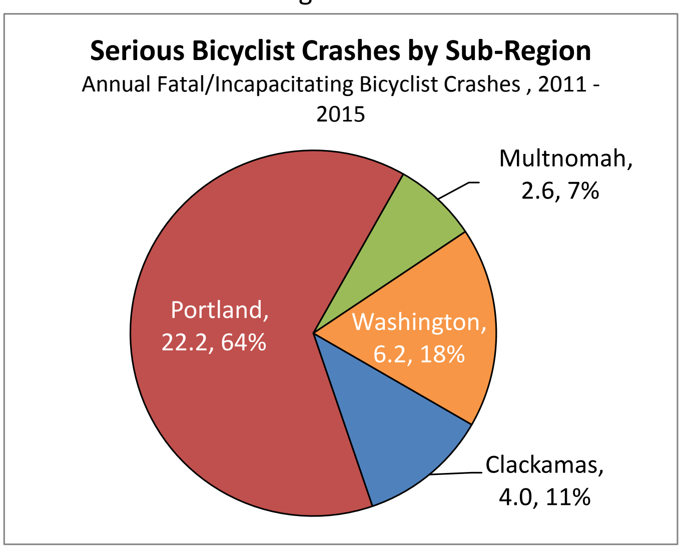
As presented in Figure 6-1, Serious Bicyclist crashes fluctuated over the 5-year period, while Fatal Bicyclist crashes declined. No clear trend is evident.

By Sub-Region

Sub-region	2011-2015 Annual Bicyclist Crashes					
	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Clackamas	0.2	3.8	26	13	43	4.0
Portland	1.2	21.0	193	98	314	22.2
Multnomah (excl. Portland)	0.0	2.6	24	15	42	2.6
Washington	0.6	5.6	63	35	104	6.2
METRO	**2.0**	**33.0**	**306**	**161**	**502**	**35.0**

Sub-region	Population (2015)	Annual VMT (2015)	Annual Bicyclist Injury Crashes		Annual Serious Bicyclist Crashes	
			per 1M residents	per 100M VMT	per 1M residents	per 100M VMT
Clackamas	290,630	1,048,000,000	149	4.1	14	0.4
Portland	620,540	2,096,000,000	505	15.0	36	1.1
Multnomah (excl. Portland)	152,611	548,000,000	273	7.6	17	0.5
Washington	539,448	2,031,000,000	192	5.1	11	0.3
METRO	**1,603,229**	**5,723,000,000**	**313**	**8.8**	**22**	**0.6**

Figure 6-2



With the highest population, transit usage, VMT, and number of bicyclists, Portland has 64% of the region's Serious Bicyclist crashes (Figure 6-2). Portland also has the highest rate of Serious Bicyclist crashes per capita and per VMT. Multnomah (excludes Portland), Clackamas County and Washington County have lower rates of Serious Bicyclist crashes, which is likely partially due to fewer people cycling.

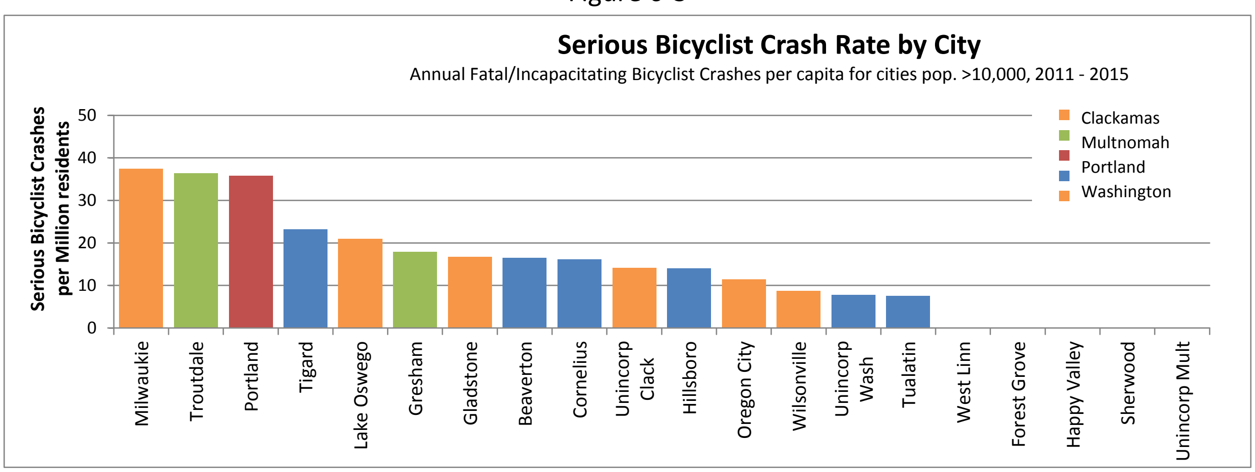
By City

City	2011-2015 Annual Bicyclist Crashes					
	Fatal	**Injury A**	**Injury B**	**Injury C**	**All Injury**	**Serious**
Beaverton	0.2	1.4	14	7	22	1.6
Cornelius	0.0	0.2	2	1	2	0.2
Durham	0.0	0.0	0	0	1	0.0
Fairview	0.0	0.0	1	0	1	0.0
Forest Grove	0.0	0.0	4	2	6	0.0
Gladstone	0.0	0.2	2	1	3	0.2
Gresham	0.0	2.0	18	12	32	2.0
Happy Valley	0.0	0.0	2	0	2	0.0
Hillsboro	0.2	1.2	15	11	28	1.4
Johnson City	0.0	0.0	0	0	0	0.0
King City	0.0	0.0	0	0	0	0.0
Lake Oswego	0.0	0.8	2	1	4	0.8
Maywood Park	0.0	0.0	0	0	0	0.0
Milwaukie	0.0	0.8	4	2	7	0.8
Oregon City	0.0	0.4	4	1	6	0.4
Portland	1.2	21.0	193	98	314	22.2
Rivergrove	0.0	0.0	0	0	0	0.0
Sherwood	0.0	0.0	1	1	2	0.0
Tigard	0.0	1.2	9	5	15	1.2
Troutdale	0.0	0.6	2	2	4	0.6
Tualatin	0.0	0.2	5	3	8	0.2
West Linn	0.0	0.0	1	0	2	0.0
Wilsonville	0.0	0.2	1	1	2	0.2
Wood Village	0.0	0.0	1	1	2	0.0
Uninc. Clackamas	0.2	1.4	9	6	16	1.6
Uninc. Multnomah	0.0	0.0	2	0	2	0.0
Uninc. Washington	0.2	1.4	13	6	20	1.6
METRO	**2.0**	**33.0**	**306**	**161**	**502**	**35.0**

While Portland has the largest number of Serious Bicyclist crashes, it is apparent from Figure 6-3 that there are a several cities with a relatively high rate of Serious Bicyclist crashes per capita. Troutdale, Milwaukie, and Portland all experienced relatively high rates of Serious Bicyclist crashes between 2011 and 2015.

City	Population (2015)	2011-2015 Annual Bicyclist Crashes	
		All Injury per 1M residents	Serious per 1M residents
Beaverton	96,704	230	16.5
Cornelius	12,389	194	16.1
Durham	1,430	420	0.0
Fairview	9,357	150	0.0
Forest Grove	23,630	254	0.0
Gladstone	11,990	250	16.7
Gresham	111,716	285	17.9
Happy Valley	20,835	115	0.0
Hillsboro	100,109	278	14.0
Johnson City	588	0	0.0
King City	3,817	0	0.0
Lake Oswego	38,156	115	21.0
Maywood Park	809	494	0.0
Milwaukie	21,365	328	37.4
Oregon City	35,004	166	11.4
Portland	620,540	506	35.8
Rivergrove	321	0	0.0
Sherwood	19,012	116	0.0
Tigard	51,642	287	23.2
Troutdale	16,486	267	36.4
Tualatin	26,617	301	7.5
West Linn	26,267	69	0.0
Wilsonville	22,932	96	8.7
Wood Village	4,056	444	0.0
Uninc. Clackamas	113,172	145	14.1
Uninc. Multnomah	10,187	177	0.0
Uninc. Washington	204,098	98	7.8
METRO	**1,603,229**	**313**	**21.8**

Figure 6-3



By Month

Month	2011-2015 Annual Bicyclist Crashes	
	All Injury	**Serious**
January	21	1.4
February	28	2.2
March	33	1.6
April	38	1.0
May	46	2.6
June	48	3.4
July	61	5.0
August	57	4.0
September	60	4.8
October	49	2.6
November	34	3.0
December	28	3.4
12 MONTHS	**502**	**35.0**

Figure 6-4

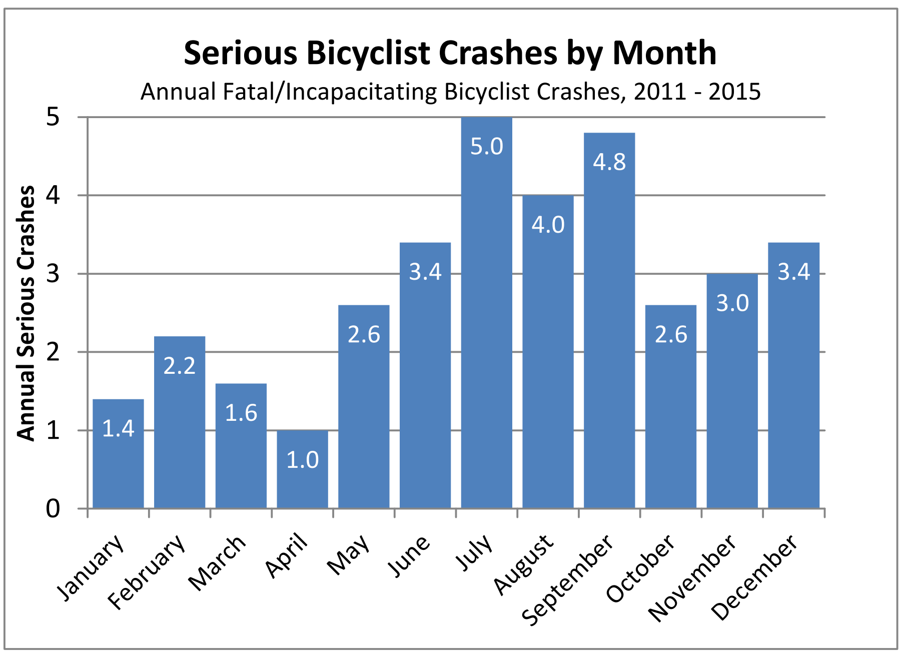


Figure 6-4 presents the annual average number of Serious Bicyclist crashes by month. May through December generally have more Serious Bicyclist crashes, with the peak corresponding to the summer months, likely related to the higher number of people cycling in the warm and dry months.

By Time of Day

Figure 6-5

Serious Crashes by Day of Week and Hour

Annual Fatal/Incapacitating Bicyclist Crashes, 2011 - 2015

Hour	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Hour	Average Wkday	Average Wkend
12 AM	0.2	0.0	0.0	0.0	0.0	0.0	0.2	12 AM	0.0	0.2
1 AM	0.2	0.0	0.0	0.0	0.0	0.2	0.4	1 AM	0.0	0.3
2 AM	0.2	0.0	0.0	0.0	0.0	0.0	0.0	2 AM	0.0	0.1
3 AM	0.0	0.0	0.0	0.0	0.2	0.0	0.0	3 AM	0.0	0.0
4 AM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4 AM	0.0	0.0
5 AM	0.0	0.2	0.0	0.0	0.0	0.0	0.0	5 AM	0.0	0.0
6 AM	0.0	0.0	0.0	0.8	0.2	0.4	0.0	6 AM	0.3	0.0
7 AM	0.0	0.4	0.0	0.8	0.6	0.2	0.0	7 AM	0.4	0.0
8 AM	0.0	0.0	0.0	0.8	0.8	0.4	0.2	8 AM	0.4	0.1
9 AM	0.2	0.2	0.2	0.0	0.4	0.2	0.0	9 AM	0.2	0.1
10 AM	0.0	0.0	0.0	0.6	0.4	0.2	0.4	10 AM	0.2	0.2
11 AM	0.2	0.0	0.0	0.2	0.2	0.4	0.4	11 AM	0.2	0.3
12 PM	0.0	0.2	0.4	0.6	0.8	0.0	0.0	12 PM	0.4	0.0
1 PM	0.0	0.0	0.2	0.4	0.0	0.6	0.2	1 PM	0.2	0.1
2 PM	0.4	0.4	0.2	0.2	0.0	0.8	0.0	2 PM	0.3	0.2
3 PM	0.0	0.4	0.0	0.6	0.4	0.2	0.8	3 PM	0.3	0.4
4 PM	0.4	1.2	0.6	0.8	0.6	0.4	0.0	4 PM	0.7	0.2
5 PM	0.6	0.2	1.0	0.8	1.0	0.4	0.4	5 PM	0.7	0.5
6 PM	0.2	0.4	0.4	0.2	0.6	0.0	0.4	6 PM	0.3	0.3
7 PM	0.0	0.8	0.4	0.0	0.6	0.0	0.0	7 PM	0.4	0.0
8 PM	0.0	0.0	0.0	0.4	0.2	0.0	0.2	8 PM	0.1	0.1
9 PM	0.2	0.2	0.0	0.4	0.4	0.0	0.0	9 PM	0.2	0.1
10 PM	0.0	0.0	0.2	0.2	0.0	0.2	0.4	10 PM	0.1	0.2
11 PM	0.0	0.2	0.0	0.0	0.0	0.0	0.0	11 PM	0.0	0.0

	Sun	Mon	Tue	Wed	Thu	Fri	Sat		Average Wkday	Average Wkend
All Day	2.8	4.8	3.6	7.8	7.4	4.6	4.0	All Day	5.6	3.4

Figure 6-5 presents the rate of Serious Bicyclist crashes by day of the week and hour of the day using a "heat map" format. Dark cells indicate the highest relative crash time periods; light cells indicate the lowest relative crash time periods. The average weekday and weekend day are summarized on the right side of the figure, while each day is summarized and compared at the bottom of the figure.

The weekday evening peak hours produce the highest number of Serious Bicyclist crashes, mirroring the pattern for all crashes, with the 4:00 – 5:59 pm as the worst. Wednesday and Thursday are the two days with the highest number of Bicyclist crashes, which is consistent with the prior report's data from 2007 – 2009. No other clear trends are evident.

By Weather

2011-2015 Annual Bicyclist Crashes	
Weather	**Serious Crashes**
Cloudy/Clear	30.6
Rain/Fog	3.6
Sleet/Snow	0.0
Unknown	0.8
METRO	**35.0**

The majority (88%) of Serious Bicyclist crashes occurred in clear or cloudy conditions (Figure 6-6), as compared to 80% for all crashes (Figure 2-16).

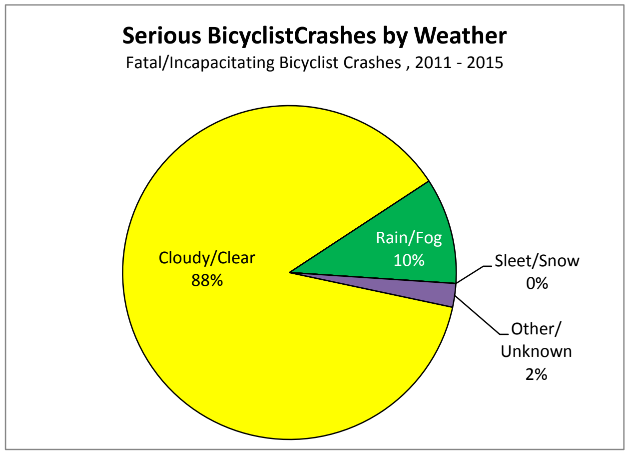


Figure 6-6

By Road Surface Condition

2011-2015 Annual Bicyclist Crashes	
Road Condition	**Serious Crashes**
Dry	29.2
Ice/Snow	0.0
Wet	5.4
Unknown	0.4
METRO	**35.0**

The majority (84%) of Serious Bicyclist crashes occurred in dry conditions (Figure 6-7), as compared to 73% for all crashes (Figure 2-17).

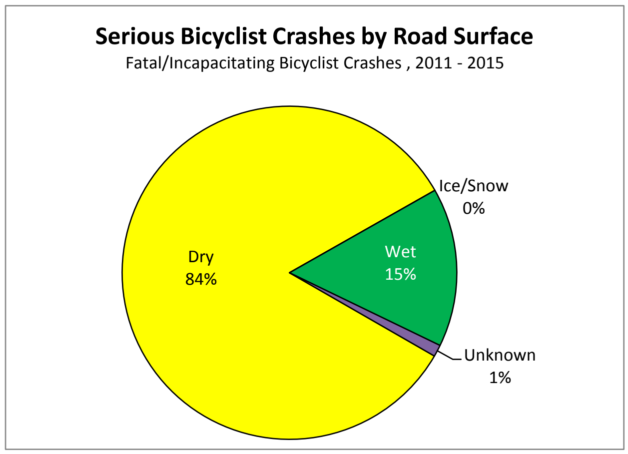


Figure 6-7

By Lighting

2011-2015 Annual Bicyclist Crashes	
Lighting	**Serious Crashes**
Daylight	24.4
Dawn/Dusk	2.8
Night - Dark	1.6
Night - Lit	6.2
Unknown	0.0
METRO	**35.0**

The majority (70%) of Serious Bicyclist crashes occurred in daylight (Figure 6-8), as compared to 59% for all crashes (Figure 2-18).

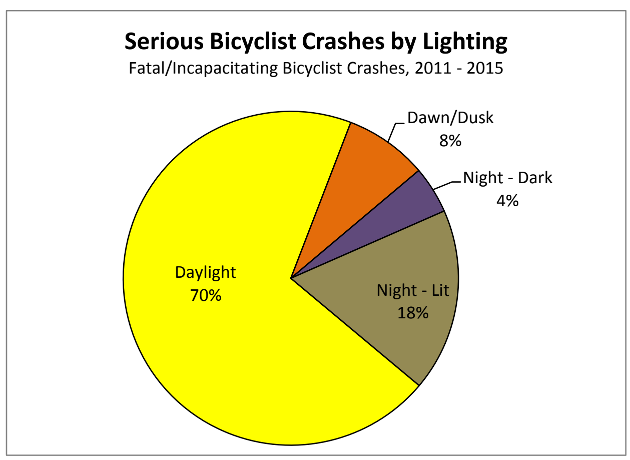


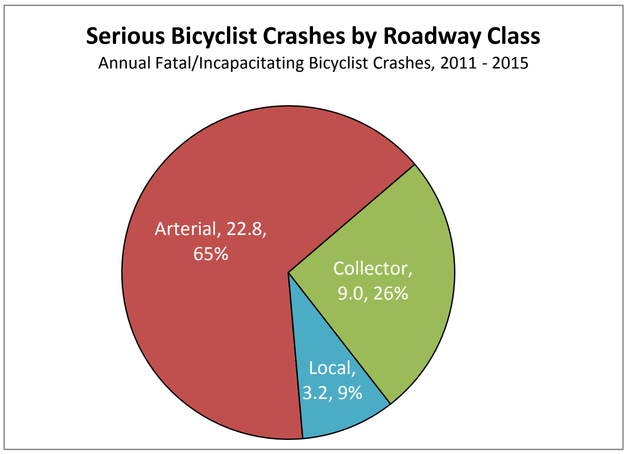
Figure 6-8

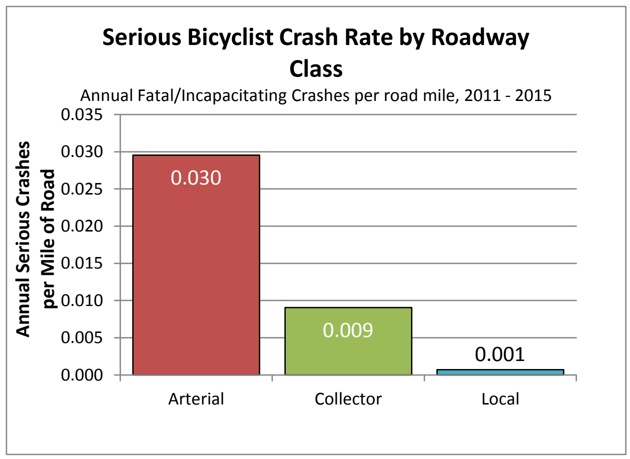
By Roadway Classification

Roadway Classification	Total Road-Miles	Annual VMT (2015)	2011-2015 Annual Bicyclist Crashes		
			Serious	Serious per Road-Mile	Serious per 100M VMT
Arterial	772	4,281,000,000	22.8	0.030	0.53
Collector	994	1,081,000,000	9.0	0.009	0.83
Local	4,565	620,000,000*	3.2	0.001	0.52
METRO	**6,331**	**5,982,000,000**	**35.0**	**0.006**	--

* VMT for local streets is a low-confidence estimate

Figures 6-9 and 6-10

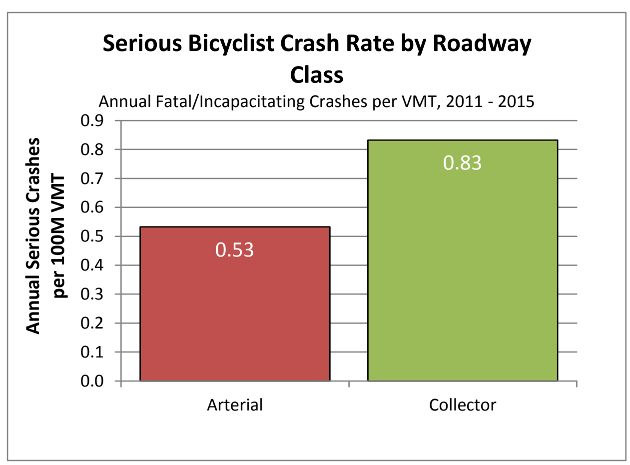




As with all crashes, the region's Serious Bicyclist crashes occur primarily on the arterials, accounting for 65% of these crashes. Figure 6-9 presents the distribution of Serious Bicyclist crashes by roadway classification. As can be seen in Figure 6-10, which presents the rate of Serious Bicyclist crashes per mile of roadway, arterial roadways are more than three times as likely than collectors per mile to be the location of a Serious Bicyclist crash, and more than 40 times as likely than local streets per mile to be the location of a Serious Bicyclist crash.

As can be seen in Figure 6-11, when normalized by motor vehicle traffic volume, the Serious Bicyclist crash rate on collectors is higher than on arterials. While the reason for this is not clear from the data, it may be related to a higher use of collector roads by cyclists relative to traffic volume as compared to arterials. Vehicle miles travelled was not available for local streets.

Figure 6-11

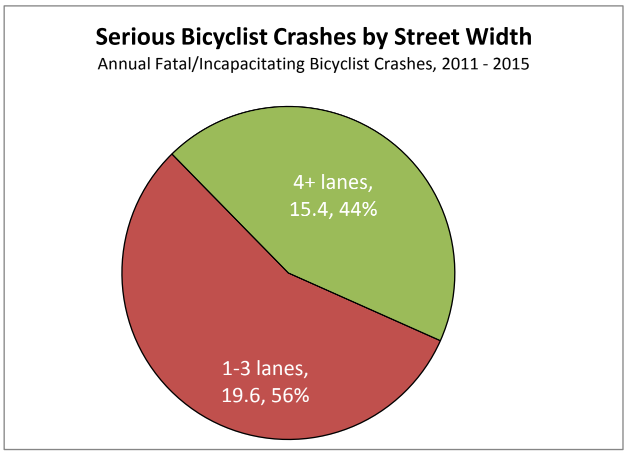


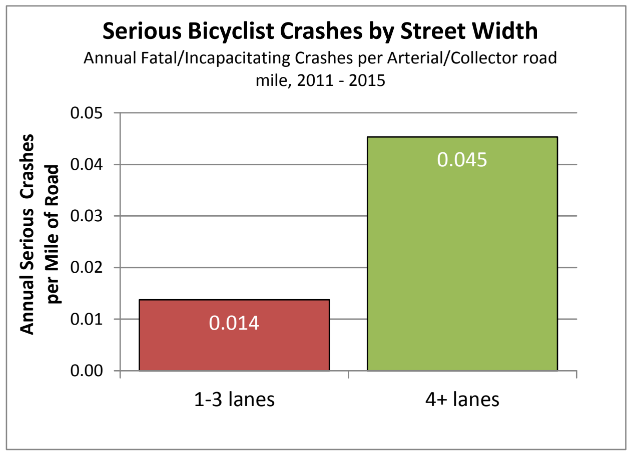
By Number of Lanes

Number of Lanes	Total Road-Miles	2011-2015 Annual Bicyclist Crashes		
		Serious	Serious per Road-Mile	Serious per 100M VMT
1 – 3 Lanes	1,427	19.6	0.014	0.66
4+ Lanes	340	15.4	0.045	0.56
METRO	**1,766**	**35.0**	**0.020**	**0.61**

* Arterial and Collector roadways only

Figure 6-12 and 6-13

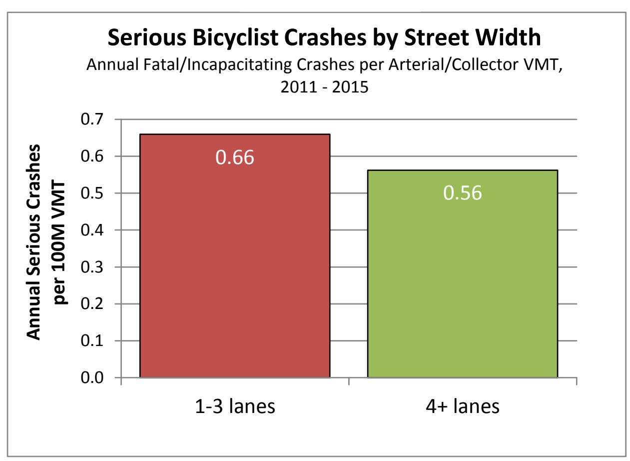




The influence of street width is consistent with the influence of roadway classification (Figure 6-12). Wider roadways are the location of a disproportionate number of Serious Bicyclist crashes in relation to their share of the overall system (Figure 6-13), although the effect is not as pronounced as it is for Serious Pedestrian crashes. The Serious Bicyclist crash rate per road mile increases dramatically for roadways with 4 or more lanes. This is a concern, given that in many parts of the region designated bicycling routes often follow arterial roadways with 4 or more lanes.

As can be seen in Figure 6-14, when normalized by motor vehicle traffic volume, the Serious Bicyclist crash rate on narrower roads is higher than on wider roads. While the reason for this is not clear from the data, it may be related to a higher use of narrower roads by cyclists relative to traffic volume as compared to multi-lane roadways.

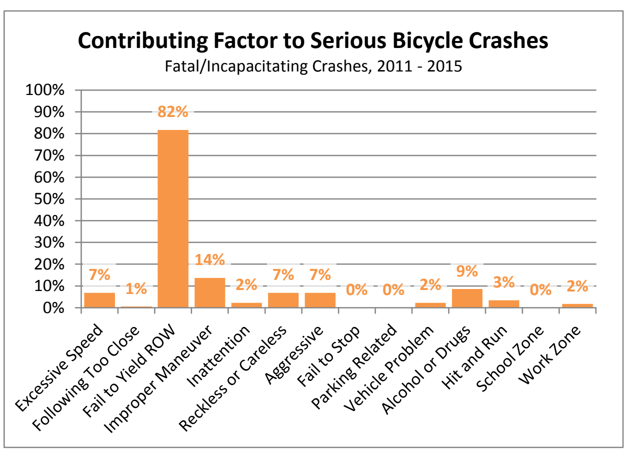
Figure 6-14



By Contributing Factor

Factor	2011-2015 Annual Crashes (Bicyclist)						
	All	Fatal	Injury A	Injury B	Injury C	All Injury	Serious
Excessive Speed	25	0.4	2	16	6	24	2
Following Too Close	13	0.2	0	7	4	11	0
Fail to Yield ROW	417	1.0	28	248	129	406	29
Improper Maneuver	77	0.6	4	41	30	75	5
Inattention	7	0.0	1	4	2	7	1
Reckless or Careless	14	0.4	2	8	3	14	2
Aggressive	35	0.4	2	21	9	32	2
Fail to Stop	10	0.0	0	5	3	8	0
Parking Related	0	0.0	0	0	0	0	0
Vehicle Problem	9	0.0	1	5	3	9	1
Alcohol or Drugs	18	0.8	2	10	4	17	3
Hit and Run	14	0.6	1	8	3	13	1
School Zone	4	0.0	0	2	2	4	0
Work Zone	3	0	1	2	1	3	1
METRO	**518**	**2.0**	**33**	**306**	**161**	**502**	**35**

Figures 6-15 and 6-16



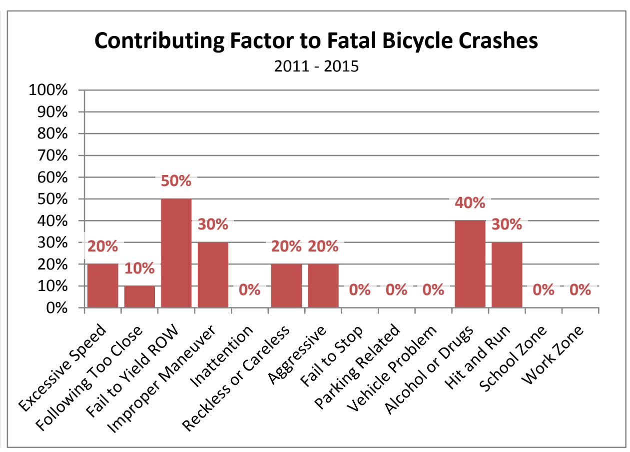


Figure 6-15 and 6-16 present the proportion of Bicyclist crashes by contributing factor for Serious and Fatal crashes, respectively. Alcohol or Drugs and Fail to Yield ROW are the most common factors. The data do not specify whether the driver, the bicyclist, or both were under the influence of alcohol. Other factors, such as Fail to Yield ROW, Excessive Speed, and Aggressive Driving, are for the driver.

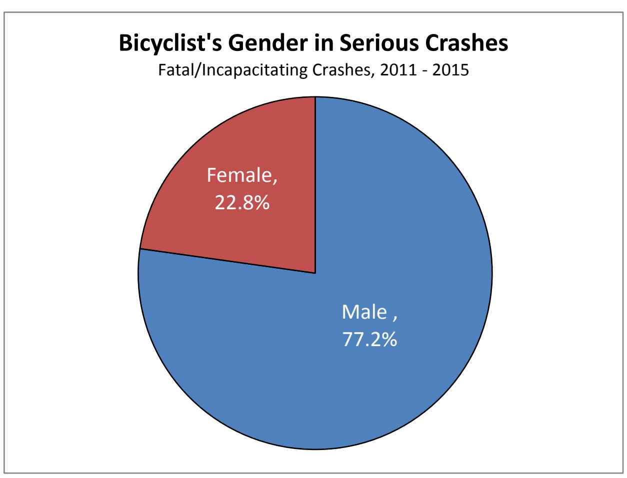
The determination of contributing factors is described in more detail in Section 7.

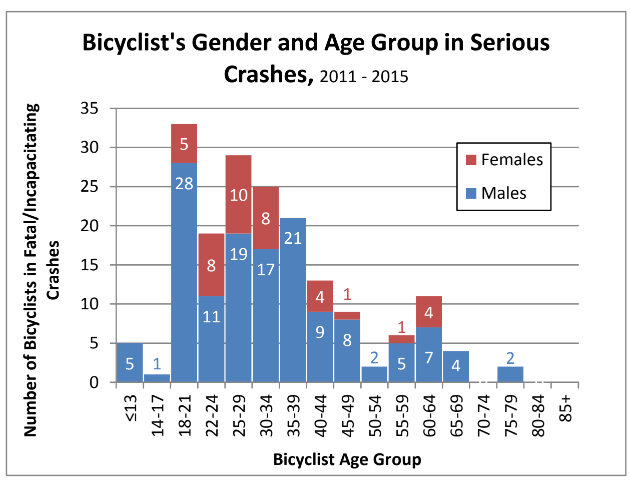
By Bicyclist's Age and Gender

The age and gender of bicyclists involved in Serious crashes are presented in the following table and Figures 6-17 and 6-18.

	Total Male Bicyclists (2011 – 2015)			Total Female Bicyclists (2011 – 2015)		
Age	All Crashes	Serious	Percent Serious	All Crashes	Serious	Percent Serious
≤13	98	5	5.1%	39	0	0.0%
14-17	131	1	0.8%	23	0	0.0%
18-21	164	28	17.1%	54	5	9.3%
22-24	236	11	4.7%	81	8	9.9%
25-29	223	19	8.5%	149	10	6.7%
30-34	262	17	6.5%	107	8	7.5%
35-39	150	21	14.0%	66	0	0.0%
40-44	154	9	5.8%	48	4	8.3%
45-49	156	8	5.1%	47	1	2.1%
50-54	116	2	1.7%	28	0	0.0%
55-59	96	5	5.2%	16	1	6.3%
60-64	71	7	9.9%	18	4	22.2%
65-69	20	4	20.0%	2	0	0.0%
70-74	17	0	0.0%	0	0	--
75-79	11	2	18.2%	0	0	--
80-84	0	0	--	0	0	--
85+	6	0	0.0%	0	0	--
Unknown	154	0	0.0%	39	0	0.0%
METRO	**2065**	**139**	**6.7%**	**717**	**41**	**5.7%**

Figures 6-17 and 6-18





Section 7 – Crash Type Detail

In this section, the four crash types identified in Section 2 as most prevalent are reviewed relative to all crashes in more detail to identify patterns. As documented in Section 2, the most common Serious crash types were Rear End and Turning, while the most common Fatal crash types were Fixed Object and Pedestrian. More detail on Rear End, Turning, Fixed Object, and Pedestrian crashes are presented here.

For each crash type, detailed crash information was summarized for all crashes of that type. The information includes crash severity and contributing factors.

Crash Severity

Every crash is assigned a crash severity based on the most critically injured victim. From worst to best, the classifications are: Fatal, Injury A, Injury B, Injury C, and PDO (property damage only).

"**Serious Crashes**" in this report refers to the total number of Fatal and Injury A crashes.

"**Injury A**" and "**Incapacitating injury**" are used interchangeably. Incapacitating injuries typically are injuries that the victim is not able to walk away from. They are synonymous with the term "**Severe injury**"

"**Injury B**" and "**Moderate injury**" are used interchangeably.

"**Injury C**" and "**Minor injury**" are used interchangeably.

"PDO" means property damage only. Crashes must result in $3,000 or more in damages to be counted.

Contributing Factors

The State Department of Motor Vehicles assigns causes and errors to participants in each crash, along with identifiers for certain risk factors, including alcohol and drugs. Several causes, errors, and/or events may apply to any single crash. Based on these causes, errors, and risk factors, crashes were evaluated for 14 contributing factors. The first cause, three errors, and one event were reviewed for up to three drivers and one non-motorist per crash, and classified for this analysis as follows:

Defined Contrib. Factor	DMV codes included in factor	Cause Codes	Error Codes	Event Codes
Excessive Speed	Speed too fast for conditions; Driving in excess of posted speed; Speed racing; Failed to decrease speed for slower moving vehicle; Driving too fast for conditions	1, 30, 31	42, 47, 50, 53	
Following Too Close	Following too closely	7	43	
Fail to Yield ROW (right-of-way)	Did not yield ROW; Passed stop sign or flashing red; Disregarded traffic signal; Disregarded other traffic control device; Disregarded officer or flagman; Disregarded emergency vehicle; Disregarded Railroad signal or sign or flagman; Failed to obey mandatory turn signal, sign or lane markings; Left turn in front of oncoming traffic; Did not have ROW over pedalcyclist; Did not have ROW; Failed to yield ROW to pedestrian; Passed vehicle stopped at crosswalk for pedestrian	2, 3, 4, 14	3, 4, 20, 21, 23, 24, 25, 27, 28, 29, 33	
Improper Maneuver	Drove left of center on two-way road; Improper overtaking; Made improper turn; Other improper driving; Improper change of lanes; Improper use of median or shoulder; Wide turn; Cut corner on turn; Left turn where prohibited; Turned from or into wrong lane; U-turned illegally; Improperly stopped in traffic; Improper signal or failure to signal; Backing improperly (not parking); Improper start from stopped position; Disregarded warning sign, flares, or flashing amber; Passing on a curve, on wrong side, on straight road under unsafe conditions, at intersection, on crest of hill, in no passing zone, or in front of oncoming traffic; Driving on wrong side of road; Driving through safety zone or island; Failed to stop for school bus; Impeding traffic; Straddling or driving on wrong lanes; Improper change of lanes; Wrong way	5, 6, 8, 10, 13, 50	1, 2, 5, 6, 7, 8, 9, 10, 11, 14, 22, 30, 31, 32, 34, 35, 36, 37, 39, 40, 41, 44, 45, 46, 49	
Inattention	Driver drowsy/fatigued/sleepy; Inattention; Distracted by passenger, animal, cell phone, texting, navigation system, or electronic device	16, 27, 28	16	2, 3, 93, 99, 102, 115, 116
Reckless or Careless	Reckless driving; Careless driving	32, 33	51, 52	
Aggressive	Excessive Speed or Following too Close, as defined above	1, 7, 30, 31	42, 43, 47, 50, 53	
Fail to Stop	Failed to avoid stopped or parked vehicle ahead other than school bus		26	
Parking Related	Improperly parked; Improper start leaving parked position; Improper parking; Opened door into adjacent traffic lane		12, 13, 18, 48	
Vehicle Problem	Improper or no lights; Driving unsafe vehicle (no other error apparent); Overloading or improper loading of vehicle with cargo or passengers		15, 17, 85	
Alcohol or Drugs	Alcohol, Drugs			
Hit and Run	Hit and Run			

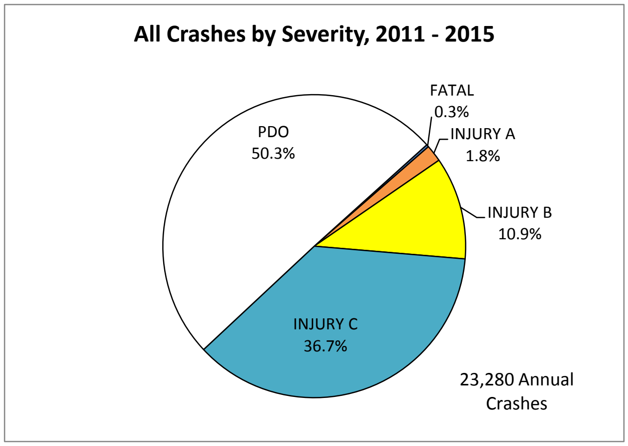
All Crash Types

The following table summarizes all crashes in the region by severity and contributing factor, as defined on the previous page.

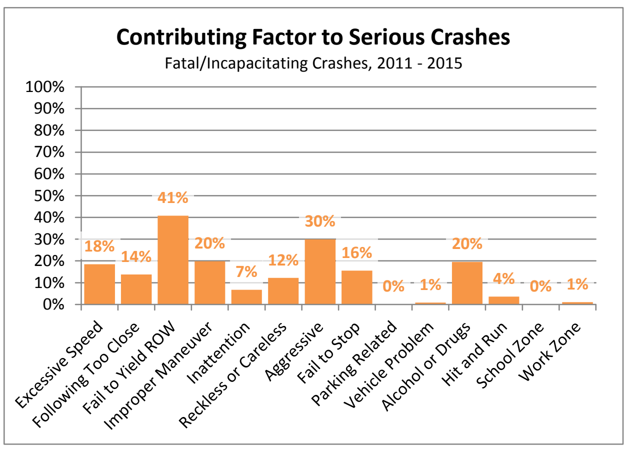
Factor	2011-2015 Annual Crashes (All Crashes)						
	All	**Fatal**	**Injury A**	**Injury B**	**Injury C**	**All Injury**	**Serious**
Excessive Speed	2,897	20.6	68	372	1,019	1,480	89
Following Too Close	7,806	1.4	65	486	3,660	4,212	66
Fail to Yield ROW	7,081	19.2	177	1,227	2,369	3,793	196
Improper Maneuver	4,636	16.4	79	400	1,137	1,633	96
Inattention	1,279	3.0	29	166	533	731	32
Reckless or Careless	1,086	6.8	52	234	375	668	59
Aggressive	9,663	21.2	123	771	4,198	5,114	144
Fail to Stop	8,979	1.6	73	514	4,228	4,817	75
Parking Related	136	0.0	0	4	18	22	0
Vehicle Problem	124	0.8	4	18	35	57	4
Alcohol or Drugs	1,056	34.4	60	215	265	575	94
Hit and Run	1,382	5.0	12	104	452	572	17
School Zone	66	0.2	1	13	26	39	1
Work Zone	177	0.2	5	25	69	99	5
METRO	**23,280**	**60.8**	**420**	**2,547**	**8,545**	**11,573**	**481**

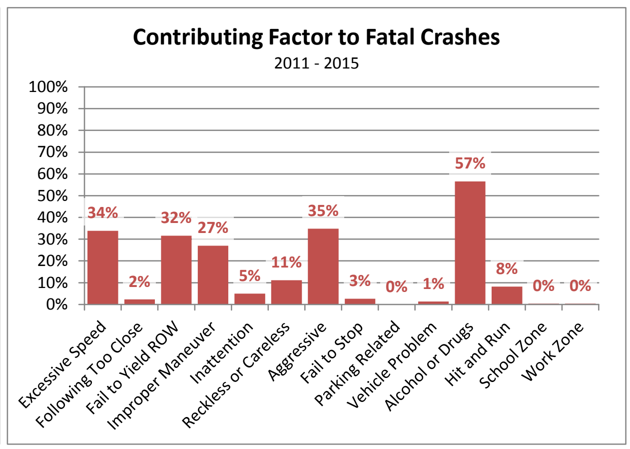
Figure 7-1 presents the crash severity distribution of all crashes. Figures 7-2 and 7-3 present the proportion of crashes by contributing factor for Serious and Fatal crashes, respectively. Each crash may have several contributing factors.

Figure 7-1



Figures 7-2 and 7-3





Alcohol and Drugs, Aggressive Driving (defined as either Excessive Speed or Following Too Close), Excessive Speed, and Fail to Yield ROW are the most common contributing factors to Serious crashes in the region.

Rear End Crashes

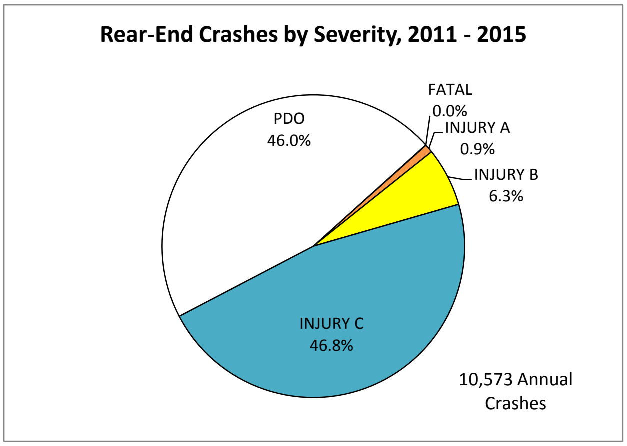
A Rear End crash results when a vehicle traveling in the same direction or parallel on the same path as another vehicle, collides with the rear end of a second vehicle. In this type, the direction of travel was parallel but continuous.

Rear End is the most common crash type in the region, and although it is rarely Fatal it is often Serious. Rear End crashes constitute 7% of Fatal crashes, 21% of Serious crashes, and 45% of all crashes in the region.

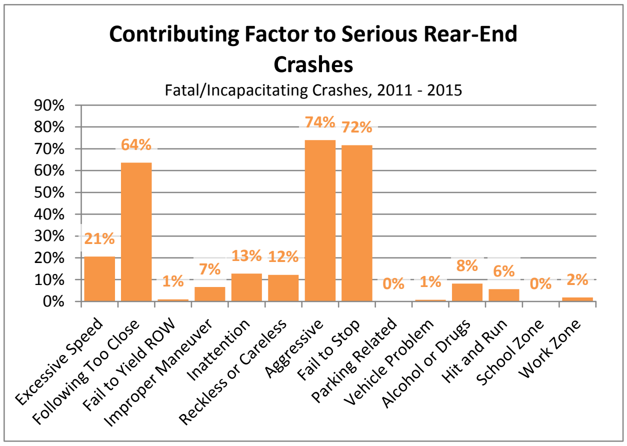
	2011-2015 Annual Crashes (Rear-End Crashes)						
Factor	**All**	**Fatal**	**Injury A**	**Injury B**	**Injury C**	**All Injury**	**Serious**
Excessive Speed	1,591	2.6	18.0	131	727	878	20.6
Following Too Close	7,639	1.4	62.2	470	3,599	4,133	63.6
Fail to Yield ROW	59	0.4	0.6	7	25	33	1.0
Improper Maneuver	455	0.8	5.8	32	184	223	6.6
Inattention	834	0.8	12.0	75	417	505	12.8
Reckless or Careless	412	1.2	11.0	67	209	288	12.2
Aggressive	8,248	3.2	70.8	520	3,865	4,460	74.0
Fail to Stop	8,748	1.4	70.2	503	4,167	4,742	71.6
Parking Related	4	0.0	0.0	0	1	1	0.0
Vehicle Problem	28	0.0	0.8	2	14	18	0.8
Alcohol or Drugs	256	3.0	5.2	36	110	154	8.2
Hit and Run	553	0.8	4.8	32	264	302	5.6
School Zone	21	0.0	0.0	2	11	13	0.0
Work Zone	89	0	1.8	9	42	54	1.8
METRO	**10,573**	**4.4**	**95.6**	**661**	**4,948**	**5,710**	**100.0**

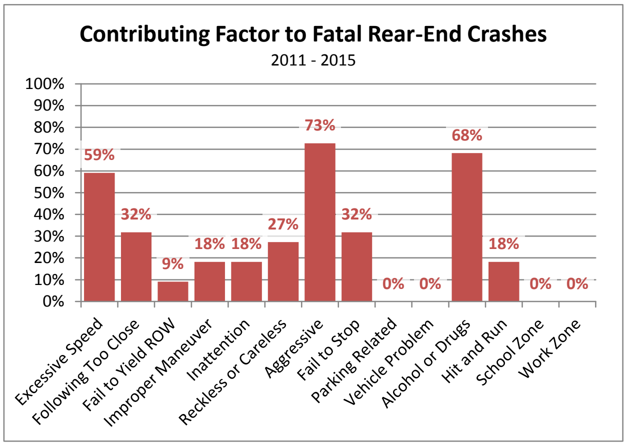
Figure 7-4 presents the crash severity distribution of Rear End crashes. Figures 7-5 and 7-6 present the proportion of crashes by contributing factor for Serious Rear End and Fatal Rear End crashes, respectively. Each crash may have several contributing factors.

Figure 7-4



Figures 7-5 and 7-6





Rear End crashes are less severe than most crashes, producing a high proportion of Injury C and PDO crashes. Aggressive Driving, Fail to Stop, Following too Closely, and Excessive Speed are factors in a substantial proportion of Serious and Fatal Rear End crashes.

Turning Crashes

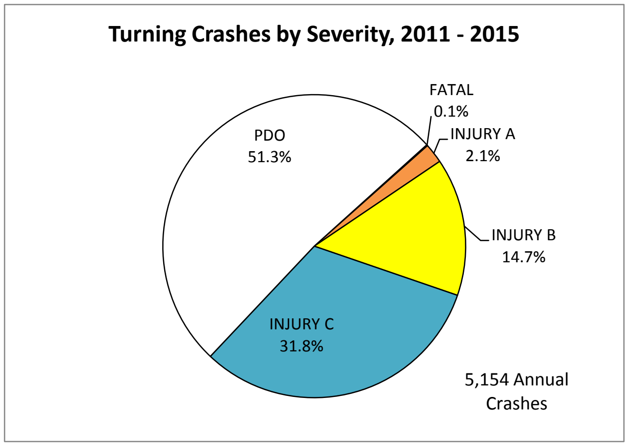
A Turning crash results when one or more vehicles in the act of a turning maneuver is involved in a collision with another vehicle. It differs from an Angle crash in that Turning crashes involve vehicles traveling on the same street, whereas Angle crashes involve vehicles traveling on intersecting streets or driveways.

Turning is the second most common crash type in the region, as well as the most common Serious crash type. Turning crashes constitute 10% of Fatal crashes, 24% of Serious crashes, and 22% of all crashes in the region.

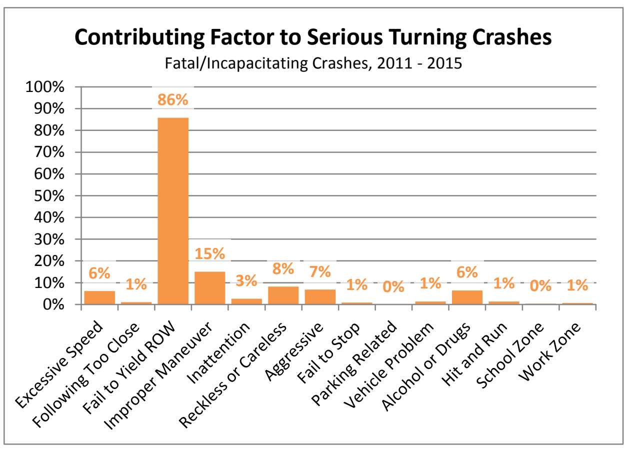
Factor	2011-2015 Annual Crashes (Turning Crashes)						
	All	**Fatal**	**Injury A**	**Injury B**	**Injury C**	**All Injury**	**Serious**
Excessive Speed	173	1.4	6	31	54	92	7
Following Too Close	102	0.0	1	7	39	47	1
Fail to Yield ROW	4,017	3.8	94	668	1,340	2,106	98
Improper Maneuver	1,160	1.8	15	104	301	423	17
Inattention	56	0.2	3	11	19	33	3
Reckless or Careless	123	0.8	9	36	41	87	9
Aggressive	238	1.4	6	34	80	122	8
Fail to Stop	86	0.0	1	3	34	38	1
Parking Related	1	0.0	0	0	0	0	0
Vehicle Problem	17	0.4	1	4	6	12	2
Alcohol or Drugs	102	1.8	6	25	31	63	7
Hit and Run	241	0.0	2	20	66	88	2
School Zone	18	0.0	0	5	6	11	0
Work Zone	25	0.2	1	5	7	13	1
METRO	**5,154**	**5.8**	**108**	**758**	**1,638**	**2,510**	**114**

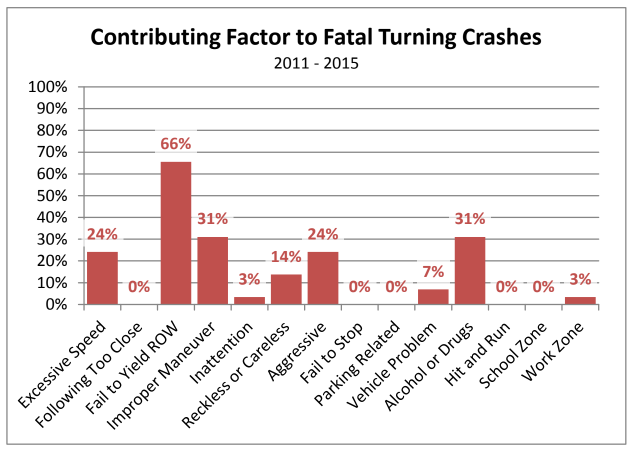
Figure 7-7 presents the crash severity distribution of Turning crashes. Figures 7-8 and 7-9 present the proportion of crashes by contributing factor for Serious Turning and Fatal Turning crashes, respectively. Each crash may have several contributing factors.

Figure 7-7



Figures 7-8 and 7-9





Turning crashes have an average rate of severity compared to other crash types. Fail to Yield ROW, Alcohol or Drugs, and Excessive Speed are often involved in Serious and Fatal Turning crashes.

Fixed Object Crashes

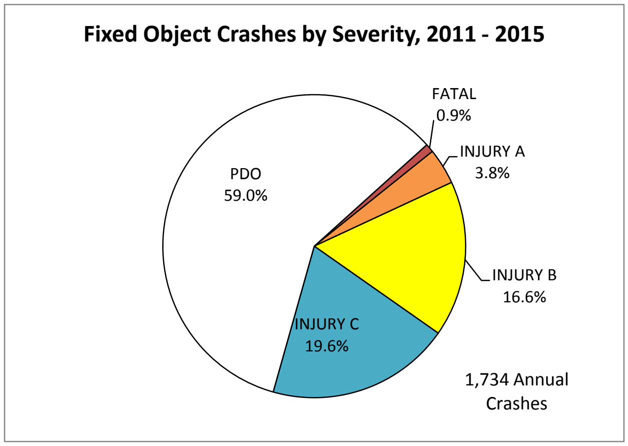
A Fixed Object crash results when one vehicle strikes a fixed or other object on or off the roadway.

Fixed Object is the second most common Fatal crash type in the region. Fixed Object crashes constitute 26% of Fatal crashes, 17% of Serious crashes, though only 7% of all crashes in the region.

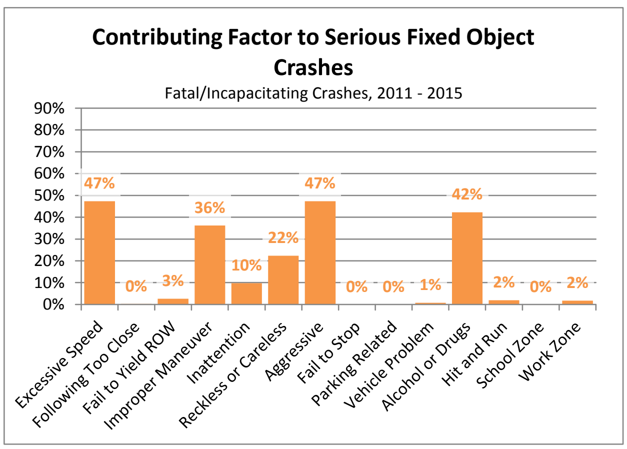
	2011-2015 Annual Crashes (Fixed Object Crashes)						
Factor	**All**	**Fatal**	**Injury A**	**Injury B**	**Injury C**	**All Injury**	**Serious**
Excessive Speed	756	11.2	27.8	136	145	320	39.0
Following Too Close	9	0.0	0.2	2	3	5	0.2
Fail to Yield ROW	31	0.8	1.4	6	5	13	2.2
Improper Maneuver	642	5.0	24.8	98	117	245	29.8
Inattention	216	0.8	7.2	43	46	97	8.0
Reckless or Careless	311	1.8	16.6	71	54	144	18.4
Aggressive	761	11.2	27.8	137	147	323	39.0
Fail to Stop	6	0.0	0.0	1	2	2	0.0
Parking Related	7	0.0	0.0	0	1	1	0.0
Vehicle Problem	33	0.0	0.6	3	6	10	0.6
Alcohol or Drugs	401	11.2	23.6	89	59	183	34.8
Hit and Run	133	0.4	1.2	18	14	33	1.6
School Zone	9	0.0	0.0	2	2	3	0.0
Work Zone	22	0	1.4	4	5	11	1.4
METRO	**1,734**	**15.8**	**66.6**	**289**	**341**	**712**	**82.4**

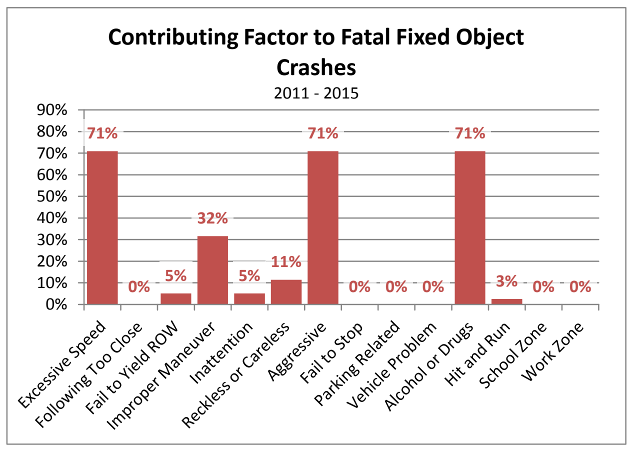
Figure 7-10 presents the crash severity distribution of Fixed Object crashes. Figures 7-11 and 7-12 present the proportion of crashes by contributing factor for Serious Fixed Object and Fatal Fixed Object crashes, respectively. Each crash may have several contributing factors.

Figure 7-10



Figures 7-11 and 7-12





Fixed Object crashes have a higher rate of severity including fatalities compared to other crash types. Excessive Speed, Aggressive Driving, and Alcohol or Drugs are often involved in Serious and Fatal Fixed Object crashes.

Pedestrian Crashes

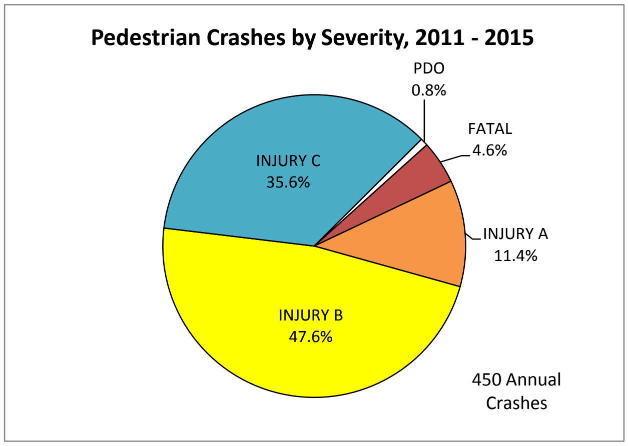
A Pedestrian crash results when the first harmful event is any impact between a motor vehicle in traffic and a pedestrian. It does not include any crash where a pedestrian is injured after the initial vehicle impact.

Pedestrian is the most common Fatal crash type in the region, and the most common crash type to be Fatal. Pedestrian crashes constitute 34% of Fatal crashes, 15% of Serious crashes, though only 2% of all crashes in the region. Pedestrian trips are 10% of all trips in the region.

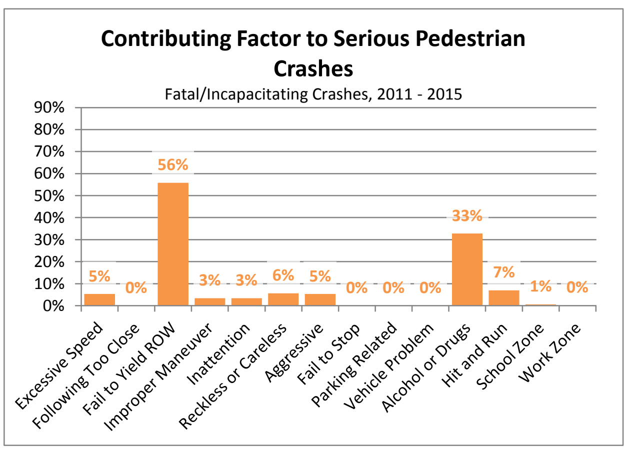
	2011-2015 Annual Crashes (Pedestrian Crashes)						
Factor	**All**	**Fatal**	**Injury A**	**Injury B**	**Injury C**	**All Injury**	**Serious**
Excessive Speed	7	1.6	2.2	3	1	7	3.8
Following Too Close	0	0.0	0.0	0	0	0	0.0
Fail to Yield ROW	331	10.0	30.2	161	127	328	40.2
Improper Maneuver	13	1.4	1.0	5	5	13	2.4
Inattention	14	0.6	1.8	7	5	14	2.4
Reckless or Careless	14	1.2	2.8	8	3	14	4.0
Aggressive	8	1.6	2.2	3	1	8	3.8
Fail to Stop	1	0.0	0.0	0	0	1	0.0
Parking Related	1	0.0	0.0	0	1	1	0.0
Vehicle Problem	1	0.0	0.0	0	1	1	0.0
Alcohol or Drugs	52	11.0	12.6	19	9	52	23.6
Hit and Run	17	3.2	1.8	6	6	17	5.0
School Zone	6	0.2	0.2	3	3	6	0.4
Work Zone	4	0	0.2	2	2	4	0.2
METRO	**450**	**20.8**	**51.2**	**214**	**160**	**447**	**72.0**

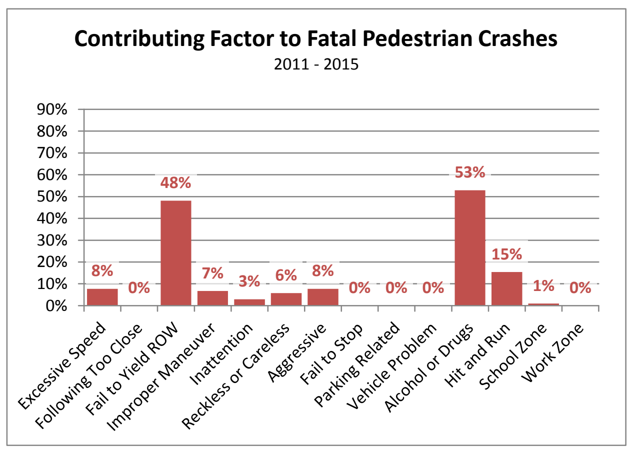
Figure 7-13 presents the crash severity distribution of Pedestrian crashes. Figures 7-14 and 7-15 present the proportion of crashes by contributing factor for Serious Pedestrian and Fatal Pedestrian crashes, respectively. Further breakdown of the reported error by user follows in Figures 7-16 through 7-19. Each crash may have several contributing factors.

Figure 7-13



Figures 7-14 and 7-15



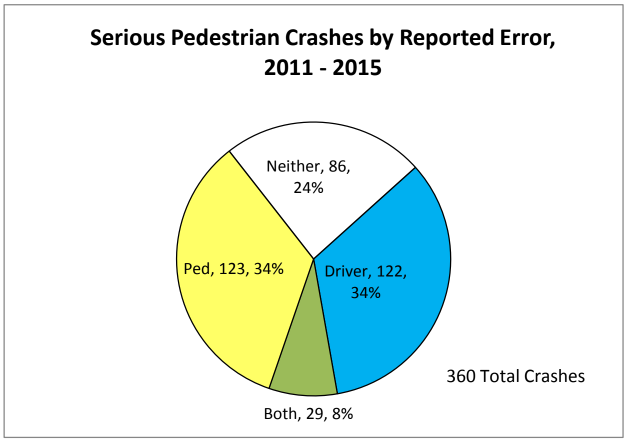


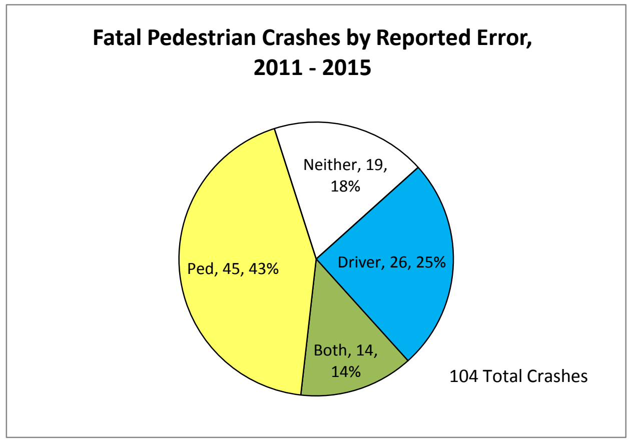
Pedestrian crashes have the highest severity of any crash type. **A Pedestrian crash is more than 26 times as likely to be fatal than a crash not involving a pedestrian, and more than 110 times as likely to be fatal as a Rear End crash, the most common crash type.** Failure to Yield ROW and Alcohol or Drugs are the most common contributing factors.

Additional analysis was done for this crash type to identify how often the driver was reported to be at fault in Pedestrian crashes and how often the pedestrian was reported to be at fault. For the purposes of this analysis, those causes, errors, and events defined at the beginning of Section 7 are considered errors.

Figures 7-16 and 7-17 present the proportion of Pedestrian crashes by reported error source for Serious Pedestrian and Fatal Pedestrian crashes, respectively.

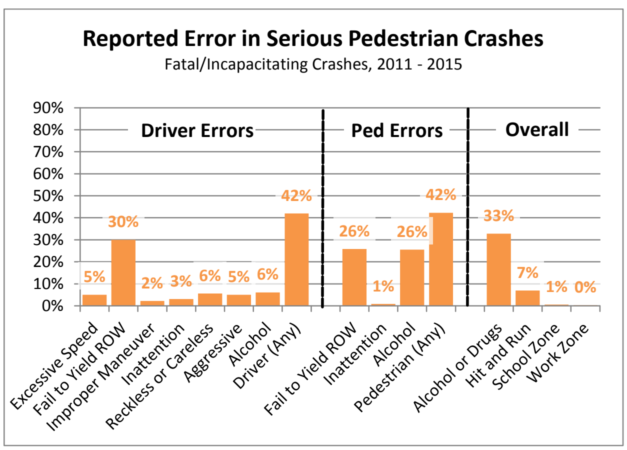
Figures 7-16 and 7-17

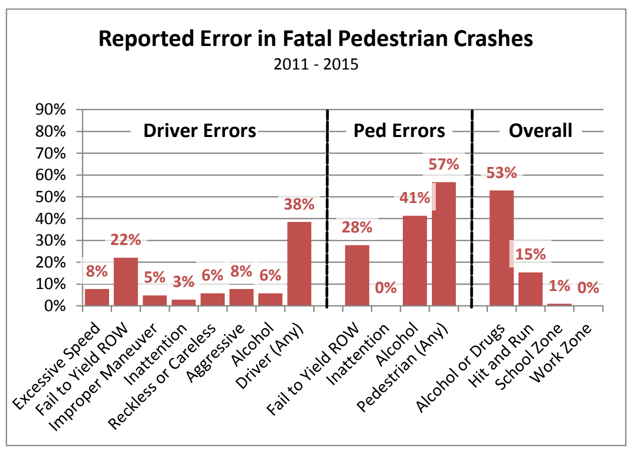




Figures 7-18 and 7-19 present the proportion of crashes by common contributing factor and reported error source for Serious Pedestrian and Fatal Pedestrian crashes, respectively.

Figures 7-18 and 7-19





Crash Factor Matrix

The Crash Factor Overlaps matrix, Figure 7-20, shows the percentage Serious crashes for different factors.

Crash Factor Overlaps - Percentage of Fatal and Serious Injuries by Row, 2011 to 2015

Figure 7-20   % of all   % of left that were…

Guide to reading this chart: Starting with the row names in Column A; Column B represents the % of all crashes pertaining to that row in Column A (eg. 62% of all crashes were on an arterial). The columns following Column B are the % of column A that were also that thing (eg. 18% of arterial crashes [in Column A] were Ped Involved). The columns following Column K [i.e. Ped Involved] are the % of serious crashes that were both that row and column (eg. 55% of serious arterial crashes were at intersections). For rows 1-7, Columns K onward represent the injury type of the row rather than serious crashes.

Column A   Col.B   Col. K

Rows 1-7

Column A	All crashes	Fatal	Serious	A	B	C	PDO	Ped Involved	Bike Involved	Auto-only	Motorcycle Involved	Truck Involved	Freeway	Arterial	Collector	Local	Intersection	non-Intersection	Angle	Head-on	Rear-end	Turning	Fixed object	Daylight	Darkness- lit	Darkness- no lights	Dawn/ dusk	Speed Involved	Followed too closely	Fail to yield ROW	Improper maneuver	Inattention	Reckless/ Careless	Aggressive	Failed to stop	Alcohol Involved	Drug Involved	Hit & Run
All crashes	100%	0.3%	2.1%	1.8%	11%	40%	50%	2%	2%	91%	2%	3%	16%	62%	16%	7%	47%	53%	10%	1%	45%	22%	7%	71%	18%	4%	7%	12%	34%	30%	20%	5%	5%	42%	39%	4%	1%	6%
Fatal	0.3%		100.0%	12.2%	14%	15%		36%	4%	38%	18%	8%	7%	69%	21%	3%	37%	63%	7%	8%	7%	10%	26%	38%	39%	15%	7%	34%	2%	32%	27%	5%	11%	35%	3%	46%	20%	8%
Serious	2.1%	12.6%		88.9%	15%	22%		16%	7%	60%	15%	4%	10%	66%	18%	6%	49%	51%	11%	4%	21%	24%	17%	59%	26%	8%	7%	18%	14%	41%	20%	7%	12%	30%	16%	17%	5%	4%
A	1.8%	1.7%	100.0%		16%	23%		13%	8%	63%	14%	3%	10%	66%	18%	6%	50%	50%	12%	3%	23%	25%	16%	61%	24%	7%	7%	17%	15%	42%	19%	7%	12%	29%	17%	14%	3%	3%
B	11%	0.3%	2.8%	2.5%		26%		9%	12%	71%	7%	3%	12%	63%	19%	6%	55%	45%	15%	2%	26%	30%	11%	67%	21%	5%	7%	15%	19%	48%	16%	7%	9%	30%	20%	8%	1%	4%
C	40%	0.1%	1.1%	1.1%	7%			2%	2%	93%	1%	2%	17%	66%	13%	4%	48%	52%	10%	1%	57%	20%	4%	72%	17%	3%	7%	12%	42%	29%	13%	6%	5%	48%	48%	3%	1%	5%
PDO	50%							0%	0%	96%	1%	4%	16%	59%	16%	8%	45%	55%	9%	0%	42%	23%	9%	71%	17%	4%	7%	12%	31%	28%	26%	5%	4%	39%	36%	4%	1%	7%

% of serious crashes that were also…

Column A	All crashes	Fatal	Serious	A	B	C	PDO	Ped Involved	Bike Involved	Auto-only	Motorcycle Involved	Truck Involved	Freeway	Arterial	Collector	Local	Intersection	non-Intersection	Angle	Head-on	Rear-end	Turning	Fixed object	Daylight	Darkness- lit	Darkness- no lights	Dawn/ dusk	Speed Involved	Followed too closely	Fail to yield ROW	Improper maneuver	Inattention	Reckless/ Careless	Aggressive	Failed to stop	Alcohol Involved	Drug Involved	Hit & Run
Ped Involved	2%	4.7%	16.4%	12.0%	48%	38%	1%				2%	2%	2%	75%	16%	7%	53%	47%	1%	0%	1%	1%	2%	36%	40%	13%	11%	7%	1%	55%	4%	4%	6%	7%	1%	29%	9%	7%
Bike Involved	2%	0.4%	6.8%	6.4%	59%	32%	3%				1%	5%	1%	64%	25%	9%	73%	27%	27%	1%	3%	63%	0%	70%	18%	5%	8%	7%	1%	81%	14%	2%	7%	7%	0%	7%	2%	3%
Auto-only	91%	0.1%	1.4%	1.3%	9%	41%	53%						11%	66%	17%	5%	46%	54%	13%	5%	29%	23%	24%	61%	25%	8%	5%	20%	19%	34%	22%	9%	14%	37%	23%	16%	4%	3%
Motorcycle Involved	2%	2.8%	18.0%	15.3%	45%	28%	15%	2%	0%			1%	12%	58%	24%	6%	47%	53%	11%	3%	15%	33%	16%	66%	18%	8%	7%	28%	11%	38%	29%	4%	14%	35%	8%	15%	3%	1%
Truck Involved	3%	0.7%	2.5%	1.8%	10%	29%	62%	8%	10%		6%		25%	64%	8%	3%	43%	57%	8%	10%	28%	22%	9%	64%	24%	8%	5%	26%	17%	32%	31%	6%	13%	41%	18%	18%	3%	2%
Freeway	16%	0.1%	1.3%	1.2%	8%	43%	51%	3%	1%	70%	18%	9%					4%	96%	1%	1%	54%	1%	24%	57%	30%	9%	4%	37%	34%	3%	23%	9%	19%	61%	28%	16%	4%	3%
Arterial	62%	0.3%	2.2%	1.9%	11%	42%	48%	18%	7%	60%	13%	4%					55%	45%	12%	4%	20%	28%	13%	58%	27%	7%	7%	15%	14%	47%	18%	7%	11%	27%	17%	16%	5%	4%
Collector	16%	0.3%	2.5%	2.2%	14%	35%	53%	13%	10%	56%	19%	2%					51%	49%	14%	5%	11%	23%	25%	59%	21%	13%	7%	22%	7%	41%	24%	5%	11%	27%	9%	21%	5%	4%
Local	7%	0.1%	1.8%	1.7%	11%	24%	65%	19%	12%	52%	15%	2%					53%	47%	20%	4%	5%	16%	22%	67%	20%	9%	4%	19%	2%	40%	26%	6%	15%	20%	2%	19%	7%	4%
Intersection	47%	0.2%	2.1%	1.9%	13%	41%	48%	17%	11%	56%	14%	3%	1%	74%	19%	6%			22%	1%	14%	37%	8%	63%	26%	4%	7%	11%	9%	68%	12%	4%	10%	19%	12%	13%	3%	3%
non-Intersection	53%	0.3%	2.0%	1.7%	10%	39%	52%	15%	4%	63%	15%	4%	19%	59%	18%	5%			2%	7%	28%	11%	26%	55%	27%	12%	7%	26%	18%	15%	27%	9%	14%	40%	19%	21%	7%	4%
Angle	10%	0.2%	2.4%	2.2%	17%	41%	46%	2%	17%	66%	13%	3%	1%	67%	22%	10%	92%	8%						71%	23%	2%	4%	7%	0%	94%	3%	3%	9%	8%	0%	10%	2%	1%
Head-on	1%	3.3%	12.1%	9.8%	27%	41%	36%	0%	1%	79%	11%	10%	2%	69%	23%	5%	11%	89%						55%	19%	15%	11%	29%	1%	4%	89%	10%	18%	30%	1%	29%	12%	3%
Rear-end	45%	0.0%	0.9%	0.9%	6%	50%	46%	1%	1%	83%	11%	5%	26%	63%	10%	1%	32%	68%						70%	20%	3%	6%	21%	64%	1%	7%	13%	12%	74%	72%	7%	2%	6%
Turning	22%	0.1%	2.2%	2.1%	15%	36%	51%	1%	20%	58%	20%	3%	1%	78%	18%	4%	76%	24%						71%	18%	4%	6%	6%	1%	86%	15%	3%	8%	7%	1%	6%	1%	1%
Fixed object	7%	0.9%	4.8%	4.0%	17%	21%	59%	2%	0%	83%	14%	2%	14%	52%	27%	7%	24%	76%						39%	40%	17%	5%	47%	0%	3%	36%	10%	22%	47%	0%	37%	10%	2%
Daylight	71%	0.1%	1.7%	1.6%	11%	41%	50%	10%	9%	62%	17%	4%	9%	66%	19%	6%	52%	48%	14%	4%	25%	29%	11%					14%	17%	44%	19%	7%	9%	29%	20%	5%	3%	2%
Darkness- lit	18%	0.6%	3.0%	2.5%	13%	39%	49%	25%	5%	58%	10%	3%	11%	69%	15%	4%	48%	52%	10%	3%	16%	17%	26%					25%	8%	38%	18%	7%	20%	31%	10%	39%	6%	7%
Darkness- no lights	4%	1.1%	4.5%	3.6%	15%	31%	54%	24%	4%	55%	15%	4%	11%	54%	29%	6%	26%	75%	3%	7%	7%	11%	35%					32%	4%	21%	32%	6%	15%	34%	4%	41%	12%	6%
Dawn/ dusk	7%	0.2%	2.0%	1.7%	10%	41%	50%	26%	9%	48%	16%	2%	6%	72%	19%	3%	50%	50%	7%	6%	20%	23%	12%					15%	13%	44%	20%	7%	10%	26%	14%	15%	4%	4%
Speed Involved	12%	0.7%	3.1%	2.5%	13%	39%	49%	6%	3%	65%	22%	5%	20%	53%	22%	6%	28%	72%	4%	6%	23%	8%	44%	45%	35%	14%	6%		12%	10%	18%	3%	23%	100%	4%	35%	9%	5%
Followed too closely	34%	0.0%	0.8%	0.8%	6%	50%	46%	1%	0%	83%	11%	5%	24%	65%	10%	1%	33%	67%	0%	0%	96%	2%	0%	75%	16%	2%	6%	17%		1%	2%	11%	8%	100%	76%	3%	1%	5%
Fail to yield ROW	30%	0.3%	2.8%	2.5%	18%	38%	46%	22%	15%	49%	13%	3%	1%	75%	19%	5%	82%	18%	26%	0%	1%	50%	1%	64%	25%	4%	7%	5%	0%		4%	3%	7%	5%	0%	11%	2%	2%
Improper maneuver	20%	0.4%	2.1%	1.8%	9%	27%	65%	3%	5%	66%	21%	6%	12%	59%	22%	7%	30%	70%	2%	17%	7%	18%	31%	57%	23%	13%	7%	17%	2%	9%		5%	15%	18%	3%	23%	6%	4%
Inattention	5%	0.2%	2.5%	2.4%	13%	47%	43%	10%	2%	77%	8%	3%	14%	68%	14%	5%	30%	70%	6%	6%	40%	9%	25%	60%	25%	7%	7%	9%	22%	20%	16%		23%	28%	32%	7%	2%	0%
Reckless/ Careless	5%	0.6%	5.4%	4.9%	23%	42%	39%	8%	4%	68%	17%	4%	16%	60%	17%	7%	39%	61%	9%	5%	21%	5%	31%	42%	42%	10%	6%	35%	9%	24%	24%	13%		42%	10%	44%	12%	6%
Aggressive	42%	0.2%	1.5%	1.3%	8%	47%	47%	4%	2%	74%	17%	5%	20%	59%	17%	4%	31%	69%	3%	4%	51%	5%	27%	57%	27%	9%	6%	62%	46%	7%	12%	6%	17%		37%	22%	6%	5%
Failed to stop	39%	0.0%	0.8%	0.8%	6%	50%	46%	1%	0%	88%	8%	4%	18%	71%	10%	1%	38%	62%	0%	0%	96%	1%	0%	75%	16%	2%	6%	5%	67%	1%	4%	14%	8%	71%		4%	1%	1%
Alcohol Involved	4%	2.9%	8.6%	6.0%	22%	30%	46%	27%	3%	56%	13%	4%	9%	63%	22%	6%	38%	62%	7%	6%	8%	8%	37%	16%	58%	19%	6%	37%	3%	26%	27%	3%	31%	38%	4%		14%	8%
Drug Involved	1%	7.1%	13.1%	7.5%	18%	33%	44%	29%	3%	57%	10%	3%	8%	65%	19%	9%	29%	71%	4%	10%	11%	4%	38%	39%	35%	21%	5%	37%	3%	20%	26%	3%	32%	38%	3%	51%		11%
Hit & Run	6%	0.4%	1.2%	0.9%	8%	34%	59%	29%	7%	58%	6%	2%	7%	65%	21%	7%	41%	59%	5%	3%	33%	9%	9%	30%	50%	13%	7%	27%	19%	28%	20%	2%	21%	41%	23%	38%	14%	